

DOCUMENT RESUME

ED 073 393

CG 007 831

AUTHOR Frazier, Alexander, Ed.
 TITLE New Dimensions in Learning: A Multidisciplinary Approach.
 INSTITUTION Association for Supervision and Curriculum Development, Washington, D.C.
 PUB DATE 62
 NOTE 105p.
 AVAILABLE FROM Association for Supervision and Curriculum Development, NEA; 1201 Sixteenth Street, Washington, D.C. 20036 (\$1.50)
 EDRS PRICE MF-\$0.65 HC Not Available from EDRS.
 DESCRIPTORS Behavior; Behavior Patterns; *Curriculum; Curriculum Research; *Learning; Learning Characteristics; Learning Experience; *Learning Motivation; Learning Processes; *Learning Theories; *Motivation; Publications; Student Motivation; Students

ABSTRACT

The papers, presented at the Sixth Curriculum Research Institute, represent an attempt to translate research findings in the behavioral sciences into educational practices with the hope of stimulating curriculum research and field study in school situations. Each of the papers included on this publication is directed toward examination of one of the three major forces that influence learning. This point of view recognizes that the physical organism, the society, and the psychological organization of a person are all determinants of learning. While the slow, orderly unfolding of the organism determines in large measure the timing of the learning tasks which an organism is capable of at any given moment, the social groups to which a person belongs and the accumulated meanings which together constitute a person's psychological organization are also major forces influencing the individual's learning and development. Each of the papers touches upon ways in which various factors influence the learning and motivation of students in the classroom; a teacher must be sensitive to these factors and make provision for them in designing appropriate learning experiences. References are included. (Author/SES)

ED 073393

PERMISSION TO REPRODUCE THIS
COPYRIGHTED MATERIAL BY MICROFILM ONLY
NOT FOR SALE

NEW
COPY AND ORGANIZATION DEPART-
MENT AGREEMENTS WITH THE U.S. DEPT.
OF EDUCATION FOR MICRO REPRODUCTION
OUTSIDE THE ERIC SYSTEM REQUIRE PER-
MISSION OF THE ORIGINAL OWNER

FILMED FROM BEST AVAILABLE COPY

New in Learning



U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRO-
DUCED EXACTLY AS RECEIVED FROM
THE PERSON OR ORGANIZATION OR-
IGINATING IT. POINTS OF VIEW OR OPIN-
IONS STATED DO NOT NECESSARILY
REPRESENT OFFICIAL OFFICE OF EDU-
CATION POSITION OR POLICY.

ED 007 831

ED 073393

New *Dimensions* in Learning:

A Multidisciplinary Approach

*Papers and Reports from
The Third ASCD Research Institute*

*Edited by Alexander Frazier
Chairman of the Institute Staff*

ASSOCIATION FOR SUPERVISION AND CURRICULUM DEVELOPMENT
A department of the National Education Association
1201 Sixteenth Street, N.W., Washington 6, D. C

Copyright 1962 by the

Association for Supervision and Curriculum Development

A department of the National Education Association

1201 Sixteenth Street, N W

Washington 6, D C

Price. \$1.50

Library of Congress Catalogue Number 62 16969

Contents

Foreword	iv
William Van Til, Chairman, Department of Secondary Education New York University, New York, New York	
Preface	vi
Walter B. Waetjen, University of Maryland, College Park Director of the Institute Staff	
<i>Multidisciplinary Approach . . .</i>	
Education and the Nature of a Discipline	1
Arthur W. Foshay, Executive Officer, Horace-Mann Lincoln Institute of School Experimentation, Teachers College, Columbia University, New York, New York	
<i>A Biological Force . . .</i>	
Physical Growth as a Factor in the Behavioral Development of the Child	8
Wilton M. Krogman, Center for Research in Child Growth University of Pennsylvania, Philadelphia	
<i>Social Forces . . .</i>	
The Learner and His Audience	24
Reuel Denney, University of Chicago, Chicago, Illinois	
Origin of Achievement Values in the Family: A Classroom Perspective	35
Fred L. Strodbeck, University of Chicago, Chicago, Illinois	
<i>Psychological Forces . . .</i>	
Recent Developments in the Experimental Analysis of Learning and Concept Formation	46
Leo Postman, University of California, Berkeley	
Psychological Research and Classroom Learning	66
Herbert Klausmeier, University of Wisconsin, Madison	
<i>Terminus . . .</i>	
Learning and the Learner: A Synthesis	83
Walter B. Waetjen, University of Maryland, College Park	

Foreword

The Association for Supervision and Curriculum Development encourages curriculum experimentation through its Curriculum Research Institutes. Through the Institutes, jointly sponsored and staffed by ASCD and by the National Institute of Mental Health, efforts are made to translate research findings in the behavioral sciences into educational practices. The hope of the sponsors is to stimulate curriculum research and field study in school situations.

The reader of *New Dimensions in Learning: A Multidisciplinary Approach* will encounter a variety of insights from scholars of three forces affecting learning; students of physical beings, of social groups, and of psychological organization of the learner. Some insights the reader will find applicable to his concerns and others will appear less applicable. The reader will encounter sections of the manuscript immediately meaningful and at other stages he will struggle with the less familiar concepts and vocabulary of varied specialists. Particularly important, therefore, are the preface, the introduction, and the synthesis for extending applicability and range of interpretation.

The wisdom of a multidisciplinary approach to learning may come home to the reader as he notes Walter Waetjen's comment in his synthesis: "Interestingly enough, not one of the papers was completely successful in confining itself to the discussion of one discipline. Conceivably, it is a hopeless undertaking even to try to confine oneself to a single discipline when considering such a complex activity as learning." He may come to appreciate Arthur W. Foshay's comment on the necessity of a multidisciplinary approach: "The practical problems we are confronted with are not mathematical, chemical, biological or literary; they are often all of these and many more."

The occasion of publication of a pamphlet such as this is an opportunity again to thank Robert R. Leeper, Associate Secretary and Editor of ASCD publications, and Ruth Ely, Editorial Associate. It is also an opportunity to express the deep gratitude of ASCD to Walter Wactjen who has developed the Curriculum Research Institute idea so well and who has now retired from the chairmanship of ASCD's Research Commission. He has been a moving spirit and he deserves the gratitude of all who read the pamphlet or attend the institutes.

April 1962

William Van Til, *Vice-President*
Association for Supervision
and Curriculum Development

Preface

When the Sixth Curriculum Research Institute was in its embryonic planning stages, it became apparent that a theme was needed which would give focus to comments scholars would make as well as to the deliberations of those who attended. Reviewing the content of previous Curriculum Research Institutes brought to light the fact that scholars from a variety of disciplines had contributed their knowledge. This was a fortunate circumstance since there had been no conscious effort to emphasize a multidisciplinary approach to the study of learning. The scholars had been engaged because they were considered outstanding in the field being considered, not simply because they were from a different discipline.

Since this multidisciplinary approach had emerged in an implicit way, the decision was made to make it explicit in the theme of the Institute for which this booklet reports the proceedings. Briefly, our point of view was that some new dimensions in learning would be discovered by considering three broad areas in the behavioral sciences. The first of these was organic forces. For this presentation we invited Wilton M. Krogman, a physical anthropologist from the University of Pennsylvania, who has long been associated with educators in their work on curricular problems. His paper deals with the relation between the physical growth of the human being and learning.

The second area in the behavioral sciences was that of social forces. In the Eastern Section of the Curriculum Research Institute, held in Washington, D.C., Renel Denney of the University of Chicago gave the paper describing the impact of selected social forces on learning. The Western Section, held in Denver, saw Fred L. Strodbeck of the University of Chicago delivering a paper on the origin of the achievement

motive in the family. Both of these papers are to be found in the pages that follow.

The final force considered was psychological in its nature. Leo Postman of the University of California, delivered at the Eastern Section, a paper on concept development; while Herbert Klausmeier, of the University of Wisconsin, gave a paper for the Western Section, on psychological factors influencing classroom learning.

We brought together competent scholars from three different disciplines to share their knowledge with us. But it became increasingly apparent that we needed a careful description of the nature of a discipline and the way in which disciplines are represented in the curriculum. This difficult assignment was accepted by Arthur W. Foshay, Teachers College, Columbia University, whose paper is presented first in this booklet. The paper should, to say the least, prove to be provocative.

While our scholars provided the substantive material about learning, it fell to the lot of the Curriculum Research Institute staff members to aid the conferees in the development of research designs. These highly skilled people who served as staff for the Institute are in no small measure responsible for whatever success was achieved. The names of these persons follow: *Eastern Section*—Glenn Dildine, National 4-H Foundation; Arthur W. Foshay, Teachers College, Columbia University; Hugh Perkins, University of Maryland; David Turney, George Peabody College for Teachers; O. L. Davis, University of North Carolina; Jack R. Frymier, Orange County Schools, Florida; *Western Section*—Gertrude Wood, Office of Superintendent of Schools, Los Angeles County; Clifford Bebell, Colorado State Department of Education; Marie Hughes, University of Utah, and Robert Bills, then of Auburn University and now with the University of Alabama; *Both Sections*—Margaret Gill, of the Association; A. Harry Passow, Teachers College, Columbia University; and James Macdonald, University of Wisconsin-Milwaukee.

As in the past the National Institute of Mental Health cooperated in sponsoring the Sixth Curriculum Research Institute. William Hollister, M.D., was not only a staff member for the Eastern Section, he also aided in making selections of scholars. Alan Miller, M.D., served as a staff member to the Western Section.

December 1961

Walter B. Waetjen, *Chairman*
ASCD Research Commission

Multidisciplinary Approach . . .

Education and the Nature of a Discipline

Arthur W. Foshay

If there were a clear-cut discipline of Education, the Association for Supervision and Curriculum Development, NEA, would have a precise segment of Education as its province. In that case, a conference on the theme, "New Dimensions in Learning: a Multidisciplinary Approach," would need no definitions, no explanations, no questioning in its opening address. However, since educators can now think and act only in a pre-disciplinary manner, I must mention a whole range of questions that educators face, all of them relevant to the curriculum, so that the following papers and the approach they represent may be fitted into the present educational setting.

In one important respect, our present educational setting is as it always has been, at least since the days of Athens. Educators are practitioners, whose practices provide for society that desirable but indefinable person, the educated man. At any given moment educators must educate on the basis of whatever knowledge they have. If they have the knowledge appropriate to the situation and if what they think is knowledge really is, they act wisely to produce the educated student. Both "ifs" are as wide as the world and as ancient as the philosopher's quest for truth; they call for endless questioning on many levels. However, they do relate to knowledge, which we believe is made within established disciplines. The recent concern about the disciplines, what they are and how they function, is the result of this general chain of logic.

We have observed that when curriculum practitioners work on educational problems, they draw on the disciplines of theology, philosophy, and political science for statements of the aims of education for schools in the United States. When they consider what should be taught in the public schools, they borrow from the disciplines that make up the humanities, from mathematics, and from the sciences. When they establish sequences for subject matter, they rely on biology and psychology, as well as tradition, for insights about the best ordering. And when they confront the enormity of the gap between the lesson presented and the lesson learned, they must use whatever the biologist, the psychologist, and the sociologist have to offer at the moment, even if they are ill-equipped to evaluate conflicting claims about whose ideas are *the* truth. Plainly, a curriculum worker should be the universal man, equally educated in all the learning the world has to offer and able to think in whatever disciplined ways exist. The older one gets, the more apparent it is that everything learned is grist for the mill now, and that one could not possibly have learned enough. One could wish to have learned more, because all his knowledge has to function now.

Since educators know they are less than universally learned, they might well leave to the philosophers the whole problem of the disciplines if it were not for the practical fact that educational proposals, often biased according to the author's own discipline, have to be supported or opposed in the public forum every day. When an economist looks at education, he looks for the factors he has been trained to consider important. He sees the masses of children to be educated and makes an estimate of the resources available to do the job. His statement of what the educational problems are and what should be the solutions is likely to have to do with the organization of people and the organization of resources. By all the logic of economics, an increase in capital expenditure per child should increase educational "production." Educators do not know whether the logic of economics is transferrable to education, but they had better know enough about the discipline of economics to ask. When a man trained in engineering looks at education, he might well find its most striking characteristic to be the failure to analyze educational activities into their basic elements, so that solutions might be conceived in terms of recombining those elements. Educators know well that the schools need more sophisticated analysis, but they are not sure they and the engineer would agree on what the elements are. The point, in any case, is that if one looks at education through the eyes of any one discipline, one is likely to get half-truths capable of causing serious mischief. The plague of panaceas proposed for the cure of our educational troubles, proposed by laymen and educators alike, has had its origin, I suspect, in such half-truths.

Practical reasons for taking a new look at the organized disciplines are only a small part of the story. Educators are more critical of the education they dispense than any outside critic could ever be. They know better than anyone that the subjects they teach often do not catch the intellectual excitement that is the heart of the matter. They are appalled at the new knowledge, even whole fields of it, that young people must have to live in the second half of the twentieth century. Since it is apparent that learning will have to be the lifelong business of every person, they are searching for ways of teaching in the schools that will give students the tools, the confidence and the curiosity to keep on learning.

If I may return for a moment to the problem of the new knowledge, I should like to make a plea here for a great public debate, once more, on the old question "What knowledge is of most worth?" It seems to me that the Sputnik-inspired emphasis on mathematics, the sciences and foreign languages—and the curriculum revisions being made in these and other subjects—is immensely valuable, but scarcely adequate to guide the schools in their education of all the children in all parts of the nation. As educators, we shall want to participate in the debate, but the question is too serious for any single segment of the population to make the determination.

Dimensions of a Discipline

Since I have mentioned so often the term "discipline," I want to explain what I think it means, then go on to the relation school subjects bear to the disciplines.

It is appealing to say that a discipline is an organized way of making knowledge. It is an organized way of inquiring. The knowledge we make most use of and have greatest respect for tends to come to us organized into disciplines. There are disciplines with names like history, mathematics, and chemistry. There are disciplines in the esthetic field: the graphic and plastic arts and the discipline of esthetics itself, there is philosophy.

Any discipline may helpfully be described according to three characteristics. In the first place, a discipline relates to a field of events or a field of phenomena: a discipline has a domain. Chemistry does not deal with the same stuff in the world that poetry does, nor theology, nor history. So one way to separate disciplines from one another is to separate their domains. However, some disciplines deal with the same field, or overlap considerably with respect to the field that they confront. For example, sociology and social psychology deal with many of the same events. We cannot separate history from economics by saying historical

events are never economic events. Yet there is an historian's way of dealing with events and an economist's way of dealing with events, and these are different.

The next of these characteristics of the disciplines has to do with the set of rules that are used--the basis on which truth may be claimed within a discipline, or how proof may be established. The historian's way of dealing with proof is not the chemist's way. The historian's way and the chemist's way are not the poet's way, and these three are not the theologian's way, and these four are not the philosopher's way. There is a set of rules for each, and it is peculiar to the discipline in question. Some of the elements of the rules, again, may be identical in one discipline and another. Both chemists and physicists conduct experiments as a way toward truth, but chemistry and physics are different disciplines. Although their rules may be similar, their domains are different. History and poetry are quite different with respect to the rules, although the events they treat might be the same. We must learn to ask the scholar in a discipline what the rules of his game are. What might I read to find out what a geographer says geography is, what a physicist says physics is, what a mathematician says mathematics is? The scholar in this connection is defined as somebody who is trying to produce knowledge according to the domain and the rules of the discipline he inhabits.

But there is more. The disciplines also have histories, and they are heavily influenced by their histories. There are older disciplines and newer disciplines, the histories of these older or newer disciplines interpenetrate the rules that are used and most especially the domains that they have established. Thus astronomy has a history that includes astrology, and to this day the domain of astronomy, while it does not deal with the myths and superstitions that astrology is concerned with, nevertheless is particularly concerned with the movements of the heavenly bodies. It is quite conceivable that this field might have taken as its center the properties of the heavenly bodies or the nature of the universe, cosmology--these being within the broad field of astronomy. But the fact that the astronomer continues to be very much interested in the *movements* of the heavenly bodies is an artifact of his own history. It is neither a good nor a bad thing, it is just a fact.

We might ask similar questions about our field of education, though it cannot be called a discipline because the rules are not clear. What is the impact of our own tradition upon us? What does it cause us to perceive as relevant? How does it cause us to think or want to think about educational problems? One thing in our history that has a substantial effect on the way we think is that education, historically, has been thought of as a moral enterprise--something that has a great deal to do with ethics and, anciently, with worship. When we think about educational

problems, almost invariably we start with what we now call value statements. We start there because our tradition is what it is. Whether it ought to be that way is not a relevant question. That is the way it is, and it influences us. If we are going to know more about what we do, we ought to know more about our own historic ways of thinking and our historic concerns.

To summarize, a discipline can be defined as a way of knowing, a way of making knowledge. As such, a discipline is characterized, first, by a domain, an area of human experience, or an area of phenomena for which the person in the discipline takes responsibility, second, as a set of rules that has to do with how truth is established and how truth is conceived of and stated, within the discipline, and third, as having a history that may be described and that presumably, ought to be known.

School Subjects or Disciplines?

Now let us turn from disciplines to school subjects. Every academic school subject that we try to teach was originally based upon some discipline, defined in the terms just given. A school subject is a translation of a discipline into a pattern of learning. What do we teach in school? We teach literacy, but is this a discipline? It could be thought of in this fashion, certainly, there is a discipline of language. We teach some of the skills that are necessary for entering into this discipline, but do we teach the discipline?

We teach arithmetic in the elementary school, but we call it mathematics when pupils leave grade eight. This is the name of a discipline, and it is also the name of a school subject. We have to ask, how good is the translation? Is the subject of mathematics as we conceive of it in school true to the discipline of mathematics as a mathematician sees it? We teach history, we teach some geography, we teach some economics, and we teach some science. The titles suggest that the school subjects have arisen from a discipline that has a substantial nature. In a good many cases our attempts to translate the discipline into viable subject matter that can be learned in school are a mistranslation, in the sense that the learning method that we have developed has taken the place of the discipline. We have become subject-centered in fact, the subject is no longer relevant to the discipline. Our objection to the artificial and largely arbitrary nature of much school subject matter is derived from the fact that it is arbitrary, superficial material. It fails properly to represent the discipline out of which it came.

Listen to a series of charges. We have taught prosody in the name of poetry, thus killing an interest in poetry for ourselves and our descendants. We have taught grammar in the name of composition, destroying

the possibility of a widespread ability to write good essays or even good expository prose. We have taught computation in the name of mathematics, and now we commonly say to one another, "The trouble is, the youngsters can do it, but they don't understand it." When we have taught phonics in the name of reading, we have produced in the early grades word-callers, not readers. We have taught place geography in the name of geography, almost killing this subject in the schools. No geographer says that this is what geography is. We have taught dates and battles in the name of history, I would say instead of history. An historian does not describe his discipline thus. Only in school do you get preoccupied with these matters—never again. We have taught facts and principles in the name of science; but science is a mode of inquiry, and the scientists now say what we are doing is not only out of date, but it is not science.

The Physical Science Study Committee conceived a way of thinking of science that stems directly from the discipline, and that does not correspond to our tradition of subject matter in the schools. They have destroyed our subject matter; they could not modify it. They could not go gradually from where we are, for example, in physics in the secondary school, to where they thought we ought to go. They had to destroy what we were doing and reconceive it from the bottom up.

Such reconceptions of the disciplines we mean to teach are the most important thing that is going on in education, because they are so fundamental. Such revision is very likely to go all the way through the subjects we teach. It includes physics, biology, and mathematics. There are some stirrings in the field of English, and we await some activity in history and the other academic fields. Sooner or later we will come to reconceptions in another kind of field. We will raise questions about the so-called vocational or, as Dr. Conant likes to say, the marketable subjects. These, too, may some day be thought of as arising from a discipline of basic technology, or something of the kind. It is interesting that we teach people typing without saying much about typewriters and how they work, how they may be thought of, where they came from, or how they fit into the scheme of things. We teach the skill naked. People who learn to play musical instruments, with the exception of the piano, ordinarily want to know how the instruments work. They like to know how they are made. They want to know something of the theory that underlies the structure of the instrument. What about conceiving of auto mechanics as a specific field of technology, and of trying to determine what is the technology behind the automobile? What theory underlies it? Not what physical theory, but what technology? The term is used advisedly, though it represents only the beginning of a thought.

If I have questioned, explained and defined sufficiently my thinking about the disciplines as they relate to education, I should like to close

with some observations on the difficulties of a multidisciplinary approach. The practical problems we are confronted with are not mathematical, chemical, biological or literary; they are often all of these and many more. It would be helpful if one could be aware, intellectually, of what one were doing when confronting a practical problem—to figuratively put on a psychologist's hat, then a sociologist's hat, then a physicist's hat, and an economist's hat, in turn. One would then need to withdraw for the purpose of synthesizing all the various insights and of arriving at a wiser solution of the problem. Unfortunately, wisdom does not usually come to us in multidisciplinary packages. When we achieve it, we tend to call it not discipline, but art, and we deny that it is a wholly rational process. Perhaps the papers that follow will help us to design our school activities in a way that takes advantage of many disciplines, yet does not foreclose our generalizing in a peculiarly educational way.

A Biological Force . . .

Physical Growth as a Factor in the Behavioral Development of the Child

Wilton M. Krogman

By "physical growth," I mean all processes of biological or organic growth, both morphological (structural) and physiological (functional). By "behavioral development," I mean the total of the cultural integration of the child in social and psychological patterning. These are minimum and rather arbitrary definitions—even restrictive definitions—but they convey some idea of two major realms in the growing life of the child, the biological and the psychocultural. These have one major element in common: both are progressive and cumulative, they are *time-linked* in the growing life of the child. This is a working premise readily acceptable.

If we proceed from the foregoing, then our core problem presents itself. How, to what extent, are these two realms correlated? Moreover, if there is some correlation, how great is it? Does the correlation differ with age-period? How variable is it? Can it be used for prediction? What is its relation to concepts of "readiness"? In substance, may we paraphrase, "A sound developing mind in a sound growing body"?

There can be no doubt but that "behavior," *per se*, is ultimately and initially organic, i.e., it is rooted in the basic neuropsychophysiological construct of the organism. In the broadest possible terms DuBrul (1960) defines behavior as an "input from the environment that propagates an output that is adaptively appropriate to the input." Burr (1960) makes the following statements. "Behavior is the way living systems adjust to

their environment", "The attributes of protoplasm determine completely the reactions", "The properties which make adjustment adequate are properties basic to protoplasm."

Statements such as the foregoing lead to the broad assumption that behavior is an entrenched affair, rooted in organic (protoplasmic) potential. There is reason to believe that the neural circuits which facilitate the stimulus-response cycle are laid down very early in embryonic life. If this be so, then "learning" in a biological sense does not so much involve the establishment of *new* connections between nerve cells as it does the utilization of different combinations of *nerve pathways already present*. At a more highly integrated level, we may observe with Hamburger (1957) that "organs are built up first, and thereafter they are taken into use."

A useful summary of developmental stages would be somewhat as follows: (a) prenatal, which centers around the origin of behavior patterns; involving a self-generating maturation process which follows an inherited and stereotypic pattern, in a strict sense, learning and exercise play no role here; (b) postnatal, where exercise and learning are the dominant factors in the perfection of preestablished structural and functional (behavioral) organization; and (c) cultural or motivational, stemming from human value systems: here entirely new, superimposed, potentialities of mind are built upon the biogenetic neural endowment. It is this last stage which has led Bullock (1958) to conclude that, "present physiology of neurons, extrapolated, can (not) account for behavior."

In attempting to evaluate the above generalizations, it will be first necessary to say a few words about the processes of physical growth and their evaluation.

Physical Growth: the Maturation Process

A favorite thumbnail definition of physical growth of mine runs like this: "We grow; we grow up; we grow older." That is, we increase in size, we change proportions, we progress toward maturity goals. Leaving size and proportion out of the picture for the moment, let us focus upon the process of *maturation*.

Quite literally we are born to grow older. This is to say that the spark of life, once it is lit at conception, is destined to flame, to flicker, to go out; to put it another way, it will burn brightly in the anabolic phase of growth, it will burn erratically in the catabolic phases of the age-changes of later life, and it will be extinguished by death. In this entire life period we shall concentrate upon the first two decades of postnatal life—the growth period, par excellence.

There are data available upon the growth-changes in the entire human body (cf. Krogman, 1941, and Lansing, 1952). Of these the one we may put to practical use is the *skeleton*. We have learned that this tissue is an excellent record of the progress of biological time. Moreover, this tissue readily lends itself to graphic recording via the X-ray film. Thus it is that standards of skeletal development are available for hand (Todd, 1937; Greulich and Pyle, 1959) and for knee (Pyle and Hoerr, 1958). These standards are acceptably reliable within the range of the age-standards themselves, i.e., within lustra of about six months. Bayer and Bayley (1959) accept these standards as the bases of the growth prediction, while Maresch (1958) regards them as "of limited value in predicting the onset of adolescence, or of adult size."

How is the age-assessment of a hand or knee X-ray film used? We interpret the "maturity" of such a film (in terms of ossification centers and their "maturity indicators") as a record and assessment of the child's *true biological age*. If his chronological age (C.A.) be 8:3 (eight years, three months) and his skeletal age¹ (S.A.) 9:3, then the 9:3 is the real age of maturational achievement. More than that, S.A. is the age of expectancy: this boy is advanced² 1:0 in his maturational progress. Suppose he were 7:3; then he would be retarded² 1:0 in his maturational progress.

Let us bring the idea of "expectancy" into sharper focus. Suppose we have two boys, both with C.A. of 8:3: the one has an S.A. of 7:3, the other of 9:3. Here are two boys of the same age—the calendar says so! Yet, here are two boys who differ by two years in growth-time; the one evidences a fast, the other evidences a slow, tempo of maturation. The difference of two years is more than a measure of biological age—it is, or may be, an arbiter of levels of behavioral ability and expectancy.

The great physiologist Cannon often referred to "the wisdom of the body," a quasi-teleological way of saying that "the body knows," i.e., knows best what is good for it, and what it can or cannot do. I believe this quite firmly, especially in terms of the growth of the entire organism. It makes sense to conceive of growth proceeding as a whole, moving more or less evenly along all fronts. It also makes sense to conceive of the common front as possessing salients and recesses, as it were, so that we need not demand a 100 percent concordance by far. It is the relatively

¹This has varying been called "carpal age," "physiologic age," "bone age," "biologic age," and so on. I use S.A. because of its more general use.

²"Advanced" and "retarded" are used here advisedly, even though "retarded" has come to be linked, in the lay mind, with mentality. "Accelerated" and "decelerated" convey the idea somewhat, even though these terms refer more to velocity.

concerted forward *progress* that counts, not the statics of a single leveled-off evaluation.

At this point I shall regard it as a demonstrated fact that we have a reliable instrument to record true growth-age in the child. It is now time to consider the implications of this "true growth-age"—how much meaning does it have in the behavioral sphere? Are growth-time and behavioral-time parts of the over-all equation of growth? If so, how are these related? Reciprocally? Integratively? Directionally, with flow more one way or the other? Are they related meaningfully, so that the educator may use the conceptual mechanisms for the fuller understanding of the learning process en masse and/or individually?

Maturation: Early vs. Late

Just as there are tall and short children, heavy and light, stocky and slender, so there are early maturers (and fast growers) and late maturers (and slow growers). The problem of defining "early" and "late" is a moot one. Some researchers use $M \pm 1$ S.D., $M \pm 2$ S.D., or $M \pm$ some arbitrary limit. For working purposes I use S.A. more than 1:6 *behind* C.A. and S.A. more than 1:6 *ahead* of C.A., for retarded and advanced, respectively. This gives a time-span of 3.0 or more between minimum limits of earliness and lateness.

We may accept as a rule that S.A. is pretty highly correlated with morphology (size and proportion) and with physiology (functional complexity and integration). This is to say that a child advanced in S.A. is more apt to be taller, heavier, and to show the earlier incipience of adult proportions, and vice versa; further, such a child will usually achieve at an earlier age the biochemical and structural changes accompanying sexual and adult maturity, and vice versa. Growth-wise we tend to reflect (and be) what we are maturation-wise. In no growth area is this more true than during the adolescent period (the entire circum-puberal period).

The age-old Nature vs. Nurture theme rears its hydra-head at this point. Hughes (1957) is pretty sure that Nature and Nurture are highly correlated:

... when a child is growing rapidly he will seek, utilize, and assimilate large amounts of nurture in many areas, and when he is growing slowly he will avoid, reject, eliminate, or be damaged by, nurtural amounts that are in excess of his growth rates.

We can agree with this up to a point, for Nature and Nurture are too complex to be equated as though each were a single variable or a single unit. We shall return to this theme when the concept of "readiness" is tackled.

In the interpretation of physical growth, we may accept three expressions of variability: (a) the *rate* of growth differs, (b) the age or time of an *accelerated* growth phase differs, (c) the *timing* of sexual and adult maturity differs. These variables are linked to behavior not so much in an emergent sense as in an expressed manner. In this way the intellectual aspect of development is only secondarily involved; it is the sociocultural aspect that is primary. For better or for worse the stamp of approval (especially self-approval) is on earliness and its concomitants, bigness, "matureness," and sex-trait achievement. This statement is especially true for boys and, hence, studies have concentrated upon them.

Jones and Bayley (1950, cited in Macfarlane, 1958) found "early" male adolescents to be peer-judged as physically more attractive, more matter-of-fact, and more relaxed. "Late" boys were judged more eager, animated, uninhibited, active, and tense. In a follow-up study at age 33 years, 11 "early" men were more dominant, responsive, making a better impression, and were less impulsive than a small sample of "late" men. Mussen and Jones (1957, also cited in Macfarlane, 1958), on fantasy themes, found "early" boys to be self-confident and assuming more mature social roles; they produced more class presidents and athletes, whereas "late" boys were more apt to feel personally inadequate, were more apt to have strong feelings of rejection and domination by others, were inclined to have prolonged dependency needs, and tended to have a rebellious attitude toward parents. At the age of 33 years, of 11 "early" boys four had very important jobs, while of nine "late" boys none had important jobs.

On the neuromuscular (motor) side, Jones (1958) found a pretty clear-cut dichotomy between early- and late-maturers. Adolescent boys with good physical abilities were more mesomorphic (athletic build), more physically fit, early maturing, higher in social prestige, and better adjusted to adolescent problems. Adolescent boys with poor physical abilities were more ectomorphic (slender build), less physically fit (poor in health), late maturing, lower in social prestige, and poorly adjusted to adolescent problems. This dichotomy rests upon Jones' statement that "physical abilities parallel each other in development, chiefly because of a common factor of muscular strength." It is important to note Jones' statement that:

Peer popularity in Junior High-School was found to show no correlation with intelligence level, school achievement, or an evaluation of the home situation, but did show significant correlation with physical ability and strength. . . .

Hanley (1951) studied the potency of physique (body-build) and high school Reputation Test scores. He used Sheldon's "somatotypes" for

two groups: I, the California Guidance Research Study, and II, the California Adolescent Growth Study. The results were as follows

	Components		
	Endomorphy (heavy)	Mesomorphy (muscular)	Ectomorphy (slender)
Sheldon	3.20**	3.77	3.53
Group I (38)*	2.87	3.87	3.54
Group II (84)	2.67	4.16	3.78

* Nos. in parentheses = no. in sample

** The nos. under each component = strength of that component on a 7-point scale.

Hanley concluded that "the results in general show an association between physique and reputation. . . ."

There is no further profit in belaboring the point. There is a positive and significant correlation between rate, time, and degree of growth (maturation) attainment, and the socio-behavioral complex of the individual boy. To a less extent this also applies to physique. Insofar as all this affects peer-rating and status, insofar as this affects the boy's concept of self and of role, then biology is a potent factor in behavior. Just how far this penetrates into the curriculum area (the total learning process) is a matter for individualization. It is a personal-social equation to be solved at individual problem level. What is important is an awareness of the possible extent to which biological processes may invade behavioral manifestations or may warp the total behavioral problem. That this holds for girls, as well as for boys, is shown by Macfarlane (1958) in two case-histories of girls who were at the extremes of early and late

Growth, Maturation, and Readiness

Just as in phylogeny, the evolution of the species or race, there is a time for the appearance of a developmental stage of brain and mind (see Lassek, 1957), so in ontogeny, the growth of the individual, there is a time for the appearance of functional stages in brain and mind (see Gerard, 1959). In fact, we might define over-all physical growth as an anatomic ontogenesis, during which there are optimum times or stages for structural and functional advancement. In essence, these times or stages represent a functional potentiality or capacity that we may call *readiness*. This is to say that there are a series of "best times" when a level of expectancy may be translated into performance. There are many such "best times" in the developmental life of the growing child, "best times" for neuromuscular coordinations, "best times" for training and cultural in-

doctrination, "best times," in short, for learning and the whole complexity of the educative process. It is our task to find out more about these "best times," in each child, and to teach him accordingly. If we do not, says psychiatrist J. A. Johnston (quoted by Brenner, 1957), we will build up adolescent disturbances and frustrations. Johnston traced many of these to improper timing of school entrance, when a new task was tackled before the child was fully able to do it well enough to satisfy the ego; motivation was correspondingly stultified in varying degree.

It is one thing to generalize about readiness as a functional potentiality—and, therefore, a maturational correlate; it is another to specify, to categorically relate to something. Brenner's statement that "readiness is always readiness for a task" makes sense. It is we who define the task in terms of demands and expectation; not only do we define task, but we set levels and degrees of performance. This is what we do when we put a child in the educational framework.

Let us start from the beginning. With growth and maturation (for form, function, and biological time proceed synchronously), there is a series of progressive functional possibilities. This is over-all behavioral readiness. From this there emerge patterns of performance in terms of integrated functioning. These patterns are time-linked in appearance and in sequence; as they emerge, as they are integrated into changes in form and function, that result in behavioral performance, the total organism is engaged in the learning process. This process is both covert (the wisdom of the body again!) and overt, the societal and cultural demands imposed on the growing child. From appearance and readiness of organic capacity, to integration, to performance via practice: these are sequentially nuclear to what we call *learning*.

It is here that Olson's concept of "Organismic Age" comes into sharper focus (1959a, 1959b). To me, as a biologist, the concept is a logical one, for behavior in its incipient expression is basically (perhaps only originally) organic. There is an organic substructure upon which the edifice of learning is reared. Obviously, this is too pat, too simple; there are too many variables and too many individual differences. As Brenner (1957) points out, a child's readiness may vary in time level, latitude, flexibility, intensity, composition, and motivation; the expected task may vary in time level of life-span, magnitude, complexity, quality, kind and degree of difficulty, and motivational power or valence. In varying combinations these two sets of variables frustrate any really simple approach to this whole business of "able and ready to learn."

Despite the pessimism of the last paragraph we may at least hitch our wagon to the star of maturational age; for, says Olson (1957), "pace, maturation, and learning go best hand in hand." The following statement by Olson is a workable concept:

For all achievements which increase with chronological age, the rapidly growing child will yield the achievement earlier, and the slowly growing child will achieve the status later than the average child of a given age.

In tackling the problem of "reading readiness," Olson clearly shows a close tie-up between reading age (RA) and organismic age (OA). In three groups of readers, slow (RA 2:0 or more below OA), intermediate (RA around OA), and fast (RA 4:6 or more above OA), the progressive curves of growth in RA and OA paralleled one another closely, group for group. I am certain that the parallelism between organismic development and readiness achievement may be demonstrated for any specific task (cf. Hughes, 1957).

It will be well at this point to note Ketcham's (1951) observations on *oral reading*. He studied 32 boys, 87-126 months of age, all very retarded in reading. They were divided into two groups, experimental and control. Both groups "had achieved what might be termed typical growth." In general Ketcham concluded that the child was "ready" for oral reading when certain "biological gradients" (energy, muscle, nerve, movement, perception of movement) were "integrated and fused" with certain "psychological gradients" (specificity, association, experience). Reading readiness, *per se*, is a stage in a bio-psychological continuum.

Readiness as a whole is "ripening," i.e., an individual potential translated in terms of capacity and ability. There is a time (to paraphrase) in the tide of growth which, taken at the full, will lead to greater learning ability.

Growth, Maturation, and Intelligence

I am not sure what intelligence is; I know what I think it is: a fairly general but effective individual response (human behavioral response) to one or all of the life-situations that constitute the socio-cultural milieu in which the individual lives. If the response is effective, we speak of intelligence; if not, of nonintelligence or ignorance. In a full sense one does not *have* intelligence; one is intelligent.

Yet, we measure intelligence as though it were an entity, as though it were some one thing either possessed or instilled, either largely endogenous (cf. Williams, 1956) or mainly exogenous (Nature vs. Nurture once more!). Whatever view taken, it is true that intelligence can be measured, quantified, so that a whole number may be given as a value judgment: the so-called Intelligence Quotient, or IQ. Here is the problem: How is the IQ related to growth and maturation? To what extent? In what degree? What is the correlation? Let us survey the evidence.

In 1893 Porter studied St. Louis children, and found that at any given

age pupils with higher grades were larger (taller and heavier). He concluded that physical growth is the basis for mental growth. In 1895 Boas stated that Porter's data proved only that physical growth and mental growth are correlated, not that the one depends upon the other. Boas also advised the use of the terms, "advanced" and "retarded." For Worcester, Massachusetts, school children he demonstrated size (height) differences due to variations in the *tempo* of growth:

CA	Grades	1	2	3	4
7		6.9	7.8	7.9	—
8		7.7	8.3	8.9	9.5
9		—	9.0	9.4	9.7

In the foregoing the figures are for height age (HA), e.g. grade 1 has an HA range of 6.9—7.7 years, grade 2 one of 7.8—9.0 years and so on.

In 1911 Boas studied the relation of height age (HA), weight age (WA), and biological age (skeletal age, SA) to the IQ. He found a significant regression of the IQ on HA and SA at a given chronological age, and concluded as follows:

The close correlation between anatomical and psychological traits in childhood must be interpreted as due to the influence of the tempo of physiological development over the body and its functions.

In 1937 Todd, in *Atlas of Skeletal Maturation*, *Hand*, observed.

Maturity is not experience—it is that upon which experience imprints itself and without which experience does not register. . . . A child who is retarded in maturation will think and act like a younger child. Experiences normal for his years simply fail to register. . . . The analysis of psychological responses or behavioral patterns is greatly aided by a preliminary assessment of the physical developmental progress, weight being an indicator of nutrition, stature of health, and maturation of constitution.

Several years ago Brenner and Morse, of the Merrill-Palmer School in Detroit, placed at my disposal certain basic data based on 16 children of kindergarten age. The Pintner-Cunningham Primary Mental Abilities Test (PMAT) was related to height and weight (as interpreted in the Wetzel *Grid*) and to skeletal age (as assessed in the hand via the Todd *Atlas*). Correlation of PMAT with H-W was $-.03$ and with S.A. was $+.35$. When the same biological variables were correlated with reading, the results were as follows:

Test	H-W Age (Wetzel)	SA (Todd)
1 Metropolitan Readiness		
Reading	.02*	.07*
Numbers	.01	.17

* All values of r are positive (plus).

Test	H-W Age (Wetzel)	SA (Todd)
2 Monroe Reading Aptitude		
Visual	.16	15
Auditory	.66	44
Motor	.38	18
Articulation	.18	21
Language	.03	55

Growth, as measured by H and W, is not a factor in PMAT, but seems to be in the auditory component of the Monroe test. On the other hand, maturation is a factor in the PMAT and in the auditory and language components of the Monroe test. It is reasonable to observe that maturation is certainly a factor to be reckoned with in the readiness or learning area. Correlation is not high enough to be predictive, to be sure, but maturation is there and cannot be overlooked.

When we go to later years we may note what Tanner (1955) has to say about the adolescent, i.e., the circum-puberal phase of adolescence. He finds, as we might expect, an IQ in favor of the early-maturers (e.g., the post- as opposed to the pre-menarcheal girls of a given chronological age).

Tanner observes that "evidently the brain does share to some small extent in the general factor of bodily maturity during this growing period." At adolescence, he says, there is in general a "heightened capacity" to carry out, "in combination as a group, as well as singly, logical operations involving the ideas of identity, reciprocity, inversion, and correlation."

If we accept the maturation process as innate and, therefore, basic we must now turn to another innate nucleus: genetics. There is reason to believe that the child inherits not only an "early" or "late" maturation pattern, but one of mental ability or potential as well. Honzik (1958) opines that, "it would appear that the parent-child resemblance in mental ability is more the result of genetic than environmental influence." To which may be added Bayley's 1954 assumption of "the existence of an hereditary core of parent-child similarities in both mental and physical characters, even though such similarities may not be evidenced during the first year or so of the child's life. . . . Differences in the mental organization of the infant and the adult could contribute to the changing parent-child relations in mental ability."

Up to this point it may be inferred that at least two major elements enter into the interpretation of the child's IQ: (a) it is influenced, in part, by maturation level, at least in earlier years; (b) it is a reflection of (true) parental background and this influence becomes somewhat stronger with age of the child. The emergent questions are, obviously:

How much is the IQ affected? Is the effect strong enough, or consistent enough, to be predictive?

In 1959 Klausmeier, Lehman and Beeman (1959a) and Klausmeier and Check (1959b) tested the relationship between physical, mental, and achievement measures and intelligence. In the first study (1959a), three hypotheses were framed:

(a) A low level of physical development within the child accompanies low achievement in arithmetic and reading;

(b) Uneven physical development within the child (split growth) accompanies low achievement in arithmetic and reading,

(c) The within-child variability in strength of grip, intelligence, reading achievement, language achievement, and arithmetic achievement, is the same among children of low, average, and high intelligence

The physical measurements used to test hypotheses (a) and (b) were height, weight, grip strength, number of permanent teeth erupted, and skeletal age (hand X-ray film). The testing of hypothesis (c) was done via the Wechsler Intelligence Scale for Children (WISC): low intelligence=55-80 IQ; average=90-110; high=115 plus. Hypotheses (a) and (b) were tested by correlational techniques, (c) by analysis of covariance. The subjects were 80 children (40 boys, 40 girls) drawn randomly from four third-grade classes and 58 mentally educable retarded children from 11 special classes. All were from Madison and Milwaukee, Wisconsin.

Level of physical development and variability in physical development correlated with arithmetic and reading achievement as follows:

	<i>Arithmetic</i>		<i>Reading</i>	
	Boys	Girls	Boys	Girls
Level physical dev. incl. dentition	.455	.128	.384	.069
Level physical dev. excl. dentition	.506	.073	.443	.046
Variability in phys. dev. incl. dentition	-.235	-.044	.047	.262
Variability in phys. dev. excl. dentition	-.027	-.065	.045	.007

The correlations of .455 and .506, and .384 and .443, for boys' levels of physical development and achievement in arithmetic and reading, respectively, are statistically significant. No such findings were made for girls. Thus, hypothesis (a) was upheld for boys only. Hypothesis (b), uneven or variable physical development (split growth), was not upheld for either sex. The testing of hypothesis (c) led to the following conclusion:

... the within-child variability in strength, WISC IQ, reading achievement, language achievement, and arithmetic achievement, was not the same among children of low, average, and high intelligence. However, when only the three achievement measures were used as the measure of within-child

variability, the groups were the same; also the within-child variability was significantly higher for girls than for boys at each IQ level.

In the second study (1959b), the same three hypotheses were tested on children with a mean age of 113 months. Five physical measurements were used (height, weight, grip strength, number permanent teeth, skeletal age). Eleven behavioral or achievement measurements were used (WISC IQ, Cal. reading achievement, Cal. arithmetic achievement, Cal. language achievement, chronological age, emotional adjustment, achievement in relation to capacity, integration of self-concept, expression of emotion, behavior pattern, child's estimate of own learning abilities). The essential findings in this study (from Table III in 1959b) are the following:

<i>Measure</i>	<i>Results</i>
Height	The high IQ group is taller than the average and the low.
Weight	There is no significant difference among means by sex or IQ level.
Grip	The low IQ group is weaker than the average and the high; the average group is weaker than the high; girls are weaker than boys.
Dentition	Girls have more permanent teeth than boys
Carpal	Girls' carpal age is higher than boys'.
Reading	The low IQ group mean is lower than the average and the high group; the average group is lower than the high.
Arithmetic	The low IQ group mean is lower than the average and the high group; the average group is lower than the high
Language	The low IQ group mean is lower than the average and the high group; the average group is lower than the high.
Emotional adjustment*	There is no significant difference among means by sex or IQ level.
Ach. and capacity*	Girls achieve higher in relation to capacity than boys.
Int. self-concepts*	No difference by sex or IQ level is significant at the .01 level; girls' mean score is higher at the .02 level.
Emotional expression*	There is no significant difference by sex or IQ level.

Behavior pattern*	There is no significant difference by sex or IQ level.
Estimate of own ability*	There is no significant difference by sex or IQ level (Girls' mean score is significantly higher at about .02 level)

* Based upon psychologists' estimates.

The most pertinent findings are:

. . . that the low IQ group is much the same as the other two groups in physique, anatomical development, and adjustment of self to others, but markedly different in achievement and also in vitality as assessed by strength of grip. . . . The researchers infer that the low IQ children are making a relatively good personal-social adjustment in the special classes, that their body structure should be capitalized upon with appropriate instructional activities, that their educational achievements under optimum learning conditions will probably continue to fall farther behind those of the average and high. . . .

In general it was found that a low or uneven level of physical development does not accompany low achievement in reading and arithmetic. With respect to within-child variability the following emerged:

1. Average girls less variable than low boys and girls and high boys,
2. Average boys less variable than low girls and high boys,
3. High girls less variable than low girls,
4. Within-child variability in reading, arithmetic and language less for average than for low or high,
5. Boys less variable than girls

Summary

1. *Physical growth* has herein been defined as the sum of all pre- and postnatal biological or organic growth processes, both morphological (structural) and physiological (functional).

2. *Behavioral development* has herein been defined as the total cultural integration of the child in socio-psychological patterning.

3. These two major processes are *time-linked* in that both are progressive and cumulative in the growing child

4. The concept of physical growth basically embraces increase in size, change in proportions, and progress towards maturity (or maturation process). The two most frequent measures of size and form are height and weight, the one most standard measure of maturity-rate is an X-ray film of wrist and hand which, when assessed, provides an estimate of biological age (skeletal age or SA).

5. The use of a biological age-framework permits the recognition of three categories of maturers: early, mid, and late. This, in turn, permits the recognition of three categories of growers: fast, average, and slow. All things being equal, these are directly, though not perfectly, correlated: early-maturer and fast-grower, mid-maturer and average-grower, late-maturer and slow-grower.

6. There is every reason to believe that the early-fast and late-slow categories markedly influence the psychosocial levels and attitudes within and between the categories, especially during the adolescent period. To a less extent this carries over into the neurophysiologic (motor) realm as well, as determined by performance levels.

7. *Readiness* is herein defined as a functional capacity or potentiality related to an ontogenetic stage of structural-functional growth and integration. Readiness implies a "best-time" for initiating a specific task situation.

8. There seems to be a useful and workable tie-up between total growth-time (Olson's OA) and readiness-stage. The more advanced the OA (especially its SA component) the more advanced the readiness-achievement level, and vice versa.

9. Maturity level is a positive factor in intelligence and in learning, but the correlation is too low to be predictive. The maturity level is an innate or endogenous factor, as opposed to exogenous sociocultural factors.

10. A further factor of endogeny is to be found in positive child-parent relationships, which suggest that intelligence and learning are entrenched in the family-line framework.

11. In boys, but not in girls, levels of physical development were significantly correlated with arithmetic and reading achievements. Uneven physical development (split growth) and within-child variability were not significantly correlated.

12. IQ grouping does not affect, nor is it affected by, physique anatomical (maturational) development, or self-adjustment categories or levels, but such IQ groupings show differences in achievement and vitality (strength of grip).

I would, just as much to aid for myself as to aid for others in the area of child development, emphasize that the growth of the whole child is a "package deal." Just as I, a human biologist, cannot neglect the whole realm of social science, so I hope that social scientists will increasingly foray into the areas of human biology.

There is much to learn. Hopefully, we can learn together, synchronously and integratively.

References

- 1 J. P. Ambuel, editor. *Physical and Behavioral Growth* Report of the 26th Ross Pediatric Research Conference. Columbus, Ohio. 1958
- 2 L. M. Bayer and N. Bayley. *Growth Diagnosis*. Chicago: University of Chicago Press, 1959
- 3 N. Bayley. "Some Increasing Parent-Child Similarities During the Growth of Children." *Journal of Educational Psychology* 45(1). 1-21, 1954.
- 4 N. Bayley. "Individual Patterns of Development." *Child Development* 27. 45-74, 1956.
- 5 F. Boas. "On Dr. W. T. Porter's Investigation of the Growth of the School Children of St. Louis." *Science*, n.s., 5 570-73, 1895.
- 6 F. Boas. "The Relation Between Physical and Mental Development." *Science* 93 339-42, 1941
- 7 A. Brenner. "Nature and Meaning of Readiness for School." *Merrill-Palmer Quarterly*, Spring 1957. p. 114-35.
- 8 T. H. Bullock. "Evolution of Neurophysiological Mechanisms." *Behavior and Evolution* New Haven: Yale University Press, 1958. p. 165-77.
- 9 H. S. Burr. *The Neural Basis of Human Behavior*. Springfield: Charles C. Thomas, 1960.
- 10 L. I. DuBrul. "Structural Evidence in the Brain for a Theory of the Evolution of Behavior." *Perspectives in Biology and Medicine* 4(1): 40-57; 1960.
- 11 R. W. Gerard. "Brains and Behavior." *The Evolution of Man's Capacity for Culture*. Detroit: Wayne State University Press, 1959. p. 14-20.
- 12 W. Goldschmidt, editor. "The Anthropology of Franz Boas." *Mcm.* 89, *American Anthropological Association* 61(5), Pt. 2. October 1959.
- 13 W. W. Greulich and S. I. Pyle. *Radiographic Atlas of Skeletal Development of the Hand and Wrist*. California: Stanford University Press, 1959. (Second Edition).
- 14 V. Hamburger. "The Concept of 'Development' in Biology." *The Concept of Development* Minneapolis: University of Minnesota Press, 1957. p. 49-58.
- 15 Charles Hanley. "Physique and Reputation of Junior High School Boys." *Child Development* 22(4): 247-60, 1951.
- 16 D. B. Harris, editor *The Concept of Development*. Minneapolis: University of Minnesota Press, 1957.
- 17 M. P. Honzik. "Fluctuations in Mental Test Scores." *Physical and Behavioral Growth*. A Report of the 26th Ross Pediatric Research Conference. (J. P. Ambuel, editor). Columbus, Ohio, 1958. p. 54-59.
- 18 B. O. Hughes. "Variability Among and Within Individuals in Relation to Education." *Merrill-Palmer Quarterly*, Spring 1957. p. 167-87.
- 19 H. E. Jones. "Motor Development and Coordination in the Adolescent." *Physical and Behavioral Growth*. Report of the 26th Ross Pediatric Research Conference. (J. P. Ambuel, editor). Columbus, Ohio, 1958. p. 78-83.
- 20 W. A. Ketcham. "Experimental Tests of Principles of Developmental Anatomy and Neuroanatomy as Applied to the Pedagogy of Reading." *Child Development* 22(3): 185-92, 1951.
- 21 H. J. Klausmeier, I. J. Lehmann and A. Beeman. "Relationships Among Physical, Mental, and Achievement Measures in Children of Low, Average, and High Intelligence." *American Journal of Mental Deficiency* 63.647-56; 1959a.
- 22 H. J. Klausmeier and J. Check. "Relationships Among Physical, Mental, Achievement, and Personality Measures in Children of Low, Average, and High Intelligence at 113 Months of Age." *American Journal of Mental Deficiency* 63. 1059-68, 1959b.
- 23 W. M. Krogman. "Growth of Man." *Tabulae Biologicae* 20:1-967. Junk, Den Haag, Nederland. 1941.
- 24 W. M. Krogman. "The Concept of Maturity from a Morphological Viewpoint." *Child Development* 21(1): 25-32; March 1950.

25. A. L. Lansing, editor. *Cowdry's "Problems of Ageing"* (Third Edition) Baltimore. Williams, Wilkins, 1952
26. A. M. Lassek. *The Human Brain*. Springfield Charles C. Thomas, 1957.
27. J. W. Macfarlane "The Significance of Early or Late Maturation" *Physical and Behavioral Growth*. Report of the 26th Ross Pediatric Research Conference (J. P. Ambuel, editor) Columbus, Ohio, 1958 p. 69-75
28. M. Maresh. "Longitudinal Evaluation of Skeletal Maturation" *Physical and Behavioral Growth*. A Report of the 26th Ross Pediatric Research Conference (J. P. Ambuel, editor). Columbus, Ohio, 1958 p. 45-49
29. W. C. Olson. "Developmental Theory in Education" *The Concept of Development*. Minneapolis: University of Minnesota Press, 1957. p. 259-74.
30. W. C. Olson. *Child Development* Boston: D. C. Heath and Company, 1959b (Second Edition).
31. W. T. Porter "The Physical Basis of Precocity and Dullness" *Trans Acad Sci St Louis* 6:161-81, 1893.
32. S. I. Pyle and N. L. Hoerr. *Radiographic Atlas of Skeletal Development of the Knee*. Springfield: Charles C. Thomas, 1955.
33. A. Roe and G. G. Simpson, editors. *Behavior and Evolution*. New Haven: Yale University Press, 1958.
34. N. J. Spuhler, editor. *The Evolution of Man's Capacity for Culture*. Detroit: Wayne State University Press, 1959
35. L. H. Stott. *The Longitudinal Study of Individual Development*. Detroit: Merrill-Palmer, 1955.
36. J. M. Tanner. *Growth at Adolescence*. Springfield: Charles C. Thomas, 1955
37. J. M. Tanner. "Boas' Contributions to Knowledge of Human Growth and Form." *Mem. 89, American Anthropological Association* (W. Goldschmidt, editor) 1959 p. 76-111
38. J. M. Tanner. *Education and Physical Growth*. London: University of London Press, 1961.
39. T. W. Todd. *Atlas of Skeletal Maturation Hand*. St. Louis. C. V. Mosby Company, 1937.
40. R. J. Williams. *Biochemical Individuality*. New York: John Wiley and Sons, 1956.

Social Forces . . .

The Learner and His Audience

Reuel Denney

In this paper I shall review and interpret some of the ways in which the social context of the learning process is being studied and reevaluated today.

All cultures expect the young to learn. Thus all cultures give some role-definition to the person as learner and all cultures assign some status in the social structure to the person as learner. The cultural variations in such assignments of role and status are, of course, wide and significant. In cultures in which the tradition is entirely or predominately oral or at least nonliterate, the place assigned to the person who is in the process of learning is relatively unspecialized, as Raymond Firth (1) reminds us, and the teacher-learner relationship is institutionalized only in the crafts and in the religious institutions.

The same is generally true in cultures which, while possessing literacy, live at a subsistence level. In such cultures the process of learning and the role of the learner are largely subsumed under some other larger classification employed by the social system—classification by age, or by sex, or by expected future occupation, or by place in the kinship system. One way in which such older cultural definitions of learning and the learner persist, even in new situations in which the culture has become literate and more complex, is suggested by Middle Eastern clay-tablet records. In the Fertile Crescent, at an early time, a culture that had taken possession of cuneiform writing provided schools for students, and called the students "sons of the tablet-house." The

culture was describing a new relationship, that between master and student, in a vocabulary that had existed before schools were even thought of.

One way of relating human learning with culture is to ask the question, "How does an individual learn the culture of his society?" This is a question that every anthropologist has to ask in one sense or another, even if his major interest does not happen to lie in the transmission of culture from one generation to another. An example is the work of Margaret Mead, which includes not only many monographic studies but that extraordinary report in *New Lives for Old* (2), the only record by the same observer before and after the shift of a whole primitive culture to a modern style of life. This is the line of research that has reminded us how important the informal, the unnoticed, the unaware, the unprogrammed elements of acculturation can be in the education of the whole person within a culture.

Another way of approaching learning and the learner is to ask, "In what way does this or that culture make a place for the concept of learning, formal or informal; and in what way does it acknowledge the presence and the role of the learner?" Every culture makes a place for the person as a member of an age group, a sex group, and an occupational group. One might also ask them, "How does it make a place for the process of learning and for the person as a member of a group of learners?" Do cultures vary in the salience that they attach to the learning process? The learner's role? In what manner? To what effect?

Within this general approach lies a subquestion that is of particular interest. One of the ways in which a society or culture institutionalizes the learner is to place itself in the position of audience to him. Thus, the instructor listens to the recitation of the student's lesson and the other members of the class provide a peer-group of listeners who form an audience to the learner's efforts. In the parents of the learner the society provides another specialized audience for the triumphs or the failures of the learner. Finally, through publicity of one sort or another, a whole national culture may give audience to the learning that goes on within it. The learner needs an audience and one is provided. The question is, what kind of an audience?

In recent years, Americans have become more and more interested in the role and the status offered to the student, not merely by his family and by his school, but by his own peer-group. We are coming to believe that the role and status which the learner thinks of himself as acting and occupying are more and more indicated to him by his peers. Inquiry along this line is to be found in *The Lonely Crowd*, in which

Riesman, Glazer and myself identified this drift as one aspect of what we called the change from inner- to other-direction. We associated this with the rise of a culture of abundance and with a shift in the pressures on the young from the older pressure to be good producers to the newer pressures to be good consumers. In a moment we shall want to look at some recent researches into this formulation and recent studies of the influences of the peer group. Right now, we must review the general sociology of the learner in society.

Nathan Glazer (3), suggests that we Americans have been concerned with three very broad questions about the relationship between society and culture on the one hand, and the learner, especially the young pupil or student, on the other.

1. How does our culture reveal to us or conceal from us the facts of what actually goes on in the learning process? A variety of researches have been directed at this question. To illustrate, there have been many interesting writings inspired by the suspicion that a widely held individualistic and competitive set of values in our culture has operated as an ideological screen, distorting our observations of learning processes in our schools, our industries, and voluntary associations. One of the best known examples is Mayo's study of the General Electric plant at Hawthorne (4). A theory of job learning and job productivity that stressed individualistic and rationalistic competition was tested in a series of ingenious experiments. They threw doubt on the idea that job-learning and job-productivity organize themselves around the simple incentive pattern suggested by the paradigms of classical economy. A result of the Hawthorne experiment was to suggest that all sorts of learning and all sorts of learning situations are concealed from our view because the value-systems provided by our culture prevent us from seeing them as they are.

2. How do different cultural and social backgrounds affect the fate of the learner? Of all three of the questions that Glazer lists, this is the one that has attracted the most attention. The question was dramatized by the recorded differences in the results of white and Negro Army intelligence tests during World War I and by the types of explanations offered for these differences. The effect of subsequent studies has been to prove that all naive hypotheses of racial difference are false, and this negative result is rather more convincing than some of the new hypotheses constructed in their place.

3. How does the institutional framework of our culture induce processes and expectations that have differential effects for learning and the learner? Recent researches suggest that many students can achieve more than their culture or they themselves think they can.

So much for a rather general view of the matter. Let us pause to look at the whole subject from a slightly different viewpoint, emphasizing the on-going talent search in the United States. All three of the themes outlined by Glazer appear in the current talent-search.

A most stimulating general commentary as background to the recent American talent-search is that provided by Paul Goodman in his book, *Growing Up Absurd* (5). He suggests that a major difficulty for young people in the process of casting themselves in future roles in life in our society is that many of the roles occupied in the American work force are themselves empty. Mr. Goodman is particularly critical of redundancy in management, the large number of people who are engaged in the margins of merchandising and advertising, and the meaninglessness of many occupational roles that we see around us. In some senses his critique also overlaps that of William Whyte, who noted for us, in *The Organization Man*, that the company town had not really disappeared, but had been translated into a state of mind, within which middle and upper management was now as fully encapsulated as the worker of yesterday by company housing (6). Mr. Goodman's main point is that the principal barrier to intelligent learning and choosing of occupational roles in the United States is the idiocy of our "adult" economy at large.

I would add to his diagnosis two other factors. The first is the anti-urban bias and the second, the bias against the future. Although country people are declining and city people increasing in numbers, many aspects of the student role in the United States seem rather overadjusted to rural expectations and underadjusted to urban expectations. This is partly a matter of votes and money: the farm-bloc alliance with small business has far more than proportional representation in our political structure and a correspondingly expanded control of institutions and values. Yet, that is not all.

Agrarian fundamentalism is associated with basic internal contradictions in the view of motivation and of achievement in our society: it preaches free competition yet often practices price-fixing. While this is true of many aspects of our monopolistically-minded society, this contradiction is not tolerated with such complacency in any other part of our society as it is within the farm economy. It is important to notice the resulting attack on urbanism in the popular culture of the press, movies, radio and magazines. For example, one editorialist, Mr. David Lawrence, wishes to rearrange voting so that the powers of the city are reduced in favor of the countryside. Mr. Lawrence sets this idea forward in a column in which he fails to observe that as of now it takes many more votes for an urban region or an industrialized state to elect its representatives than it does for rural regions and agrarian states!

The extension of this attitude into both the formal and informal

structuring of the student role in the United States seems to be considerable. It is at least associated very closely with a rather crude vocationalism and pragmatism which is still the prevailing temper of many school systems and universities. It also appears to be associated in some instances with what Riesman, Glazer and I called "curdled inner-direction," a high involvement in the slogans of 19th century individualism and a low commitment to their content. An ill-tempered sector of the attack on John Dewey certainly comes from this quarter. It is the kind of attitude that delightfully points up the research report showing that permissively reared boys have more trouble than others in deciding their future occupations but makes no mention of the research showing that permissively reared boys score well on "control" compared with all the others, and score better on "creativity."

One of the results of this complex of attitudes is the disturbing conformity that remains relatively untouched by the free play of ideas either internally or by access to the various media of communication. Samuel Stouffer made a study of the rigidities of American thought in *Communism, Conformity and Civil Liberties* (7). Measured in terms of its willingness to hear unpopular ideas, according to Mr. Stouffer, and to hear unpopular ideas debated in public, the Midwest of the United States was only slightly ahead of the whole South. There is much that is frightening in the fact that the richest agricultural section of the country and the world, unburdened by the historic weight of slavery, is almost as little interested in the free play of ideas as is the South, a society upon which that historic burden has always rested so heavily on all individuals and all groups.

A second bias, in my opinion, is the bias against the future. One of the interesting aspects of our culture at the moment is the degree to which scientism and vocationalism seem to have conquered in educational spheres. But it is a discounting of our future to put so much emphasis on the technological and industrial. In our attitudes toward curricular content, the slighting of the classics, literature and the arts is still strong. Students are fond of arguing that there is really no future in these studies, as if they were studying only for job qualifications. And even in this they show their ignorance of the probabilities of the future American occupational structure.

Any probable future social structure in the United States, 25 years from now, say, will be of necessity one in which languages and intercultural and artistic skills will be on a par with any of the other disciplines. This is indicated in a variety of researches, including for example, George Stigler's basic study, *Trends in Employment in the Service Industries* (8). It is also to be presumed, that since it is now fashionable to sub-

sidize the scientists, doctors and engineers, both in their lifework and in their preparation for it, it will soon be possible and fashionable to do so for other groups such as painters, actors and dancers.

For new and more self-confident humanistic attitudes to develop, there must be many changes in our schools and universities. At the moment, the universities, not the lower schools, are the great offenders. All too slow-footedly, for example, the colleges and the universities are developing "art centers," centers which have the effect of legitimating new types of curricular efforts, new types of student interests and indeed new types of students. But to provide a so-called art center, is for a university to admit that it is not yet what it might have been—a center for the arts. It is to admit, also, that universities have an overinvestment in teaching the trades. I myself do not see how the health of the American college and university can be maintained in the face of a vocationalism that is both persistent and narrow. Either universities might divorce themselves from some of their applied research institutes or immediately increase by hundreds of percent their investment in the humanistic and artistic processes—processes that train for consumption at higher levels as well as for productivity in these more specialized sectors of the economy.

Along these lines, it would be not too difficult to show that the present occupational structure of the United States was largely unanticipated by the educational system of 50 years ago. Its growing "service" sector was then, as now, underestimated. Certain types of intellectual crises in curricular design are associated with this fact. Let us take one example: the rise of the career in the popular arts and leisure in the United States. A curriculum preparing people for production and consumption of the popular and fine arts should necessarily include high literacy and philosophic training. Such curricula rarely include a sufficient emphasis on languages and literature, including Greek and Latin. They rarely do. On the other hand, higher education in the United States continues to insist on looking the other way with respect to the rise of the visual and the popular arts in the United States. The university in general refuses to interest itself as much as it needs to in these nonverbal modes of expression and communication. When it does so, it tends to reduce these to art history, or vocationalism, or the status of "extras."

More generally, the humanistic tradition in the United States is itself in need of repair. The historicism of the Germans replaced the moralism of the British without really changing things very much. Modern university literary scholarship is in general either in the historical mode or in the "new critical" mode, *and both are somewhat disrespectful of the concept of the audience*. It follows, for example, that the new things that can be said about the older works of art as a result of our several generations of experience with film are still treated casually or even with

contempt. In many colleges students are expected to understand Luther's theses and Tillich's theology before they understand the films of Bergman. How can someone who cannot understand Bergman possibly understand what Luther was talking about?

Our universities need a deeper critique of the humanities than has yet been offered by Santayana or Barzun or Snow or that recent, essentially professional and organizational approach to the subject, Howard Mumford Jones' *One Great Society* (9). The work of Kepes at the Massachusetts Institute of Technology in the visual arts, the efforts of the American Council of Learned Societies in their seminars for secondary school teachers of classical languages, at Wisconsin, and the development of drama centers at various places in the United States, are among the good signs in this field. So is the appearance of a brilliant handbook for the study of the media to be conducted in secondary schools by Marshall McLuhan. *The Mechanical Bride* (10).

Many of our current interests in learning and the learner are the result of a shift from interest in the cognitive to interest in the apperceptive. This leads directly to a concern with the cultural setting of the aspirations of the learner. How is it that some subcultures encourage the learner while others discourage him?

The small Protestant institution is chief collegiate contributor to high level scholarship in the United States. The Protestant, small town, middle class has been conspicuously in the lead in its contribution to the ranks of top level scientists in the last generation as well as in the generations before. On the other hand, Catholic educators are uneasily recognizing that Catholics generally fail to occupy top level roles in intellectual life in the United States. The result of such observations is that it is probable that we can expect to see a shift in such comparative positions in the coming decades and that these shifts will reflect in turn those changed views of the curriculum and those geared-up expectations of the learner that are already being discussed by self-critical leaders of Catholic higher education in the United States.

Yet, in looking at these religious and ethnic backgrounds, it is interesting to notice that the increased importance in American life of the design and fashion profession is providing a new channel of mobility (and new stimuli in the curriculum) related to the development of Latin peoples in the United States. For years, American visual culture has been a borrowing from the Latins, carried out by Germans, for the marketing practices of a predominately Anglo culture. Now the tide has begun to turn, and differential attitudes toward design professions, which are increasing in importance, are beginning to have their effect. Sociologist Mason Griff, in his researches in Chicago, learned that, insofar as

the selection of an artistic career is concerned, Italian families in Chicago are favorable to the idea and Anglo families are not favorable to the idea. One of the results, of course, is that as the design professions become increasingly important in our economy, Anglos may be proportionately disadvantaged and people of Latin backgrounds will be proportionately advantaged by this cultural bias.

The point about the advantage of the ethnic disadvantage can be broadened in another direction, as it is in that brilliant book, *The Overseas Americans* (11). There, we are told that, all other things being equal, second and third generation stocks in this country, especially from south and central Europe, interact more effectively with members of foreign cultures than those of long native descent. This contains a number of interesting possibilities when you think of it, in terms of the problem of intercultural learning within and outside our culture.

With the rise of the influence of the older subcultures in the United States, we can begin to see some improvement in our traditions in fields as various as the visual arts and diplomacy. I suggest that the perceptions of the teacher and student will change as the values held in high esteem by these rising subcultures are now becoming more highly valued by the culture at large.

Recent work by Getzels and his associates at the University of Chicago bears upon this. Developing instruments that tell us something about a student's creativity as well as his intelligence, he and his associates are contributing a pressure toward changed role-definition and achievement-focus for the student, and a change in the culturally-approved profile of school skills (12). These new standards, when generally applied, will legitimate more of the intuitive and artistic aspects of student mentality than were legitimated before. This could provide a better "audience" to certain kinds of learners and perhaps even ethnic groups than they have been given by schools and teachers before.

It seems appropriate to mention a specific example of recent research on the learner and his audience—the volume, *Talent and Society*, by McClelland and others (13). There are many notable things about this report, which is concerned with such issues in the identification of talent as: (a) lack of fit between school and life performance, (b) the loss of potential talent, (c) cultural differences in occupational achievement, and (d) the meaning of good performance. Most interesting is the work's emphasis on those aspects of the learner's performance suggested by the terms, *motives* and *values*. Here, we find research dealing with the learner in his culture which receives its impetus from the interest of Max Weber and the Kluckhohns in cultural values, the essays of George Herbert Mead on the structure of roles, and the interest of social psychologists in patterns of motivation.

A report by Strudtheck, in this volume, studies the lower aspiration level of certain ethnic in the United States as a function of their "family vs. community orientation." Out of this study come searching recommendations that seem to exemplify new lines of thought about the relation of the young learner to society. The authors' recommendations include

The study of the expressive character of the learner, his values, motives, and skills in social perception should have a high priority in research

The study of the structural characteristics of the situation in which talented performance occurs

It seems that it would be rather easy for research along these lines to show that our models of group organization in learning, as in work, are still overformalized in the United States; that our schools are still run too much as factories—when they could be more productively modeled after the *atelier*.

Earlier it was noted that Riesman, Glazer and myself were interested in the control of the learner by his peers and were indeed, to some extent, worried about it. Following our suggestions, some recent studies of students have been carried out in terms of our distinction between the typical character of the inner-directed and the other-directed persons. Studies at Rutgers found that students, if asked about their aspirations, put "being liked by peers" higher than "being academically excellent." While students saw their parents as reversing this order, the parents actually wanted their children to be equally successful in both studies and sociability.

At Brooklyn College, inner-direction proved to be correlated with object perception relation tests in the sense that the more inner-directed showed more veridical judgment in the separation of object and distracting field (14). The most interesting finding in this research was that inner-direction, high orientation toward productive achievement, was associated in some cases with anxiety levels as high or higher than those present in the other-directed. In short, anxiety for achievement was perhaps both functional and dysfunctional in the personal growth of the students who were the subjects of this research.

Among many studies of the effect on learning and behavior of an anchorage in peer groups, one of the most interesting is the 1955 investigation by John Johnstone (15). He studied groups of popular-music fans and learned that the most popular girls in the groups were those who were nearest the norms for the group's taste level. All such studies raise the question, "How are a given young person's or learner's productivity and creativity affected by the controls exercised over him by the social groups to which he belongs?" Why does a school get higher academic product, as one did in Chicago, when it acquired a new wrestling

team? James Coleman's recent book, *The Adolescent Society*, suggests some of the answers (16). Why are private school boys underachievers and public school boys overachievers? Group-anchorage here seem to be of basic importance.

It appears that the social psychologist is the chief natural heir and organizer of all the studies of the way in which the perceptions of an individual are conditioned by the expectations others have of him, and the effects of this upon his attempts to learn. In short, the social psychologist is discovering the importance to the learner of his place as an actor in an actor-audience relationship. Not all of the relationships between an individual and his group, of course, can be seen in that light. Yet, among all the concepts that have been suggested in the growth of social psychology since Wundt and Baldwin, the audience-concept is one of the most interesting.

The process of the response-to-audience in all organic creatures is, as we know, quite basic. While reading one of the volumes reporting the Darwin Centennial meetings at the University of Chicago (17), I came to a section reviewing some new studies in the mechanism of adaptive coloration, that process by which an organism, having become aware that it is being sensed by another organism, changes its appearance. The change may be, among other things, a reflex retreat into camouflage, or the putting up of signals designed to scare away an enemy, or sexually cooperating response to a prospective mate. The earliness of these mechanisms, and their intensive and extensive elaboration at the level of instinctual response, suggest how deeply the life of the "individual" is dependent on his sense of the "other."

Man, of course, does not change his appearance or self-concept by instinctual mechanism, like the chameleon. He does it by a series of slowly developing cultural techniques beginning perhaps with the tattoo and the mask. These techniques, in turn, form part of the basis for subtler, more verbal, and more psychological methods of dramatizing or "undramatizing" the self. Freud's theories are in one sense a study of the way in which selves reveal themselves to themselves and others not merely by physical signs, but by transformations of the perceptive and cognitive systems by which human beings read these physical signs in each other.

Research into such processes is now receiving fuller development in one of the most interesting intellectual developments of our time, a generalized interest in "expectation systems." The smaller units of such systems are studied by, among others, the experimenting social psychologist. The larger units are studied by, among others, such specialists as the game theorists. It is from such sources that we seem to be getting new ideas about the learner and the effects upon him of expectations.

that he will or will not learn. Here, in the study of the learner's "audience," is a major salient of the new social learning about learning.

References

1. Raymond W. Firth. *Elements of Social Organization*. New York. Philosophical Library, 1951.
2. Margaret Mead. *New Lives for Old*. New York. William Morrow and Company, 1956.
3. Nathan Glazer. "Three Possible Contributions of Sociology to Education." *Journal of Educational Sociology* 33. 97-104, November 1959.
4. Elton Mayo. *The Human Problems of an Industrial Civilization*. New York. The Macmillan Company, 1933.
5. Paul Goodman. *Growing Up Absurd*. New York. Random House, 1960.
6. William H. Whyte. *The Organization Man*. New York. Simon and Schuster, Inc., 1956.
7. Samuel A. Stouffer. *Communism, Conformity and Civil Liberties, A Cross-Section of the Nation Speaks Its Mind*. Garden City, New York: Doubleday & Company, Inc., 1955.
8. George J. Stigler. *Trends in Employment in the Service Industries*. Princeton. Princeton University Press, 1956.
9. Howard Mumford Jones. *One Great Society, Humane Learning in the United States*. New York: Harcourt, Brace & World, Inc., 1959.
10. Herbert Marshall McLuhan. *The Mechanical Bride, Folklore of Industrial Man*. New York. The Vanguard Press, Inc., 1951.
11. Harlan Cleveland, G. J. Mangone and J. C. Adams. *The Overseas Americans*. New York: McGraw-Hill Book Company, 1960.
12. Jacob Getzels. "Problems of Values, Value Change, and Personal Identity in Education." *Frontiers of Secondary Education*. Paul M. Halverson, editor. Syracuse, New York: Syracuse University Press, p. 26-37.
13. David C. McClelland and others. *Talent and Society, New Perspectives in the Identification of Talent*. Princeton. D. Van Nostrand Company, Inc., 1958.
14. Matilda White Riley, John W. Riley, Jr. and Mary E. Moore. "Adolescent Values and the Riesman Typology", and Elaine Graham Sofer, "Inner-Direction, Other-Direction and Autonomy: A Study of College Students." Both in: Seymour Martin Lipset and Leo Lowenthal, editors. *Culture and Social Character, The Work of David Riesman*. Glencoe, Illinois. The Free Press, 1961.
15. John Johnstone. *Popular Music and the Adolescent*. Chicago: University of Chicago, Committee on Communication, 1955.
16. James S. Coleman. *The Adolescent Society*. Glencoe, Illinois: The Free Press, 1961.
17. Sol Tax, editor. *Evaluation after Darwinism*. Chicago: University of Chicago Press, 1960.

Social Forces . . .

Origin of Achievement Values in the Family: A Classroom Perspective

Fred L. Strodbeck

There was a contemporary of Freud's whose approach to the problems of human motivation was in a sense complementary to Freud's. Whereas Freud focused upon the eternal dilemmas of socialization, without specifying in detail the value systems of the cultures involved, Max Weber emphasized the values of a people and closed his eyes almost completely to the ways in which values are inculcated.

It is the particular responsibility of our scientific generation to fuse the emphases of Freud and of Weber. Our understanding of the linkage between the values of parents and the values their children come to hold is today at the same stage as was our understanding of children's diseases at the turn of the century. We have some hunches, some names for mechanisms involved, a broad spectrum of behavioral scientists are at work on the problem, but we have no certain findings.

As we trace interrelationships between socialization practices and values, we find that frequently it is the most obvious ones which we are slowest to understand. For example, we have been able to surmise relationships between the toilet training of the infant, a socializing experience, and certain personality tendencies of the child. Yet we have been less ready to recognize the significance of the fact that it is those mothers who place a high demand upon cleanliness and neatness who tend to

toilet train very early. We almost reluctantly recognize that parents, although they may not understand fully the mechanism by which they achieve their result, do tend to produce the kind of behavior in their children which suits their own ideas of a desirable adaptation to society.

An interesting example is provided by the studies made by McClelland and his associates of the folk stories of the Plains Indians, the so-called coyote stories. The degree to which the hero in these stories faces barriers, feels happy when he is successful and disappointed when he fails is interpreted by McClelland to indicate the degree of stress put on achievement. This emphasis is much stronger in some groups of the Plains Indians than in others. McClelland also demonstrates that those societies which put the highest value on achievement in their coyote stories tend to have the most demanding and harsh socialization practices in their infant training.

Such ingenious assessment of interrelations between values and socialization practices has, for some inexplicable reason, been more easily made of foreign cultures than of our own. Perhaps we are so convinced of the complications in the functioning of our society that we are reluctant to undertake first steps which must necessarily seem so primitive.

Let me demonstrate that first steps *are* possible by mentioning a study by Marion Winterbottom. She asked mothers the following four questions:

1. At what age do you believe that a child should know his way around the city?
2. At what age do you think a child should be willing to try new things?
3. At what age do you think that a child should be able to do well in competition?
4. At what age do you think that a child should be able to make his own friends?

Taking the four ages given in response to these questions, adding them and dividing by four gives an average age which has been found to differ significantly for mothers selected from different cultural backgrounds. Mothers of Jewish ethn city give ages which average 6.1 years. This is the youngest for any of the larger ethnic groups. For the Protestant groups, the figure is 6.2 years; for the Irish Catholic, 7.1 years; and for the Italian Catholic, 8.2 years.

What is the meaning of these differences in emphasis? At the two extremes are the Jewish and the Italian Catholic groups, both of which came to this country at about the turn of the century, and were more equally prepared for adaptation to American life than is ordinarily assumed. Yet, during the intervening 50 years, the Jews have achieved a much higher status than have the Italian Catholics. Can the difference

in age-of-mastery expectations have had any conceivable role in producing these differences? Note, that this question is raised not about some exotic culture. We are here concerned with cultural values and subsequent adaptation in our own competitive society.

Significance of Daily Behavior

A proper study of socialization requires systematic observation of the day-to-day, repetitive, behavior which takes place between parents and their children and between family members and representatives of the larger society. The problem is that there is an overwhelming amount of such data. Within this body of data, therefore, we must isolate smaller segments. We must not circumvent lack of knowledge about the functioning of socialization systems by undue concentration on individual phenomena as do many current approaches. The explicit recognition of the social linkage between mass society and individual motivation has not come easily and must not be lost.

For example, when we attempted, during the last war, to assess the effects on the morale of men in the armed forces of large scale information programs designed to raise morale, we found very little relationship. What seemed to be most important in maintaining the morale of the individual soldier was his relationship to the other three or four or five men with whom he lived and fought most closely. As a result of this insight, considerable modification has been made of the way in which men are recruited, trained and assigned into various units of the army. There is now a firmer disposition to recognize the importance of keeping men together in primary units.

Again, in studies of voters and voting preferences we find that it is less the individual's response to the candidate that is so important than it is the individual's response to his group's evaluation of the candidate. Similarly the famous studies of Warner and his associates on the achievement system in a small community show that the paths of mobility in such communities lead upward not individually, but by steps of successive identification with different cliques.

The Child's Responses

Is it not also probable that we shall have to take the family into account as an intervening system if we are really to understand how the socialization of the individual child is affected by the achievement demands of the larger society? To illustrate this possibility, let us assume that the ultimate achievement of a child is a value widely held by all families. We shall also assume that between the child and other members

of the family there are relationships which, to a degree, parallel the interrelationships of individuals in other types of groups. If the family functions as other groups do, we may assume that the lower the rank of the child in the family, the less he will believe in and subscribe to its norms. And, on the contrary, the higher the rank of a child as a group member in the family, the greater will be his feeling of dedication to the family's norms. In other words, we suggest that negative consequences arise in the family, as in other groups, when difference in rank among the persons who participate in joint activity is accentuated.

From the general study of small group functioning we are led to believe that differences in rank can be handled in two ways. Differences in rank which have existed at one time may be reduced as the group goes through various phases of activity. The negative consequences of differences in rank can also be mitigated by role specialization. A classic example is the reduction of competition when male and female roles are clearly assigned. Indeed, there are observable emotional costs to families in which conventional father-mother role specialization is not present. Our knowledge about adult-child role specialization and its effects, particularly in early adolescence, is not so clearly understood.

Research Findings and Hunches

Viewing the family as a social group provides hunches as to what problems may be important and suggests ways in which these problems may be investigated. Let me be more personal in this connection. I have worked largely with families consisting of mother, father, and an adolescent son between 14 and 16 years of age. In all cases, the adults have been "second generation" residents in this country and their children "third generation."

To obtain a sample of their on-going relationships with one another, we ask each member of the family a series of questions, such as: If a boy goes into the army with a group of other boys from his neighborhood and has a chance to get ahead if he leaves his group, should he think first of getting ahead or of sticking with his friends? In this case, we get independent answers from the boy, from his mother and from his father. With this and other questions we seek to understand the value orientation that a family wishes to communicate to its son. If we find that a mother and father agree and the son disagrees, or father and son agree and the mother disagrees, we encourage them to talk over these differences so that they may then come to understand how each member of the family reached his or her position. We ask them to indicate, if possible, a solution which best represents the thinking of the family as a whole. When a recording of this discussion is carefully studied, one not only obtains a measure of

the supportiveness offered, but also of the pressures utilized by these individuals in dealing with one another. Finally, the degree to which one family member has the power to make his own point of view prevail is disclosed.

Power scores arrived at in this way systematically differentiate between father and mother and son roles: the father wins roughly 38 percent of the decisions; the mother, 33 percent; and the son, 29 percent. Interestingly, as the socioeconomic status of the family rises, there is a systematic shift in the power of the father. The higher socioeconomic status father wins more decisions than does the father of lower status.

An Important Principle

Here we see the application of an important principle: in all groups, a problem of responding to external demands is present, and those who have the greater competence at this external adaptation come to have the greater power in the group. And so it is that we frequently find that even though the lower class Italian father wishes to tell his boy what to do, he encounters resistance because the boy can observe that a father who still carries his lunch pail is not one to turn to for "answers." On the other hand, if the father is a successful executive, he can ordinarily handle disputes on values in such a way as to persuade the members of his family to accept his views. In general, the higher the socioeconomic status, the greater the power of the father.

The main objective of my research was to look for evidence of a relationship between the power structure in the family and the achievement motivation of the son. As an adjunct to this, eight attitude statements which relate to the achievement of children were evolved. A few of these are: (a) "Planning only makes a person unhappy since your plans hardly ever work out." (b) "When the time comes for a boy to take a job, he should stay near his parents, even if it means giving up a good job opportunity." (c) "The best kind of job to have is where you are part of an organization all working together, even if you don't get individual credit."

"Disagree" answers to these questions are added to provide an achievement value, or "V" score. If a boy answers these questions in such a way as to indicate a belief that by his own effort he can manipulate the world rather than being mostly at the mercy of chance . . . if he desires to work in a situation where you get individual reward . . . if he believes that it is legitimate for a boy to leave his family in order to get ahead . . . and if he is disposed to defer immediate gratification for longer term gains, he will have a higher "V" score.

We find after we have factored out ethnic and status differences,

that the higher the power of the father in the family decision making situation, the lower the "V" score of the son.

In what way does the achieving, adequate father actually undercut the goal that he strives for most in regard to his son? What is the mechanism by which this takes place? And how can we understand this mechanism if we view the family as an operating group?

What Fosters Achievement?

If we look both at the early socialization period and at the socialization period which characterizes early adolescence, we discern two important processes. In the early period, the child who is pushed a little ahead of his own competence develops the same sort of persistence that comes with aperiodic rewards in learning situations. The child receives rewards for acting in ways he does not fully understand. The same is true for punishments. If the mother is generally supportive, the child comes more to hope for success than to fear failure. But whereas he persists in the reward activities, at the same time he comes to believe that his relations with his parents are contingent upon his performances—their love is not altogether unequivocal. Later in life, therefore, when he faces the dilemma of a choice between direct interpersonal gratification and the more impersonal rewards from achievement-related activity, he tends to choose the latter.

If this developmental trend is coupled with a family experience in which the child as an early adolescent feels he makes a real contribution—and for this to be the case he must *make* a real contribution—he is likely to conceive of the external environment as being responsive to his own efforts to achieve. This theory as to how an "achiever" proceeds is, at best, just a hunch, for this hunch to be validated will require much disciplined observation of that life around us which, unfortunately, seems so obvious.

The Small Group Perspective and Non-Family Behavior

My studies have not extended directly into the classroom and, for that reason, I am not disposed to try to generalize the family findings. Nevertheless, I have had extensive experience with the study of jury decision-making. So, if I have something to say about determinants of performance of citizens in the jury situation, the reader will be able to make the intervening step of stating the implications for curriculum development.

Let me first review briefly an empirical discovery by members of our research group. Our data cards contain, in conveniently accessible lo-

education information on relative participation (based on interaction process acts) for 20 deliberations, and responses to attitude questions from a predeliberation questionnaire for a full set of more than 60 deliberations. A member of the research team, while making a routine cross tabulation of participation and the 13 attitude questions, noted marked similarities in a subset of eight questions which discriminated between high and low participation. As we prepared to discuss these findings, another member of our group attempted to identify eight of the 13 items which best exemplified what we were, at that time, calling Puritanism. To our surprise, the two operations produced agreement on seven of the eight questions. This, then, determined our decision to reexamine the data in order to understand more clearly what appeared to be a remarkable congruity.

The dominant theme underlying the questions yielding the personal control score (PC) is that the attainment of individual success or failure is not a matter of destiny, but a result of one's own efforts. A second theme is that skill, not personality, is the basic requirement for success. A third theme is rejection of a philosophy of immediate gratification. A fourth is a preference for decisions based on a rule of law over decisions based on personal standards of fairness. The eight questions on which the PC score is based have a single common factor: *the expectancy held by an individual that his own behavior can determine his attainment of success and higher status.* (See Table 1.)

TABLE 1. Personal Control Questions

1. When a man is born, the success he is going to have is already in the cards, so he might as well accept it and not fight against it. (Disagree)
2. The most important things that happen to people are:
 - a. The result of circumstances beyond their control.
 - b. More the result of their own efforts. (Positive PC)
3. Having a nice personality and being well liked are more essential for success than any particular type of skill. (Disagree)
4. Most people with low incomes can't do very much about it. (Disagree)
5. Nowadays with world conditions the way they are, the wise person lives for today and lets tomorrow take care of itself. (Disagree)
6. If a man is born into a poor family, he nevertheless has a good chance to become a comfortable middle-income person. (Agree)
7. In deciding a case a juror should try to do what he thinks is fair, rather than sticking to the letter of the law. (Disagree)
8. When you get right down to it, being a success in life is really up to yourself alone. (Disagree)

Relating Personal Control and Participation

Eleven years ago, in a paper written in collaboration with R. F. Bales (2), the senior author presented a rudimentary theory of group process which provides a basis for directional prediction concerning the effects of our PC score on participation. This theory may be briefly summarized as follows:

Group process is conceptualized as involving three dimensions: the *instrumental*, relating to a concern for the solution of problems external to the group—in this instance, obtaining a fair verdict within a reasonable time, the *adaptive*, relating to the concern with the strain on interpersonal relations arising from the differences in internal rewards—in this instance, participating in the deliberation is viewed as being intrinsically rewarding, and *expressive*, relating to the motivational gratification of the individual participant—in this instance, realizing positive aspects of one's self-conception by being a member of a group which has created a residue of good feeling while accomplishing its task.

In using this model here, we assume that the expressive needs of jurors are randomized so that a negligible correlation with PC score exists. This reduces the model to two dimensions.

The basic empirical finding in this study is that there is a significant positive relationship between PC score and participation for male clerks, skilled workers, and laborers, and for female clerks, laborers and housewives. There is no such significant relationship for male proprietors. A possible explanation of this lack of relationship is that male proprietors were already so high in participation that they might perceive the need to allow others to talk as necessary to the attainment of unanimity. From the composite data the positive relationship is firmly established and PC score (used alone) is just as effective as occupation (used alone) in reducing the variance in predicting participation (3).

In terms of current psychodynamic and developmental thought, a belief in personal control might be viewed as a somewhat primitive attitude. If it is seen as a measure of a persistent value orientation toward man's relations to nature and to the affairs of society, one might be concerned that it makes no provision for a personality disposition which would cause a person to try hard only when the stakes were low and then not try hard when the stakes were high because of a greater fear of failure. Is it possible that the sense of personal control may operate consistently when role salience is low, as in the jury situation, but operate very inconsistently when salience is high? The evidence for believing that such personality mechanisms as fear of failure exist has involved measures of motivation which are much more projective than is the PC score. The intent of the PC score is manifest; we have made no attempt to guard

against the possibility that a person may "fake" his PC score. There are, however, widespread cultural norms by which a person could justify either a high or a low score, and there is no reason for believing that a jury or classroom situation would motivate respondents to hide their true position.

Hopefully, our disposition to see the effects of PC primarily as increasing consciousness of task problems and decreasing sensitivity to adaptive strains in face-to-face groups provides a new perspective. This way of viewing the PC construct complements similar thinking which has arisen in macro-social theory relating to the concept of alienation. Discussions of this topic from Marx, Weber, and Durkheim through contemporary writers, have contained, but failed to distinguish between, the different meanings of the term "alienation" which include powerlessness, isolation, and self-estrangement. The powerlessness component, emphasized in our study, can be seen as being in the tradition of the long-standing concern with "the individual's belief that his own behavior . . . (can) . . . determine the occurrence of the outcome he seeks" (4).

Other recent theoretical analyses which complement the present paper are White's analysis of *competence* and Thibaut and Kelley's analysis of *salience*. White considers the psychosexual stages of development in terms of the individual's increasing desire for control over the environment (5). This theory provides interesting insights into the relationship between the sense of personal control and psychological maturity (6). Thibaut and Kelley's work is important for the sharper definition it gives the term "salience" and for the way in which this definition helps one understand how persons with a high sense of personal control might become more responsive to task demands. They suggest that those parts of one's environment which one has learned to manipulate to obtain rewards (or which incur costs) become salient as one looks ahead to new circumstances (7). The high PC person is thus one who has satisfactorily manipulated a larger portion of his psychological environment.

In these terms, the capacity of high PC persons for expending greater effort to solve task problems is viewed as arising from a greater conviction that the environment can be manipulated, not from a greater capacity to recognize the problem. This carries the interesting implication that if lower status persons have lower PC scores than do higher status persons, as our data indicate, and if our theory is correct, then we should be able to deduce some of the systematic differences between middle and lower class cultures. The lower PC for the lower status groups should cause a narrower range of environmental stimuli to be viewed as salient for goal achievement; as a result, there should be an elaboration of intra-familial and expressive emphases, because these constitute opportunities for reward which are least directly affected by impotency felt in the face of the ex-

ternal system. This lower sense of "fate control" (Thibaut and Kelley's term) should be reflected not only in lower participation in extra-familial groups, but also in lesser capacity for long-term planning, and perhaps by lesser capacity for universalistic decisions in jury cases. Thus from our initial concern with participation in jury deliberations, our interest in "personal control" has led us both to macro-social considerations and to new hypotheses for the examination of the jury data.

It is possible this line of inquiry may have similar implications for the analysis and understanding of the role of the school situation in the inculcation of achievement values. We are all familiar with many curriculum objectives which have as their implicit goals the same consideration of personal control which has been discussed. It is hoped that by making more explicit how such values are developed and how they may be measured that we make possible an earlier application to education.

References

1. We are embarrassed not to know the origin of all our questions. Leo Srole has kindly called our attention to the parallel between the absence of a belief in personal control and Fromm's "helpless" individual, Durkheim's fatalistic suicide, and his own anomia scale in which he uses a question like number 5. See "Social Integration and Certain Corollaries," *American Sociological Review* 21: 709-16, December 1956. Strodbeck used similar questions in his V-scale. See his "Family Interaction, Values, and Achievement," in David C. McClelland, Al Baldwin, Urie Bronfenbrenner and Fred L. Strodbeck, *Talent and Society*, Princeton, N. J.: Van Nostrand, 1958, p. 135-94, and Florence Kluckhohn and Fred L. Strodbeck, *Variations in Value Orientations*, Evanston, Ill.: Row, Peterson, 1961. What is here called personal control would, in Florence Kluckhohn's value orientation scheme, be roughly equivalent to the Man versus Nature alternative in the *man-nature* orientation.
2. Robert F. Bales and Fred L. Strodbeck, "Phases in Group Problem-Solving," *Journal of Abnormal and Social Psychology* 46: 485-95, October 1951, and Robert F. Bales, "The Dimensions of Action-Space," in Talcott Parsons, Robert F. Bales and Edward Shils, *Working Papers in the Theory of Action*, Glencoe, Ill.: Free Press, 1953, p. 63-109.
3. Sex does not make a significant contribution to reduction of the variance, largely because of the low overlap in classifications; that is, there are no female proprietors or skilled workers and no male housewives. It has been retained because of the theoretical importance of demonstrating the slope differential presented above, and to maintain continuity with the sex role and status papers.
4. Melvin Seeman, "On the Meaning of Alienation," *American Sociological Review* 24: 783-91; December 1959. Seeman's bibliography is well chosen. For related references, see also Bruce P. Dohrenwend, "Egoism, Altruism, Anomie, and Fatalism: A Conceptual Analysis of Durkheim's Types," *American Sociological Review* 24: 466-73, August 1954; and Dwight G. Dean, "Alienation and Political Apathy," *Social Forces* 38: 185-89, March 1960. The definition of personal control used in this paper is adapted from Seeman's definition of powerlessness. That empirical relationships can be obtained between rather informal, somewhat *ad hoc* measures of powerlessness and attitudes on a public issue may be seen in Wayne F. Thompson and John E. Horton, "Political Alienation as a Force in Political Action,"

Social Forces 38, 190-95, March 1960. See also John P. Clark, "Measuring Alienation Within a Social System," *American Sociological Review* 24, 849-52, December 1959, and Elizabeth Douvan and Allan Walker, "The Sense of Effectiveness in Public Affairs," *Psychological Monographs* 70, No. 22 (1956), p. 1-17. This last cited study is of interest for the authors' report that persons who see the outside world as controllable have greater personal satisfaction with their lives, but contrary to the Authoritarian Personality hypothesis, are not more (or less) accepting of normal impulses. Beliefs about personal control in general seem relatively uncomplicated psychodynamically, as if they were to a large degree generalizations of later (in contrast with early) socialization experience. Some searching applications of the PC score are being made under the direction of Marvin Sussman at Western Reserve University in the investigation of how age and sickness affect patients' willingness to take responsibility for their rehabilitation regimes. In this connection it is interesting to note, both as a validation of the meaningfulness of the score, and as a caution in other applications, that PC decreases from 6.0 at ages under 35 ($n=186$), to 5.5 between 35-45 ($n=234$), to 5.3 between 45-54 ($n=255$), and to 4.5 for jurors over 55 ($n=150$). However, this trend is not as smooth when education is controlled.

5. "Competence and the Psychosexual Stages of Development," *Nebraska Symposium on Motivation* Lincoln, Neb.: University of Nebraska Press, 1960, p. 97-141.

6. We also read with interest the writings of the psychoanalyst Ives Hendrick who says, "Primary pleasure is sought by the efficient use of the central nervous system for the performance of well-integrated ego functions which enable the individual to control and alter his environment." "Work and the Pleasure Principle," *Psychoanalytic Quarterly* 11: 311-29, 1942. But we are not entirely happy with the parts of the theory which hold that behavior to control the environment results from the blockage and deflection of drives arising in successive erogenous zones. We fear that heavy emphasis upon developmental origins of the need to control the environment may be permitted to overshadow an appreciation of the degree to which behaviors are determined in later life by the norms and role expectations of a given situational context.

7. John W. Thibaut and Harold H. Kelley. *The Social Psychology of Groups*. New York: John Wiley and Sons, p. 84-99, 100-126, 176-78, 1959.

Psychological Forces . . .

Recent Developments in the Experimental Analysis of Learning and Concept Formation

Leo Postman

The purpose of this paper is to review some recent developments in the experimental study of human learning and concept formation. Instead of considering a single issue in detail, work in two selected areas will be reviewed. These areas were chosen with a view to sampling the current research activities of learning psychologists and because each has important potential implications for education in the classroom. The topics to be considered are: (a) the role of reward and punishment in human learning, and (b) the experimental analysis of concept formation.

Reward and Punishment in Human Learning

Few psychologists have influenced our conceptions of learning and the process of education as profoundly as Edward L. Thorndike. His theory of stimulus-response connectionism and his laws of learning have been the point of departure for many major developments in learning theory and have inspired more than half a century of productive debate and experimentation. At the center of the controversy have been Thorndike's views of the action of rewards and punishments. Time and again his generalizations appeared to be refuted or in doubt, only to be reaffirmed by new evidence. Today his theory of rewards and punishments is still

under active consideration, and much of the most recent evidence again points to the basic correctness of his views. It is with some of the recent experimental work on Thorndike's principles of reward and punishment that this section of the paper is concerned.

Thorndike's Law of Effect

It will be useful to begin by recalling Thorndike's basic position as expressed in his law of effect. As originally formulated, the law of effect asserted that rewards strengthen, and punishments weaken, stimulus-response associations. Rewards and punishments exert their effects directly on the stimulus-response associations which they follow; their action is independent of ideas or intellectual understanding. The only necessary condition for the operation of the law of effect is that a connection between situation and response be followed by a reward or punishment (satisfier or annoyer). As Thorndike emphasized, the law does not assert that responses which are in themselves satisfying are strengthened, or responses which are in themselves annoying are weakened. Instead, it is the nature of the after-effects of a response to a situation which is critical for the formation of associations.¹

In Thorndike's investigations, and in those which followed, symbolic rewards and punishments were used almost exclusively—announcements of "Right" and "Wrong" following the subject's response to a stimulus.² The question has often been raised whether such announcements can be properly regarded as rewards and punishments: they are not just satisfiers and annoyers; they also convey *information* to the learner about the responses which are correct or incorrect in any given situation. We shall return to the difficult distinction between reward and information later, but let us for the moment accept Thorndike's operations for defining satisfying and annoying consequences.

On the basis of Thorndike's own experimental work, the law of effect underwent an important modification.³ The evidence obtained by Thorndike and many others firmly established the effectiveness of rewards in strengthening stimulus-response associations: announcements of "Right" reliably increased the probability of repetition of responses. It is in the an-

¹ The original statement of the law of effect may be found in: E. L. Thorndike, *Animal Intelligence*. New York: The Macmillan Company, 1911. p. 244.

² The major body of Thorndike's experiments with human subjects is reported in: *Human Learning*. New York: Century, 1931; *The Fundamentals of Learning*, New York: Teachers College, Columbia University, 1932; *The Psychology of Wants, Interests and Attitudes*, New York: Appleton-Century, 1935.

³ For a discussion of the development of Thorndike's theoretical thinking, see: E. R. Hilgard, *Theories of Learning*, Second Edition, New York: Appleton-Century-Crofts, 1956; L. Postman, "The History and Present Status of the Law of Effect," *Psychological Bulletin* 44: 489-563; 1947.

analysis of punishment that the facts led Thorndike to a far-reaching revision of his views. Contrary to theoretical expectations and, indeed, to common sense, the evidence stubbornly failed to reveal weakening effects of punishment. Announcements of "Wrong" not only failed to decrease the probability of repetition, usually the strength of the stimulus-response connection appeared to be increased by the punishment. The apparent strengthening effect of punishment was, however, never as great as that of reward.

Thorndike concluded that his original hypothesis concerning the effects of punishment had been in error. Punishment, he now held, does not influence behavior in ways which are symmetrical and opposite to the effects of reward. Whatever effects punishment does have are indirect: it favors variability of behavior and thereby provides opportunities for correct responses to be made and strengthened by reward. Although punishment favors variability, it appears to strengthen responses because the sheer occurrence of a response—the fact of exercise—strengthens the association and counteracts the increase in variability. Thus, the "punishment clause" of the law of effect was abandoned, and the law of effect became a law of reward only. The strengthening effects of reward are automatic and inevitable and provide the only dependable method for the modification of behavior.

Two features of Thorndike's final theory have, above all, remained at the center of controversy: (a) the asymmetry of the effects produced by rewards and punishments, and (b) the automatic nature of the action of rewards. In both cases, the major opposing view is that rewards and punishments are ways of imparting information which the learner uses according to his prevailing motivations and the requirements of the moment. We shall now consider some recent experimental work bearing on these issues.

Measurement of the Effects of Punishment

Much of the criticism against Thorndike's views of punishment has been methodological. In his multiple-choice experiments Thorndike used deviation from *a priori* chance to measure the effectiveness of rewards and punishments. For example, in one of the situations which he used widely in his experiments, subjects were required to guess a number between 1 and 10 to each of a list of words. Thorndike assumed that during the initial presentation of the list the probability of any number being chosen was .10. During the second presentation of the list the probability of repetition of the first response was again estimated to be .10, and the influence of rewards and punishments on repetition was measured from this baseline. The use of a mathematical chance baseline proved to be an

error. It is impossible to assume that the subject's initial choices are truly random and do not reflect prior habits and associations with which he enters the experimental situation. Repetitions above *a priori* chance will occur on successive trials independently of rewards and punishments because the habits and dispositions favoring the initial choices would persist from trial to trial. The assumption of a chance baseline results, of course, in the systematic overestimation of the effects of reward and underestimation of the effects of punishment. (The methodological problem at issue here has, of course, far-reaching general implications. Whenever the effects of an experimental or instructional treatment are to be assessed, it is essential to determine the extent to which prior habits and dispositions lead to patterns of responses which coincide with those attributed to the experimental treatment.)

Much effort has been devoted, therefore, to the construction of an empirical baseline from which the effects of rewards and punishments can be measured without bias. The problem turned out to be extremely difficult to solve. The obvious solution is to use control conditions in which the subject responds repeatedly to the same situation but receives neither reward nor punishment. It is by no means certain, however, that a truly neutral baseline is obtained in such a control situation. The learner may construe the absence of any feedback from the experimenter as tacit approval or disapproval of his responses. Moreover, the context of a learning situation may establish a set to repeat earlier responses when the situation recurs. While these difficulties have been recognized, the use of a control group which is tested for repetition in the absence of aftereffects has remained the major method for assessing the influence of rewards and punishments. Extreme care must be taken, however, to minimize extraneous sets to repeat responses, or to avoid repetition, under the control conditions. In assessing the effects of punishment *per se*, it is also important not to administer rewards in close temporal proximity to it, as was often done in Thorndike's own experiments, since the two types of consequences may interact in significant ways.

The most conclusive modern work on the effects of symbolic punishments was carried out by Stone and his associates.¹ Their experiments, using elaborate control-group designs, provide rigorous and unbiased tests of Thorndike's theory of punishment. In general, their results supported Thorndike's contention that punishments fail to weaken stimulus-response connections and often increase rather than decrease the strength of the response. The findings concerning the cumulative effects of punishments are of special interest. When the same response was punished several times in succession, the probability of repetition of

¹For example, G. R. Stone, "The Effect of Negative Incentives in Serial Learning. VII. Theory of Punishment," *Journal of General Psychology* 48: 133-61, 1953.

that response increased slowly but steadily. We are justified in concluding from these studies that, at least in a multiple-choice situation, punishment is likely to have positive fixative effects. Thorndike's findings concerning the effects of punishment can no longer be dismissed as artifacts of measurement against a faulty baseline. In considering the implications of these facts it is important to note, however, that these results were obtained in what Thorndike called a "vanishing" situation, i.e., a situation in which the learner does not have an opportunity to correct himself or to try an alternative response after the punishment has been administered. If the learner can remain in the situation after the punishment and does have an opportunity to continue responding, the correct reaction may eventually be reinforced by reward. Punishment will then appear to have been successful because it motivated the learner to continue responding until he was successful.

In some recent experiments in our own laboratory we have used a new method for assessing the relative effectiveness of reward and punishment in changing the strength of responses. Practically all available evidence concerns the short-term effects of rewards and punishments. Typically the changes in behavior are measured on a trial immediately following the reinforcements. Such measures lack sensitivity and have only limited generality. In studies of conditioning and rote learning it has often been found that tests of extinction and forgetting may reveal differences which cannot be detected by measures of acquisition. These considerations have led us to investigate the course of *retention* for habits established through differential rewards and punishments. We have been able to show that, with amount of original training held constant, rewarded responses are retained better than punished ones. To put it differently, after a period of time the learner remembers better what he has been positively taught to do than what he has been taught *not* to do or to avoid. Thus, long-term modification of behavior can be achieved more effectively through reward than through punishment.

We have also compared the effectiveness of explicit and implicit rewards and punishments. In a two-choice situation, reward for one alternative implies incorrectness of the other alternative. Conversely, punishment for one alternative implies correctness of the other alternative. As measured by both speed of acquisition and retention, explicit reward for the correct alternative is superior to explicit punishment for the incorrect alternative. Again, positive reinforcement of the correct response provides the most effective method of influencing behavior both in the short and long term.

Two critical features of Thorndike's theory—the automatic action of reinforcements and the asymmetry between rewards and punishments—came into sharp focus in the analysis of the spread of effect.

The Spread of Effect

This phrase refers to the observation that a reward strengthens not only the stimulus-response connection which it immediately follows but also punished connections which precede and follow the reward. The closer a punished connection is to the point of reward, the more it is influenced by the spread of effect. For example, if a subject gives number responses to a series of words and is rewarded for some of his guesses and punished for all others, the probability that punished guesses will be repeated on a test-trial varies inversely with the distance from the reward. Thus, there is a gradient of *repetition of punished responses* around the point of reward. Thorndike considered these findings as striking proof for his basic principles of learning. The systematic strengthening of punished responses as a function of their distance from reward supported the view that after-effects act automatically and often independently of the learner's understanding. The results also provided a clear demonstration of the asymmetry of the effects of rewards and punishments.

Thorndike's original studies of the spread of effect suffered from numerous methodological deficiencies. The basic phenomenon, however, has been confirmed repeatedly under well controlled conditions, at least as far as the spread following reward (after-gradient) is concerned. Many of the later investigators failed to obtain evidence for a reliable spread preceding reward (fore-gradient). What is of greatest interest is the development of the theoretical interpretation of the phenomenon. This development provides an interesting example of "challenge and response" in the interpretation of empirical findings.⁵

In his analysis of the spread of effect, Thorndike considered only the influence of rewards and punishments on stimulus-response connections. There is, however, an alternative way of looking at the facts. Quite apart from the stimuli, the responses which the learner makes to successive stimuli may not be independent of each other. For example, if his task is to give number responses to a series of words, he may be disposed to give these numbers in a non-random sequence. Suppose that he does, and that he is rewarded for some of these responses and punished for others. If he is then tested with the same words, the rewarded numbers are likely to be repeated. Once a rewarded number has been repeated, the subject's response biases will make it likely that the number which followed the rewarded response on the original trial will follow it again, quite regardless of the effects of reinforcement. Thus,

⁵ The history of research on the spread of effect is described in M. H. Marx, "Spread of Effect: A Critical Review," *Genetic Psychology Monograph* 53: 11-186, 1956.

the reward serves to ensure the repetition of a key response which initiates a systematic sequence of further responses. The linkages between successive responses are, however, probable rather than certain. The larger the number of steps by which a given step follows the reward, the less probable it becomes that all the intervening responses have been repeated. Hence, the subjects' response biases, reinstated by repetition of rewarded responses, will generate a gradient of error repetition. This interpretation of the spread of effect became known as the "guessing-sequence hypothesis."

Considerable experimental evidence appeared to support the guessing-sequence interpretation and to reduce the spread of effect to an artifact of measurement. These developments appeared to deal a serious blow to Thorndike's theory, since the spread of effect was widely recognized as providing a critical test of his general position. Recently, however, new evidence has caused the pendulum to swing back toward Thorndike's interpretation. Demonstration of the fact that guessing sequences can generate gradients of error repetition did not justify the conclusion, which many investigators were ready to draw, that wherever the spread of effect occurs, it can be safely attributed to guessing sequences. The next step was to measure the spread of effect with guessing sequences held constant. Some recent important experiments by Marx and his associates have done just that.*

The critical new step was the introduction of a control group which is treated like the experimental group but is neither rewarded nor punished. If the control group is large enough, it will include a number of cases in which the response in the position corresponding to that rewarded in the experimental group will be repeated by chance. When the "repeaters" in the experimental and control groups are compared, the influence of guessing sequences has been held constant, since both groups have given the critical response to which the biased sequence of subsequent responses is assumed to be anchored. The experimental group has, however, been rewarded and punished and the control group has not. If there is a difference in the amount of spread, it must be attributed to the effects of reinforcement. In the studies of Marx and his associates, the experimental (rewarded) subjects showed a regular and pronounced gradient, whereas the gradient for the control subjects was only slight. Since the influence of guessing sequences was held constant, the steeper gradient of the experimental subjects must be attributed to the spread of the effects of reward.

*For example, M. H. Marx and F. E. Goodson, "Further Gradients of Error Reinforcement Following Repeated Reinforced Responses," *Journal of Experimental Psychology* 51: 421-28, 1956.

Some recent studies in our own laboratory have also led us to the conclusion that the guessing-sequence hypothesis cannot account for the spread of effect. That hypothesis implies that a spread of effect should be obtained only if the rewarded response itself is repeated, since the presence of the rewarded response is required to reinstate the biased sequence of responses which had occurred during training. A clear-cut test of this deduction is difficult. If we simply compare the gradients for subjects who do and do not repeat the rewarded response, we select subjects for learning ability. In order to vary the frequency of repetition without selecting subjects for learning ability, we have compared the spread of effect obtained immediately after training and after a period of delay. A typical gradient was found on the immediate test and persisted on the delayed test in spite of a large drop in the repetition of rewarded responses. Thus, the most recent evidence again points to the conclusion that the closer a punished error is to a reward, the more likely it is to be repeated in spite of the punishment. If this conclusion continues to be supported by the evidence, its practical implications may be considerable.

Learning Without Awareness

The spread of effect is important because it appears to provide evidence for the automatic action of rewards. For the same reason the question of "learning without awareness" continues to be of interest. The hypothesis of automatic action of reward would receive strong support if rewards and punishments could be shown to remain effective even when the subject is unaware of what it is he is learning. The specific experimental question is whether rewards strengthen stimulus-response associations when the learner remains unaware of the rule according to which the rewards are contingent on his responses.⁷

Again, the formulation of the problem and some of the important early experiments must be credited to Thorndike. One of his studies, which served as a point of departure for several subsequent workers, exemplifies the kind of experimental procedure that has been used to investigate learning without awareness. This experiment was conducted as a study of free association, i.e., the subjects were instructed to respond to each of a series of words with the first association that came to mind. The subjects were led to believe that for each word some associations had been arbitrarily designated as right, and others as wrong. Actually, however, all sequential or rote associations (such as

⁷For a discussion of recent studies of learning without awareness, see L. Postman and J. Sassenrath, "The Automatic Action of Verbal Rewards and Punishments," *Journal of General Psychology* 65: 109-36, 1961.

"yours—truly") were called right, and denotative associations (such as "yours—mine") were called wrong. The subjects gradually learned to give the class of associations for which they were rewarded. Few subjects showed a sudden complete shift from one class of associations to the other, and from the gradualness of the improvement Thorndike concluded that the subjects had not been aware of what they were learning.

Later critical analyses have shown, however, that it is hazardous to draw conclusions about awareness from the slope of the learning curve. The rate of improvement does not necessarily reflect the presence or absence of insight into the rule governing the correctness of responses. Thus, in the experiment on word association, even when subjects were explicitly informed about the rule of correct responding, the curve of improvement remained gradual. If the prescribed responses are complex and unfamiliar, the acquisition of the necessary skill may be slow and hence the performance curve will rise slowly.

Since the slope of the learning curve does not permit the assessment of awareness, the criterion of awareness which has been used almost exclusively in more recent studies is the subject's ability to verbalize the rule of correct responding. In still another repetition of the experiment on word association, it was possible to show that there is a steady increase in the number of correct responses prior to the point at which the subject is able to verbalize the correct principle. Verbalization of the principle is accompanied by a large increase in the number of correct responses, which is in turn followed by further gradual improvement. Thus, some progressive improvement occurs prior to verbalization of the rule. Verbalization leads to accelerated improvement, but even after the rule has been understood and stated, further training is needed to translate the understanding of the rule into the requisite skills.

We have used the studies of word association as reference experiments to exhibit some of the problems of control and interpretation which arise in studies of learning without awareness. In recent years a substantial number of studies conceived along the same lines have been conducted, employing a wide variety of materials and rules of correct responding. The conclusions which we have stated above concerning the relationship between verbalization and performance have in general been supported. One way of summarizing the evidence is to say that there seems to be no sharp dividing line between learning with awareness and learning without awareness. Instead, it appears that awareness, as reflected in the ability to verbalize a rule of response, represents an advanced stage in the development of a habit under differential reinforcement. In showing that awareness of what is being

rewarded is not a necessary condition for the operation of the law of effect, the results continue to be in accord with Thorndike's position.

An experimental technique which is closely related to the present problem and which has recently attracted much interest is that of operant verbal conditioning.⁸ In an operant conditioning situation there is not a series of discrete trials on each of which the subject gives a response to a specific stimulus. Rather, the subject emits responses at his own rate. Differential reinforcement has been used effectively to enhance the rate at which a particular class of responses is emitted, e.g., plural nouns, personal pronouns. In many cases impressive changes in performance have been achieved by this method in which the subjects remained unaware of the principle of reinforcement or, indeed, of the fact of reinforcement itself. In this connection it should be noted that effective reinforcers in verbal conditioning are often quite subtle—a slight nod, an encouraging sound may do as well as an explicit announcement of "Right" or "Good." There is good reason to believe that verbal conditioning is among the most powerful available techniques for the rapid manipulation of verbal behavior.

Conclusion

We have considered the present status of the law of effect in human learning. Thorndike's hypothesis that rewards strengthen the stimulus-response connections which they follow, and that they do so automatically and inevitably, has remained a center of theoretical controversy and experimental inquiry. Moreover, the law has been absorbed into some of the major contemporary theories of learning, such as that of Hull. Similarly, the apparent asymmetry between the effects produced by rewards and punishments remains a focus of investigation. In spite of many methodological difficulties and unresolved contradictions in the empirical findings, the balance of the evidence remains consistent with Thorndike's basic position.

Experimental Analysis of Concept Formation

In the preceding section we have been discussing some of the conditions which govern the formation of connections between stimuli and responses. This general approach to problems of learning, of course, has been criticized traditionally as unduly "molecular," as arbitrarily dividing behavior into bits and fragments which have no counterpart in the functioning of the individual. These strictures are largely beside the point.

⁸ L. Krasner. "Studies of Conditioning of Verbal Behavior." *Psychological Bulletin* 55: 148-70; 1958.

Stimulus-Response Analysis

The purpose of a theory of learning is not to describe ongoing behavior in its full complexity. Rather, the purpose is to develop analytic tools which will make it possible to construct models which exhibit the basic principles governing the modification of behavior through training. In pursuing this goal, it is essential not to be distracted by the obvious discrepancy between the properties of the analytic model and the richness, subtlety and apparent unpredictability of learners' behavior as we observe it all around us. The basic point is that the theorist seeks to construct a model that embodies some of the properties of the learning process. He does not and should not aim at building a faithful replica of learning behavior. At the same time, however, there must be no hesitation to complicate and modify the model if it fails to represent the essential characteristics of the process under investigation. These considerations are well illustrated by the application of stimulus-response analysis to the process of concept formation. Stimulus-response analysis has succeeded in isolating some of the conditions determining the formation of concepts, but in the course of experimental analysis the initial model has been modified in important ways.⁹

We infer that an individual has formed a concept when he is able to identify, or to respond to a common property shared by a number of objects or events. These objects or events may differ from one another in a variety of ways but all share the critical property defining the concept. In short, concept formation represents the discrimination of a common critical feature in a variety of contexts. For purposes of concept formation, the common feature is the *relevant* characteristic whereas the variable characteristics accompanying the common feature in specific instances are *irrelevant*.

In early attempts to apply basic principles of learning to this form of behavior, concept formation was considered a special case of stimulus generalization. Stimulus generalization is, of course, one of the basic characteristics of classical conditioning: when an organism has been trained to respond to a particular conditioned stimulus, other stimuli falling along the same stimulus dimension will also evoke the conditioned response. The greater the similarity between the conditioned stimulus and the test stimulus, the higher the probability that the response will occur. In studies of conditioning, similarity has usually been defined in terms of distances along a sensory continuum such as loudness or brightness. When the principle is applied to concept formation, the similarity responsible for evocation of the correct response resides in the common

⁹ For a review of early studies of concept formation, see W. E. Vinacke, *The Psychology of Thinking*, New York: McGraw-Hill Book Company, 1952.

relevant feature. Thus, concept formation can be treated as a special case of a general law of learning. An important implication of this analysis is that the successful formation of a concept is not dependent on an act of insight or the perception of a relationship by the learner. This is not to say that concept formation may not be accompanied by such perceptual events. Rather, the assertion is that the perception of relationships is not a necessary condition of concept formation.

Most of us are familiar with Hull's classical experiment demonstrating the continuity between stimulus generalization and concept formation. He trained his subjects to respond with nonsense names to a series of Chinese characters. Although each character was unique, groups of characters shared a common radical. All characters sharing a common radical had a common nonsense name. Hull's subjects gradually learned to apply the proper nonsense name to new characters which they had never seen before, and they often did so without being able to verbalize the basis of their classificatory responses. The conditions of concept formation appeared to be analogous to those of generalization in conditioning.

Here the matter rested more or less for a long time as far as the basic stimulus-response analysis of concept formation was concerned. Concept formation based on generalization along a variety of dimensions of similarity was demonstrated but no additional theoretical assumptions appeared to be necessary to account for the results. It is only in recent years that this theoretical picture has begun to change in important ways. New and refined experimental analyses have made it increasingly clear that a simple stimulus-response model cannot handle the facts of concept formation even in a highly restricted and controlled situation. Specifically, it has proved necessary to modify the stimulus-response model so as to allow for the role of mediational processes in concept formation. Before reviewing some of the experimental data which led to this theoretical reformulation, let us describe the essential differences between a simple or "single-unit" stimulus-response model and a mediational model.

The Mediational Model

The analysis of concept formation within the framework of a mediational stimulus-response model is largely the work of H. H. and T. S. Kendler. This section will lean on their formulation and findings.¹⁰

A single-unit stimulus-response model represents learning as the change in the strength of associative connection between an external stimulus and response. It is a single-unit model because no assumptions

¹⁰ H. H. Kendler and T. S. Kendler "Vertical and Horizontal Processes in Problem Solving." *Psychological Review* 69 1-16, 1962.

are made about events intervening between the external stimulus and the response. According to a mediational model, the external stimulus and the overt response are terminal points of a more complex chain of events. The external stimulus (S) evokes an implicit response (r) which embodies the discrimination or classification of the stimulus by the learner. The occurrence of the implicit response changes, or adds to, the stimulation by providing an implicit cue (s) to which the overt response (R) is associated. Thus, the formula for the single-unit model is S-R, that for the mediational model is S-r-s-R. The difference between the two models can be illustrated by considering the events which are assumed to take place when a subject learns a pair of words, e.g., the French equivalent of an English word. According to the single-unit model, repetition of the pair of words gradually strengthens the association between them so that the English stimulus has an increasingly high probability of evoking the French response. The mediational model assumes, on the other hand, that the English word (S) evokes a mediating response (r) differentiating it from other English words. The occurrence of this mediating response produces implicit cues (s) to which the overt French response (R) is associated. The assumption of a mediating chain makes it possible to assume that responses are associated not only with specific physical stimuli but also with the "meanings" and contexts belonging to these stimuli. The mediational model also makes it possible to broaden our definitions of the dimensions along which generalization can occur. Stimuli evoking the same or overlapping mediational responses become functionally equivalent even if they are quite different as physical events. In this connection it matters little whether the assumed mediational processes are confirmed by our subjective experiences or the introspective reports of our subjects. Mediational chains have the status of symbolic constructs and their value as analytic tools must be assessed in terms of their ability to handle experimental facts and to generate new testable hypotheses.

Let us now return to the analysis of concept formation. The most recent studies of the conditions governing the attainment of concepts have led to the conclusion that a single-unit stimulus-response model is not adequate to account for the observed conditions of concept formation, whereas a mediational stimulus-response model can predict the experimental results with considerable precision.

Reversal and Nonreversal Shifts in Concept Formation

Experimenters are sometimes fortunate in finding a single experimental situation which enables them to pit alternative theoretical explanations against each other and to make a decision between them on the basis of the empirical results. In the evaluation of the single-unit

and the mediational models, such a situation was provided by the experiments comparing reversal and nonreversal shifts in the learning of concepts. The nature of the situation and its bearing on the theoretical issue may be best illustrated with the aid of a specific example.

Suppose a group of subjects is given the task of sorting a pack of cards into two piles. On each of the cards there is a triangle. The triangles vary along two dimensions—size (large or small) and color (red or green). Thus, there are four possible combinations: large green, small green, large red and small red. The two piles into which the cards are to be sorted are identified by two models: (A) a large green triangle and (B) a small red triangle. During the first stage of the experiment, the relevant characteristic which determines the correct assignment to the one or the other of the two piles is size. Thus, all large triangles regardless of color must be matched to Model A, and all small triangles regardless of color must be matched to Model B. The subject's choices are differentially reinforced (called right or wrong), and training is continued until a criterion of several successive errorless matches has been achieved. The subjects are now subdivided into two groups, and each group has to learn a second concept. The first group has to learn the *reverse* of the first concept, i.e., all large triangles regardless of color must be matched to Model B, and all small triangles regardless of color must be matched to Model A. In short, whereas in the first stage large went with large and small with small, the reverse relationship is now true. Hence, this group is called the Reversal Shift Group. The second group has to learn to sort the cards on the basis of a new dimension which had previously been irrelevant, viz., color. That is, all green triangles regardless of size must now be matched to Model A, and all red triangles regardless of size must be matched to Model B. This is the Nonreversal Shift Group.

Which of the two groups will learn the second concept faster? According to a single-unit stimulus-response model, we would expect the nonreversal shift to be learned more quickly. In the first stage of the experiment, the response of matching sizes directly has been consistently reinforced, and this habit should interfere maximally with the acquisition of the new habit by the Reversal Shift Group of mismatching sizes. On the other hand, the Nonreversal Shift Group has to learn to use a new dimension, and interference from the old habit would be expected only on half the trials (i.e., that half of the cases in which matches according to color and size do not coincide). The fact is, however, that with college students as subjects the reversal shift is learned reliably faster than the nonreversal shift. This finding falls into place if we assume that what is critical for the speed of concept formation is the mediational response (r) evoked by the stimuli. During the first part of training the

differential response mediating the correct choices is size. Thus, for the Reversal Shift Group, the appropriate mediational response—differentiation according to size—is already available and all that has to be changed is the nature of the overt response. For the Nonreversal Shift Group on the other hand, a new mediational response—differentiation according to color—has to be acquired although half the time the old overt responses remain correct. The large differences consistently obtained in favor of the Reversal Shift Group indicate that the transfer of mediational responses is far more significant in concept learning than is the transfer of specific overt responses.

Developmental Changes in Concept Learning

At this point it is interesting to note that comparisons between reversal shifts and nonreversal shifts yield diametrically opposite results with animals and adult human subjects. Whereas for adults the reversal shift is much the easier, the opposite is true for rats. This discontinuity between animals and humans suggested to the Kendlers that mediational responses gain in importance as appropriate verbal and symbolic mediators become available. Thus, the single-unit model may be appropriate to inarticulate organisms with limited symbolic capacities, and the mediational model to organisms capable of verbalization and related symbolic acts. The next step was, therefore, to investigate developmental changes in mediational control of concept formation. One obvious hypothesis is that such control becomes increasingly more important in the concept learning of children as the ability to verbalize and to use symbols develops. The current work of Kendler and Kendler is giving support to this expectation. For example, these investigators compared the relative difficulty of reversal and nonreversal shifts in an experiment with kindergarten children, using brightness and size as the critical dimensions of discrimination. For the group as a whole, there was no difference between the two conditions. However, when the subjects were divided into slow and fast learners on the basis of their performance on the initial problem, it was found that the reversal shift was easier for fast learners and the nonreversal shift was easier for slow learners. A reasonable interpretation is that for the fast learners the verbal and symbolic processes essential in mediational control had developed to a higher degree than for the slow learners. A further confirmation of this general analysis is provided by the fact that the percentage of subjects favoring reversal shift over nonreversal shift increases steadily from 3 to 10 years of age.

Two conclusions based on these studies deserve emphasis: (a) Stimulus-response theory which has proved fruitful in the study of con-

ditioning, rote learning and simple discrimination learning can be effectively applied to the analysis of more complex processes such as concept formation and problem solving (b) A simple single-unit conception of stimulus-response association is not adequate for the analysis of these more complex processes. However, the necessary extensions and modifications of the model can be accomplished within the framework of stimulus-response theory. The acquisition and utilization of mediational responses are assumed to be governed by the basic laws of associative learning.

Informational Analysis of Concept Formation

There is an altogether different approach to the study of concept formation which reflects the interest of experimental psychologists in applying the theory of information and communication to the analysis of human learning and problem solving. The emphasis here is not so much on the processes mediating the solution of problems and attainment of concepts as on the capacity of the organism to receive, store and transform information received from external sources.

As Hovland has put it, "the concept-formation experiment may be regarded as a communication situation in which the experimenter transmits the combination of elements he has selected as constituting the concept through a series of messages, some of which are labelled 'correct' (positive instances) and others 'incorrect' (negative instances)."¹¹ In any given situation in which the subject is required to form a concept on the basis of a series of correct and incorrect instances it is possible: (a) to specify exactly the number of alternative hypotheses which can be entertained, and (b) the amount of information or reduction in uncertainty produced by each successive positive and negative instance. An example will illustrate the nature of such an informational analysis.

Suppose a subject is presented with a series of cards showing a series of geometric designs which vary in three dimensions—shape, size and brightness. There are two shapes (square and circle), two sizes (large and small), and two shades of brightness (black and white). With three dimensions and two values on each dimension there are $2 \times 2 \times 2 = 8$ cards or instances which can be used in the learning of the concept.

Suppose the subject knows that the concept to be learned is defined by a combination of one value of one dimension with one value of another dimension, with the third dimension irrelevant. For example, the concept may be a *small circle*. We ask first how many hypotheses the subject can entertain when he is given the task of determining which of the possible concepts are correct. Since two of the three dimensions will be

¹¹ C. I. Hovland, "A 'Communication Analysis' of Concept Learning," *Psychological Review* 59: 461-72, 1952.

relevant, there are three ways of choosing combinations of two dimensions. Once the two dimensions are chosen, there are four ways of combining one value each from the two dimensions. Thus, if size and shape are relevant, we may have: large circle, small circle, large square, small square. With three possible combinations of dimensions and four possible arrangements within dimensions, there are 12 hypotheses which the subject may entertain. We ask next how many positive instances and how many negative instances are required to determine the correct concept. There are two positive instances of the concept, *small circle*. These are: small white circle and small black circle. Both of these will be required to determine the concept completely. The first positive instance narrows the number of possible hypotheses from 12 to 3. For example, if small white circle is the first positive instance, the possible remaining hypotheses are: small white figures, small circle, and white circle. The second positive instance then reduces the possibilities to one, in the present case showing color to be irrelevant.

If the correct concept is *small circle*, six of the eight possible instances will be negative. It can be shown that five of these six negative instances are required to eliminate all hypotheses except the correct one. Thus, if the subject behaved like an information-processing machine, he should learn the concept equally well after two positive instances and after five negative instances. The analysis, of course, can be extended to consider the combinations of positive and negative instances that should lead to the attainment of the concept.

Concept Attainment as a Function of the Conditions of Information

The basic advantages of this type of analysis are twofold. First, it becomes possible to specify and control the amount of information transmitted to the subject by any given succession of positive and negative instances. In many of the earlier studies, the conditions of concept attainment were difficult to describe with precision because the informational value of the instances presented to the subject was not known. It is now possible to chart the course of concept learning as a function of the amounts and patterns of information communicated to the learner. Secondly, the information-processing model provides us with a norm for the evaluation of the performance of the human learner. We can ask to what extent he does as well as the machine, and under what conditions and in what ways he lags behind the machine. Thus, it becomes possible to identify some of the specific conditions which produce psychological barriers to the processing of information and the attainment of concepts. Let us review some of the findings of experimental studies which have applied such informational analysis to concept attainment

Informational analysis has made it possible to provide a definitive answer to a question which has interested students of concept formation for a long time, viz., whether and to what extent negative instances—examples of what a concept is *not*—aid in the attainment of the solution. The results of early studies were ambiguous, since it was not known whether the positive and negative instances provided equivalent amounts of information. Negative instances were found ineffective, but this may have been because they imparted less information or because the information conveyed by negative instances was difficult to assimilate and use. The critical experiment comparing the effectiveness of positive and negative instances with the amount of information exactly equated was performed by Hovland and Weiss. The results show clearly that a series of negative instances produces slower learning than does a series of positive instances. However, negative instances do produce some learning. With a mixture of positive and negative instances the speed of learning is intermediate. The effectiveness of negative examples increases when all the instances are presented simultaneously rather than successively, but positive instances remain more effective even with simultaneous presentation.

The results cannot be attributed to the fact that usually a larger number of negative than positive instances is required to convey equivalent amounts of information. It is possible to devise problems in which equal numbers of positive and negative instances are required to provide the information necessary for solution. In such a case positive instances still lead to faster attainment of the concept. It is only when positive instances are used that the critical differential responses mediating the identification of the concept occur in temporal contiguity with the relevant stimuli. If we assume that such contiguity facilitates the acquisition of the mediational responses just as it does other associations, the superiority of positive instances falls into place. It may not be amiss to draw a parallel to the asymmetry between the effects of rewards and punishments. The conditions of training under which the subject learns what to do are more effective than those under which he learns what not to do.

A number of investigators, notably Archer and Bourne, are currently engaged in a systematic study of the quantitative relationships between the amounts and patterns of information communicated to the subject and the speed of concept attainment.¹² Some major conclusions are:

¹² For example, E. J. Archer, L. E. Bourne, Jr. and F. G. Brown, "Concept Identification as a Function of Irrelevant Information and Instructions," *Journal of Experimental Psychology* 49: 153-64, 1955; L. E. Bourne, Jr. and R. B. Pendleton, "Concept Identification as a Function of Completeness and Probability of Information Feedback," *Journal of Experimental Psychology* 56: 413-20, 1958; L. E. Bourne, Jr. and R. C. Haygood, "The Role of Stimulus Redundancy in Concept Identification," *Journal of Experimental Psychology* 58: 232-38, 1959.

1 The greater the amount of relevant information required for solution, the slower is the acquisition of concepts. For example, the larger the number of dimensions that are relevant to the definition of a concept, the more slowly is the concept attained. These findings are fully consistent with the amount-difficulty relationship which holds in the learning of verbal materials: difficulty-per-item increases directly as a function of the amount of material to be learned. As the amount of material to be learned and recalled increases, so do the opportunities for interference among the units of the task.

2 The greater the amount of irrelevant information, e.g., the larger the number of irrelevant dimensions along which both positive and negative instances vary, the lower is the identification of concepts. Irrelevant dimensions add to the informational load which the subject must process and enhance the opportunities for interference.

3. While the use of redundant (i.e., correlated) dimensions does not increase the amount of information, it increases the efficiency of concept formation when the redundant information is relevant. Thus, it is easier to attain the concept, *small circle*, in an example like the one given above, if all small figures are presented in a black frame whereas all large figures are presented in a white frame. The color of the frame is a redundant dimension since it correlates perfectly with size, but it facilitates the identification of positive instances. By the same token, the addition of redundant dimensions is detrimental when the information they convey is irrelevant. The findings point to the role of perceptual factors in concept learning since redundancy may be assumed to enhance the perceptual saliency of the relevant or irrelevant dimensions.

4. The specific conditions of "feedback" (information about the correctness of response to each instance) are important, as we would, indeed, expect on the basis of our discussion of after-effects. First, the longer the delay in the feedback, the slower is the progress to solution. The results here are more substantial and clear-cut than those obtained in other situations in which the delay of rewards and punishments has been manipulated with human subjects. Secondly, the more complete the feedback, the faster is concept attainment. Thus, the subject will progress more rapidly if each of his responses is followed by full correction, i.e., identification of the appropriate choice, than if he is merely told whether he was right or wrong. Finally, the more frequently such feedback is given the more rapid will be the rate of concept attainment. Here again the results are consistent with general principles of reinforcement. The specific conditions of feedback assume increasing importance as the complexity of the task becomes greater, i.e., as more relevant and irrelevant information must be discriminated and assimilated.

As our review has shown, the conditions of concept formation can be attacked experimentally from more than one theoretical point of view. We have considered two such approaches, and there are others beyond the scope of this paper. It is to be hoped that as these approaches develop, they will also converge on a common analytic language. A real promise of such convergence is, indeed, found in some of the most recent mathematical models of concept formation which combine analytic constructs of stimulus-response theory and information theory.

Psychological Forces . . .

Psychological Research and Classroom Learning

Herbert Klausmeier

Many psychologists have been and are interested in the process of learning. Psychological scientists concerned with learning have tried to understand how learning occurs, and some have tried to predict and control the course of learning. As in other sciences, the aim is to arrive at a relatively small number of laws or principles which clarify the nature of learning.

The Unit of Behavior To Be Studied

In general, learning theorists with S-R and S-O-R preferences have experimented in laboratories, using lower forms of animals as subjects. This they have done in order to secure the necessary control over a large number of variables connected with the stimulus, response, organism, and experimental arrangements. Such theorists as Watson, Thorndike, Guthrie, and Skinner, who have used animal subjects, and other experimental psychologists who have worked with eyelid conditioning in human subjects have accepted the stimulus-response connection or some variant of it as the unit of behavior from which to infer learning processes. In general, these psychologists describe learning in atomistic and mechanistic terms (Hilgard, 1956).

Cognitive theorists Tolman and Lewin, the pragmatist Dewey, organismic psychologists Perkins and Wheeler, dynamic theorist Freud,

and phenomenological theorists Combs and Snygg have not accepted fully the reflex arc or a variant of it as a satisfactory behavior unit. The cognitive theorists deny that conditioning or mechanical association of stimulus and response is applicable to most forms of human behavior. Instead, they stress perception, ideation, thinking, and the organizing and reorganizing of experience, which occur in the central nervous system between perception and subsequent actions or responses. Unfortunately, they have not specified clearly what an appropriate unit of behavior is, except that it is a whole of some sort which encompasses a larger segment of behavior than an association between a specific stimulus and specific response.

Up to the present time there is more disagreement and theorizing among psychologists than there is substantive information about the proper unit of behavior by which to study learning processes. And education seems similarly to swing back and forth from consideration of the whole child to mastery of isolated segments of organized subject matter. At present, the most appropriate unit of behavior for studying learning is not only of theoretical interest but of highest practical importance for education, especially with the coming of TV instruction, teaching machines, programmed textbooks, and electronic laboratories in foreign languages.

A resolution of the molecular-molar controversy about the unit of behavior has been proposed recently. Miller, *et al.* (1960), give a clear statement of why neither the molecular nor molar unit of behavior is appropriate to the study of human learning in all its forms and outcomes. These authors propose that since we now have electronic computers to handle data, we can look at wholes and parts simultaneously, that the nature of an appropriate unit of behavior should not depend upon a psychologist's or educator's preference but upon analysis of the large amount of information which is needed to describe human behavior and learning as represented in such a seemingly simple behavioral sequence as driving a nail into wood until the head is flush with the surface. Instead of treating the entire job of driving the nail into the wood as an additive series of simple connections between stimuli and responses, or as one total act which is more than the sum of its parts and therefore cannot be analyzed according to parts, they propose a hierarchical sequence. The individual prior to hammering perceives what the total task is, uses his perceptions of the total task in initiating his first striking movements, guides subsequent actions by his total perceptions as hammering the nail progresses, eventually decides when the nail head is flush with the surface of the wood, and then stops the activity.

These proposals of Miller, Galanter and Pribram are fruitful for drawing inferences about how learning proceeds and how learning proc-

esses of pupils might be guided efficiently in school, and are more fruitful than are the proposals of any single association, cognitive, phenomenological, or dynamic psychologist. Though these proposals are interesting, they deal with methodological and theoretical problems rather than providing factual information about efficient learning. Therefore, we must yet survey a large mass of research on learning, conducted by persons representing many different viewpoints, in order to arrive at fairly direct principles, applicable to human learning in school settings.

Inadequacy of Present Research

Exhaustive study of primary research (*Annual Review of Psychology*) shows that we do not yet have a concise, generally agreed upon description of the learning process, applicable to all types of learning outcomes in human beings at all age levels and other characteristics in all situations. There are at least seven groups of variables that must be considered by the researcher who wishes to manage situations to produce efficient pupil learning. Briefly, these seven groups of variables are: (a) characteristics of the learner such as mental development and intellectual abilities, physical development and psychomotor abilities, and level of social-emotional development; (b) characteristics of the teacher; (c) the amount and kind of interactions between teacher and pupils and among pupils; (d) the characteristics of the learners as a group, such as size of the group, cohesiveness of the group, and attitudes; (e) the physical characteristics of the setting such as space, supplies, instructional materials and equipment; (f) outside forces acting upon the teacher and learners; and (g) the nature of the learning task itself (Klausmeier, 1961). Inferences about the learning process may vary among experimenters, because of differences among the experiments regarding any of these variables.

Despite the inadequacy of research which deals with all these variables systematically, consider some representative research concerning retention, transfer, reinforcement, and practice; and then examine what this means for instruction in school, particularly in connection with two recent innovations—TV and teaching machines.

Retention

An outcome may be said to have been acquired when first incorporated in the learner's behavior pattern; for example, when a child demonstrates the correct spelling of a word. If at a later time the child correctly spells the same word or solves the same problem, we say that he has remembered or retained what he has acquired. And transfer of learning occurs

when whatever is learned in one situation is used in a new or different situation. Thus, the relationship among acquisition, retention, and transfer is fairly direct; nothing can be transferred unless it is remembered and nothing can be remembered unless it is learned in the first place.

But research is contradictory about explanations of retention, mainly because of differences in the type of material used in the experiments and in how well the material was acquired during the original learning. Ebbinghaus originally showed a large loss in retention during the first 24 hours. Strong (1913) also demonstrated a near 80 percent loss during the first 24 hours after learning. These experimenters, as many others, used nonsense syllables which did not have inherent meaning for their subjects.

Many experiments have been done in order to find means for improving retention of meaningless material. Krueger (1929), using nonsense syllables, showed that when the same amount of time was subsequently given to overlearning or repeated learning, as had been used in the original learning, loss was only about 55 percent after 1 day; when half the amount of original learning time was used for overlearning, the loss was about 64 percent after 1 day. Cain and Willey (1939) found that distributed practice on nonsense syllables resulted in only 25 percent loss after 1 day; whereas massed practice in one learning session resulted in about 55 percent loss.

No one presently disputes the facts about the forgetting of nonsense material by human subjects or denies the need for overlearning through subsequent repetition and review. Possibly learning to spell correctly, to acquire vocabulary in a foreign language, to acquire symbols in science and mathematics, and to learn some of the important factual material in social studies and other subjects does require much repetition and review. The teacher who expects children to acquire factual material that does not have much meaning should implement these principles, make the original learning complete, continue to practice or overlearn soon after the material has been first acquired, and review it periodically thereafter. These principles, as will be shown later, are incorporated in teaching machines.

But is meaningful material subject to the same degree of forgetting as is nonsense material? The answer is clearly negative, some behavioral episodes are experienced once and retained thereafter. Consider representative research with meaningful material.

Newman (1939) demonstrated that 84 percent of the essential material from a story was recalled after 8 hours of sleep, whereas only 47 percent of the nonessential material was recalled. After 8 hours of activity following the 8 hours of sleep, 84 percent of the essential material was recalled but only 25 percent of the nonessential. Gilliland (1948) likewise

found his human subjects to recall about 85 percent of the observed material in a set of pictures 48 hours after the original learning. McKeachie and Solomon (1957) found students to answer 86 percent of the same items correctly from a general psychology exam after three months in an educational psychology exam, and 81 percent after seven months.

Klausmeier and Feldhusen (1959) worked with three groups of children at a mean age of 127 months. One group of mentally retarded children had IQ's of 56-81, another group had IQ's of 90-110, and the high group had IQ's of 120-146. In the first experiment we found out how well each child could count and then taught him to count a series of ten items. In the second experiment we found out how well each child could add and then taught him as meaningfully as possible 10 addition exercises at the next higher level of difficulty. Thus, each child, regardless of IQ, learned to count or to add, using exercises of appropriate difficulty. The tasks to be learned were socially significant rather than nonsensical, and we tried to teach each child as meaningfully as possible. There was no significant difference among the three IQ groups in amount of recall at five minutes or six weeks after the original learning. Further, the recall, without practice or review by the children, was about 80 percent after 6 weeks on the counting exercises and about 75 percent on the addition exercises. We concluded that to facilitate retention the principal task of the special teachers of the mentally retarded, as well as of other teachers, was to make the original instruction for each child meaningful and thorough.

Transfer of Learning

The research on transfer of learning shows much the same pattern as that for retention, except that the researchers started to use meaningful material earlier in their transfer experiments.

Judd (1908) demonstrated that the generalizations underlying specific facts and skills, rather than the specific facts and skills as such, transferred to new situations. His research received little attention for many years, as associationists such as Thorndike and conditioning psychologists such as Watson dominated American psychology. Hendrickson and Shroeder (1941) replicated Judd's 1908 experiment as best they could. They not only found that understanding the underlying principle improved transfer to new situations but that it also contributed to higher efficiency of the original learning.

Birch and Rabinowitz (1951) showed clearly that when individuals learn a particular use of a tool in solving a problem, they will not depart from that use in a new situation, even though it is inappropriate. Rigidity in problem solving thus comes about as individuals achieve success with a particular method but do not analyze the method in relation to other

alternatives. One properly infers from this and similar studies of functional rigidity that people may be conditioned, through use of teaching machines and other procedures, to acquire a particular method of problem solving or of learning which produces negative rather than positive transfer to new situations.

But material and methods of learning acquired with meaning do transfer to new situations. Klausmeier and Check (1961) in a series of follow-up experiments with the same groups of low, average, and high IQ children mentioned previously found no significant differences among the three groups in amount of transfer from the original problems to new problems after elapsed times of five minutes and of seven weeks. Using problems which required making change with money and also exercises in subtraction, we gave each child material suited to his present achievement level, taught the principles underlying the processes with as much meaning as possible, and secured a high amount of transfer.

In summary, positive transfer from one situation to others, including from in school to out of school, from one subject field to another, and from one grade level to another, can be facilitated best by making certain the learning task is meaningful and not too difficult, by emphasizing the principles and methods of problem solving rather than specific procedures and correct solutions, and by giving help to the learner as needed. Given enough control over the child's environment, we can also condition him to use only a given method of attack and he will use this method in situations even though it hinders efficient learning.

Reinforcement

Reinforcement of the response that the experimenter wants the subject to learn is essential in all forms of conditioning. As the term, reinforcement, is now used in the literature, it includes both the idea of rewarding and confirming. Thus, when a child spells a word correctly and the teacher says "Right," the child may interpret the "Right" as a reward for spelling the word correctly or he may interpret it as a confirmation that his response was the right one. If the teacher does not tell the child that he has spelled the word correctly but he goes to the dictionary and finds he has, this originally was called confirmation but is also now called a reinforcement even though it is self-initiated. Similarly, a broad smile, a high grade, or a piece of candy given to the child may be designated a reinforcement or a confirmation of desired behavior.

It is fully established that organisms over which the experimenter has considerable control can be conditioned through proper schedules of reinforcement to make any responses of which they are capable to any stimuli they can discriminate. Humphreys (1939) and Grant, *et al.*

(1951), found that reinforcing every eyelid blink in human subjects led to better acquisition of the desired response but that less than 100 percent reinforcement led to better maintenance of the desired response. Skinner (1955), after much experimentation with rats and pigeons, made a most positive case for reinforcement theory to be applied to education in school settings.

At present, it is generally accepted that rewarding or reinforcing a desired response has a tendency to increase the probability that the rewarded or reinforced response will be repeated subsequently in a similar situation. It is established equally well that punishing an incorrect response may not decrease the probability of repeating that response, for continuing the activity may be more attractive to the individual than the punishment is offensive to him. Also the punished person may yet repeat the response, for he does not know what else to do because the punished response is the only behavior he perceives as appropriate.

Practice and Repetition

Of the vast amount of experimentation done in connection with the management of practice, most of it has been S-R oriented, using factual type material, or else it has been done in the area of psychomotor activities. Though there is yet much disagreement about the management of practice in the learning of skills, there are four principles which appear applicable to a variety of skills, verbal as well as psychomotor, and to human beings representing a broad range of physical and intellectual characteristics. The four principles are: guide responses carefully in the early stages of skill development, provide appropriate practice tasks, distribute rather than mass practice, and provide the learner knowledge of results.

Early Guidance

The importance of helping the student learn the skill, rather than letting him learn as best he can independently by trial and error, was demonstrated in a physical education class. Davies (1945) divided an archery class of college women into an experimental and a control group. The experimental group was taught an accepted technique of shooting a bow and arrow and was referred to as the tuition group. The experimenter gave the tuition group members the verbal instructions that she thought necessary for them to understand the nature of the skill and to become proficient in it. The women in the control group were given only the necessary equipment, minimum safety instructions, and thereafter proceeded on their own. Both groups met for 18 class sessions during a three-

month period. At the end of the semester the tuition group performed better than the control group. Differences favoring the tuition group were apparent early in the semester and became greater as practice progressed. The control group tended to acquire an inefficient method and to stay with that method during successive class periods even though the progress of the group was poor.

Davies concluded that in at least three ways the teacher aids the learner to vary and improve his learning behavior: by directing the learner's attention to more adequate techniques than those he has acquired and has been employing, by promoting the growth of intellectual insight on the part of the learner into the factors related to his success; and by giving him a feeling of security and confidence in relinquishing a familiar mode of behavior and seeking one that is better. These three conclusions of Davies suggest quite adequately the purpose of providing early guidance.

Appropriate Practice Tasks

Providing appropriate practice tasks for the development of skills is yet debated, and properly so, for we do not agree upon the nature of wholes and parts. A practice task is not appropriate unless the unit of behavior practiced is the one that results in most efficient acquisition of the skill.

Part of the disagreement originates in that a whole skill for a beginner is a part skill for a more skilled performer, or vice versa. Another difficulty lies in the organization of the within-tasks in many games and sports. For example, what is the total task in playing baseball? Is the total task that of hitting, running, catching, and other skills? Is batting a separate whole skill or should it be further broken up into a number of smaller parts which in turn might be called wholes?

One way to look at the whole-part arrangement is in terms of the organization of the activity itself. Some activities are closely knit; others are loosely organized. Diving is a closely knit skill, whereas football and baseball are loosely organized aggregations of skills, each of which must receive concentrated practice. Though a final definition of wholes and parts cannot be clearly delimited for all skills, three of many studies which suggest the importance of beginning practice on the whole activity are now examined.

Knapp and Dixon (1952) used three groups of university senior males to test three conditions of practice in juggling three balls. One group practiced using the three balls from the start, the whole method. A second group practiced according to a prescribed procedure of progressive part-whole method: first, one ball was used until it could be caught,

then two balls until both could be caught, and then three balls. The third group used one, two, or three balls at any time during practice, as the members chose. The whole method proved definitely superior to the rigidly scheduled part-whole method, with about a 20 percent saving in time needed to reach the criterion of one hundred consecutive catches. The whole method also yielded somewhat better results than did the free-choice part-whole method.

McGuigan and MacCashin (1955) investigated whole and progressive-part methods in rifle marksmanship. The subjects were infantry trainees in army basic training. In the part method, practice was divided into seven components of firing, and the general procedure was to practice the first subtask, then the second, and then combine the first with the second. The third subtask was practiced next and was then combined with the first and second, and so on until, eventually, the seventh was combined with the first six. In the whole method, the subjects first watched a half-hour demonstration of the entire sequence of seven movements, from assuming a well-defined posture for firing to actually squeezing the trigger. Thereafter, this group practiced the total sequence in each of 28 practice periods, with instruction given on the subtasks as well as on the whole sequence during each practice period. The first group, using the progressive part-whole method, did not get to the seventh step—actually firing—until the twenty-fifth practice period, having spent the first 24 periods on the six parts leading up to actual firing. For trainees with IQ's 100 and above, the whole method was far superior to the part method. For trainees with IQ's 99 and below, only a small difference was found between the two methods.

Woodworth and Schlosberg (1954) give an excellent review of experiments completed from 1890 to 1952 in connection with learning to receive International Morse Code. In World War II there was much opportunity, as well as great need, to try out efficient methods of teaching Morse Code. Among several features that were finally incorporated into the military teaching procedures, four are appropriate to the present discussion of skill learning: prompt reinforcement of the correct response, the whole method of teaching, a standard-speed presentation of signals, and distributed practice. In the whole method all 36 symbols of the code—26 letters and 10 digits—were introduced to the learners in the first practice session. This method contrasted sharply with previous ones wherein early instruction was devoted to lengthy practice on separate symbols (similar to the progressive part-whole method in rifle firing just mentioned). The following dramatic results were achieved:

Students spent 8 weeks at code school. Normally, they practiced code for 7 hours a day for the first 5 weeks, and devoted the last 3 weeks to other topics. Kelier thought such massed practice might be wasteful, so he tried

spreading out the code instruction over the whole 8 weeks, devoting 4 hours daily to code, and the rest to other topics. It turned out that the 4-hour group was as good as the usual 7-hour group at the end of 5 weeks, despite the shorter hours of practice. Of course they still had 3 more weeks to practice code, for they had been taking up their other topics along with the code, they ended up markedly superior to the massed group (Woodworth and Schlosberg, 1954, p. 812).

It is unfortunate that funds are not available to do research in schools as was done in military settings. We might come to a resolution of the proper unit in early instruction in reading—letters, words, or phrases, and in swimming, total swimming or leg and arm movements, and also in other fields such as shorthand, vocal music, and instrumental music.

Distributed Practice

Let us examine some representative research related to the length and spacing of practice sessions.

Knapp and Dixon (1950) studied the effect of two different distributions of practice on efficiency in learning to juggle three balls. The experimental and control groups were male seniors with majors or minors in physical education. Both groups used the whole method. The distributed-practice group used five minutes in active practice daily, the massed-practice group used 15 minutes on alternate days. Individuals in each group practiced until they could catch 100 balls consecutively without dropping one. The distributed practice yielded much better results: 70 minutes were used by the distributed-practice group, whereas 126 minutes were used by the massed-practice group to reach the same level of skill. One minute of practice in the 5-minute daily arrangement proved as effective as 1.80 minutes in the 15-minute, alternate-day arrangement. Though this was the case, fewer 15-minute than 5-minute practice sessions were required to achieve the criterion of 100 catches without error.

Using a rotor-pursuit task, Duncan (1951) ascertained the extent to which intervals of rest could be directly substituted for intervals of practice with no reduction in the final level of learning. The entire experimental session took only 20 minutes, divided as follows: 5 minutes prerest practice, 10 minutes rest, and 5 minutes postrest practice. During the 5-minute prerest period, two of the groups worked under distributed practice conditions with 10 seconds practice, 20 seconds rest, 10 seconds practice, and so on. The other groups worked under massed practice with continuous practice for 5 minutes at the beginning and at the end of the 20-minute session and 10 minutes of rest between. The distributed practice was so arranged that the two groups receiving it practiced only

one-third as much as did the massed practice group. In the last 5 minutes, one of the original distributed-practice groups was given massed practice and one of the massed-practice groups received distributed practice. At the end of the first 5 minutes of practice, the distributed-practice groups were performing better, even though they had only one-third as much actual practice time. At the end of the 10-minute rest session, the distributed-practice groups were the same, however, the one which then received distributed practice performed significantly better than did the massed-practice group. Although this entire experiment was conducted within a time period of 20 minutes, it poses significant questions about the proper spacing of active practice and rest in many school learning activities such as handwriting, typewriting, and instrumental music.

Teachers in junior and senior high schools usually have no control over the length of class periods. They work in schools where class periods in all subject fields are of the same length, usually from 45 to 75 minutes. In any subject in which skills are part of the desired outcome, the teacher should raise questions such as these: Within a class period of this length, what is the best arrangement of active practice and rest for a beginning class? For an advanced class? Will the students acquire skill more rapidly through active practice each day of the week or through active practice on alternate days?

In the elementary school, teachers have more opportunities to manipulate time arrangements, since elementary schools are not so completely departmentalized as are junior and senior high schools. The elementary teacher has better opportunity to experiment with a variety of practice-rest arrangements. In the fourth grade, for example, experimenting could be done to ascertain whether children learn to spell as efficiently with 15 minutes of active practice on alternate days as with 15 minutes daily. When cursive handwriting is introduced, a test could be made to find whether 20 minutes of practice in four 5-minute sessions during the school day would achieve the same or better results than 20 minutes at one time during the school day. Most teachers simply accept the arrangement that someone, without evidence that it is the best one, has previously set up.

Knowledge of Results and Overcoming Errors

Providing the learner knowledge of results and helping him to learn how to overcome errors is probably the most difficult task experienced by teachers in a group situation. Yet this principle, if carried out well, would probably increase learning efficiency markedly in most school situations. Deese (1958) presents an excellent summary of the research establishing this principle in connection with skill learning.

Tiedemann (1948) working with 10.5 fifth-grade children, arranged

a situation whereby testing and reviewing were accomplished simultaneously with prearranged groups of children at intervals of 1 day, 14 days, 28 days, and 63 days. Best results were obtained when the review and knowledge of results were given 1 day after learning rather than later. But equally important, incorrect or erroneous responses that were not corrected persisted, if the pupils made errors which were not corrected they tended to accept and retain the errors as correct.

The discussion thus far has shown that many of the difficulties encountered in research on learning have resulted from three main sources. First, learning theorists have failed to find an appropriate unit of behavior from which to infer learning processes in human beings. Second, incorrect applications were made to human learning in group situations from the early research on learning, S-R oriented and set in laboratories with lower-form animals. Third, cognitive and other organismic theorists have not submitted their theoretical propositions to the comprehensive experimentation needed in school situations. It is equally true that one or another psychological conception about learning has been tried out in the schools, also without controlled experimentation or other careful evaluation.

The preceding discussion has also established these points: First, the nature of the material to be learned and the conditions under which it is learned markedly influence how well it is learned originally, how well it is retained, and how well it can be used in situations other than that in which it is learned. In general, learning tasks which are of significant social value, which are properly graded in difficulty to the child's present achievement level, and which focus upon principles and meanings are remembered and transfer better than does material of low meaningfulness acquired by rote memory.

Teaching Machines and TV Instruction

Examine now some ideas about learning incorporated in teaching machines and in TV instruction. Only the main points about each are discussed in order to compare the two media and to suggest needed research.

Teaching machines, based on Skinnerian ideas of learning, incorporate all of the following: First, introducing material to the student as an individual in small bits or items, one at a time, second, having the student make successive responses to each item or bit; third, reinforcing or confirming each correct response immediately after it is made and giving the correct response if the student makes an error; fourth, repeating or seeding some of same items in successive programs to secure the proper amount of repetition, fifth, using only material which is experienced through vision.

mainly in symbolic form; and sixth, requiring the responses to be made directly on the machine or closely related thereto, not in some situation removed from the machine (Galanter, 1959).

What kind of material can best be programmed for machine use? Factual information to which the student's responses can be judged as correct or incorrect; factual material which can be organized readily into successive programs on some basis such as difficulty or structural relationships; factual material which can best be understood in symbols and which does not require familiarity with the referents for which the symbols stand; and factual material which is relatively self-contained in small units. Subject matter which is already being incorporated into machine programs is spelling, arithmetic, and grammar. The person who writes the programs in these fields organizes the material into small bits in successive programs and for each bit decides what the correct response is for the student to make.

Overlooking many problems yet to be solved in producing appropriate programs, consider some other questions about teaching machines which need experimentation in schools (Klausmeier and Lambert, 1961).

1. How efficiently can such important outcomes of school learning as concepts, attitudes, values, study skills, and creativity be learned from machines? For example, can the ability to communicate orally in a foreign language, the ability to spell correctly, the ability to work well with others, the ability to identify and solve problems, be nurtured equally well with machines?

2. Is machine instruction equally efficient with all age groups? For example, will first graders learn as well as high school seniors?

3. How long will students of any age respond with high motivation to machines? For example, if half of the total instructional program is incorporated in machines, will students use the machine without teacher forcing for 20 minutes? a day? a week? a month? a year? six years? 12 years? Will students want to learn from machines throughout life, as many now from books and other printed material?

4. Can a program of instruction be arranged in the school system which encourages each student to proceed at a rate appropriate for him, kindergarten through twelfth grade? Though this idea is accepted by many at the verbal level, the writer is unaware of any school system that actually accomplishes it well. And there is no point in introducing machine instruction unless it is accepted in practice. Children can be denied the opportunity for using appropriate levels of programmed material, as, for example, many of the more proficient sixth graders are now being denied use of any of the required textbooks or other instructional material used in the seventh grade.

5. What are the possibilities for transfer of machine-acquired responses to other situations? Research on rigidity and set in problem solving shows conclusively that when an individual experiences repeated success in solving problems with a certain method or instrument, he clings to that method or instrument even though it is inappropriate for solving new problems he encounters for which other methods and/or instruments are appropriate. Thus, through widespread and repeated use of machines and the method of learning incorporated therein, students may become highly dependent upon someone else to decide for them what to learn, how, why, when, and how well to learn it. This could lead to negative transfer to non-machine learning situations and to lack of sensitivity to problems, of originality, and of flexibility. Also on the negative side, with respect to transfer from machine learning, is the possibility that many outcomes cannot be acquired with meaning; further, only verbal applications of new learning are usually presented in the teaching machine. Machine instruction encourages the learner to respond correctly or appropriately, as determined by the programmer. The better and more widespread the machine instruction, the more fully must the learner come to rely upon it as the most efficient way for him to learn.

The above questions are only representative of the many that might be answered through research and for which we do not now have sufficiently accurate information. Now consider TV instruction briefly in comparison with teaching machines.

First, TV introduces the same material or lesson to many students simultaneously, thus not providing for differences among students; second, each student may respond to each bit of information presented, but there are not adequate means of inferring this and the TV teacher proceeds through the lesson without this knowledge; third, the TV teacher has no means of reinforcing correct responses or correcting wrong responses immediately, fourth, the students' responses may be recorded and evaluated while viewing the TV lesson but this is not the usual case. In the above respects, TV instruction has weaknesses in comparison with the teaching machine in connection with teaching factual material and some verbal skills.

However, TV has at least four distinct advantages. First, the TV teacher can reach a large number of students simultaneously. New information not yet available in textbooks or elsewhere can be brought to the students. Second, any subject matter in still life or in movement that is available to the TV camera and related sound equipment can be transmitted to the students, thus permitting the students simultaneously to see and hear. Further, the TV camera can record much information not available to the naked eye, either because it is too small to be seen, too

large, too distant, or is otherwise inaccessible. Third, the TV teacher is not so limited in ordering the material in the presentation. Instead of building small bits of information into a larger pattern, the TV teacher can move in the opposite direction, thus the nature of the wholes that can be presented by TV is much more flexible than for teaching machines. Fourth, the TV teacher can provide students more realistic examples of a variety of concepts, problem-solving processes, and skills than can be done with current machines.

With these advantages, we may examine briefly two subject fields in which TV instruction is used in the elementary schools—foreign language and science. Why is foreign language being offered by TV? Is it because research has shown that pupils can learn to speak a foreign language most efficiently in this manner? A well-prepared teacher in each elementary school building, equipped with a good electronic laboratory, might achieve much better results (Holton, *et al.*, 1961). A well-prepared teacher without the electronic laboratory might also achieve good results. Yet since we do not have enough well-prepared teachers, we use TV as the best present means of offering the foreign language to large numbers of pupils.

It is possible, too, that science is being taught by TV because of lack of knowledge and skills in science on the part of many present day elementary school teachers. The TV teacher knows and presents more recent information with better visualizations of scientific concepts and processes than can many of our present elementary teachers. Whether or not children of elementary school age learn science more efficiently from a well-prepared classroom teacher who also has the material and equipment that the TV teacher does, has not been investigated carefully.

These examples point to the need for research on many learning problems in school settings. Since many innovations are being tried, the research arrangements should be able to be managed without too much difficulty. For example, when a foreign language is offered in a larger school system, at least three arrangements for teaching it should be investigated simultaneously—TV teaching, a well-prepared teacher not using electronic equipment, and a well-prepared teacher using electronic equipment. We have no prior knowledge or learning theory on which to eliminate any of these three. Conceivably, a well-prepared teacher with electronic equipment will achieve much better results than a TV teacher.

Conclusion

I am perhaps more skeptical than many persons in moving directly from theoretical statements about learning processes to applications in school settings. Also, I probably put more emphasis than do many

learning theorists upon the characteristics of the learners, of the teacher, of the setting, and the nature of the outcomes to be learned. I do not believe that, at this moment, there is any one theory of learning or of behavior that is applicable to all types of learning outcomes with all human beings. Similarly, I do not believe that there is any one method of teaching or any teaching aid, such as TV, machines, programmed textbooks, sound movie films, or electronic laboratories that is equally appropriate to all subject matter fields. We have much more to learn about these matters through research in the next few years than is known up to the present time. Bruner (1961) expresses a somewhat similar point of view.

In school settings, my preference for research is controlled experimentation to ascertain the conditions under which pupil learning proceeds most efficiently. In laboratory settings with human subjects, my preference is to identify the learning-to-learn procedures used by human beings of varying age and other characteristics in acquiring a large number of different outcomes. If we could ascertain the latter, we would be better prepared than at present to make decisions about how to organize learning activities in school, not only by TV or machines, but also by teachers, textbooks, and other means. I feel a sense of urgency about these matters.

Knowledge is accumulating at a very rapid rate. The need for persons with more knowledge and higher-level skills is acute. We do not have any but the poorest estimates of the top limits of learning in human beings. Both for the welfare of society and for the optimal mental and emotional development of the individual, we cannot afford to argue about learning phenomena associated with teaching and learning about which we are uncertain; we had better proceed as the natural scientists are doing—add to mankind's knowledge and skills through research.

References

1. *Annual Review of Psychology*. Stanford: Stanford University Press, 1961, 1960-1959, 1958, 1957.
2. H. G. Birch and H. S. Rabinowitz. "The Negative Effect of Previous Experience on Productive Thinking." *Journal of Experimental Psychology* 41: 121-25, 1951.
3. J. S. Bruner. *The Process of Education*. Cambridge: Harvard University Press, 1961. Ch. 6.
4. L. F. Cain and R. Wilcox. "The Effect of Spaced Learning on the Curve of Retention." *Journal of Experimental Psychology* 25: 209-14, 1939.
5. D. R. Davies. "The Effect of Tution Upon the Process of Learning a Complex Motor Skill." *Journal of Educational Psychology* 36: 52-65, 1945.
6. L. Deese. *The Psychology of Learning*. New York: McGraw-Hill Book Company, 1958. p. 197-201.
7. C. P. Duncan. "The Effect of Unequal Amounts of Practice on Motor Learn-

- ing Before and After Rest" *Journal of Experimental Psychology* 42: 257-64, 1951
8. E. Galanter, editor. *Automatic Teaching: The State of the Art*. New York: John Wiley & Sons, Inc., 1959.
9. A. R. Gilliland. "The Rate of Forgetting." *Journal of Educational Psychology* 39: 19-26, 1948.
10. D. A. Grant, *et al* "Acquisition and Extinction of a Verbal Conditioned Response with Different Percentages of Reinforcement." *Journal of Experimental Psychology* 42: 1-5, 1951.
11. C. Hendrickson and W. H. Schroeder. "Transfer of Training in Learning to Hit a Submerged Target." *Journal of Educational Psychology* 32: 205-13, 1941
12. E. R. Hilgard. *Theories of Learning*. New York: Appleton-Century-Crofts Inc., 1956. p. 9-13.
13. J. S. Holton, P. E. King, G. Mathieu and K. S. Pond. *Sound Language Teaching*. New York: University Publishers, Inc., 1961
14. L. G. Humphreys. "The Effect of Random Alternation of Reinforcement on the Acquisition and Extinction of Conditioned Eyelid Reactions." *Journal of Experimental Psychology* 25: 141-58, 1939
15. C. H. Judd. "The Relation of Special Training to General Intelligence." *Educational Review* 36: 28-42, 1908.
16. H. J. Klausmeier. *Learning and Human Abilities*. Educational Psychology New York: Harper & Brothers, 1961
17. H. J. Klausmeier and J. Check. "Retention and Transfer in Children of Low, Average, and High Intelligence" *Journal of Educational Research*. (Scheduled for publication May 1962.)
18. H. J. Klausmeier and J. Feldhusen. "Retention in Arithmetic Among Children of Low, Average, and High Intelligence at 117 Months of Age." *Journal of Educational Psychology* 50: 88-92, 1959.
19. H. J. Klausmeier and P. Lambert. "Teaching Machines and the Learning Process." *Educational Leadership* 18: 278-83; 1961.
20. C. G. Knapp and W. R. Dixon. "Learning to Juggle: II. A Study of Whole and Part Methods." *Research Quarterly* 23: 398-401, 1952.
21. C. G. Knapp and W. R. Dixon. "Learning to Juggle: I. A Study to Determine the Effect of Two Different Distributions of Practice on Learning Efficiency." *Research Quarterly* 21: 331-36, 1950.
22. W. C. F. Krueger. "The Effect of Overlearning on Retention." *Journal of Experimental Psychology* 12: 71-78; 1929.
23. F. J. McGuigan and E. F. MacCashin. "Whole and Part Methods in Learning a Perceptual Motor Skill." *American Journal of Psychology* 68: 658-61; 1955.
24. W. J. McKeachie and D. Solomon. "Retention of General Psychology." *Journal of Educational Psychology* 48: 110-12, 1957.
25. G. A. Miller, E. Galanter and K. H. Pribram. *Plans and the Structure of Behavior*. New York: Holt, Rinehart and Winston, Inc., 1960. p. 5-39
26. E. B. Newman. "Forgetting of Meaningful Material During Sleep and Waking." *American Journal of Psychology* 52: 67-71, 1939
27. B. F. Skinner. "The Science of Learning and the Art of Teaching." *Current Trends in Psychology and the Behavior Sciences*. Pittsburgh: University of Pittsburgh Press, 1955.
28. E. K. Strong. "The Effect of Time-Interval upon Recognition Memory." *Psychological Review* 20: 339-72, 1913
29. H. R. Tiedemann. "A Study of Retention in Classroom Learning." *Journal of Educational Research* 42: 516-31, 1948
30. R. S. Woodworth and H. Schlosberg. *Experimental Psychology*. New York: Holt, Rinehart and Winston, Inc., 1954. p. 656-88, 809-13.

Terminus . . .

Learning and the Learner: A Synthesis

Walter B. Waetjen

Each day, in thousands of classrooms across the nation, teachers confront children with tasks which they must master. This mastering of tasks lies under the banner of "learning." Learning may be defined as a change of behavior resulting from stimuli originating within the individual or from external stimuli acting upon him. It is considerably more difficult to state the exact nature of these stimuli and the specific way in which they have an impact upon learning. Nevertheless, this booklet has attempted to point up what some of these forces are and the way in which they influence learning. Admittedly, the task has not been fully completed.

Apparently, every teacher has some idea of how learning proceeds and the factors that influence learning, no matter how inclusive, erroneous or valid such ideas may be. For example, a teacher must conceive of behavior as being modifiable, otherwise there would be no point in his attempting to teach. Yet how a teacher conceives of learning and the learner will determine the classroom behavior of that teacher. It will determine what the teacher does; and, in a real sense, will probably determine what the learners will do. Almost immediately one might raise the obvious question, What *should be* the teacher's views of the learner and learning? The answer to the question could get lost in a welter of philosophical considerations. Without concerning ourselves with the philosophy of the matter at the moment, this booklet has taken an

implicit position about the learner and his learning. The position has been that learning is dependent upon and arises from three major forces: first, the person as a physical being, second, the social groups to which one belongs, and third, the psychological organization of the learner. The papers reflect this orientation.

Krogman has given us information about children as physical beings. Denney and Strodbeck have written of the social groups that operate in a child's life, while Postman and Klausmeier have told us how children's psychological organization is a determinant of learning. As Foshay would put it, each of these people has described aspects of learning from the special vantage point of his own discipline.

A Point of View

In a less straightforward way, the papers have described a point of view about learning that should be made explicit. That point of view recognizes that the physical organism, the society and the psychological organization of a person are all determinants of learning. The slow, orderly unfolding of the organism determines in large measure the timing of the learning tasks which the organism is capable of at any given moment. Krogman has described this process in detail. However, he has pointed out how a cultural evaluation is placed on physical size, physical strength and early maturation which elicits certain responses from the society causing children to learn about themselves. Thus, the growing, behaving child has an impact on his social environment which is evaluated and reflected to the learner by the society.

A second major force influencing the development and learning of the individual is that of the social groups to which a person belongs. These groups include the family, church, school, classroom group and the peer group. Yet, these are loosely defined terms, as witnessed by the fact that families are not alike. Not only do families value and believe differently, but they express their values and beliefs differently to their children. The important fact, however, is that all social groups do take steps to communicate their beliefs to the young. Some of these steps are consciously taken, explicitly transmitted, while others are not so consciously taken and are implicit in the behavior of the people who transmit them. The papers by Denney and Strodbeck indicate that the social groups to which one belongs serve three functions in the learning of children.

In the first instance, these groups determine the *nature of the tasks* which the growing child shall accomplish. The tasks may vary from expressions of politeness to knowing one's way around the community to mastering a body of content in a school. The group, however, will

invariably define tasks, learnings or problems which the child must demonstrate he can handle in appropriate ways. The group does not withdraw after having simply defined the tasks with which to confront the child. Now it imposes standards of excellence which normally include an age at which the task must be mastered. Strodbeck tells of research in which mothers from different social groups expected their offspring to master certain tasks at different ages. The tasks were the same, the age of mastery different. There remains another dimension to the impact of society on the individual's learning, namely, the way in which the learner's 'audience' responds to his learning attempts. Denney makes it clear that each learner has various audiences and these audiences have unique ways of reflecting to the learner the relative success or failure that he has achieved. So it becomes evident that the physical organism (the individual) has some impact upon his society, and his society, in return, attempts to mold and give direction to the learning of the organism.

Simply to say that the organism affects its social environment and that the social environment shapes the learning of the individual is not enough. We have omitted the fact that out of this interactive process the individual derives meanings. These meanings may be about objects, institutions, natural phenomena, other people or one's self. These meanings are emergent in that with accumulated experience there is greater likelihood that these meanings will arise. Also, as Postman and Klausmeier indicate, these meanings are not only an indication of what *has been learned*, but they strongly influence what *shall be learned*. So this is the third major factor influencing learning—the accumulated meanings, which together constitute a person's psychological organization. This organization arises out of the interaction of the organism with its social environment and becomes a force in itself.

The point of view described above is reflected in Figure 1. In this drawing, "A" represents the biological organism, "B" represents the

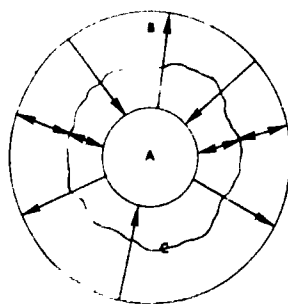


FIGURE 1.

social environment in which the organism functions, and "C" represents the emergent psychological organization of the individual. The arrows emanating from each of the foregoing indicate the effect that a given force has upon another of the forces influencing learning.

Similarities

Each of the preceding papers is directed toward examination of one of the three major forces that influence learning. Interestingly enough, not one of the papers was completely successful in confining itself to a discussion of one discipline. Conceivably, it is a hopeless undertaking even to try to confine one's self to a single discipline when considering such a complex activity as learning. It has often been said that man is an indivisible unity—he responds "all of a piece." It is not surprising, therefore, that some similarities are apparent in the papers presented in this booklet. These similarities may well represent partial leads to a description of the learning behavior of man. The very fact that there has been a recurrence of certain ideas, facts and meanings in the several papers suggests that these recurrences should be made explicit.

The modes of learning and relating to people tend to be consistent. In his paper, Stredbeck writes of the situations in which a family had been given a problem situation for which the members had to make some decisions. During the course of working out the decisions, observers recorded the number of times each family member participated. In a number of cases it was found that a given member of the family spoke 65 percent of the time. After being informed of this, he still spoke 64 percent of the time in the group decision-making experience. Apparently, one's way of relating to people is not appreciably influenced when one is given the facts about these ways of relating. In a somewhat similar vein, Klausmeier points to the research which indicates that when individuals learned a particular way of solving a problem they did not depart from that use in a new situation even though the use was inappropriate. What this amounts to is rigidity, or at least stability, in one's organization, that creates a resistance to learning. However, we would hasten to add that it is not suggested there is complete resistance to change and learning.

Learning involves the relinquishing of old modes of behavior as well as the acquisition of new modes. One way to view learning is that it causes the learner to switch from old, tried and comfortable behavior to behavior that is new and untried. This, too, may account for the "resistance" phenomenon in learning. Klausmeier cites Davies' study on learning of motor skills in archery, in which it was concluded that a

teacher can help students learn new motor skills by directing the students' attention to more adequate techniques, by helping the learner to see the factors related to his success, and by giving him a feeling of confidence and security. Worthy of note is the fact that the learner receives specific help and instruction from the teacher so that acquisition of new modes is much clearer and relinquishing of old modes of behavior that much easier.

The family studies by Strodbeck allude to this same point in connection with subscribing to family norms. These studies reveal that the higher the rank of a child as a group member in the family, the greater will be his willingness to subscribe to the family's norms.

In both of the cases mentioned here, it is apparent that more than instruction is needed in order to enable a person to learn. The teacher gave the archery students a feeling of confidence and security. The family had assigned a high rank to a child, making it easy for him to learn the family's standards of behavior. So, we have a corollary to the fact that learning something new involves relinquishing the old. The corollary is that *acquisition of new modes and relinquishing of old modes of behavior are facilitated by warm, supportive human relationships*. To add more support to this idea, one can point to the research cited by Postman having to do with the effect of rewards on learning. Rewards have the tendency of strengthening performance while punishments do not seem to have a commensurate weakening effect on performance.

There is a "best" time for structure (growth) and function (learning) to occur. Almost immediately it becomes apparent that this alludes to the readiness concept which so thoroughly pervades educational theory and practice. Krogman makes a strong point when he indicates that there are propitious times when neuromuscular connections are made. These connections appear to be time-linked in the development of any individual, and, therefore, the learning to be mastered by the individual must be commensurate with the nature and complexity of those neuromuscular connections.

There can be little doubt that adults attempt to gauge the complexity of these neuromuscular connections and then impose certain tasks to be learned. How precise the timing must be is a matter of speculation. Strodbeck cited the research by Winterbottom in which parents from different ethnic groups varied with regard to the age at which they expected their children to master certain things, such as knowing their way around the city and making friends. Albeit the parents may be quite wrong in their expectations, it is nonetheless true that the readiness concept prevailed in the parents' thinking. As Denney would put it, the learner's "audience" (his parents) played a major role in the what, how, and when of learning.

That there is an exquisite relationship between structure and function is highlighted in Postman's comments regarding the developmental sequence in the learning of certain concepts. It will be recalled that Postman reported research in which it was indicated that the learning of many concepts is dependent upon the use of language symbols. Clearly, the use of language is dependent upon the maturation of the nervous system. This has been recognized by educators over the years, but in a gross way. Now we are challenged to identify those conceptual learnings which are contingent upon the subject's being able to symbolize at the verbal level.

The learner's sense of personal control of the environment is related to his learning and motivation. Perhaps the word "control" could be misconstrued to mean domineering behavior of the learner. That would be an unfortunate interpretation. It is intended to convey the meaning that personal control of the environment causes the learner to perceive himself as one who is more active, rather than passive, toward his environment. One who has a high sense of personal control over his environment has more of an impact *upon* that environment and to a lesser extent is passive toward it. In his studies of family interaction, Stroudbeck has found that if the early adolescent has that type of family experience in which he feels he makes a real contribution, then he is well on the road to a career in which he conceives of the external environment as being responsive to his efforts to achieve and learn. A somewhat similar note was sounded by Krogman, reporting on the study conducted by Jones and Bayley. These investigators discovered that early maturers were more dominant, more responsive, produced more class officers and athletes, and took more mature social roles. Again, it would seem that these early maturers perceived themselves as more active toward their environment than passive.

Klausmeier reported a study having to do with retention in which 80 percent retention was achieved by pupils in addition exercises when the arithmetic content was appropriate to their learning level and the instruction was thorough. It seems fair to assume that when curriculum content is appropriate to the learning level of children, it will generate in them a feeling of personal control over the material that is to be learned.

Another similarity runs through the papers presented in this booklet. However, this similarity is much more implicit than explicit. Each of the several foregoing papers touches upon several ways in which various factors influence the learning and motivation of the students who come into the classrooms. In order to be sensitive to these factors and to make some provision for them in designing appropriate learning experiences,

the teacher is faced with the problem of numbers. How many students can a teacher teach and still have time to develop the sensitivity needed to aid them in their learning? It makes a person feel impotent to say so but it is apparent that a figure cannot be given.

On the other hand, each of the preceding authors implicitly *holds out against large groups and against the blind mechanization of teaching*. How can a teacher possibly ascertain a youngster's biological maturation, his sense of personal control of the environment, the nature of his learning audiences, the level of conceptual ability relative to language development, or the appropriateness of the material to be learned if he is burdened with large numbers of children in his classes? However, we would be quick to add that if a teacher does not and will not attempt to discover the individual factors that influence learning, then there is no reason why he should not have large classes. Even with a smaller class such a teacher would not have a facilitating effect on the learning of his pupils.

Klausmeier is particularly outspoken on the matter of mechanization of teaching. Yet he does take an unequivocal position on the matter. The mere fact of using television or teaching machines for instructional purposes does not in itself assure increase in learning. We have yet to determine whether all kinds of youngsters learn equally well when placed before a television set or a teaching machine. Therefore, as Klausmeier indicates, we are not justified in using certain instructional devices with large groups until we have valid information regarding the learning of those who are confronted with the devices.

On Furthering Curriculum Research

The Sixth Curriculum Research Institute had as its major objective the furthering of curriculum research, so it is not at all beside the point to pause and consider what has been suggested that might be taken into account by the curriculum researcher.

Actually, in the immediately preceding section there might have been added two more of the similarities or recurring themes which emerged in the papers of the scholars. One of these was the admonition that *we must commit ourselves to more research and better instrumentation*. A decade ago this suggestion would have fallen on relatively deaf ears, since curriculum research was then very much of a stepchild in our professional activities. Such, however, is not the case today. We have a well-informed professional group who are eager to have research undertaken. There are, of course, stumbling blocks in our way. One of these is that we have too few people able to conduct the research. Running a close second as a deterrent is that too little time is provided

for research activity since it is often true that the research person carries a heavy burden of responsibility in addition to the research function. Often the "other" responsibilities are those which demand immediate attention and, so, the research is postponed. Of course, there is always the limitation of funds, but this has been offset somewhat by the availability of federal research funds.

A second similarity running through the comments and writings of our scholars has to do with *what* was being researched. *Research calls for a careful specification of the unit of behavior or phenomenon being investigated.* We would do well to recall the statement used by Fosha in describing the characteristics of a discipline. One of those characteristics had to do with the bases on which truth is established within a discipline. Each of the papers presented here has made a rather careful description of the exact phenomenon that was being investigated; and, at least to this extent, the criterion for a discipline has been met. Curriculum research is sometimes found wanting in this regard. Perhaps we might even say that education, in this respect, is found wanting. For example, it is not uncommon to find curriculum research which centers around "learning to read." To the present writer, "learning to read" is so comprehensive and all-inclusive an activity that no single unit of behavior has actually been identified. If learning to read in our research is the ability to call words, then we should say so. On the other hand, if learning to read in our research is precision in pronouncing words, or the meaning one derives from a written passage, or the youngster's ability to indicate that a certain sound is represented by a certain printed letter, then we should be equally specific. Perhaps the examples chosen are unfortunate, but the fact remains that we can do a better job in curriculum research of specifying the exact behavior that is being investigated. In so doing, not only will our research be of better quality, but we will have taken one more step toward becoming a discipline.

As one reads the papers presented in earlier sections of this booklet he is tempted to speculate about possible problems for curriculum research, field exploration and experimentation. A multitude of these research problems are available in the information given earlier in this publication. One cannot hope to indicate all of those; perhaps one should not even attempt to do so, for the curriculum researcher will identify those problems which are particularly relevant to his situation. Therefore, the beginning point for one curriculum researcher is different from that for another.

How can we develop in children a greater sense of personal control over their environment? Conceivably, there are children in classrooms

who are entirely adequate to learn in an intellectual sense, but have low regard for their ability to control their environment. These are students who are passive toward their world when, indeed, learning demands that the learner be active toward his world. There is little reason to believe that such a youngster's sense of control over his environment will be changed by a teacher who becomes sterner in expecting the youngster to learn the same subject matter. As a matter of fact, such an approach could make the situation worse.

Without becoming a clinician, a teacher, it appears, could help a student to attain a better view of the control he exerts over his environment. The object of this research would be to build into children the view of themselves as active agents in the learning endeavor by providing a physical environment (curriculum) upon which they could have some observable impact. The curriculum content and instructional material presented to these youngsters would need to be exquisitely geared to the next level of difficulty above which they are functioning in order that they would perceive the activity as one which they are able to deal with adequately.

What does "readiness" mean when applied to specific learning tasks?

A major assumption underlying curriculum development is that there is a sequence to learning experiences which in large measure is determined by the readiness of the learner. The temptation is to extend the concept of readiness to the point where it becomes meaningless. Is it accurate to ask whether children are "ready for first grade," "ready for junior high school," or "ready for small group work"? From the material presented by Krogman, it appears that we should examine the specific, even minute, learning tasks that must be mastered in first grade, or junior high school, or in small group work in order to use the readiness concept realistically. To go back to an idea expressed earlier in this section, we would profit by specifying the unit of behavior (the learning task) for which a certain kind of readiness is prerequisite.

Of course we know that one general guide to pupil readiness is knowledge of the typical or average behavior at a given level of development. The difficulty is that it leads us to generalize from cases which are not typical to a given level of development. Our need, therefore, is to develop techniques by which we can ascertain whether individual pupils are, indeed, ready for that which they must learn.

How can we ascertain children's modes of learning and the appropriateness of these modes to specific situations? It seems entirely probable that children run counter to our commonly held notion that learning proceeds the same for all. There is some evidence that children choose different roads to learning and, potentially, each of these roads

is good for the individual. We have need to sensitize ourselves to these different ways in which children bring their mental processes to bear on the material that is to be learned. For decades we have argued the merits of part-to-whole and whole to part learning, but now we must find out whether modes of learning are so individual as to make our former attempts at generalizing invalid. But even if we were to discover that individuals do have highly unique modes of learning, there is another step that must be taken. Klausmeier alerted us to this step when he reported that pupils in one experiment, having found a method of learning effective in one situation, tended to utilize that same method of learning in situations in which it was inappropriate. There was a marked rigidity in their behavior in this respect. We would want to determine, then, whether or not the mode of learning employed by a youngster is appropriate to the situation.

Another aspect of this problem area for research is that of boy-girl differences in learning. Since boys and girls are trained to be quite different kinds of people, it is not beside the point to speculate on the impact this could have on their learning. Ordinarily we assume that children of the two sexes learn similarly, but we would suggest that this matter needs research. It is possible that there are sex differences in the way learning proceeds.

There are a number of questions that might help to give focus to research or investigation on this topic. Are there different ways of learning for different children? Do children have a repertoire of modes of learning? Are these ways of learning used appropriately for specific learning tasks? How can teachers help children to diagnose *what* is to be learned so that they will then be able to utilize that method of attack that will produce the greatest precision of learning?

What does the learner perceive as reinforcement? Conditionists assume that some overt action must be made toward the learner by another person or by the nature of the situation in order to bring about "reinforcement" of learning. Ultimately, the answer to reinforcement is in how the learner perceives it. Postman suggests that reinforcement may be much more subtle and covert than imagined. If this be true, then teachers could be providing reinforcement when they do not intend to do so! This serves to highlight another problem area that might be attacked by teachers, namely, what behaviors do teachers manifest as reinforcement of children's learning?

Also, it would be enlightening to arrange a series of learning situations in which teachers gave increasingly overt responses to children's efforts to learn. Then we might try to ascertain from children what they perceived as reinforcement and what was perceived as *most positive* reinforcement.

By what means can we increase the achievement motivation of children? Clearly, there are some children whose achievement motivation does not need to be increased; on the other hand, there are some youngsters who do seem to lack the motivation to achieve.

Every teacher has had pupils with low motivation to achieve and with high intellectual ability. And every teacher has speculated as to how these pupils might be helped. An experimental research design with the following elements might prove of help to these pupils.

1. Focus the pupils' attention on the learning goal or curriculum objective. At all times in the classroom experience, the teacher would make certain that the learners had clearly in mind the goal that was to be achieved. This would give the learners a means-ends perspective.

2. Help the children to set realistic or attainable goals that are in the direction of the major learning goal. Necessarily these goals would have to be at the next higher level of difficulty than the learners' present performance.

3. In the process of goal setting, the teacher would capitalize on the curiosity that the learner has and would encourage his existing interests and competencies. To do this the teacher will have to make a careful study of the children to determine their interests and competencies in order that he can arrange learning tasks exquisitely appropriate to the ability of the youngsters.

4. Aid the learners in making and evaluating their progress toward the goals that have been set.

How do children perceive the teacher's attempts to influence the achievement motive? Apparently the achievement motive has two components, doing things well, and doing things by one's self. Of these, the former is somewhat more important. In certain families each of these components is transmitted by a separate parent. But we know little about the role of the teacher with regard to the achievement motive. Teachers do try to influence the achievement motivation of children by getting them to do things well and by expecting them to do things alone. Here we find that the teacher's function is different from that of the family. So we must ask ourselves whether this dual role the teachers play is confusing to children. Can a teacher socialize youngsters to doing things well (achievement training) and doing things alone (independence training) without thus predisposing them toward being cautious since they are unable to predict the teacher's role at the moment?

What is the learner's perception of his audience? While we can speculate at length as to what the learner considers his audience to be, we are still not assured that our speculation is valid. For example, we

do not know whether youngsters consider their primary audience to be teachers, family or classmates. Nor do we know if there are combinations of these possibilities that would make the matter even more complex. There is also the possibility that the audience could change as the learner proceeds from one developmental level to the next. Moreover, it may be that social class affiliation would make a difference.

When we speak of the learner's audience, we are asking who are the people or groups or significant others *for whom* the learner perceives his learning as being important. However, we must extend this a bit further in order to bring out the implications this might have for curriculum development. We must determine whether the learner perceives *himself* as being part of his own audience. That is to say, the learner must feel that what he is learning is significant and that it has positive meaning. Indeed, it may be that the learner is the most important part of the learner's audience.

Which concepts to be learned are those dependent upon the use of language symbols? Postman has alerted us to the fact that the learning of certain concepts appears to be dependent upon the ability to use language symbols. There can be no doubt that this could have powerful implications for the teaching of certain concepts, particularly in the primary grades. It is here that we might identify a few concepts deemed important in the primary grades and investigate their development in connection with the language facility possessed by certain children. The initial selection of children for this experiment might be on the basis of their language facility. One group of children might be selected with high language ability and another group with low level language ability. We would then proceed to teach a given concept, being careful to provide the same material to each of the groups and then to assess thoroughly the mastering of the concept by children in each of the groups.

Always There Stands the Unknown

While some research lends itself to being conducted by classroom teachers in limited kinds of circumstances, it appears that research on the problem being considered here would have to be done on a more formal basis. The selection of children should be done carefully and the assessment of the degree to which a given concept has been mastered should be done with equal precision. This is not to say that teachers could not conduct such research; but it does suggest that consultant help should and can be utilized when and where it is appropriate.

The papers in this booklet have cast light upon the way in which learning occurs. There has been research presented about the way in

which the growth of children influences learning; the influence of social groups and forces upon learning; and the way in which psychological factors affect learning. Each of these appears to be part of the total parcel of learning; yet no single force can be accountable for an individual's learning. Much as we have discovered about learning, there remains much more to be discovered. We need not feel guilty about not having the complete answer; but we cannot be dilatory in our efforts to discover more truths about learning. There are a multitude of things unknown about learning, some of which are highlighted by the four questions which follow.

Is learning a singular process? Casual conversation with educators strongly suggests that they do envision learning as being a single process, quite unique, differing from all other aspects of human functioning. This may be true, but the papers in this booklet suggest otherwise. If learning is not a singular process and if we assume that it is, then our avowed intention to teach the whole child becomes a platitude that we mouth. Should further research reveal that learning is a series of processes, only then can we teach the whole child if, indeed, that is humanly possible.

Is learning a means to an end? There is a widespread belief among educators, psychologists and lay people that would lead them to answer this question affirmatively. One learns something, is the belief, so that he can use it to do something. Learning, according to this position, is a tool or an interim activity. Many of our curricula are constructed on this belief. One cannot argue too strenuously against this point of view, for it is only reasonable that learning should enable a person to do something better or differently. The genesis of this belief is deeply rooted in the production orientation of our culture. Unless we can report that something tangible was produced or something done, we feel that the activity was insignificant.

Is it possible that learning is not simply a means but also an end? The question is based on the belief that human beings tend to derive satisfaction from using their nervous systems fully. What would happen to the curriculum if we were to discover through research that there are two major functions in learning? First, that learning is a tool or interim activity; it is something that we employ to bring about change in our externality. Second, learning is an activity and an end unto itself because it has helped man to increase his psychological complexity.

What occurs organically when children learn? We know a great deal about different aspects of learning; but we know exceedingly little about what occurs organically with respect to learning. The people who are coming to grips with this problem are those in neurophysiology and

electroencephalography. Other than the research findings from these disciplines, we speculate as to what happens inside of man when he learns. We observe that a person behaves in a given way and then we speculate as to what happened organically to give rise to the behavior. Historically, this lack of knowledge about what happens internally when learning occurs has caused us to look outside of man for our answers. Conceivably, this is why we engage in lengthy and sometimes heated discussions about methods of teaching reading, grade placement of certain units of instruction, and the teaching of physical skills.

Is learning the same for all? Not knowing differently, it is easy to assume that learning is the same for all, whether a rat, an underachiever, a chimpanzee, a child from suburbia or from a blighted community, or whether the learner is a boy or a girl. There is some evidence to indicate that, while there are some common ways of learning, there are also some very personal ways. We do not know whether school learning is the same as nonschool learning. Nor do we know whether problem solving in a testing situation is the same as problem solving in a nontest situation. Similarly, we lack knowledge as to whether learning in one curriculum area occurs in the same way or in different ways than does learning in other curriculum areas.

These questions are not intended to ridicule or attack the curriculum worker. Rather, they are intended to highlight the need for more research about learning in order that the curriculum worker will be able to be more precise in his work.

Learning

is treated in other ASCD publications . . .

Learning More About Learning

Relates findings in perceptual psychology, communications and curriculum to learning and to teaching.

Pages 88

Price \$1.00

Freeing Capacity To Learn

Applies new advances in behavioral sciences and curriculum development to the discovery of what helps to free capacity to learn.

Pages 96

Price \$1.00

Human Variability and Learning

Shows how certain variables in learning relate to individual differences among pupils.

Page 96

Price \$1.50

Order from:

Association for Supervision and Curriculum Development, NEA
1201 Sixteenth Street, N.W.
Washington 6, D.C.