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By-Allen, William H.

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This compilation of readings in educational media and research makes accessible published and unpublished documents relevant to designers and users of educational media. Volume III includes part 6, "Learner Characteristics," and part 7, the "Conditions of Media Use." "Learner Characteristics" relates the nature of human aptitude to instructional media research and practice, considers the characteristics of a learner as member of an audience, and studies eye-movements and television viewing. "The Conditions of Media Use" demonstrates some applications of instructional media to instructional practice. The strong influence of film, media policy making, areas of needed research, choice of a specific medium for instruction, and instructional media research in teacher education are considered in seven papers. Extensive bibliographies follow these papers. The sources of the papers in these three volumes are AV Communication Review and the research in instructional media made by the United States Government. Dr. Allen's headings in these three volumes of readings are the same as his headings in "A Course of Study and Bibliography for Instruction in Educational Media Research and Theory. (MM)

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(Volume III)

William H. Allen
1355 Inverness Drive
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William H. Allen

1355 Inverness Drive
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U.S. DEPARTMENT OF
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PART SIX

LEARNER CHARACTERISTICS

APTITUDES AND INSTRUCTIONAL MEDIA

by Richard E. Snow and Gavriel Salomon

Stanford University

The concern of this paper is with the nature of human aptitude and its relevance for instructional research and instructional practice, with particular reference to film and television. It begins with the bald statement of a truly null hypothesis: virtually nothing is known, as of today, about the teaching effectiveness of instructional media.

There are probably many complicated reasons which might be offered in support of such a view, and as many justifications for rejecting it. The simplest, most extreme, but hopefully an instructive supporting argument has been chosen for consideration here: almost all of the research evidence accumulated to date applies to some generalized "average student," and thus to no one.

The argument is not new and, as usually overstated, it is not a particularly constructive one. Most behavioral research problems seem intractable without some kind of averaging and it is possible, after all, to specify conditions under which the procedure is more or less justified. Learning theorists and laboratory experimenters have faced the issue intermittently for decades. Since their ultimate objective is general theory, they have deemed it appropriate in this pursuit to average out intraspecies, or individual, differences. Thus ignored for the present, many experimentalists believe that such differences can eventually be treated as parameters in established theoretic equations. Currently, a reluctant but relatively broad attack on the problem seems to be mounting in some of these circles (7).

Among educational experimenters, also, there is growing awareness that instructional technology must be conceptualized as some combination of learning theory and individual differences, among other things. Individualized teaching, in the form of programmed or computer-based instruction, appears not to reduce the effects of individual differences,

Reprinted from "Aptitudes and Instructional Media," AV Communication Review, XVI (Winter 1968), in press.

as originally hoped. Gagné (6), in fact, has suggested that individual aptitudes must be ranked among the most important independent variables in the study of complex learning. In studies of instructional film and television, however, the problem seems still to be largely ignored. Faced with the need to understand an immensely complicated stimulus aggregate, usually used as a fixed global treatment or as an adjunct with unspecified instructional objectives, media specialists have settled for an undifferentiated and largely inadequate view of learner response. In the most recent annual convention of the Department of AV Instruction (Houston, Texas, March 1968), for example, nineteen research papers were presented. Of these, only one included concern for individual differences in interaction with instructional-media variables.

A Problem of Experimental Design

The point of the argument is not, of course, directed at the operation of averaging, but rather against the use of undifferentiated averages as the final arbiters of instructional practice. The problem is rooted in the design of experiments.

Research on instructional media, as educational research in general, has relied somewhat blindly on classical principles of experimental design borrowed from the animal laboratory and the agricultural experiment station. It is not that these design principles are wrong--they are absolutely essential--but their use hardly obviates the need for an investigator to think carefully about what he is doing. Their indiscriminate application in educational research frequently includes an implicit, bad metaphor. A man is not a rat, nor is he a plot of farmland. He was not bred from a single strain, nor is he in any important sense adjacent in space to other men. Breeding and plot-splitting make individuals homogeneous and random division maintains homogeneity. Treatment averages are meaningful here because deviations from the averages are small in such groups and because most background variables can be assumed constant. But random division of a heterogeneous group maintains heterogeneity. College sophomores may look alike psychologically relative to differences observed in the general population. Relative to differences among rats or plots however--and here a bad metaphor can be used in the other direction--a collection of sophomores looks more like a zoo or a farmers' market. Treatment averages here are meaningless. It is like comparing "tigators" or "applanges." Some improvement is brought to the situation if individuals are first separated into "tigers" and "alligators" or "apples" and "oranges" so that average comparisons can be meaningfully interpreted within these subgroups. This clearly does not solve the whole problem, but if the variables used to stratify the group are well chosen, then at least the stage has been set for a new kind of instructional improvement, one based on the hypothesis that there is no "one best way" to teach anything.

Many investigations of learning under different modes of instruction simply assign students randomly to two or more treatments, compare

average performance on some criterion, and find no significant differences. No one familiar with the research literature on instructional film and television needs reminding that the great bulk of TV vs. live comparisons and many film vs. live comparisons, have ended this way. To underline the general problem and to introduce the solution proposed here, the comments of two prominent psychologists seem particularly apt. Hilgard (11, p. 3) states the problem as follows:

It is surprising that, after all these years of doing it, we know so very little about effective teaching. The payoff of careful studies . . . is very slight indeed. It is surprising that studies of class size, discussion vs. lecture, and teaching aids such as motion pictures and TV point to so few differences in the effectiveness of teaching. These studies, therefore, give us little guidance. It is not that these studies are poorly done, and even studies which show little differences in effectiveness leave us with freedom of choice. My guess is that they fail, however, to understand the subtle differences made by kind of student, kind of teaching setting, and kind of long-range goals that are operative.

And Cronbach (5, p. 681) proposes the solution as follows:

Applied psychologists should deal with treatments and persons simultaneously. Treatments are characterized by many dimensions; so are persons. The two sets of dimensions together determine a payoff surface. . . . We should design treatments, not to fit the average person, but to fit groups of students with particular aptitude patterns. Conversely, we should seek out the aptitudes which correspond to (interact with) modifiable aspects of the treatment.

It is disconcerting to note, incidentally, that Cronbach's statement was made in 1957 while Hilgard's was made in 1965.

An Alternative

Some illustrations will explicate the proposed alternative more fully and provide implications which can then be treated in more detail. The traditional academic prediction paradigm, in which some aptitude variable is correlated with achievement in a single instructional treatment, serves as a starting point. In Figure 1, the aptitude variable is positively related to learning in treatment T_1 . Individuals with higher aptitude scores learn more than do individuals with lower aptitude scores. Most prior work which has considered aptitudes at all has been limited to this outcome. But this finding is not particularly helpful because we are not simply interested in selecting students who will learn more, we are interested in increasing the learning of everybody. Suppose, however, that another instructional treatment (T_2) can be found or designed in which the same aptitude is differently, even negatively, related to learning--that is, where low aptitude students do especially well. Figure 2 shows what has been called a disordinal interaction. The two regression lines intersect, in this case, near

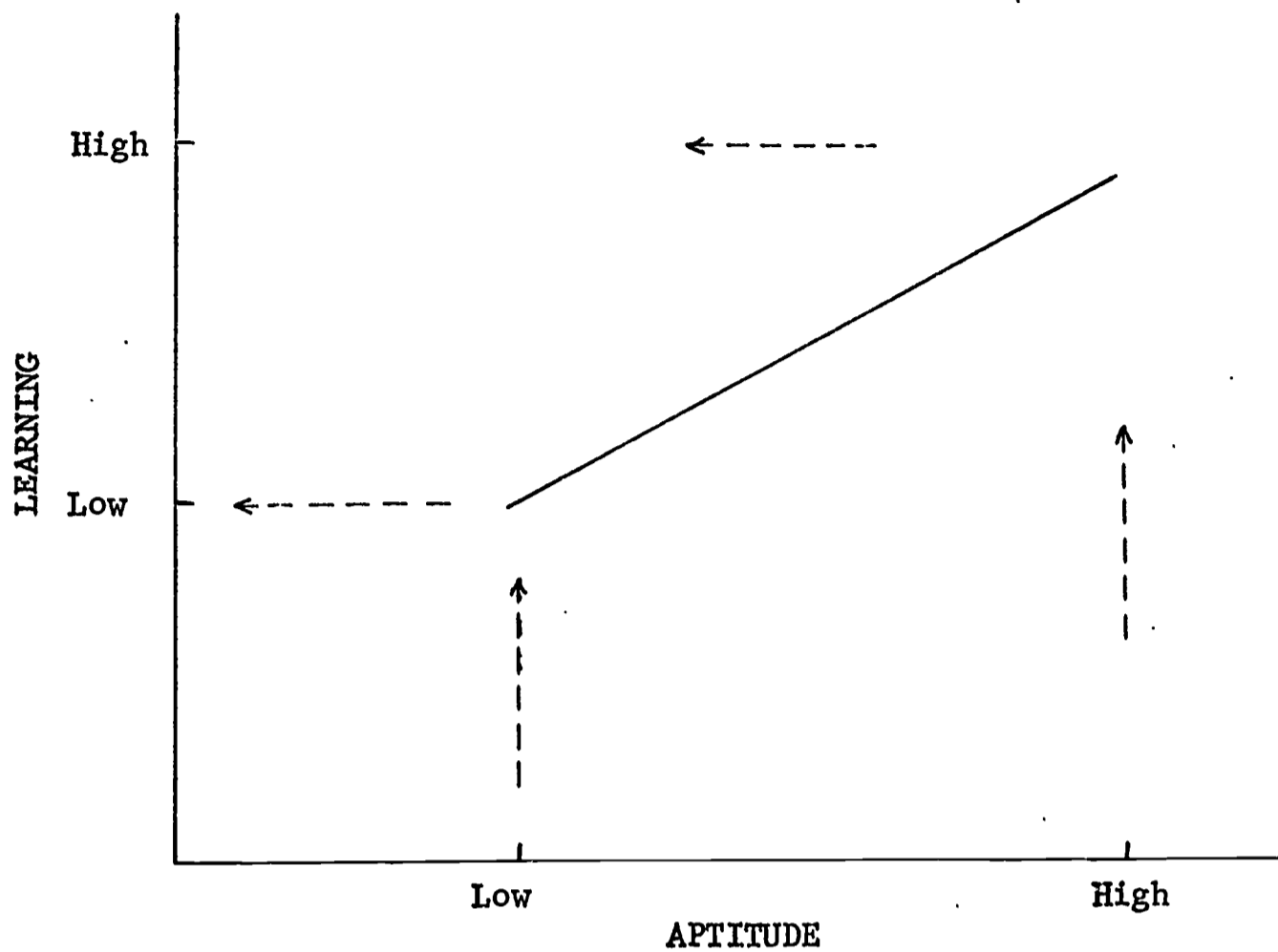


Figure 1

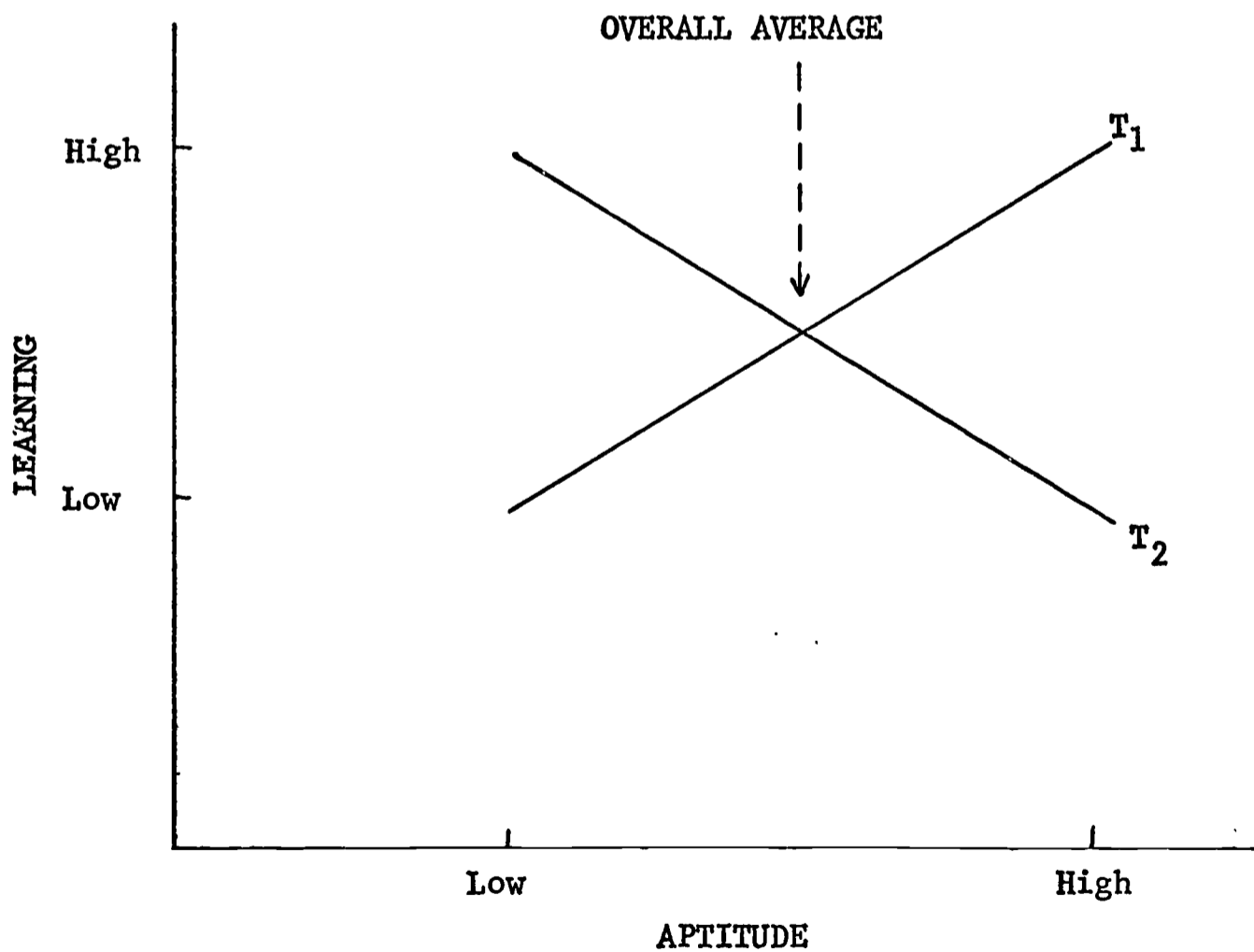


Figure 2

the average of each. An overall comparison would yield no significant difference. But it is quite clear that if we use the aptitude variable to divide the group and assign the two subgroups to different instructional treatments, we can greatly improve the learning of each kind of person. Note that, to use such a finding, it is only necessary that the regression lines for the two treatments intersect (hence are disordinal) somewhere within the obtained ranges of the aptitude and criterion variables. Note also that, to find the intersection, the regression slopes rather than the correlations alone must be studied.

Had we gone on trying to improve treatment T_1 , ignoring the aptitude interaction, some average increase might have been obtained, but it is likely that some students would still have been better off in a different treatment. If, instead, we seek to improve both treatments with specific reference to the functioning of the aptitude variable, then it is likely that the regression slopes rather than the averages will be increased. Selected placement of students in the appropriately tailored treatment condition then maximizes the payoff for both groups.

It may be doubted that such disordinal interactions actually exist. A few selected examples from some previous work (31) should establish that such findings can in fact be obtained, at least in some situations. First, in Figure 3, the aptitude is a personality variable called "ascendancy," the dotted line represents live presentation of introductory college physics demonstrations while the solid line represents filmed demonstrations. The ordinate is learning as measured by immediate post-tests. Note that there is no difference for the middle group but that for highly active, self-assured, assertive individuals the live condition is best and for students on the low end, characterized as passive, observers rather than participators, lacking self-confidence, and dependent on others, the film condition is best. Next, in Figure 4, the aptitude variable is "responsibility." Here, low responsibility students, described as unable to stick to tasks that do not interest them, and as flighty or irresponsible, seem to profit more from live than from filmed demonstrations. Again, there is a tendency toward reversal at the other end of the aptitude continuum.

Such findings are merely suggestive at this point; they represent only scattered unreplicated hunches. With these considerations, however, there seems to be sufficient reason to justify a search for other relationships of this kind. There are two major questions to be answered: 1) What aptitude variables are particularly relevant for filmed and/or televised instruction? 2) What media-attributes under what task requirements are particularly likely to interact with aptitudes? There is no theoretical framework currently available to direct the work and there has been no general review of the literature on the subject. While a number of studies reviewed or abstracted by Hoban and van Ormer (12), Allen (1), and MacLennan and Reid (22) have included aptitude variables, most suffer from the inadequacies previously mentioned. Interactions which have been found previously were, for the most part, unanticipated outcomes of studies designed for other purposes. Some

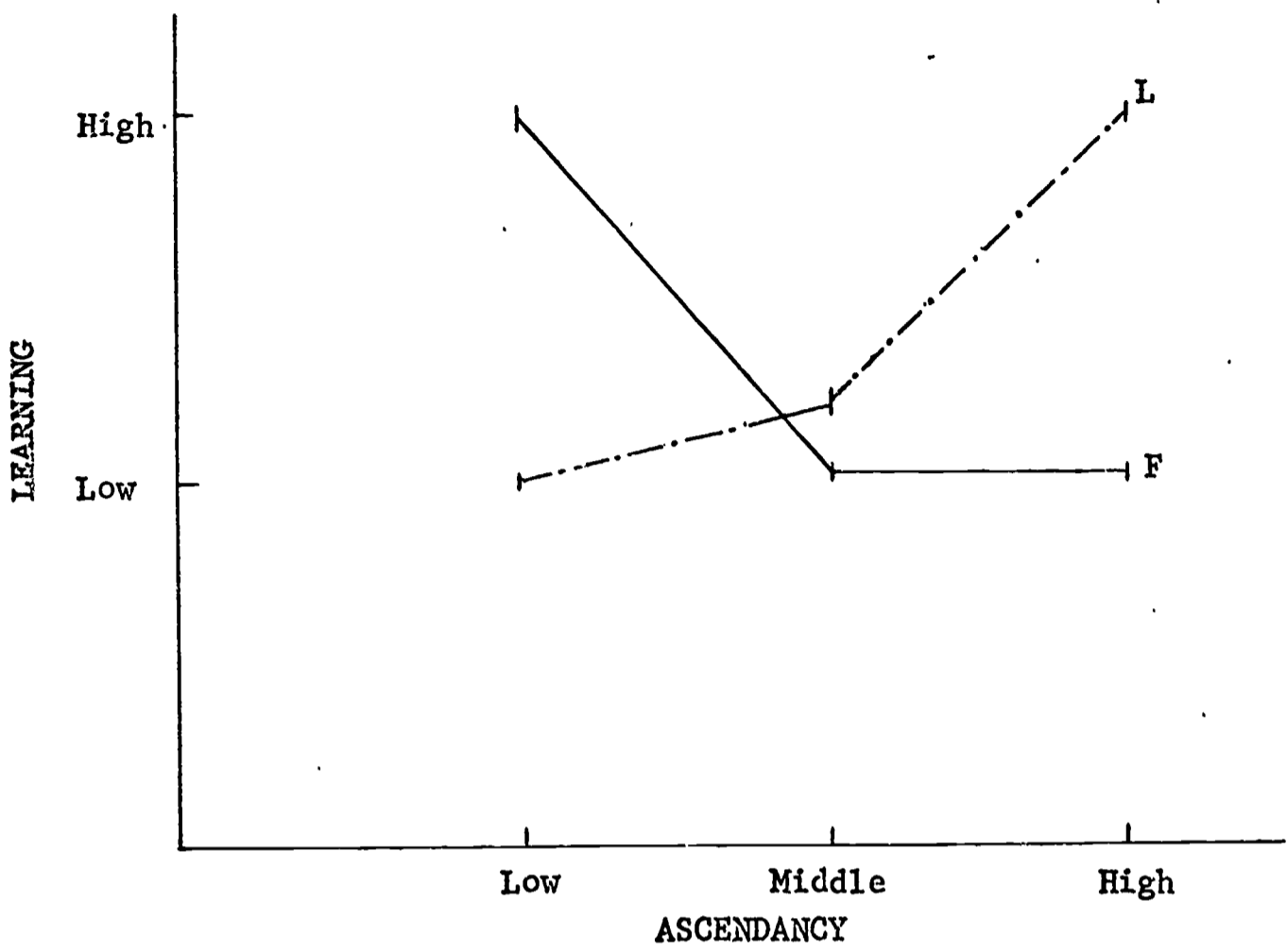


Figure 3

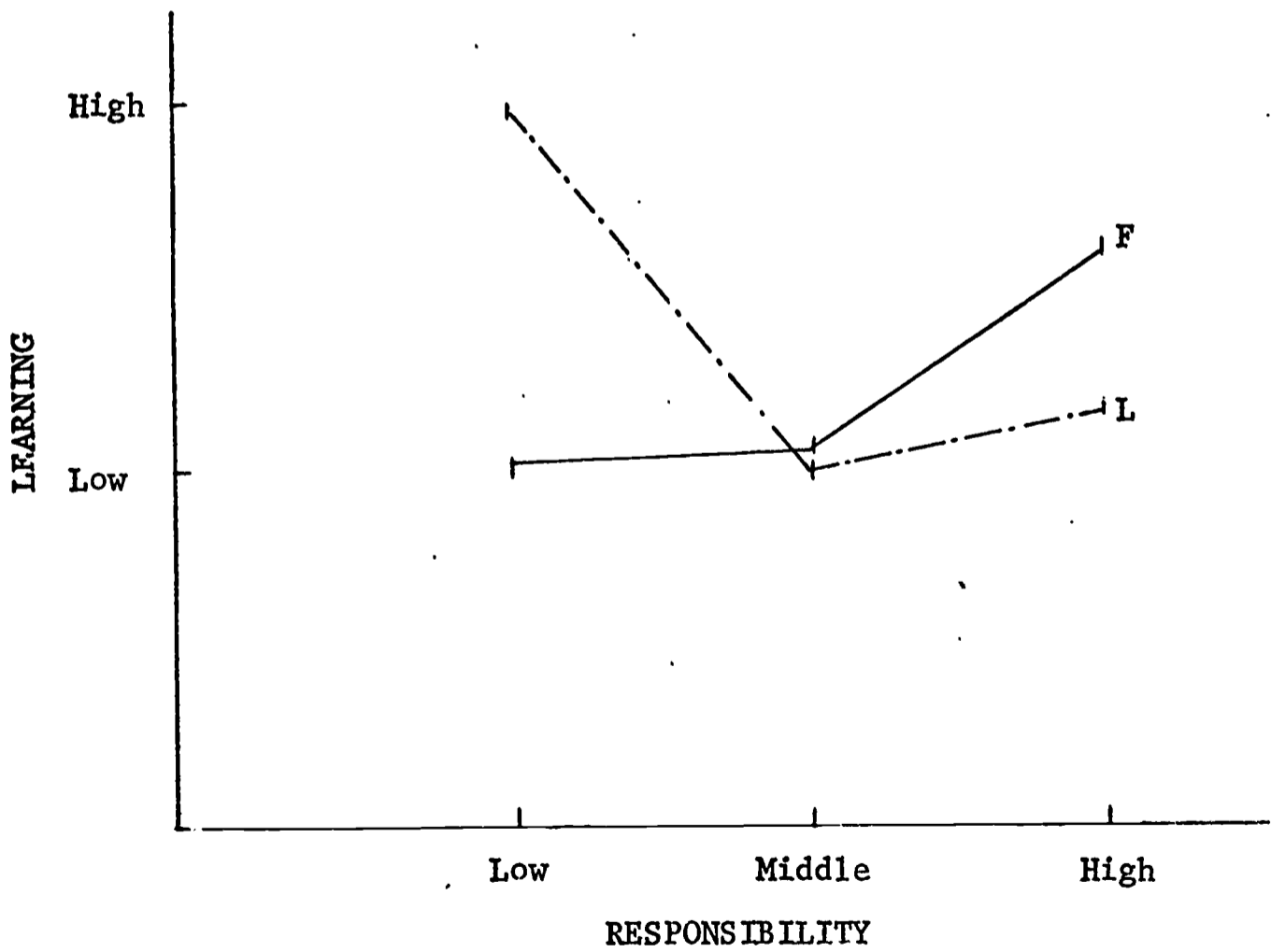


Figure 4
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evidence seems to be available in this literature but it would require a reanalysis of reported and unreported data, in most cases, to dredge out the relevant contrasts. While a general review of the literature is clearly beyond the scope of the present paper, a rough summary and some guidelines may tentatively be offered.

Aptitude as an Input

Upon entering instruction, an individual may be characterized in terms of an aptitude pattern which reflects the prior history and development of that individual. The term "aptitude" refers to any individual difference variable which functions selectively with respect to learning, that is, which tends to facilitate learning in some students and some instructional treatments while limiting or interfering with learning in other students and other instructional treatments. The term does not mean "general mental ability." Of the previous studies recognizing the possibility of aptitude-treatment interactions, too many have simply collected IQ information and left it at that. IQ is not expected to be particularly useful here because it is a global assessment that correlates positively with everything. While there might be reason to expect interactions between general ability and film-live or TV-live comparisons, especially when the live condition represents a differently paced or self-paced treatment like script-reading (see Kress and Grop- per, 21), this aptitude variable is probably insensitive to more specific variations in treatment characteristics. Some 64 studies abstracted by MacLennan and Reid (22) included some form of general ability or IQ measure. Of these, about one-third reported positive interactions between aptitude measures and film or TV-mediated vs. conventional instruction. Of these, however, only a handful showed clearly disordinal interactions. In one study (8), televised instruction was found superior to conventional instruction for high GPA children while the reverse was obtained for low GPA children. Even this one study involved statistical problems which limit the generalizability of its results. Similar observations are reported by Kanner and Wesley (19), using Air Force Qualification Test scores as a measure of general ability, and by Jacobs and Bollenbacher (15) who found high ability students to learn more from TV and low ability students to learn more from face-to-face presentation (Figure 5). Other reported interactions all show differences between media at one ability level with no differences at another. Methodological problems, sampling differences, and other shortcomings make construction of consistent patterns among these findings extremely difficult, but a rough overview suggests that one hypothesis advanced earlier may deserve further consideration. Both Westley and Barrow (32) and Schramm (27) have noted the possibility that, in an unrestricted population representing the full intelligence range, televised instruction might well be found superior to conventional presentations at both high and low IQ levels, with no differences between methods appearing in the large middle range of the general ability continuum. The rationale for this view rests on the presumed value of the more rigorously organized and attention-focussing character of most televised instruction, for individuals of lower intelligence, and its tendency to contain more information per time unit for reception by individuals of higher

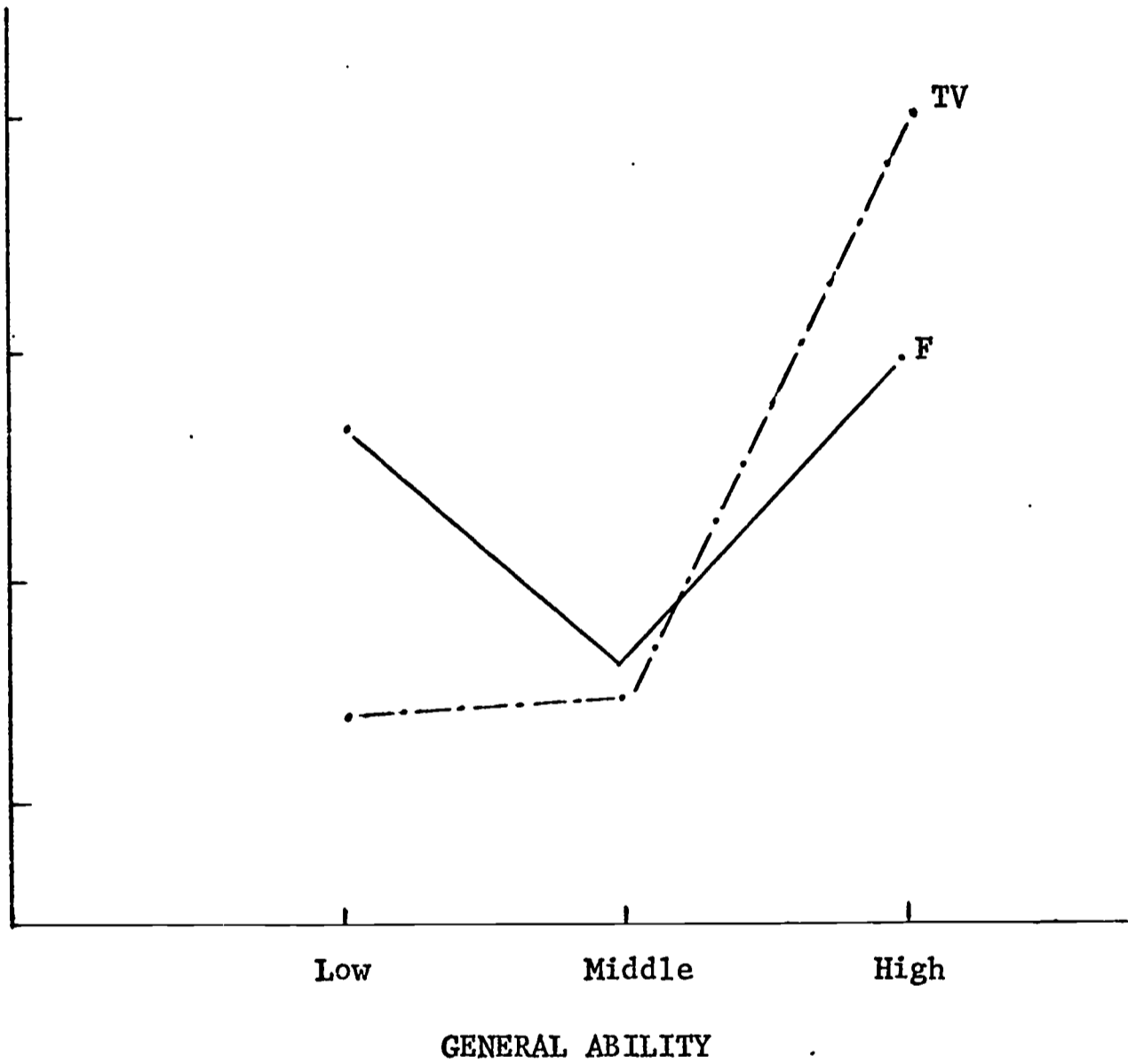


Figure 5

intelligence. Some support for the attentional hypothesis may be derivable from research on discrimination learning in retardates (33). Also, in a study of Kanner and Rosenstein (17), it was found that low-ability groups of trainees tended to learn more from color than from black and white TV presentations while high-ability groups obtained more from the black and white mode. For the low-ability Ss, apparently, clear presentation was needed in which the displayed electronic particles could be easily discriminated from one another. High-ability Ss, on the other hand, seemed not to need the attention-directing addition of color in that particular learning task. The redundancy or noise thus introduced functioned to reduce the amount of material apparently learned by these individuals. In another study, however (9), high general ability students exposed to a programed televised lesson obtained significantly higher criterion scores than high ability students exposed to conventionally televised material, using both immediate and delayed posttests. Low ability students, on the other hand, achieved higher scores when exposed to the conventionally televised lesson, but this difference was judged significant only for the delayed posttest. Several other studies (17,18,20) have reported that students of high ability learn more than students of low ability regardless of method of instruction or mode of presentation. This conclusion would be in line with the earlier suggestion: general ability measures may be expected to correlate positively with achievement regardless of the instructional treatment used.

Other individual difference measures, almost as readily available as general ability indices, are sex, age, and attitude toward the medium. These variables have not typically provided interactions in the past (see, for example, 2,3). Interactions obtained here would likely be indirect. That is, it is not these variables per se that would interact with learning but rather some other "hidden" variables correlated with sex, age, and attitude. There are still other potential aptitude variables correlated with the content of instruction rather than with the method or medium of instruction. These also are not good candidates since they correlate with an aspect of instruction that is common to all possible presentations. One must beware, however, of such a general distinction between form and content since, for example, prior knowledge of the subject-matter, a content aptitude, may be a moderator of other interactions. One study (30) found an interaction between numerical aptitude and film vs. live presentation in a low prior knowledge group. The effect was also apparent in a high prior knowledge group but its directions were reversed. A similar finding occurred using attitude toward instructional films as the aptitude variable. Although such higher-order relationships pose special problems for interpretation, they are to be expected especially with intellectual aptitudes.

Potential interactions are likely to reside in three classes of aptitude variables: 1) specific intellectual abilities like those defined in the work of Guilford (10), 2) specific personality traits like those defined in the work of Cattrell (4), and perhaps most importantly 3) aptitudes in a poorly defined group of cognitive styles and prefer-

ences, learning sets, information-processing and coding strategies, and other subtle experiential variables.

Taking the personality class first, consider the two variables mentioned earlier: "ascendancy" and "responsibility." If the interpretation is correct, then similar interactions might be expected in TV vs. live comparisons, particularly if the television condition included no talk-back link and no discussion leader or monitor. Within the TV condition, talk-back vs. no talk-back and discussion leader vs. no discussion leader may also interact with these aptitudes. Taken together, these aptitudes suggest a distinction between an interpersonal instructional atmosphere and an intrapersonal atmosphere. Any TV or film utilization variable which produces this contrast is likely to interact with such temperamental characteristics in students. Also noteworthy is the old Hovland, Janis, and Kelley (13) work on persuasibility and self-esteem. Instructional presentations which differ in authority reference or credibility should interact with high vs. low self-esteem. Another personality variable appears here also. Recent research directed by McGuire has shown relations between kinds of anxiety and persuasibility. In turn, differences in anxiety might relate to instructional treatments differing in pace, complexity or presentation, or reliance upon short-term-memory (29).

It is now appropriate to make a rather important distinction regarding the use of film or television simply as a distribution system as opposed to their use as unique visual media. The personality variables considered previously seem fairly pervasive in their effects. One might expect them to operate even when live lectures are compared with televised lectures or film recordings of lectures. Cognitive and experiential variables, on the other hand, should interact increasingly with treatment variables as these treatment variable depart from simple recording of live teacher behavior. When film or television is used to present contrived or illusory visual experiences, we can expect many complex interactions with perceptual and cognitive aptitudes. This domain is virtually untouched but one hypothetical example has been suggested elsewhere (23). In a comparison between motion pictures and film strips in teaching map reading, Hovland, Lumsdaine, and Sheffield (14) found a difference in learning on an item concerned with interpreting contour lines. The motion picture had used a visual transformation, from horizontal to vertical, to show the lines as projections of differences in elevation. In effect, a spatial visualization ability had been supplanted by a cinematographic technique. Although this aptitude was not included in the study, it would be reasonable to expect that students with highly developed visualization ability would not need or want the filmic presentation while students without this capacity would find film essential. It should be noted, however, that the visual transformation from horizontal to vertical, used in the film, could be used equally well by the film-strip. The difference between the two would then be only with regard to continuous motion presented by the former and absent in the latter. It can be hypothesized that in such a comparison another aptitude would interact with the presentations, namely, an ability to visualize an integrated continuity from a series of still

shots. The effects of other treatment variables, such as auditory vs. visual or single vs. multiple channel information transmission should also find their clearest expression in interaction with relevant aptitudes. In general, aptitudes involved in receiving, organizing, coding, manipulating, storing, and retrieving visual images should interact in many complex ways with variables reflecting different cinematic and editing practices.

Given even the limited available knowledge about individual differences in quantity of information intake, sensitivity to uncertainty, tendency to seek information, preferred level of stimulus complexity, etc. (28), we are able to formulate specific hypotheses as to possible interactions. It is reasonable to hypothesize, for example, that individuals who are easily overwhelmed by uncertainty (i.e., experience low response uncertainty) will learn more readily from straightforward "linearly" edited film, while others who prefer a higher level of uncertainty will be bored and thus inhibited by such a film. On the other hand, when a film is edited to leave wide gaps in the course of action or to carry several story lines simultaneously, those who experience more response uncertainty and reach higher arousal levels should display improved performance, while those who are less aroused should be overwhelmed. Hypotheses of this sort require, however, a clear specification of the amount of uncertainty contained in each film version (26). On the basis of results obtained by Suedfeld and Struefert (31), it may be suggested that such individual differences will interact also with the amount of new information given per unit of time in the film. Individuals who experience a high degree of response uncertainty tend to search for new information. Hence, highly loaded films should serve them best. Those who experience less response uncertainty and thus need more correcting feedback (see 22), will profit more from presentations that provide such feedback or repetition.

These last considerations begin to elaborate the third category of likely variables listed earlier and suggest a somewhat different approach to the whole problem. Aptitude can be viewed as the transfer of learning sets or information processing strategies from previous learning experiences. Individuals who differ in amount or kind of previous experience with film seem to differ also in the extent to which they profit from film learning treatments. Hoban and van Ormer (12) called this phenomenon "film literacy" and it has been suggested that this unique aptitude represents a kind of comprehension of the "grammar" of cinema (23). As television, both commercial and educational, develops a comparable visual language, we can expect comparable interactions with "media literacy." The earlier distinction between form and content aptitudes is essentially a distinction between aptitudinal and applicational transfer. Media literacy deserves considerable attention as a general aptitudinal transfer phenomenon, because it may represent both aptitude interaction with subsequent learning and aptitude development. Such a variable might be extremely important, also, in multi-cultural educational settings where students of different social classes or cultures differ both in degree and kind of "media literacy" (24).

Aptitude as an Output

It is apparent from this view that an aptitude can affect learning and it can in turn be affected by learning. In the search for aptitudes as selective predictors, it is hoped that we will also keep an eye on aptitudes as outcomes of instruction. After all, the objectives of education are, in large part, aptitudinal in nature. We expect students to forget part of the information but to retain and expand upon the learning and thinking processes that educational experiences help develop. The instructional contributions made by film and television in this regard cannot be evaluated until aptitudinal criteria are included in the study of media effects. For instance, Salomon and McDonald (25) have shown that teacher interns who are dissatisfied with their own teaching performance and seem to have generally low self-esteem react differently to self-viewing on videotape than interns with higher self-esteem and self-satisfaction. The former devalue the idea of teacher education after self-viewing, attending to the many physical cues of their own appearance. The latter improve their self-evaluation and tend to notice more cues relevant to their teaching performance. On the basis of such findings it is reasonable to expect that the low self-esteem teachers will change their self-esteem and their teaching behavior by means of defense-reducing experiences, e.g., reinforcing first-hand experience in classrooms. They cannot be expected to change when faced with their own image on videotape screens. The high self-esteem teachers, on the other hand, can be expected to benefit more from self-viewing than from repeated classroom teaching without such self-confrontation.

Conclusion

There was a time when it would have been ridiculous to suggest alternative filmed or televised presentations for selected subgroups of students. But multichannel systems and videotape editing now make the suggestion feasible. Even for open-broadcast educational television, multiple channels may someday be available. Without these facilities, the aptitude-treatment interaction problem takes a different complexion. Nonetheless, more specific description of target audiences in aptitudinal terms and appropriate tailoring of program presentation could yield significantly improved results.

Hopefully, media specialists will increasingly consider the inclusion of aptitude variables in their thinking and in their work. Most previous research has pitted instructional media and methods against one another without concern for individual differences. While one cannot really argue that none of the treatment variables studied thus far produce general effects across all students, it is appropriate to ask how many such studies have masked real and important interactions by averaging in overall comparisons. Truly general effects will never be separated from important special effects until the possibility of interaction is directly investigated. The latter approach may well be the wisest road currently available toward genuine instructional improvement.

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FACTORS IN LEARNER RESPONSE TO FILMS

by Charles F. Hoban

The Annenberg School of Communication
University of Pennsylvania

Edward B. van Ormer

Pennsylvania State University

Predispositional Factors in Audience Response

Predisposition to Acceptance

Some experimental evidence is available to support the hypothesis that the predisposition of an audience to accept an attitude or opinion is a factor which operates in the interpretation of experience from a motion picture. The effect of this predisposition may at times not manifest itself immediately, but may appear after a longer period of time.

Theoretically, it is probable that the individual not only tends to forget those items of experience that are inconsonant with this predisposition, but also perceptually rejects experience from any medium either by not "seeing" or by not immediately accepting these items during their initial presentation in communication. Most of us are familiar with people who consistently refuse to "see what they do not want to see." Psychological knowledge and understanding of this process of selective perception is, at present, inadequate.

Thresholds of Excitability

We may conclude from the evidence at hand that the threshold of excitement from movies portraying danger, conflict, romance, and humor varies within any age group, and that excitability generally declines as we approach adulthood.

Excerpted from Instructional Film Research: 1918-1950. Technical Report No. SDC 269-7-19, Instructional Film Research Program, Pennsylvania State University. Port Washington, L.I., N.Y.: Special Devices Center, U.S. Office of Naval Research, 1950. Pp. 7.12, 7.16-7.17, 7.27-7.28.

The relationship between excitement, involvement, and acceptance is not clear. Here is one of the major areas for film research. It is basic to the choice of dramatic or narrative technique in instructional films.

Likes and Dislikes

Effects on Opinion Change. The limited evidence at hand suggests that adult-audience "likes" and "dislikes" of a film are related to the direction of the influence of the film on opinion, when such an influence is intended and/or occurs. Those who dislike a film appear to be less positively influenced or influenced negatively in opinions, and those who like a film appear to be influenced positively in opinions. ("Positive" is understood to refer to the direction of the intended influence.)

Effects on Rating of Educational Value. Likes and dislikes of something in a film also appear to be related to student judgment of the educational value of a film, in that few films disliked were highly appraised for their educational or instructional value. Questions for further research are: does this relationship apply to instructors as well? Is this judgment of educational value related to amount of informational learning from the film?

Effects on Informational Learning. The limited data available fail to show a consistent correlation between degree of interest in a film and amount of informational learning among certain college classes and armed-forces trainee groups. However, in some of these groups, under certain inexplicable conditions, there may be a fair correlation between interest and amount of learning.

a. Preferred Teaching Aids Were Not Markedly Superior in Teaching. Even though college-age students seem to prefer motion pictures as a supplementary aid in a unit of instruction, and believe that motion pictures benefit learning, their achievement scores do not always reflect increased learning. On the other hand, some less preferred medium may actually benefit learning more.

Some groups of upper elementary school pupils greatly overestimated the helpfulness of a preferred type of verbal accompaniment with a film and underestimated the helpfulness of a much less preferred type. A limited sample of junior high school pupils was found to show a slight tendency to prefer science films in color to identical prints in black and white. This preference seemed to be reflected in a slightly greater (though not highly reliable), efficiency in learning which was more evident in delayed tests.

b. Preferred Session-Length Depends on Material. Certain college classes and armed-forces trainee groups had no consistent tendency to rate either long or short film sessions high or low in interest in the case of four different film series. In one series of films there was

evidence that the long session received a less favorable rating, and at least an indication that slightly less learning resulted from the single long session than from the four 15-minute sessions. Apparently, the intrinsic appeal and difficulty of the subject matter in the films are two predominant factors in determining whether an audience feels that a one-hour film session is too long. Also, there was some evidence that a given class might show a consistently negative attitude regardless of the length of film showings, an attitude which that class might have toward instructional films in general.

Thus, the limited evidence at hand suggests that degree of interest is no sure indication of the amount of learning that will result from a film, and that preference for a certain characteristic of a film, or for a certain way of using a film, cannot be taken as an index of greater effectiveness in information learning.

* * *

Social Factors in Audience Response

Roles Adopted Appear to Influence Some Reactions to Films

There is some evidence that the roles ascribed to an individual, and which are adopted and "played" by him, are related to his reaction to a motion picture. Roles related to socioeconomic level, religion, educational status, age, and sex of the individual may at times affect the influence of the film on him. From the scanty evidence available, but based on good theoretical reasons, the following hypothesis may be suggested: the nature and degree of the influence of the motion picture is affected by the extent to which the content of the film is directly related to the behavior and response patterns embedded in one or more of the individual's social roles.

Film Preferences Vary with Age

In considering age differences, we must not lose sight of the importance of intellectual maturation and other physiological factors which change with age and sexual maturity. It seems probable, however, that some of the age differences are culturally influenced when the individual tries to "act his age" and adopt the group code for that age.

Sex Role and Film Influence

It is difficult to state the extent to which the differences in the way the two sexes respond to the films discussed here can be attributed to the individual's acting in accordance with the sex role which he knows has been ascribed to him by society, his family, and his peer group. Possibly some of these differences are at least partially due to more basic physiological differences between the sexes, but this is hard to demonstrate. Certainly a large number of these differences are in-

fluenced to a considerable extent by cultural factors related to our concept of the assumption of a role ascribed to and adopted by that particular individual.

Some Sex Differences in Film Influence Which Are Possibly Related to Role Adoption

There is some evidence of sex differences in responses to films. These differences appear as differences in rating the educational value of films; some emotional and attitudinal differences in reaction to a given film, or part of a film; differences in film topic preferences from at least the age of ten years and upwards; a tendency for boys to learn more than girls from certain films relating to science and mechanical processes.

Social Role and Identification

In theory, at least, social role ascription and adoption, is intimately related to the phenomenon of "identification," which is discussed in Chapter VIII in relation to audience involvement in film experience and its relation to learning from films.

* * *

Intelligence and Educational Level

Influence on Informational Learning

1. It appears that, in regard to this learning outcome or objective, there is a fairly high positive correlation between intelligence and learning from films as a pictorial-verbal medium of communication. This relationship seems to exist throughout the public school years and at least into early and middle adult life. (This relationship has not been investigated for persons in their late adult years.)

2. Many of the investigations suggest that "unto him that hath shall be given." The more intelligent persons usually know more about the topic when they start, make a greater absolute gain, and maintain their superiority over the lower and average intelligence levels at the end of the film learning.

3. In some cases, but certainly not universally, teaching with a film or with the aid of a film, seems to bring about a greater increment in learning among those of lower intelligence than it does among those of higher intelligence. However, this greater increment does not increase their total learning to the extent that it surpasses that of the average of superior groups.

4. The few studies that have been made with retarded pupils and with semi-literate adults indicate that suitable films can bring about a definite increment in learning for these groups.

Influence on Perceptual-Motor Learning

1. Apparently little research has been done on the relationship between intelligence and perceptual-motor learning from film presentation. The one study quoted found a very low correlation between knot-tying and intelligence, but the correlation was somewhat higher when the scores on a pencil and paper mechanical aptitude test were compared with the knot-tying.

Influence on Opinion Change

1. The few studies available, made with recruits in the U.S. Army, indicate that there is an overall increase in opinion change with higher educational level.

2. This increase is algebraic and results from three types of relationships: a positive correlation between amount of change and educational level; no correlation; and, a negative correlation with educational level. Predispositions and willingness or unwillingness to accept a given interpretation appeared to be factors complicating the relationship.

Effects of Prior Knowledge and Training

Influence of Familiarity and Previous Knowledge

The effect of familiarity of context and previous knowledge of the specific subject requires further investigation. However, it seems likely that the so-called "difficulty" of a given film may not be entirely due to its subject matter. The difficulty of a film depends on the learner's intelligence, and is probably related, as well, to the extent of his previous knowledge of the subject.

Thus, the amount of learning that results from a single showing and repeated showings of a film appears to depend as much or more on the previous knowledge held by the individuals in the audience than on the density of factual content and the effects of repetition.

Influence of Propaganda Awareness

There is no evidence that persons who have received training in the techniques of propaganda are better able to resist propaganda material in films. However, one study does suggest that persons, who suspect that their opinions are being manipulated, are less likely to shift their opinions as a result of film experience.

Effects of Language Facility

The studies on this topic suggest three points: (1) That some measures of the reading ability and vocabulary knowledge of the individuals

in a film audience might serve as a fair indication of the amount of informational learning, and possibly of some other types of learning, which will occur from a film presentation. (2) Though the correlations between reading and listening comprehension are fairly sizable, a given individual may still be a much better comprehender by one or the other sensory channel. (3) Sound films may definitely facilitate the learning of individuals whose reading comprehension is definitely lower than their listening comprehension.

Effects of Film Literacy

The data from the studies of film literacy suggest that some perceptual and other specialized learning abilities develop with increased practice in observing and learning from films, and that this ability helps the individual to learn more from future instructional films.

AUDIENCE-LEARNER CHARACTERISTICS

by William H. Allen

University of Southern California

The importance of the characteristics of the learner upon the reception of instructional communications cannot be overemphasized. The earlier concept of the audience as a kind of atomistic mass, subject to persuasion or instruction by powerful communication mediums, is being viewed with increased skepticism. We seem to be gradually approaching the position taken by Carpenter (5) when he expressed the opinion that the effects of film instruction, within certain limits, depend more upon the characteristics of the perceivers, individuals, and audiences than upon the elemental variables within films themselves.

Predisposition to Acceptance

Evidence exists that the predisposition of an audience to accept an attitude or opinion operates to influence the individual's interpretation of the communication. Ramseyer (24) pointed out the reactions of pupils to films dealing with social subjects was related to the occupations of their parents. Hovland, Lumsdaine and Sheffield (14) found that military trainees who were predisposed to accept certain opinions prior to a film showing tended to hold these same opinions nine weeks after the film, although when tested shortly after the showing, their opinions fell into no discernible pattern. Wiese and Cole (33) found that the effects of an attitudinal film was largely determined by the social, cultural, and economic backgrounds of the audience. Greenhill and McNiven (8) discovered a relationship between learning from a film and the degree to which the viewer perceives the film to be of use to him.

Kishler's study (16) supports this generalization. Hoban (11) studied reactions to two actors in an Army training film on the operation of a motion picture projector by a target audience made up of new enrollees in an Army Projectionist School and by a nontarget audience of soldiers not enrolled in the school. The target audience made over

Reprinted from Audio-Visual Communication Research. Santa Monica, Calif.: System Development Corporation, 1958. Pp. 33-37.

80 percent more responses on a reaction questionnaire and appeared to be about twice as interested in the film. In addition, the target audience tended to identify more with an "expert" model in the film and the nontarget audience with the "trainee" model. Hoban thereby hypothesized that audience involvement in an identification with instructional films is determined more by audience aspiration and the relative value placed on the aspired-to-role than to audience status at the time. In another analysis Hoban (12) concluded that audience status was related to reactions to a film and that some impedance of communication was likely to result on the upper-status level of an audience when the film presented values associated with the lower-status level. Scollon (26) studied variables concerned with the prestige of the main character in a film, the degree to which he was characterized, and his relationship to the trainee. He concluded that (a) a prestigious communicator lent effectiveness to the film, (b) a high level of characterization of the communicator was no more effective than a low level, and (c) the degree of relationship of the communicator to the audience reference group was probably more important than the level of characterization. Maccoby and Wilson (18), in two studies in which entertainment films were shown to Grade VII children, found that the viewers identified themselves with like-sexed leading characters. However, they identified with the character whose social class corresponded with their aspired to social class rather than with their current status.

Studying the effects of 5 mental hygiene films on university women, Mertens (20) found that the poorly adjusted women showed greatest emotional involvement with the films, and that women with problems similar to those dealt with in the films reacted more strongly, remembered the films longer, and interpreted them in a slightly different manner. Stein (28) arrived at similar conclusions from a study of the effects of four of the same mental hygiene films on normal and abnormal individuals. Those who found the films most personally relevant and acceptable learned the most from them, women appearing to be more responsive than men, and psychologically deviant (except those acutely mentally ill) individuals finding them more relevant than normal individuals. Iscoe, Mims, and White (15), studying the therapeutic possibilities of personal adjustment films, discovered that emotionally-disturbed boys tended to see in the films situations very close to their own, often reacting with fear or anger. Rose's analysis (25) of audience reactions to the commercial films, "Life of Riley," by means of infrared photography emphasized the importance of the background, experience, and set of the audience.

Likes and Interests

Hovland, Lumsdaine and Sheffield (14) found that likes and dislikes of a film are related to the film's influence on opinions. However, studies by Ash (2), Heidgerken (10), VanderMeer (31), Westfall (32), and Twyford (29) found little or no relationship between interest in films and the information learned from them. In a study of liking and learning from educational television programs, Merrill (19) achieved similar results.

Intellectual Ability, Training, and Prior Knowledge

There is evidence from a number of studies that persons of high intelligence usually learn more from films than those of medium or low intelligence. However, in some cases those of lower intelligence appear to make a greater increment in learning, but not enough to surpass the learning of the average or superior students.

Hoban and van Ormer (13) concluded that the difficulty of a film depends not only on its subject matter, but also on the learner's intelligence, training, or previous knowledge of the subject. Sekerak (27) found a relationship between intelligence and the type of mass communication used by junior high-school students. There is evidence that some form of what may be called "film literacy" develops with increased viewing of and learning from films and this factor may increase the viewer's ability to learn from the films. Studies by Hansen (9), VanderMeer (30), and the Australian Commonwealth Office of Education (3) supported this hypothesis. Lumsdaine (17) compared the knowledge gained from a high-school science film by students who had already had considerable study of the subject with those who had received no previous formal instruction. He found that the group with previous instruction learned more from the film than the more "naive" group relative to what each could have learned.

Several studies investigating the "listenability" of film commentary as related to the grade level of students were made. O'Connor (23) compared a measure of 21 elements in a series of educational films with two measures of film effectiveness and identified eight elements that were related in amount of information recalled from the films. Gladstone (7) compared two versions of an instructional film with commentaries that differed four or five grade levels in difficulty as measured by the Flesch and Dale-Chall readability formulas. He concluded that the easier commentary was related to increased learning of the factual content. In a similar study, Allen (1) found that easier commentary, as measured by the Flesch Readability Formula, resulted in significantly greater factual learning than commentary two grade levels more difficult. Moldstad's (21) results differed in that he found no significant differences between commentaries that varied as much as six grade levels in difficulty when he showed the film twice. Nelson and VanderMeer (22) studied the effect of modifying spoken commentary of an animated film. They found that all simplified commentaries were consistently superior to the original commentary (but not significantly), and that the best had the shortest sentences and the most personal pronouns. Blain (4) obtained conflicting results, finding no differences in factual learning from a film that differed in level of difficulty, but some evidence that factual information presented in an informal, conversational, and more personalized manner did affect learning of factual information. Chall's (6) recent comprehensive review and appraisal of research and literature in readability is a useful guide.

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EYE MOVEMENTS AND TV VIEWING

by Egon Guba and Others

Ohio State University

School children are being exposed increasingly to learning from television, and it is likely that in the near future a substantial portion of what the school child learns may first be presented to him via this medium. In the face of this apparent trend it is surprising that so little is known about how children learn from television. It is equally surprising that the production of educational materials for television continues along "artistic" lines based largely on rules of thumb, rather than along scientific lines based on empirically derived principles of visual learning.

An interesting analogy exists between the present status of TV teaching and the status of teaching from books that existed a half-century ago. Then little was known about the ways in which children learn from the printed page, and the production of books for educational use was likewise guided by "common sense" rather than by established principles. In that area, a considerable breakthrough was achieved when systematic research on eye movements was undertaken. As a result, new methods of teaching were devised, mechanical aids to increase perception span and reading rate were developed, and even the format of the printed page was altered to take advantage of the new facts about the ways in which children actually used their eyes in reading.

It seems reasonable to suppose that similar studies in the area of TV viewing might have similar breakthrough results. It is possible that children have certain "natural" eye-movement patterns which they utilize in learning from the TV medium and that different modes of visual presentation utilize these patterns more or less advantageously. Visual representations may turn out to be well or poorly paced, reinforcing or distracting, simple or cluttered, focused or diffuse, etc., when judged by the criterion of whether or not they elicit efficient eye-movement patterns, whatever these may be. Since individual differences character-

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ize children on every measurable variable, it is also likely that eye-movement patterns will be found to differ sharply; if certain patterns are found to be more efficient in learning, they ought to be identified and made the basis for teaching "looking" skills.

The present research was prompted by such considerations. There was at the outset no assurance, of course, that the hoped-for outcomes would indeed be achieved; in any event, it was clear that not all of the above conjectures could be studied in what was perforce an exploratory venture into this apparently promising field. The following objectives seemed reasonable for such a pilot effort, however, and were adopted accordingly for the study:

1. To develop an appropriate experimental system for the recording of eye-movement data.
2. To collect such data for a sample of about 40 fifth-grade children.
3. To analyze these data to identify relevant variables and to develop hypotheses about eye-movement responses to a dynamic visual scene.
4. To relate the identified variables and patterns to specific subject and stimulus characteristics.

The Experimental Apparatus

The experimental apparatus consists of six major components: a projector for the presentation of the stimulus materials; a simulated TV set for the display of the stimulus materials; a helmet-mounted corneal reflection system and TV camera to obtain eye-movement data,¹ electronic controls for the helmet-mounted TV camera; a TV monitor for the display of the eye-movement data; and a motion picture camera to record the eye-movement data from the TV monitor.

* * *

. . . Light from a miniature filament bulb is reflected by the corneal surface of the eye. The tube transmits the reflected light beam to the optical system on top of the helmet. As the eye rotates, this light is reflected through a corresponding angle, indicating the eye movement; this corneal-reflection beam forms the so-called eye marker. A double prism functioning as a half-silvered mirror effects the superimposition

¹The corneal reflection system was devised and built by Norman H. Mackworth, when he was senior scientist with Dunlap and Associates, Stanford, Connecticut, and adapted by the Institute for Research in Vision, Ohio State University, in accordance with suggestions from their staff and the project staff. The TV camera was specially devised by Dumont Laboratories.

of the eye marker on an image of the visual field obtained by the scene lens, located near the front of the small TV camera. This small, transistorized TV camera is mounted as an integral unit together with the corneal reflection light source, the scene lens, and associated optics. Provisions have been made on the helmet for adjustments to focus and reference the eye marker and to aim the TV camera properly at the visual field. In addition to being counter-balanced (a) so as to seem relatively weightless, the apparatus is also somewhat balanced about the axes of head movements. The mouthpiece system (e), stabilizing the helmet on the head, has provisions for individual attachments fitted for each subject with a dental impression compound. With this system of counter-balancing and stabilizing, the apparatus is comfortable and relatively nonrestrictive of normal head and body movements for a seated subject.

The eye-movement data obtained with the helmet apparatus are displayed on the TV monitor. The image of the total visual field appearing on this monitor covers an area of approximately 20 by 30 degrees of arc, while the stimulus field (the simulated TV screen) covers approximately 12 by 16 degrees.² The eye marker, indicating where in this field the subject is looking at any instant, appears as a bright spot which is typically one degree in diameter. That both the object seen and the subject's eye marker are immediately observable on the monitor is one of the significant features of this apparatus.

The stimulus materials were displayed for the subject on the simulated TV set by a rear-projection method. A convincing simulation of a TV display was achieved by using a TV cabinet from which the chassis had been removed and replacing the original picture tube by a ground glass screen. The controls on this simulated TV set also operated the stimulus materials projector, which was located in the adjoining control room. The TV monitor and the 16mm camera, which made a permanent record of the data, were likewise located in this room.

The Stimulus Materials

The stimulus materials were selected primarily to exemplify educational TV materials as they are usually found. Two segments were finally included: a telecast, "Health Habits," from the series Adventures of Science, produced by the Midwest Program on Airborne Television Instruction, and a short clip from a commercial presentation, "The Lively Ones," produced by the National Broadcasting Company. The latter segment was a fast-paced and visually compelling scene based upon the ballet music from West Side Story. The total viewing time for the edited version was 17 minutes.

²The maximum dimensions of the simulated TV screen were 13 by 17 inches, and this screen was placed approximately 62 inches in front of the subject.

The Subjects

The sample consisted of 43 children (21 boys and 22 girls) from four fifth-grade classes in two schools convenient to the Ohio State University. Candidates were examined by their school nurses to determine fitness for the procedures involved. Minimal criteria were 20-30 vision, normal hearing, and fair dental condition, necessitated by the mouthpiece on the helmet.

Data Analysis

Following a survey of the data films with a variable speed motion picture projector, intended to afford some initial insights into what the data might contain, two methods of detailed analysis were devised as follows:

Density Analysis

The purpose of this analysis was to determine what objects were looked at by the subjects and the duration of each look and to evaluate the attention value or valence of various visual stimuli. This analysis was completed for nine segments of the telelesson.³ For each segment, the stimulus field was divided into a number of "objects" (e.g., face of narrator, illustrative chart, nonrelevant elements included in the "set," and the like), whose valence for the subject could be obtained. The apparatus to perform this analysis consisted of a keyboard wired to a series of counters and to a strip-chart recorder. As the analyst observed the data film at a speed of four frames per second, he pressed first one and then another of the keys according to a predetermined code depending on the particular object at which the subject was looking. The depressed keys activated appropriate counters which recorded both the frequency with which a subject viewed the encoded objects and the duration of time spent in viewing each object. These data were also recorded on the strip-chart recorder. For four of the nine scenes analyzed, density data were collected by a more detailed frame-by-frame analysis utilizing a film editor. For these analyses the data were recorded manually rather than electrically; however, the form in which these data were recorded was similar to the automatic form.

Movement Analysis

The purpose of this analysis was to identify, and if possible to quantify, various indices of eye movement. The preliminary analysis had indicated that not all observable movement phenomena could be classified into the standard categories of "fixation" and "saccade" that had developed out of other eye-movement studies. It became apparent that the terms "fixation" and "saccade" represented the extremes of a continuum

³Since the data were recorded on more than 650,000 individual film record frames, sampling was necessary.

of possible movements. The movement analysis was intended to describe these intermediate possibilities.

Data were collected by means of frame-by-frame analysis utilizing a film editor. Because of the extremely laborious nature of this process, only two scenes were analyzed: one "dynamic," i.e., with a moving field, and one "static," i.e., with a still field. Data were recorded manually.

Selected Findings

The most obvious finding resulting from the density analysis is, as would surely be expected, that the eyes do tend to focus of "cluster" on certain areas of the visual field. To put it another way, subjects did find certain areas of the field more visually compelling than they did others.

What is surprising about the data is the fact that the subjects tend to be preoccupied with the face of the narrator (when he is on screen) to the virtual exclusion of other objects. The data of Table 1 are illustrative. The common element uniting these five scenes is that the narrator is visible throughout. Briefly, the content of each scene is--

1. Scene A: The narrator talking from behind a table.
2. Scene B: The narrator presenting and discussing a Petri dish with mold.
3. Scene C: The narrator presenting and demonstrating various cleaning aids.
4. Scene D: The narrator discussing an animated chart of the human body.
5. Scene E: The narrator beside chart of human body, not discussing it.

TABLE 1
MEAN PERCENT OF THE TIME SPENT IN SIMILAR SELECTED AREAS

Area	Scene A (N=25)	Scene B (N=21)	Scene C (N=17)	Scene D (N=26)	Scene E (N=27)
Face Area of Narrator	91.9	77.1	36.2	17.4	57.1
Hands, Empty	2.4	--	3.7	4.6	1.8
Hands with Object	--	17.3	23.7	--	--
Background Objects	3.4	2.7	5.5	5.3	3.3
Foreground Objects	--	--	14.6	72.9	36.9
Off-Image Field	0	1.5	17.1	0	0

Scenes A, B, and C have the same background objects: a microscope and plant standing on shelves visible over the narrator's shoulder. There are no foreground objects in Scenes A and B, but in Scene C there is a tray containing soap, fingernail file, brush, and shampoo. While differing markedly in auditory subject matter, the visual composition of Scenes D and E are nearly identical, with a large animated chart of the human body in the foreground and a pair of scales on a small shelf above and behind the chart as a background object.

Preoccupation with the face of the narrator continues even when there is a strong distractor in the field. In Scene D, for example, the narrator is illustrating circulation of the blood with an animated figure, almost life size, next to which he is standing. A few moments later (Scene E), the narrator shifts topics, but continues to stand next to what now becomes a distracting figure. We may note that even when the subject is expected to look at the animated figure (Scene D), 17.4 percent of the time is still utilized by looking at the face. When the animated figure is merely a distractor (Scene E), the face receives attention 57.1 percent of the time, while the distractor (surely the most powerful distractor found throughout the film) receives attention only 36.9 percent of the time.

Two unexpected phenomena were also detected. The first of these, termed blooming by the experimenters, is concerned with variations in the size and shape of the eye marker during the experimental runs. The majority of low intelligence subjects displayed a large amount of this blooming. Investigation of the phenomenon indicates that it is caused by a change in focus of the corneal reflection beam. These changes in focus, moreover, are probably due to translational movements of the eyeball backward and forward in its socket. It is, of course, also possible that apparatus slippage on the head may produce such effects; but when this occurs, the change in focus is permanent and continues through several scenes. The blooming of concern here is transitory in nature and is easily distinguished from that produced by apparatus error.

Blooming frequently occurs when the eye marker is not on a center of attention, as, for example, when the gaze begins to wander after a comparatively long scene showing nothing except the narrator talking. Upon the introduction of a new object, of movement of some type or of a scene transition, the blooming ceases abruptly as the eye marker shifts to the new center of attention. It is conceivable that this phenomenon, when better understood, may be useful as an attention index.

The second unexpected phenomenon was that characterized by the experimenters as "surrender." This was noted in connection with the fast-paced West Side Story sequence shown following the educational lesson, which consists almost entirely of a series of stills depicting scenes from the play changed so rapidly as to give an impression of movement. As the segment first appears on the screen, the subject's initial tendency is to "track" various objects introduced onto the screen.

Many subjects soon discover, however, that it is virtually impos-

sible to follow all of the objects. The initial tendency to track is replaced by a "hovering" near the center of the screen; the subjects continue to focus approximately at a central area. A first guess by the experimenters was that this behavior represented a kind of coping in which the subjects attempted to utilize peripheral vision to "take in" what was going on. Questioning after the filming sessions indicated, however, that subjects were unable to recall any specifics of the content of the peripheral field. Hence it seems likely that the "surrender" phenomenon represents either an attempt to cope that failed or, more likely, simply a withdrawal from a relatively impossible visual task.

Results of the Movement Analysis

It had been anticipated at the beginning of the study that movement analysis would be accomplished in terms of the classic concepts of fixation and saccade, the former representing a fixed point of focus on the scene, and the latter the movements between fixations, during which, according to theory, the subject cannot see. So far as may be seen from the data films projected at normal or even slow speeds, this anticipation was verified. When the data films are analyzed on a frame-by-frame basis, however, it is quickly apparent that other types of movements are involved. Experience with this kind of analysis led the research team to define a continuum of movement as follows:

No Observable Movement (NOM). The operational definition of a NOM is that the position of the eye marker shall not have changed observably between two successive frames of the data film. Several problems arise in identifying NOM's because of the nature of the analysis utilized. The image field is dynamic, and it is difficult to determine movement if both eye marker and stimulus translate on the film frame. Moreover, movements as large as 30 minutes of arc may go undetected because of their small size. As a result, it is likely that film frames classified as NOM's include most of the tremors, drifts, and physiological nystagmus reported variously in the literature.

Minimovement (MIN). The operational definition of a MIN is that the position of the eye marker shall have changed observably between two successive frames, but that the distance between positions shall be less than one diameter of the eye marker, (i.e., approximately less than one degree). These MIN's have a minimum extent estimated at approximately 15 minutes of visual arc. They differ from the micro-nystagmus-type movements often reported in the literature in that they are larger. Moreover, the MIN is typically not a random movement (as might be expected from a tremor, drift, or other neuromuscular instability), but usually may be seen to track around the contours of objects, over edges, etc.

Slides. The operational definition of a slide is that the position of the eye marker shall have changed over three successive frames and that the distance between the first and second positions, and between the second and third positions, shall each be greater than one diameter

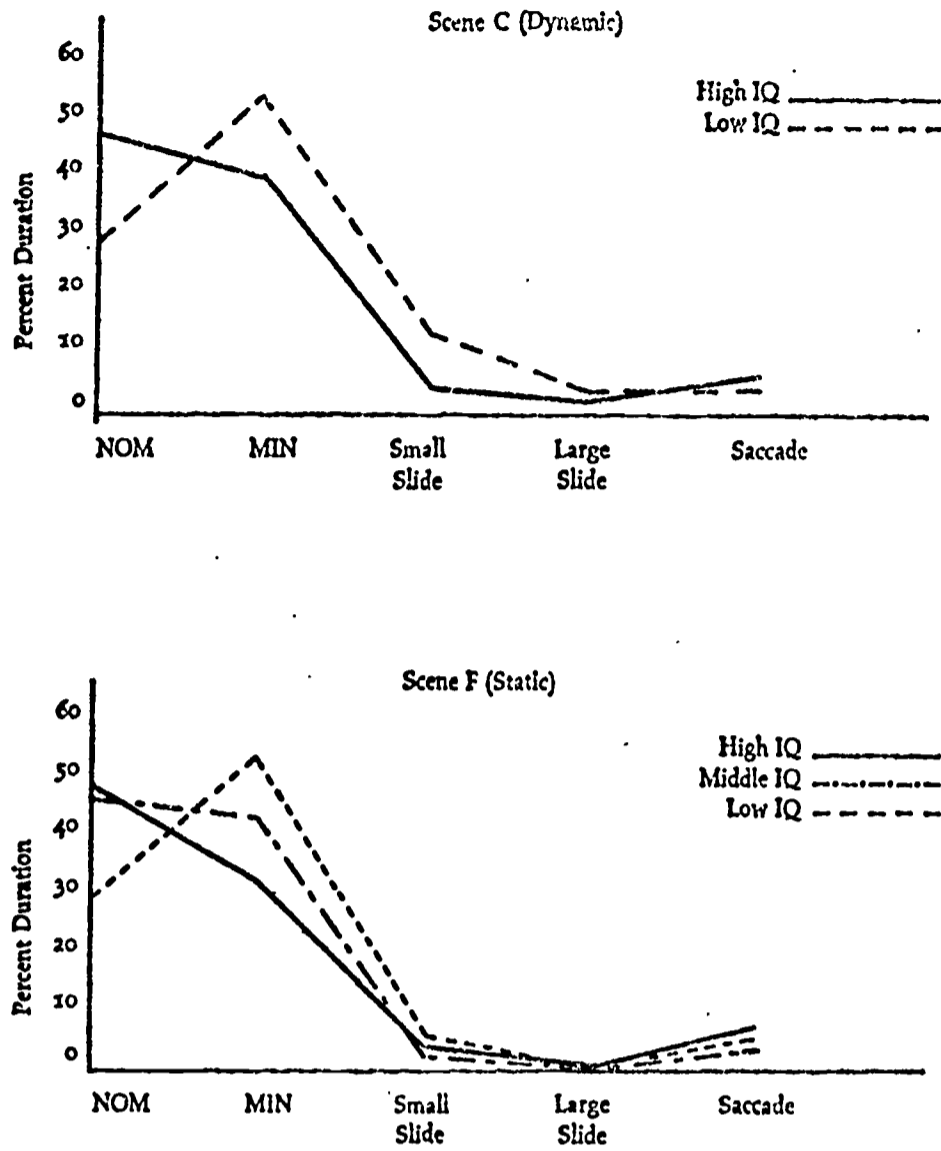


Figure 1. Distributions of eye movements (duration).

of the eye marker. Slides were classified as "large" or "small," depending on their extent. Small slides were typically of slower velocity as well; large slides are similar to slower saccades.

Saccades. The operational definition of a saccade is that the eye marker shall have observably changed position over two frames, that the change in position is greater than one diameter of the eye marker, and that the distance traversed by the marker before or after the saccade is less than the diameter of the eye marker. Generally speaking, this definition fits well the saccades defined by other researchers.

Typical findings from these analyses are shown in Figure 1 and Figure 2 for two scenes: Scene C, a moderately dynamic scene, and Scene F, a still scene (a drawing). Data are shown both for duration (percent of time) of movements and occurrence of movements. The data for Scene C are based upon five high intelligence subjects (IQ greater than 124) and four low intelligence subjects (IQ less than 83). The data for Scene F include these same subjects and a middle IQ group of five subjects as well.

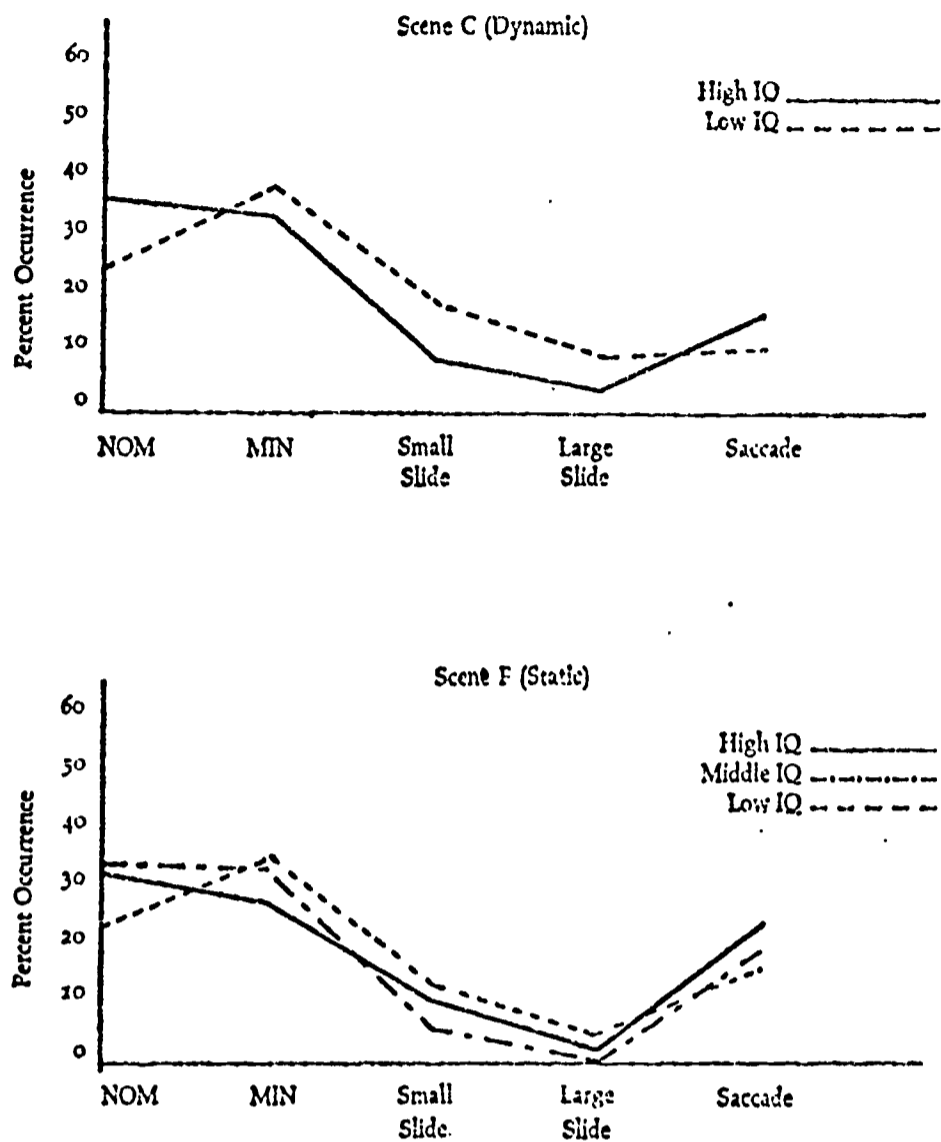


Figure 2. Distributions of eye movements (occurrence).

It will be seen from Figure 1 and Figure 2 that the following generalizations seem to hold:

1. Curves for both occurrence and duration are qualitatively similar; in both cases NOM's and MIN's are predominant.
2. The curves are quite similar for both dynamic and static fields.
3. The curves for intelligence groups differ sharply for NOM's and MIN's. High intelligence subjects display more NOM's than MIN's, while low intelligence subjects display more MIN's than NOM's.

This latter finding was so striking that a further attempt was made to relate movement types to intelligence. Correlations were obtained between the eye-movement indices for duration and various scores obtainable from the California Test of Mental Maturity, data which were available from school records. The findings from this analysis are shown in Table 2.

TABLE 2
CORRELATIONS OF EYE MOVEMENT INDICES WITH CTMM MEASURES (Scene F)

	NOM	MIN	Small Slides	Large Slides	Saccades
Total IQ	.61*	-.70**	-.17	0.00	.25
Total M.A.	.57*	-.71**	-.17	0.00	.31
Nonlanguage IQ	.66**	-.79**	-.21	0.00	.13
Spatial Relations	.73**	-.75**	-.33	0.00	.15

* P < .05

** P < .01

Since it was evident that the relationship of intelligence to the indices was greatest for NOM's and MIN's, several compound indices that would combine these two values into one indicator were formed. The ratio of NOM's to MIN's (N/M) and the difference between NOM's and MIN's (N-M) were formed, as well as the index defined by the logarithm of N/M. The latter index was used since the ordinary ratio N/M seemed to be somewhat curvilinearly related to IQ. The correlations obtained between these three compound indicators and the four CTMM scores are shown in Table 3.

TABLE 3
CORRELATIONS OF COMPOUND EYE MOVEMENT INDICES WITH CTMM MEASURES (Scene F)

	N/M	N-M	log(N/M)
Total IQ	.65*	.70**	.76**
Total M.A.	.60*	.69**	.68**
Nonlanguage IQ	.67**	.77**	.76**
Spatial Relations	.66**	.85**	.78**

*P < .05

** P < .01

It is apparent from Table 2 and Table 3 that a remarkable relationship exists between the indices NOM, MIN, and various combinations thereof and intelligence. The meaning of these relationships is not entirely clear at this point, but the correlation coefficients are of such a size as to suggest that these indices are very close to being physiological indicators of intelligence.

Because of these interesting findings, the indices NOM and MIN were more closely investigated; the ratio N/M was selected for this purpose.

Specifically, the ratio was studied separately for high and low intelligence subjects as a function of time elapsed within a scene. Scene C was utilized for this purpose. The mean value of N/M for each two-second interval of this scene was determined and plotted, as shown in Figure 3.

It will be seen from the figure that for the initial portion of the scene, the curves for the two intelligence groups are similar; this phase (Phase One) may correspond to the "orientation period" suggested by other researchers. It is noted here that this initial phase is longer for the low IQ subjects.

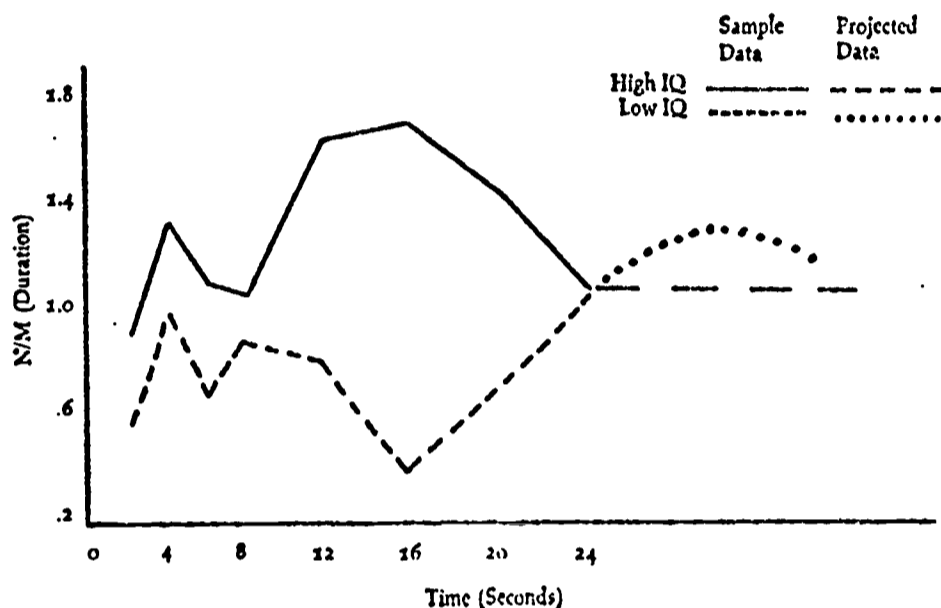


Figure 3. Change in N/M with time (Scene C).

The second phase (Phase Two) is initially determined by a sharp and large increase in the value of N/M. Thus, the positive slope at the end of the scene for the low IQ group corresponds to the slope between 8-12 seconds for the high IQ group. Although the scene ends at 24 seconds, the two curves are "projected" in agreement with the hypothesis of the existence of the two phases.

The projections are somewhat confirmed by a similar analysis done on Scene F for high IQ only. This distribution is presented in Figure 4. It is interesting to note that Phase One is of similar duration as in Scene C. Phase Two is of shorter duration, which is not unexpected, since this scene is static while the other is dynamic.

It is probably a safe assumption that activity of these indices is related to perception and learning. The index N/M changes for both high and low intelligence groups over time; as the scene remains on the screen, the proportion of NOM's and MIN's changes. There seems to be a predictable sequence of phases. Is it safe to assume that learning occurs primarily in Phase Two? Is it also safe to assume that learning diminishes as activity levels off? If so, it is conceivable that the time function of N/M for any given scene might well be used as

an indicator of the amount of exposure needed for at least minimal learning. If the upper limit of Phase Two can be determined, the time of maximum exposure is also determined; for if the scene is exposed for a longer time, very little additional learning will take place. The data, of course, are only suggestive at this point; obviously, a great deal of additional study is required.

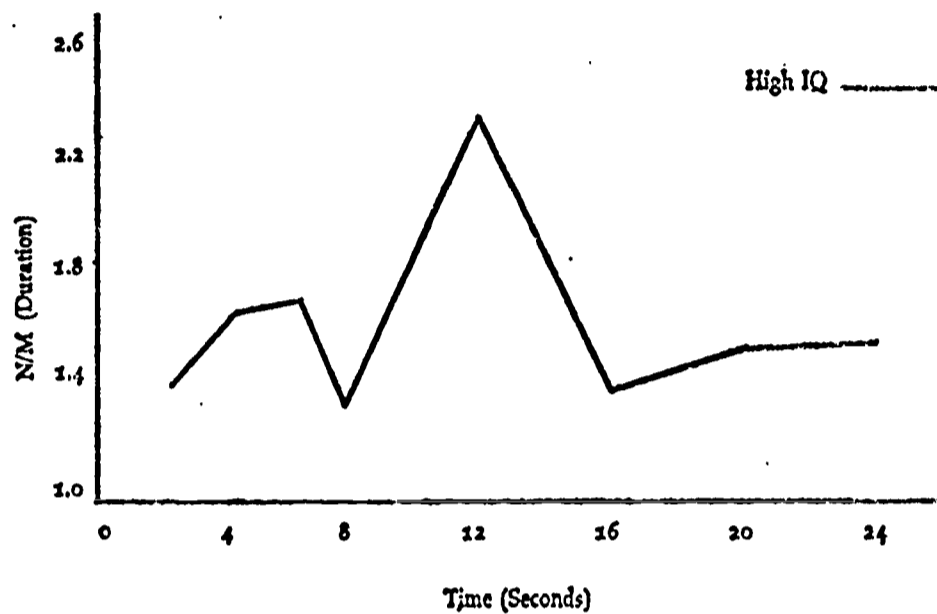


Figure 4. Change in N/M with time (Scene F).

Summary

This paper has described very briefly an initial excursion into the field of eye movements and television. The results are at best highly tentative; they are, however, also highly suggestive. The following conclusions may at least be entertained:

1. There is clustering of eye movements about certain areas of the visual field. The most definite tendency is to focus on a narrator's face when the narrator is present, at times (and particularly in some subjects) to the virtual exclusion of other elements, including those the scene is intended to dramatize. There seems to be little tendency to be distracted by nonrelevant elements in the scene.
2. Apparently, systematic translations of the eyeball in its socket occur which may be related to attention.
3. A distinctive "surrender" pattern is exhibited in response to highly complex or "busy" scenes.
4. The classic indices of "fixation" and "saccade" are not sufficient to account for all eye-movement phenomena; instead the researchers found it necessary to define a continuum of movement which included "minimovements" and "slides" in addition to the aforementioned indicators.

5. Eye-movement indices, particularly minimovements and no observable movements, and several combinations thereof, are highly related to intelligence.

6. Patterns of movements over time may be identified which may prove to be related to scene exposure time for maximum learning.

In interpreting these findings the reader should bear in mind continuously their tentative nature, particularly because of instrumental and interpretive unreliabilities, because of the small number of subjects involved, and because of the limited nature of the stimulus material. Work is proceeding to obviate these problems and to extend the generalizability of the findings through a broader study involving subjects at different age and intelligence levels and a variety of stimulus materials.

PART SEVEN

THE CONDITIONS OF MEDIA USE

FROM THEORY TO POLICY DECISIONS

by Charles F. Hoban

Annenberg School of Communications
University of Pennsylvania

Most workers in the field of newer media in education, be they producers, researchers, administrators, or teachers, are aware that both theory and research have had limited usefulness in policy making and in operational decisions which directly affect the use of newer media in schools and colleges.

Why is this so? Certainly, it is not because of a lack of quantity of research studies on newer media in education; the stack of research reports is impressive in size. Nor is it for lack of an arsenal of theories of learning or models of communication.

Some Fundamental Difficulties

Let us start with the existence of critical gaps which prevent the integration of related, ordered knowledge and interacting flow of theory, research, and action on the operating level of education.

Unbridged Gaps

Gaps exist (a) between the requirements of formal and partial theory formulation and the actual state of theories; (b) between theories relevant to problems formulated for research in educational media and much of the research which has been and is being done in educational media; and (c) between relevant theories and research in educational media, on the one hand, and the application of both, on the other hand, in the turbulent and complex institutional programs of education-in-action on all levels.

This gap structure is complicated by the fact that learning theory, communication theory, and sociological theory have been developed in relative isolation from each other. Tribal organization and identification within the intellectual society of America gives rise to fierce tribal pride, intensified by the brawling and caterwauling among

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families and among individuals within families. Psychology and sociology have not only their own tribal language systems but also their own dialects. The yearling field of mass communication has expropriated its language system from other fields and is now beginning to show signs of tribal identity.

It is not becoming for me to assume the role of a third- or fourth-rate C. P. Snow in discussing this alarming phenomenon. My task is to call attention to the fact that growing intellectual cleavages prevent or inhibit the development of a system(s) of thinking which we all agree would help us to cope with the problems of educational media as these problems actually exist on the practical level of formal education.

There is reason to hope that this isolation--this separateness--in the realm of the rational ordering and the use of knowledge in a technology of education may be bridged, in part, by specialized disciplines of social psychology, educational psychology, educational sociology, and the newly emerging area referred to as communications. This hope is not easily negated by the fact that such specialized disciplines have either not attracted increasing numbers to the fold or are showing signs of a withering of interest. The hope is fed by an increased demand for the services of people trained in these between-the-cracks specializations of the social and behavioral sciences, and knowledgeable in their complex rituals and rubrics.

For example, I was recently asked to recommend an educational psychologist for appointment to the staff of a division of academic research of an institution of higher education in another state. Upon extensive inquiry I discovered that (a) such people as exist are carefully hidden away from raiding expeditions by the institutions in which they are presently employed, and (b) institutions that provide such specialized training cannot meet the demands of the market. There is a mere trickle flowing through the pipeline of people-in-training. Recently, a sociologist who has been especially active in formulating theory and doing research in the fields of mass communication and education told me that his institution is unable to meet the market demands for educational sociologists. The demand exceeds the supply in these specialized fields of "applied" social science.

The notion of specialized disciplines to provide mechanisms for bridging gaps among theory, research, and educational operations is introduced as a feasible way of establishing systematic interconnections. A range of mechanisms will be discussed later in this article.

Limiting Concepts

A second class of circumstances that cannot be ignored is that of the limiting concepts of theoretical formulations, of research methodology, of the nature of educational media, and of the central problem(s) of education.

Take, for example, the concept educational media. This concept includes just about everything and almost nothing. All education involves mediating agencies and mediating channels. Without such mediating agencies and channels, we are likely to produce a product similar to Itard's wild boy of Aveyron, whose halting and low-ceiling re-education is discussed lucidly and perceptively by Brown in Words and Things (1).

What we actually include in the term educational media are motion pictures, filmstrips, tapes, television, radio, transparencies, and "teaching machines"--to use the shorthand term. We don't include books (including the new paperbacks), or maps, or charts, or globes, or workbooks, or other such paraphernalia of education--without some sort of conversion of these exclusions into included categories.

The common element of all of these educational media is machines. It takes a little stretching to consider a programmed book as a machine, but for the sake of the argument, let it be so considered. When we consider the part machines play in education, we are forced into a consideration of man/machine systems. When we consider man/machine systems, we are forced into a consideration of technology. By a process of progressive forcing, we advance to the broader concept of educational technology, or technology in education, as a central subject to which we must relate theories, research, and educational practice.

The point here is that the term educational media does not, in itself, suggest the ramifications for research, educational policy, and operating procedures which are inherent in the term technology of education. Technology is not just machines and men. It is a complex, integrated organization of men and machines, of ideas, of procedures, and of management. The introduction of this complex generates many systematic problems that can be, and have been, either ignored or generally neglected in theory, research, and practice in education. The term "educational media" limits; and the term "educational technology" expands the areas of theoretical development, research, and implementation in education.

In many of the conferences I have attended, and in the reports of conferences I have read, the emerging "science of management" and "policy science" in general have left me detached from our ultimate goal (improvement of education) and from a basic element, decision making and management of technology in education. Full representation of all relevant disciplines and areas is not possible in this article. This observation brings us to some of the limiting concepts of research in the field of educational media, or technology, and to some of the limiting concepts of education itself.

It is frequently said by educators and educational researchers that the central problem of education is learning. Learning is a process central to human survival. The central problem of education

is not learning, but the management of learning. Learning and the management of learning are not equivalent terms, any more than are learning and teaching. The so-called teaching-learning problem is subsumed under the management-of-learning problem.

For the past few years, I have been studying the backgrounds and reactions of people, mostly adults, to college credit courses offered by the College of General Studies of the University of Pennsylvania over both a commercial and an educational television station. From an institutional point of view, one of the critical problems is that of attracting a greater number of people to enroll in the courses so that, among other things, tuition payments will reduce the deficit in the instructional budget incurred by the presentation of the courses over television.

The over-all problem is much more complicated. It involves the responsibility of an urban university to serve the intellectual and social needs of the community, the hour at which the program is offered, the selection of courses for presentation over television, and so on. But central to the institutional problem, and intrinsic to the broad problem of the management of learning, is the fact that educational television for noncaptive audiences is underutilized. It attracts only a trivial percentage of its potential audience. Perhaps, as someone has been suggesting, viewing educational television programs of an academic mold between 6:00 and 7:00 a.m. is a status symbol, and the viewers are status strivers. There is evidence that some are and others are not. But the fact remains that whatever theory and research specify for improved management of learning via educational television, these mechanisms can operate only when there is an audience in-being and when this audience is of sufficient magnitude and/or composition to justify the cost of educational television. No one has yet discovered how to determine this except by administrative fiat or myopic accounting.

This problem may be viewed as one of educational management, but it also may be viewed as a broad problem of management of learning. There is some reason to believe that the problem of management of learning becomes more acute when any aspect of new technology is introduced into education. Programed instruction, for example, involves a high degree of control of the stimulus-response-reinforcement pattern and frequently also a high degree of permissiveness in rate of progress of the learner. The former removes the classroom teacher from the direct teaching process, and the latter performs the teachers' functions so that the management of learning on the part of the classroom teacher involves a new set of clerical activities, a new type of broad programmatic planning and administration, plus the introduction into the instructional program of a wider range of creative, analytical, and interpretive activities. I suspect that these activities are also required to make educational television effective and efficient.

No matter which of the new educational media is introduced, the situation into which it is introduced is transformed by the introduction. Acceptance of management of learning as a central problem of organized and institutional education would, at least, permit the admission of a wider range of alternative procedures, techniques, and methods in teaching--without threatening or substantially altering the critical functions of education, teaching, or learning.

Party-Line Conformity

A third limiting concept is to be found in the tendency among theorists, researchers, and practitioners to minimize risk in their professional careers by hewing closely to professional party lines and visibly conforming to them. This tendency acts as a strong force against the intrusion of "alien" ideas or procedures which, at least, deserve an open hearing, if not a good try. This limitation will be discussed in more detail later in this article with reference to research methodology and to the functions of research in the field of education.

Requirements of Improvement

Implied in the preceding discussion, if not made too explicit, is the proposition that relevant theories, theory-oriented research on technology of education involved in theory, research, and application will not come to fruition without (a) changes in our ways of thinking about these problems, (b) the development of some mechanisms that will bridge existing gaps, and (c) a more comprehensive concept of the function of research on educational media. Throughout this entire article, there is an underlying bias directing educational research toward educational operations (6, 7). It is possible to dismiss this bias with unpleasant remarks about "educational engineering." It is also possible to sanction it by this same label. After all, what would we do without engineering? Educational research is neither a closed system nor a closed loop in which theory generates research and research generates theory. Within the bias of this article, educational research must have a primary use orientation.

Recommendations for Practice: Whose Responsibility?

At the Symposium on Psychology of Learning Basis to Military Training Problems (11), Gregory A. Kimble commented on some statements made by Ernest R. Hilgard in his paper on theories of human learning and problems of training:

The experimental psychologist, in Hilgard's view, has neglected his responsibility to education. He has failed to validate his theoretical ideas in practical situations. He has shunned experimentation in the applied areas. He has largely ignored the contribution of those who do work in educational research. I object more strongly to what appears to be the basic premise here than to anything

else in Hilgard's paper. So long as our science remains a democratic one, the translation of theoretical ideas into practically useful recommendations is no one's responsibility. It is the right and privilege of anyone who is interested. The same holds for experimentation. Tastes in such matters cannot be dictated. . . .

A great deal of water has flowed over the dam since 1953 when this symposium was held. Some viewpoints have changed in the meanwhile. The ideological dogma that there is a democratic science and nondemocratic science has been shaken by the scientific output of nations and social systems which we think are not "democratic." Nevertheless, Kimble's statement regarding responsibility (nonresponsibility) of the behavioral scientist for translating theoretical ideas into practically useful recommendations is probably representative of today's thinking, although it has been dented by developments in the field of programmed instruction in which psychologists have played a decisive role.

If useful application of theory and research is not the responsibility of the scientist, then some mechanism must be developed to get this job done. In an increasingly interrelated and interdependent world, laissez faire is an outmoded social dynamic.

In this connection, it may be significant as well as suggestive to note that audiovisual educationists have been wearing a hairshirt, much as a tennis player wears a T-shirt, and indulging in a rash of self-criticism for having failed, in one way or another, to become the technological middlemen upon whom the development of an effective technology (of new educational media) depends, at least in part.

Robert Lewis Shayon (10) added the quality of his graceful writing and his sense of social identity and direction to this process of critical self-examination at the 1961 convention of the NEA's Department of Audiovisual Instruction:

The word "pandemic" was coined by Professor W. H. Cowley of Stanford University's department of education Professor Cowley asserts that three kinds of individuals are to be found in almost every society. The first is the "logodemic." He is the scout on the frontiers of knowledge, concerned exclusively with discovering new fragments of truth and adding them to the world's stockpile of knowledge. The logodemic is at one end of the spectrum. At the other end is the "practidemic" type. He is the individual who puts to practical use the knowledge discovered by the logodemic man. Between the logodemic and the practidemic is the "pandemic" man. His job is to mediate between the other two types. This mediation is necessary because the logodemic man speaks an esoteric jargon which only other logodemics understand. . . .

.

Pandemic man is the man who can get the general drift of the logodemic's ideas--translate them, and communicate them to the practicals. The pandemic communicator must be a generalist. He must be able to catch the essentials of the specialists' mysteries, without being contaminated by their parochialisms. He must be a student of his audiences. He must be schooled in esthetics. He must be a philosopher with the hand of a showman, the heart of an educator, and the spirit of a poet. Many of you may not aspire to such a combination--nor can any of us achieve the ideal. Yet as you educational technologists shape your future character you must recognize the importance of this member of your team--do what you can to train him for his work. . . .

Shayon not only specifies the requirements for, and characteristics of, the mediator between the discoverer and the organizer of knowledge, and the practical man who is to apply this knowledge; he also adds the imperative, must, to the recognition of the importance of the mediator--the pandemic man in the field of media in education--and to the assignment of responsibility for his training.

Here then is the function, and here too is a possible social mechanism for bridging the gap between theory and research, on the one hand, and the changes in educational practice which both imply.

Restraints of Research Methodology

A heavy commitment to the controlled experiment in research on media in education presupposes the adequacy of both theory and range of insights involved in specifying theorems as hypotheses. Furthermore, such a commitment may very easily substitute precision for accuracy where the latter is more relevant to the problems at hand than the former. It applies to research, particularly in the field of media in education.

In the Summer 1961 issue of Studies in Public Communication (12), Uliassi, its editor, went on record regarding "the discouraging gap which has developed between the breadth of insight, freshness of approach, and frankness of expression of the 'dissent' journals and the 'journals of opinion' and the narrowly defined, empirically researchable problems of the 'academic' journals in the field."

What seems particularly needed is more research into the broad social and historical context in which communication media in fact have an impact. Our over-concern with research using the developed methods of controlled empirical investigation seems highly antagonistic, as others have noted, to insight regarding broader social processes at other levels of description and analysis.

What seems to be needed in the communication field as in other areas of social sciences is an increased recognition of the critical importance, for scholarship--and research--of seeking out the correct questions. What also seems necessary is a lesser "intolerance

of ambiguity," encouraging creative and informed insights on problems whose social significance is approximated by their complexity. The problem is one of research strategy--and research priority.

The idea of seeking out the correct questions is not new, but the suggestion that a range of relevant insights is to be found in the analytical and critical writing of scholars from other disciplines is important in the sense that it underscores the importance to both theory and research of broad insights and of different levels of insight.

In a provocative paragraph, Uliassi touches on the fundamental problem of precision and of the reflection of imprecision in research methodology:

The basic question, and one which has, of course, been asked before, is whether the supposedly "hard" or "rigorous" studies are, in fact, those which are most precise. What seems to have been occurring is the substitution of one mode of imprecision, currently fashionable, for another, currently unfashionable. The imprecision of interpretive, multivariate, historical analyses of complex processes and problems has yielded to the currently more acceptable mode of imprecision: the imprecision of artificially-simplified studies whose narrow empirical character makes them only partially relevant to the actual social situation being studied. The case is analogous to that of looking under a street lamp for a coin lost in the forest--because the light is better there.

Scarcely one of us who has even a passing acquaintance with the research literature on mass communication and on media in education can fail to itemize a depressingly long list of studies which exemplify the "currently fashionable" mode of imprecision, in which statistical analysis exudes pseudo-sophistication, but the results are untranslatable into meaningful situational terms, or in which the problems investigated are operationally trivial or theoretically unrelatable. The relationship between research methodology and the yield of insight was stressed by the late Franklin Fearing (3). In his review of a study of effects of television crime-drama on children and adolescents, he discussed this relationship briefly, but in a vein similar to that mined by Uliassi.

There are, roughly speaking, two basic research designs for the study of the effects of the mass media. The first may be called the field design after the fact. The second is the experimental design where the attempt is to subject the hypothesized variables to systematic control. The first is exemplified by Cantril's study of the impact of The Invasion from Mars radio broadcast, and Merton's analysis of the Kate Smith bond-selling campaign on radio as reported in his Mass Persuasion. . . .

It must be admitted that the field-after-the-fact type of investigation has yielded more significant insights into the social dynamics of impact than the meticulously controlled experimental study with its manipulation of variables and refined statistical analyses.

Commenting on the results of the study under review, which employed the latter (controlled experiment) research methodology, Fearing said:

These results are solidly based and are certainly suggestive, but one cannot escape the impression that they are scarcely proportionate to the amount of effort required to design and carry out the research.

Many of us have made this same type of evaluation of many of the research studies in media in education, but generally in the informality of talk among close colleagues. Fearing's description of results as "solidly based" does not carry the same ring of conviction as that of the scriptural "house built upon a rock." The rock is there but not the house.

It may be oversimplifying and/or misrepresenting a significant difference between two types of research methodology, in field studies of the type cited, to point out that insights into social dynamics develop out of the analysis of the observed behavior in its broad and complex social context; whereas, in experimental research, the insights are essentially a priori requirements of hypothesis formation.

The narrowness of problems investigated by the experimental method, and the likelihood of hypothesis blindness--which diverts attention from the alert observation of a range of behavior to the formalistic analysis of quantified data related only to the hypotheses--are sources of criticism of both the experimental method and of the neglect of the field study and other research methodologies. A wider range of research methods is required. Some of these research methods admittedly produce data which are imprecise and in which confidence must be based on other than statistical criteria.

Contextual research, i.e., the conduct or research within the context of the organization and operation of an existing instructional program, is a move in the right direction. As elsewhere noted (7), contextual research frequently uses "the controlled experiment to control variables which can best be controlled in the laboratory, and ignores many of the critical operating decisions involved in the art of teaching and in the art of educational administration." Yet, contextual research is one of those middle steps that are necessary to move research on media in education into the area of operation to which media research in education is practically relevant, and thus provides a bridge between research and educational practice, if not between

theory and research. A newly emerging and significant development in theory-based contextual research in this field will be discussed later in this article.

Principles Considered as Theoretical Constructs

Both research on media in education and the practical development of useful technologies of education can be facilitated by the recognition and use of "principles" which are relatively free of the distinctions and differences that exist among theoreticians. In the sense used here, principles are general statements based on common knowledge of the operation of factors or influences in given situations or processes--such as learning, institutional innovation, etc.

Glaser (4), in a lucid paper on programmed learning sequences, points out that programming techniques utilize "(1) the principle of reinforcement, (2) the principle of progression, (3) the principle of prompting . . . [and] (4) the principle of fading and vanishing."

Hilgard (5) also points out a set of principles "that can be kept as reminders when practical applications of learning are under consideration." He itemizes a total of 18 such principles under the categories of S-R theory, cognitive theory, and personality theory. Here are a few: learner activity, cognitive feedback, goal setting, and group atmosphere. His statement on cognitive feedback, for example, is that it "establishes probabilities and (in some cases, at least) is an appropriate explanation of effective reinforcement. The corresponding S-R principle is that of knowledge of results. The notion is that the learner tries something provisionally, and confirms his attempt by its consequences."

Such "principles" constitute generalized theoretical constructs which are not theory bound. They do not involve the highly technical formulations of specific theories, and they are relatively independent of competing theories which attempt to order and to explain the same behavior.

Theory-Related and Referenced Research

We now come to a stage of research which is both theory related and referenced to prior research. The experiment is referenced to a prior experiment(s) in that it is based on findings of previously reported research. It frequently involves "replication" under conditions varying from, but related to, those of the referenced experiment(s). It involves extension of a hypothesis (deduced from theory which may be implicit or explicit) to other conditions, other contexts, and/or other forms of manipulation of the independent variable, and other dependent variables.

There are, to be sure, some media researchers who frown in disavowal of this as "true" replication--with good scientific logic to

back up their unmasked frown. There are others, including myself, who are more interested in extending hypotheses relevant to education than in a logical requirement that increases the verifiability of the hypothesis under identical conditions of limited significance in the stubbornly practical world of education.

To illustrate theory-related and referenced experimental research, considerable liberty will be taken with a report of a study by Kumata (8) of attitude change and learning as a function of the prestige of the instructor and the mode of presentation. Essentially, Kumata's study deals with "source credibility," a term dignified and promulgated by the late Carl I. Hovland and his colleagues.

Source credibility is derivable from communication theory as set forth by Bettinghaus. Anyone familiar with Cantril's study of The Invasion from Mars and Merton's study of Kate Smith's war-bond marathon (and who isn't) is aware of the idea that the "authority" of the source(s) interacting with the "authority" of the channel (e.g., radio) have, under certain circumstances, a predictable, immediate effect on "audience" reaction.

Kumata varied the prestige of the instructors teaching a college course by having each described in rotating roles as a "national expert," a "departmental expert," and an "ordinary instructor." He varied the mode of presentation (channel) by face-to-face teaching and teaching over television.

The results of the study are more or less as complicated and complex as the design of the experiment. No attempt is made here to summarize the findings. For our purpose, the significance of Kumata's study lies in the fact that it investigated the educational implications of both theory and previously reported research studies on source credibility.

Purely as a matter of satisfying curiosity, it is noted that Kumata found that in learning, face-to-face teaching of a lesson was somewhat superior to teaching over television; that learning under face-to-face teaching or television teaching was consistent from instructor to instructor; that teachers rated by students as varying in certain attributes related to "good" and "poor" teaching also produced informational learning in the same order as their rating by the students, whether in face-to-face teaching or in teaching by television. It is not clear as to how the theory of learned behavior accounts for this, if at all. This lack of clarity is one of the bothersome gaps between educational theory and learning theory. From an educational point of view, "good" learning is associated with "good" teachers. Some educators take for granted (too freely, to be sure) that one of the best sources of information on the "goodness" of teachers is the judgment made by their students. Empirical data suggest that confidence in the evaluative judgment of students is not entirely misplaced.

Theory-Derived, Operationally Significant Research

The two-step gaps between theory and educational media research and between educational media research and improvement of educational practice are eliminated in one neat stroke when research is based on hypotheses derived from theory and when these hypotheses have a direct bearing on the character and cost of education on the level of practical operation.

Happily, this approach is increasing in educational media research. It is happening in the field of programmed learning. It is happening in the field of television and motion pictures in teaching.

Deutschmann, Barrow, and McMillan (2) published a progress report on a study comparing the effects of different modes of communication upon learning relevant and irrelevant information. In the prefatory note, it is pointed out that the report "proposes that ordinary classroom instruction is less efficient than a mass communications counterpart because it screens out less irrelevant material." This, itself, is significant of a growing sophistication in educational research in that the article "proposes" rather than "proves."

The opening two paragraphs of this report are quoted below as an illustration of the process by which implications are derived from theory and applied to problems in education.

The Shannon-Weaver model of the communication process . . . can be easily applied to the classroom or laboratory situation. The teacher can be equated with the communicator-encoder; the students with the decoder-receivers. The total complex of stimulation available to the receivers is the message plus noise. In most cases, this stimulation probably exceeds the receiver's capacity to decode.

That part of the stimulation--including lectures, audiovisual materials, and discussion--which is relevant to the instructor's purposes, we may designate as message. That part of the stimulation which is irrelevant, we may call noise: this includes not only literal noise inside and outside the classroom but also irrelevancies intermingled in the lecture or audiovisual aids. Frequently, some parts of the stimulation which appear to be message are, in fact, noise, i.e., irrelevant to the communicator's purpose.

In developing the rationale (the implications of theory which have particular significance in terms of the technical nature of the "channel"), the late Paul Deutschmann and his associates introduced a degree-of-focusing concept.

If . . . we compare teaching by film or television with classroom or laboratory instruction, some differences are apparent. The film or TV situation may be designed to screen out some of the irrele-

vancies present in the natural situation. Or, if it does not screen them out entirely, it may reduce their intensity.

For example, TV reproduction of a stimulus situation--classroom or lab--always loses a small amount of the original situation's detail. In many instances, the fine detail which is lost is part of the irrelevancies available in the natural situation. Film also is a means of focusing and/or reducing the intensity of irrelevancies. If a film version is shorter than a natural version, for example, the amount of irrelevant stimulation available will be reduced. While this reduction in a filmed counterpart of classroom instruction should be noticeable, it should be even more apparent in the counterpart of a laboratory situation, which seems manifestly richer in total stimulation--and particularly the irrelevant--for the student.

This interesting and significant research involves comparison of instruction in "natural laboratory," "laboratory plus film," "film only," and "TV reproduction of film." The "degree of focusing" is hypothesized to proceed in that order from minimal to maximum focusing, and "channel efficiency" is hypothesized to follow this same rank order.

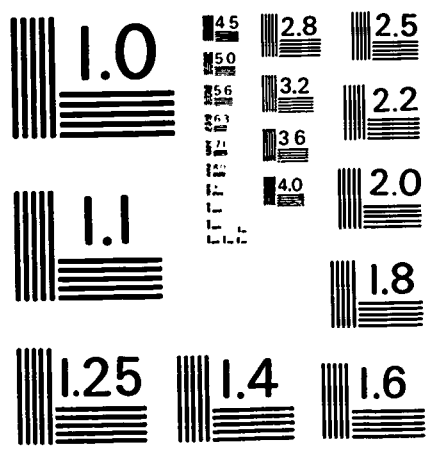
The results of the research partially support the hypothesis that students exposed only to the film will obtain significantly higher "channel efficiency" scores than students exposed only to the natural laboratory condition--the only conditions compared in the research reported.

One might take issue with the encoding-decoding concept as one of those intervening operations which cannot be observed by available research instrumentation. Or, one might find the concept troublesome in that it is dependent on a dictionary of equivalents which does not exist in the field in which the research is conducted. However, in the sense used in this reported research, the concept is heuristic and its use is convenient. Whether it is accurate or precise remains to be seen.

Another aspect of this reported research deserves more than passing attention. The films used in the research study were produced either by or with the full cooperation of one of the departments of the university to whose instructional methodology it applies. This suggests that some decision will be or has been made on using films in departmental teaching. It further suggests that the research reported by Deutschmann and his associates may have a bearing on a departmental decision on the way in which films or television reproduction of films will be used in addition to the "natural laboratory," or as an alternative to some of the uses of the laboratory in the instructional program.

If these suggestions are realities, then the purpose of educational media research moves from an exclusive concern with the extension

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and ordering of knowledge to the use of this extended knowledge in decisions on educational operations. In this event, the two-step gap is being bridged.

It may well be argued that a great deal of the educational media research of the past has involved exactly this dual function as, in fact, it has. It may also be observed that researchers have, in fact, carefully concealed, suppressed, or ignored the relationship between research findings and policy and operating decisions in actual educational situations. This is one of the limiting concepts prevalent among researchers in educational media, and in the disciplines basic to such research, which was discussed in the first part of this article. There seem to be rules that prohibit researchers from expressing interest in the useful application of research results in policy and operating decision. Apparently, the "party line" forbids this as "unscientific," whatever that is supposed to mean.

Research and the Right Reason Thereof

The bias in this article toward a use orientation of research on educational media, as well as research in the general field of education, is by now evident. Knowledge relating to a field of action that is sought without committed interest in or intention of facilitating action in the field of action is very much like salvation by faith without good works. Good works are assumed to be the dynamically inevitable expression of soul-saving faith. The trouble arises when faith is not soul saving, but merely status preserving.

A totally different rationale of educational media research has recently developed among individuals and groups giving thoughtful consideration to research and development in the field of educational media, i.e., in the technology of education as it applies to programmed instruction, television, motion pictures, tapes, etc. This rationale is embodied in two sentences of a memorandum (9) related to the research and dissemination programs specified in Title VII of the National Defense Education Act of 1958.

Preference should be given to projects which promise to move in an orderly sequence through the following stages:

- a. hypothesis discovery
- b. hypothesis testing
- c. field suitability testing
- d. administrative logistics testing
- e. program and media production
- f. all-out demonstration

Preference should also be shown to studies initiated anywhere in this sequence when it is demonstrated that earlier steps have been reasonably well accomplished.

2

I would add one more step beyond all-out demonstration to the progression: implementation in educational practice.

The quoted statement needs no major elaboration. It rejects the illusion that theory is theory, and research is research, and products are products, and education in action is action in education, and that somehow, sometime, and somewhere these elements will all fall neatly into orderly place without plan, or program, or system analysis, development, and integration. I believe that this illusion is nothing but a comforting fantasy that relieves everybody of social responsibility beyond that of self-definition, self-assignment, and "tastes."

The Nub of the Matter

We now come to the nub of the matter. Let me crystallize it quickly in ten loosely formulated statements:

1. Neither cognate theory nor media research in education is likely to contribute significantly--either to each other, or, more importantly, to the improvement of education at the practical levels of policy and operations--if the happenstance relationships that now exist among these three areas of activity are perpetuated.
2. Cognate theories provide media researchers with a rich repertoire of conceptual tools very likely to improve the formulation of problems and the relevance, the quality, and the appropriateness of research on educational media; but the theories are so variant and disparate that careful selection among "principles" basic to the variant and disparate theories is essential to any given media research program or project.
3. While research on media in education and a variety of research methodologies are very likely to provide new and fruitful insights for cognate theories of learning, communication, and sociology, the primary responsibility of educational media research is to contribute directly to the formulation of educational policy and to the improvement of educational operations, both of which occur on the local or regional levels.
4. This anchorage of responsibility implies a type of planning, organization, and programing of research that not only has been anathema to academic scholarship in America but also (until recently) has been viewed as subversion of "democratic science" in a "free society." A free society must be free to do what needs to be done and free from the evils of self-defeating controls.
5. The assertion that educational operations are unique to each educational institution and, therefore, are not a proper area of research in general, and media research in particular, arbitrarily and unnecessarily limits the scope of research.

6. Very little effort of educational media research on improvement of policy formation and operations in education at the action level is likely unless policy makers and practitioners of education are consulted, involved, and made active participants in educational media research--both at its inception and its prosecution. Mechanisms of social change can be built into educational media research, and change itself (when justified) should be one of the measures of the value of media research.

7. As long as different language systems are used exclusively by theory builders, researchers, and practitioners, none of these is likely to communicate easily or effectively with the others. Translation, or what the communication people call encoding-decoding, is obviously a missing but necessary process in overcoming the language barrier.

8. Research in educational media is, in fact, research in education--not in psychology, communication, or sociology, as such. In this circumstance, the burden of proof is on the cognate theoreticians and on the researchers--discomforting as this requirement may be to both of these respected members of the academic community.

9. Education is a priority problem in the United States as well as in the world. The time has come to re-examine the hierarchical status system which assigns professional education and educational research to the bottom of the totem pole.

10. If the interrelationships among theory, research, and educational implementation are to be strengthened, the training of educational media researchers must be broadened so as to include both the cognate theories and the curricula, institutional structure, and social organization of education. Rather than prescribe a longer period of graduate study for this purpose, the possibilities for on-the-job training of researchers in context should be explored.

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PRINCIPLES OF FILM INFLUENCE

by Charles F. Hoban

The Annenberg School of Communication
University of Pennsylvania

Edward B. van Ormer

Pennsylvania State University

Part I. Values of Instructional Films

"What good are movies in teaching, anyway?" In answer to this blunt, but pertinent question, film research studies suggest five major values of motion picture instruction.

VALUE 1: People learn from films.

They can learn factual knowledge, concepts, motor skills, attitudes, and opinions. Probably, films are useful in achieving other educational objectives, such as appreciations and creative imagination, but there is little evidence available on these outcomes.

VALUE 2: When effective and appropriate films are properly used, people learn more in less time and are better able to retain what they have learned.

When a film satisfies, to a fair degree, the majority of the ten principles of film influence (see Part II), it frequently results in more factual learning than comparable reading materials or lecture presentations, and requires less instructional time. Moreover, when films are used and integrated with other instructional procedures and materials, more learning results from the combination than from either medium alone.

Reprinted from Instructional Film Research: 1918-1950. Technical Report No. SDC 269-7-19, Instructional Film Research Program, Pennsylvania State University. Port Washington, L.I., N.Y.: Special Devices Center, U.S. Office of Naval Research, 1950. Pp. 9.1-9.9.

Films used alone, or combined with other instructional methods are in many cases superior to purely verbal methods of presenting facts, as measured by both immediate and delayed tests of effectiveness, and especially by the delayed measures. Occasionally, an audience has even been found to know a higher percentage of certain facts presented in a film or to have stronger film-directed opinions several weeks after the film than did a comparable audience a few hours or days afterward.

Nevertheless, the statement of Value 2 must be qualified. As we pointed out at the end of Chapter III and substantiated in Chapter VI, "there is nothing in a motion picture presentation, per se, that guarantees better learning." Some films have turned out to be no better than other methods, except that they make it possible to instruct a larger group simultaneously, and some films may even promote less learning than usual methods.

What is implied in proper use is outlined in Part II under Principles nine and ten of film influence. The meaning of effective and appropriate is sketched, as far as our present insights enable us to go, in Principles one to eight on film influence.

VALUE 3: Instructional films may stimulate other learning activities.

Several research studies indicate that certain instructional films are likely to stimulate such activities as discussions, voluntary reading, investigations, art work, and the like. How much of this type of activity is stimulated probably depends on the nature of the film, the permissive or domineering attitude of the teacher, and the accessibility of reading materials, as well as other factors.

VALUE 4: Certain films may facilitate thinking and problem solving.

Thinking is a process of using what a person knows. If this thinking leads to problem solving or becomes critical thinking, the person must comprehend new relationships or patterns in the perceptions and ideas he is using. The experimental evidence from at least four carefully controlled studies indicates that films aid in promoting comprehension, or understanding to a greater extent than they do the learning of specific facts of a rote memory nature.

One study found that general science classes taught with text and supplementary films were better able to apply their learning than classes taught only with textbooks and other usual methods. A recent study indicates that films which merely repeat what text and teacher present may not aid in problem solving.

VALUE 5: Appropriate films are equivalent to at least an average teacher, and sometimes even to an excellent instructor insofar as the instructor's function is communicating the facts or demonstrating the procedures presented in the film.

This finding is supported by several studies, mostly involving high school, college, and armed-service trainee populations. In at least three studies, the film presentation gave better results than a "good" lecture that utilized charts and other aids.

This value has at least three important applications: (1) good films may improve the effectiveness of poor teachers in instructing classes; (2) films can substitute for the instructor in certain demonstrations and lectures, thus making it possible to teach certain topics when a qualified teacher is not available to present those topics (as in small schools, large groups, televising to several schools, home study, etc.); (3) the wise use of film instruction can, to some extent, save the teacher's time and energy for situations where face-to-face leadership, individual instruction, and personal guidance are required.

Part II. Principles Governing the Influence of Films

It is often assumed that a motion picture provides a common experience for the group that sees it. A given picture does not vary physically in the content presented from one shown to another or from one group to another, but it does not follow from this that all individuals who observe the film have the same experience. Motion picture experience is a common experience in that it is shared, but this experience always has a somewhat different meaning (sometimes the difference is considerable) for the individuals who see the film.

The difference in the meaning of film experience and, consequently, in the learning by the individuals in the audience, may be understood, at least partially, in terms of ten major principles or postulates of film influence. The principles of film influence presented here are tentative generalizations derived by the authors of this review from the data reported in published studies. In a sense, these principles or postulates represent our attempt at creative synthesis of present knowledge of film influence, insofar as this knowledge is reflected in the published literature of experimental film research. Future research results may require their extension, reformulation, or revision, and future development in systematic psychology may require their reorientation and modification. Within the limits of the available data, and the insights of the viewers, these principles are presented here so as to facilitate more accurate prediction of film results, better methods of film planning and production, and more effective ways of using films in instruction.

It is clearly evident in the mass of film research data that the influence of motion pictures on behavior is dynamic, rather than exclusively inherent in the medium of the motion picture. Film influence depends not only on (1) the content and the treatment of the film, but also on (2) the psychological make-up of the audience, and (3) the social and instructional characteristics of the situation in which the film is presented.

When the influence of films is accepted as dynamic in nature, and when the dynamics of film influence are understood, even if imperfectly, the mystery of the influence of motion pictures on human behavior begins to disappear, and with it the exaggerated hopes and fears of "movie magic."

No one principle or postulate can satisfactorily or completely "explain" film influence. The ten major principles of film influence are interrelated. Quite certainly, other principles can be formulated and applied to the production and use of motion pictures in instruction. For example, the principle of closure (especially as it relates to the tendency to remember and complete an interrupted act or sequence) appears to be highly important to instruction in general, and to instructional films in particular. But there is no evidence that this principle has been satisfactorily or systematically applied in either the production or use of instructional films. What is perhaps unique about the proposed principles of film influence is that they have direct application to the motion picture as a medium of communication and direct implications for instructional film production and use. The ten principles and some of their implications follow.

I: Principle of Reinforcement

Films have greatest influence when their content reinforces and extends previous knowledge, attitudes, and motivations of the audience. They have least influence when previous knowledge is inadequate, and when their content is antagonistic or contrary to the existing attitudes and motivation of the audience.

This principle takes on meaning when we remember that the motion picture is a medium of communication, and not an independent determinant of behavior. A person responds to a film in terms of what he already knows, what he can do, how he feels, and what he wants at that time in that situation. A film helps to change the person in the sense that it helps to change his way of looking at things, including himself, and presents a model of new responses that he can make in that or similar situations.

The influence of any one film is likely to be limited, just as the influence of any ordinary experience lasting less than an hour, or an hour or two at most, is likely to be limited. However, the influence of several related films is likely to be cumulative. Two or more films with similar bias on the same or similar subjects, each of which has little measurable effect on audience learning, may have a measurable effect when used consecutively in instruction.

There is experimental evidence that the influence of any motion picture depends to a very great extent on the reinforcing experiences that occur before, after, or during the film showing. The effectiveness of a given film in implementing any instructional objective is likely to decrease if, at any point during its production, distribution, and

utilization, the film departs from the context of instructional and educational experience in which it is intended to be used. Unfortunately, many instructional and informational films are produced without adequate consideration of the context of their use, and without due recognition of other instructional materials and instructional procedures which are required in organized teaching, and in organized training and information programs.

Implications. The principle of reinforcement has implications for both the production and use of films. It implies that whether the purpose of a film is to (1) extend and reinforce behavior, or (2) reorganize and redirect behavior, it will probably be most effective when it is planned, distributed and used as one of a series of related and cumulative experiences all of which operate in the same direction. This means that films should be produced and used as part of a package of instructional materials, not as unique instruments of total instructional power and influence. The principle of reinforcement does not imply that films have no influence in reorganizing and redirecting behavior, that is, in helping the audience to understand and to respond in a new way.

The concept that a motion picture is an independently effective experience is likely to be wishful thinking. When the objective of instruction is reorganization and redirection of behavior, it becomes more necessary to reinforce film instruction with supporting instructional materials and experiences and a related social environment, conducive to the learning which films are intended to stimulate.

II: Principle of Specificity

The influence of a motion picture is more specific than general.

This holds true for all instructional objectives. We cannot expect an audience to have a broad general attitude, a general motivation, a general increase in knowledge, or a general improvement in perceptual-motor skills after seeing a single film, especially when these objectives are not treated directly in the film. The cumulative effect of related films, shown over a period of time and reinforced by the social environment and by other instructional experiences may be more general, but, even in this case, the general influence is limited to the broad area of the film content.

Implications. The principle of specificity implies that the sponsoring agencies must define in very specific terms the instructional objectives which a film is intended to serve. The failure to define film objectives specifically in the planning stage of production handicaps film producers severely, and reduces the likelihood that the film will be as influential as it might otherwise be.

III: Principle of Relevance

The influence of a motion picture is greater when the content of the film is directly relevant to the audience reaction that it is intended to influence.

The validity of this principle is immediately apparent when stated in abstract terms but, in the production and use of specific films and in the prediction of audience reactions, it is frequently overlooked and disregarded. There is evidence that some producers, users, and research workers expect a film to influence behavior even though the film content is not directly relevant to the anticipated or predicted behavior. For example, instructors sometimes expect the quality of students' handwriting to improve after showing a film which demonstrates the correct arm and finger position for handwriting. In other cases, instructors expect to find an improvement in arithmetic computation as a result of a film portraying the social applications of arithmetic; or, increased skill in manipulating machinery from a film which explains the operating principles of the machine. Such expectations lead to disappointment.

Implications. The principle of relevance has three implications for film producers.

1. If motion pictures are to have specific influences on the behavior of their intended audiences, the instructional objectives must be defined in terms of specific behaviors.
 2. After, and only after, the desired behavior changes in the intended audience have been defined and described, can the producer select the relevant film content and its treatment. In a motion picture, subject matter content is purely instrumental, and within any given subject matter there is a wide range of possibilities for selection and treatment.
- The selection of proper film content is the general responsibility of the project officer or the technical advisor, and is the immediate responsibility of both the writer and director. A film producing agency cannot develop a precision instrument for influencing behavior if the intended influence is defined for the creative artist in terms of subject matter and not in terms of desired audience response and change of audience behavior.
3. A third implication of this principle is that only those things which are relevant to the behavior pattern which the film is intended to affect are relevant to a film produced to influence that behavior pattern. For example, if a film is intended to demonstrate the firing of the bazooka, then the history of the research on and the process of manufacture of the bazooka is irrelevant. The relevant content of the film is the operations involved in firing the bazooka.

The efficiency of film production is likely to be increased by omitting content that is not relevant to the specific behavior desired. For example, one study definitely established that some "how-it-works" sequences in a film had little, if any, influence in teaching the assembly of a part of a complicated piece of equipment. In this instance, "how-it-works" was irrelevant to the behavior involved in actual assembly. Production time, facilities, and expense, as well as training time, can be reduced by omitting irrelevant content without impairing the instructional effectiveness of the film.

IV: Principle of Audience Variability

Reactions to a motion picture vary with most or all of the following factors: film literacy, abstract intelligence, formal education, age, sex, previous experience with the subject, and prejudice or predisposition toward the subject.

It is often assumed that a motion picture has the same effect on every individual of the audience. Actually, there is a wide range of individual differences in any audience; the more heterogeneous the audience, the greater the range. Moreover, the range of these differences increases as the individuals in the group approach maturity. These differences in individual characteristics cause people to respond differently to instructional films.

Six variables that affect differences in individual response to motion pictures have been thus far identified in research studies.

1. Film Literacy. Film literacy is an ability to learn from films, ostensibly developed by practice in observing entertainment films, instructional films, or both. The psychological nature of this ability is not clearly understood at this time, but probably, as an individual becomes more familiar with the motion picture medium (as measured by the number of movies he has seen), his ability to learn from a film tends to increase also. However, viewing habits appropriate for entertainment films may not be entirely appropriate for instructional films and re-teaching may be necessary.

2. Intelligence. 3. Level of Formal Education. A high level of intelligence is usually accompanied by an extensive formal education in the general population, and both influence the amount of factual learning from films. Intelligence also affects the validity of the interpretation of the material presented (opinions formed). The notions that the motion picture is best utilized for instructing an audience that is inferior in abstract intelligence (the so-called "dull"), and that films waste the time and talents of the mentally-gifted, are not supported by the experimental evidence. Students of below-average intelligence learn more from films than from verbal materials, but students of above-average intelligence often learn proportionately more in terms of possible learning and, perhaps, different kinds of responses

than do the below-average students, provided, of course, that the films do not impose a ceiling on the amount of learning possible.

4. Age. Intelligence and formal education increase with age up to a given point, but age itself is a variable in the way people react to films. As a variable, age is important to the extent that breadth of experience, interests, resistance to excitability, and the leveling and declining of mental alertness vary in different ways with age in an otherwise rather homogeneous group. The ability to perceive and to retain motion picture content seems to reach its peak somewhere in the late teens or early adulthood, and then gradually declines. Moreover, excitability and resistance to excitability, that is, "emotional discount," appear to be rather well established in the late teens, although there is probably some change during later ages.

5. Sex. In some cases, persons of different sex have been found to respond differently to films. Most likely, sex differences in responses to films are largely the result of the values, activities, occupations, and other social norms assigned in the American culture to males and females. Whatever their origin, sex differences may affect the attitudes and information gained from films, and they do affect attendance of teen-agers, at least, at entertainment motion pictures.

6. Predisposition. A person's predisposition, or prejudice, toward the subject of a film influences the degree to which he accepts the point of view and interpretation of the film, and the direction of the effect of the intended influence of the film. In general, the influence of the film will be in the direction in which the film content is slanted, but this influence is likely to vary in degree and durability according to the predisposition of the individual. As a result of predisposition, individuals vary in the direction and degree of their response to films, and any one individual may respond differently to single items in a film. Boomerang effects (reinforcement of the individual's prevailing mind-set) may occur when the bias of the film is contrary to the individual's predispositions. Other things being equal, predisposition is likely to have a stronger effect than the immediate intended influence of the motion picture if its bias is contrary to the individual's predisposition.

Implications. One implication of this principle is that the effectiveness of a film or films cannot be assured unless the audience characteristics which influence the nature and extent of response to the film (1) and known, (2) are carefully described, and (3) the film presentation is appropriate to them. Therefore, if film production is to have a scientific basis, as well as artistic treatment, a considerable amount of pre-production research on audience characteristics must be done. This research requires more than a pre-release testing of a given film on a sample of its target audience, although this procedure probably helps to improve specific films. It involves knowing, insofar as possible, the distribution of ages and learning abilities, the

previous knowledge and training of the audience in the particular subject, and the predispositions of the audience (or, at least their dominant direction) on attitudes, opinions, interests, and motivation. After the target audience has been described in terms of these variables of response, the producer can plan more effectively and develop the appropriate film content and organization.

A second implication of the principle of audience variability as applied to film production is that, for a target audience with a relatively narrow range of ability, a single film, produced for a level slightly below the average level of intelligence and education of the audience, is likely to be effective. But, if the audience has a rather wide range of ability, two or more film versions, each presented on a different level of complexity and instructional technique, may be and probably are necessary for most effective learning. There is no experimental evidence that film instruction techniques designed for pupils of average intelligence interfere with or impede learning among pupils of above-average and superior intelligence. A fact that military-film producers have apparently overlooked in the present emergency is that the level of formal education of the current draftee population has increased over that of the draftee population of World War II. The majority of today's draftees have completed high school, and one out of five has had some college training.

The use of audience participation techniques and film introductions are apparently effective under certain circumstances in increasing learning of the below-average individuals in the audience. They are not as positively effective among above-average individuals, but, as far as is known at this time, they at least do not interfere with learning by the above-average individual and probably make some contribution to it. Furthermore, (1) limiting the amount of film instruction in a session of a given length, and (2) showing films at intervals rather than consecutively, do not interfere with the learning of the above-average individuals, but packing or crowding of film instruction into a long film session and showing films consecutively may have an adverse effect on an average or somewhat below-average audience.

For film users, the principle of audience variability implies that there is no one method of using films which is appropriate to all audiences or to every person within an audience. The instructional procedure for using a film must be adapted to suit the abilities and backgrounds of the majority of a particular audience. As implied in the Principle of Reinforcement, instruction becomes more difficult as the variability of the audience increases.

V: Principle of Visual Primacy

The influence of a motion picture is primarily in the strength of the visual presentation, and secondarily, in the narration or commentary. It is relatively unaffected by "slickness" of production as long as meaning is clear.

This principle may profane some sacred cows of the film industry, but its validity for instructional films* is becoming increasingly clear from comparisons of the relative instructional effectiveness of: visual and auditory elements; various levels of verbalization; attention-gaining devices; and color and black and white film.

The primacy of the visual factor is further suggested in film-analyzer studies of audience like-dislike reactions to the visual and auditory elements of sound motion pictures. It is consistent with the hypothesis that all learning involves individual discovery, that discovery itself is in some degree non-communicable, and that communication serves only to facilitate discovery. The picture (still or motion) makes individual discovery possible, as does the actual situation it portrays. Language puts this discovery into words, or alerts the audience to it. Film commentary can actually interfere with, as well as facilitate, learning from the pictures. There apparently is a golden mean of amount of verbalization in an instructional film commentary, somewhere between the "blamable extremes" of too little and too much.

Many of the visual and auditory usages characteristic of the entertainment film and radio industries seem to have little direct influence when applied to instructional films. For instance, unless the color provides crucial learning cues (e.g., as in identifying colored signal flags), color film does not give better instructional results than black and white film for many kinds of content. There is some evidence to suggest that visual or sound attention-gaining devices do not add significantly to the instructional effectiveness of an otherwise well-made film. Musical background, which has been studied very little, was found in one small study to have little effect on the instruction of elementary school pupils. Possibly, music may serve to announce some particular sequence or underscore a mood, and its effect probably depends on its familiarity and symbolic significance to the individual.

Implications. The implications of this principle are more apparent in relation to the production than to the utilization of instructional films. For one thing, it suggests that a motion picture should not be approved for production unless the subject lends itself to fluent visual presentation that can be well specified. The basic criterion for deciding to produce a motion picture is not the importance of the subject, as such, but the suitability of the subject for communication by motion picture.

A second implication is that the production staff should continually remember that it is producing a motion picture, and not an illustrated lecture. The story-board, although more exacting and more time consuming in the pre-photographic stages of planning and production is likely to be more useful and efficient than the purely verbal script.

*Those which are truly films, and not lectures combined with some more-or-less related pictures.

Story-board treatments may require closer teamwork and less specialized division of labor in the pre-production stages between artists, writers, directors, and technical advisors.

A third implication is that the amount of language (commentary, narration, and dialogue) used in a motion picture should be limited, and that it be used either to express or integrate the meanings of the pictures or to alert the audience to these meanings.

A fourth implication is that the production cost of instructional motion pictures in time, facilities, and personnel may be substantially reduced with little, if any, sacrifice of instructional effectiveness by reducing the emphasis on filmic devices and "slickness," and increasing the emphasis on straightforward use of the camera and integrity of presentation.

The implication for the film user is that when motion pictures are produced as motion pictures, rather than as pictorial backgrounds or illustrations for the verbal lessons presented in the sound track, the effect on the audience is more likely to be stimulating: discussion, analysis, re-showing, and other independent activities are likely to be a natural consequence of film use, rather than a routine and sometimes painful requirement.

VI: Principle of Pictorial Context

An audience responds selectively to motion pictures, reacting to those things which it finds familiar and significant in the pictorial context in which the action takes place.

It is wishful thinking for film producers and film users to assume that everything shown and said in a motion picture will be seen and heard, learned and remembered by everybody in the audience. People respond to motion picture selectively, not photographically, and it is apparent that audience variables affect the selectivity of response. The question is, "What factors in the motion picture influence the selection of responses and the nature of the responses selected?"

The most important factor determining response selection in a motion picture seems to be the pictorial context or surroundings in which the action is presented. Moreover, it is important for the context to be (1) familiar, and (2) significant in terms of audience values. Therefore, the condition that apparently determines the perception and retention of specific scenes in the film by an audience, is not the action itself, but the importance or meaning of the action; not the close-ups themselves, but the significance of the object in the close-ups; and not the performance of the task, but the meaning of the task to the audience. What an audience sees in a film depends on the answer, in the film, to the individual's question, "What does this mean for me?"

Implications. This principle suggests that alternative structures of film form and, treatment, such as cartoon or live photography, and

dramatic or "straight" treatment, may not be effective in themselves. Rather, the effectiveness of any structural form or treatment depends on the way the context of action is developed in the film. The crucial cues for learning a particular subject or task should be identified and "built into" a film using a suitable treatment. Important scenes or interpretations must be made to appear important to the audience. A priori decisions on structural form and treatment, based entirely or primarily on artistic, aesthetic, dramatic, or entertainment preferences, are likely to involve time and expense in film production out of proportion to instructional results.

VII: Principle of Subjectivity

Individuals respond to a motion picture most efficiently when the pictorial content is subjective for them.

This principle applies to the camera position from which the content is photographed, to the roles characterized in the film, and to the treatment of the content of the picture. The subjective camera angle, that is, photographing the action from the eye-position of the learner, makes for better learning than photographing the action from the opposite position. The influence on attitudes, exerted by the prestige role of the principal character in a film and by audience identification with the social institution involved, such as a religious denomination, have been suggested in film research. Similar influence on factual learning has also been suggested, but the evidence is less reliable.

Implications. The principle of audience subjectivity emphasizes that it is desirable to show the errors the learner is likely to make in learning to perform a task. This application is contrary to the somewhat widely accepted doctrine that wrong methods ("negative instruction") should never be shown in instructional films.

For the film producer, the principle of audience subjectivity implies that the instructional content of a film be presented much the same way as the audience would normally view the actual subject, and in such a way that it can see itself in the film. An audience probably sees the subject and itself in terms of variables indicated in the Principle of Audience Variability. Creative film artistry requires not only a clear, workmanlike representation of the subject or lesson in a film, but also a representation of the subject or lesson that causes the audience to become involved in the subject and accept, with some degree of enthusiasm, the lesson of the film.

Theoretically, at least, an audience becomes involved in a motion picture to the extent it can identify itself with some or all of the following factors: the role of the protagonist or principal characters, the personality of the actors, the situations portrayed, the obstacles encountered, the mistakes to be avoided, and the successful resolution of the problem or task portrayed in the film.

A second implication has to do with the final approval of an instructional film for distribution or use. A film, acceptable on the basis of accuracy of subject matter and excellence of technical production, may be ineffective for the audience for which it is intended. The "expert" who has the authority of approval is likely to be "expert" in subject matter or photographic technique, rather than in a knowledge of the intended audience and the suitability of the instruction in the film for that audience. This latter type of "expertness" is a prerequisite for legitimate evaluation of a film prior to its release for distribution.

VIII: Principle of Rate of Development

Rate of development influences the instructional impact of a motion picture on its audience.

There has been a tendency on the part of film producers and film users to regard more learning in less time from films as an absolute goal, and, accordingly, to put a large amount of instructional material into a relatively short film. An audience's liking for entertainment films packed with fast action is often generalized and applied to instructional films. However, one of the differences between entertainment and instructional films is that the former is designed to please, whereas the latter is designed to instruct.

A slow rate of development in an instructional film is greatly superior to a rapid rate of development; in fact, a succinct (condensed) treatment of instruction material, particularly in perceptual-motor learning, may be very ineffective. It is clear from the research that learning from films takes time and effort, and that some of this time must be provided by the film itself.

Implications. This principle implies that instructional material must be presented in a film at a rate that is geared to the learning capabilities of the intended audience. In general, the rate of learning from instructional films is somewhat slower than is popularly believed.

IX: Principle of Instructional Variables

Established instructional techniques, properly built into the film or applied by the instructor, substantially increase the instructional effectiveness of a film.

Instructional motion pictures have been produced and used as if the traditional instructional techniques either did not apply to the motion picture as an instructional medium or were nothing more than the eccentricities of "old maid" teachers. But these techniques do apply, and the following is a list of the instructional techniques, which, if properly used, significantly increase learning from films:

1. Orienting an audience on what it is going to see or summarizing what it has seen.
2. Announcing that a check-up or test on learning will be given after the film.
3. Repeating the important points (with variation) within the film. Showing the film more than once.
4. Conducting audience-participation (pr practice) exercises during or after a film showing.
5. Informing the learner of how much he has learned. Giving test results or correct answers as soon as possible, or during the film if the practice is conducted during the film.

Research indicates that there is a cumulative effect in the combined use of some of these procedures. The two instructional procedures which have been repeatedly shown to have a critical effect on the amount of learning from a film are: (1) repetition, and (2) participation or practice of the relevant behavior, either during a film showing or following it. Discussion after a film and taking a test on the film material are both forms of practice or participation.

Implications. This principle implies that the instructional effectiveness of films can be increased during both the production and utilization stages by the deliberate inclusion and insightful application of well-known and proven instructional methods. But, these procedures should not be applied in a dull, dreary, or "stuffed-shirt," manner when making a film or using one. Without creative artistry, learning, which involves "suffering and undergoing" even under the best of circumstances, becomes a more difficult process.

This discussion suggests two ways of improving the structure and use of films: (1) insert the appropriate instructional techniques and methods directly into instructional films, especially when the instructor or the conditions of instruction are likely to be poor; and (2) train instructors in effective instructional techniques, and how to apply them to film instruction.

X: Principle of Instructor Leadership

The leadership qualities of the instructor affect the efficiency with which his class will learn from the film or filmstrip.

The instructor is a leader of the group under instruction. As a leader, he plans, arranges, and manages instructional situations, materials, and procedures in a way that creates a favorable atmosphere for learning and stimulates the performance of the group. Instructors vary in their ability to create this atmosphere.

One of the most significant findings of film research is that the amount of learning from an instructional film depends not only on the film and on the audience, but also on the motivation and morale that result from the leadership qualities of the instructor. In one study this motivation and morale appeared to carry over to film learning when the instructor was actually not present during two or three separate showings of the films.

Implications. The principle of instructional leadership implies that films do not and cannot substitute completely for the good instructor, especially in the exercise of leadership functions, and that a well-trained instructor is one of the essential elements of effective film instruction. There is no evidence that the instructional methods or procedures used with films are any different from the methods used with other instructional media.

Part III. Some Observations

The five instructional values of appropriate films were clearly indicated in the research literature reviewed. The ten principles of film influence have been suggested by and are at least partially supported by the accumulated film research of the past thirty-odd years. As research continues, as better techniques of observation and analysis are developed, and as theoretical systems provide new insights, these principles can be extended and modified as necessary. More creative and courageous minds may be attracted to the field of research as the interest in and uses of audio-visual media increase. Eventually, the paralyzing fear of imperfection that obstructs pioneer thinking and deprives research of the derring-do of scientific inquiry will diminish.

In drawing this review to a close, a few general observations on the influences of motion pictures and on ways of improving films so as to capitalize on this influence appear to be in order. These observations are made on the basis of our review of film research and our experiences in actual situations of instructional film planning, production, and use.

1. When NECESSARY and DESIRED learning is dependent upon a background of experience possessed to only a slight degree by the learner, the advantage of the film over other media, especially for rapid mass instruction, may be most evident.

A good film, with its subjective presentation designed to create involvement, can give the learner clear-cut notions of unfamiliar objects and actions in the world about him better than other methods of instruction, with the possible exception of television. This seems especially true in those situations where the individual must learn a series of motions in performing a complex skill; or where he must acquire a concept of certain action sequences such as might be involved in physical or chemical processes, biological development, social be-

havior, or tactical maneuvers; or where it is desired that he feel the atmosphere and spirit of the situation or "times" being portrayed.

2. The actual influence of a given motion picture is frequently less than its anticipated influence.

This holds for a single motion picture, and it holds for the influence of this one motion picture on information, opinions, attitudes, skills, and other behavior patterns. The effect upon information is likely to come closer to expectations than will that of the other types of learning outcomes. A notable exception was the pronounced success of certain versions of the 40mm breechblock films in teaching a somewhat puzzling assembly task (Jaspen, 1948).

There is very little or no evidence that the experience of a motion picture, in and of itself, is a sole determinant of certain thoughts, feelings, or actions. Instead, the evidence indicates that prior knowledge, attitudes, dispositions, and values relating to the subject of the film enter into the individual's interpretation of the message of the film and its meaning. Motion picture experiences, to be effective, generally require reinforcement by other related experiences and by appropriate social and psychological rewards.

The "adult discount" noted in connection with the Payne Fund studies of entertainment film influence in the early 1930's, may have increased during the past twenty years as defense against overstimulation from radio, movies, and more recently, television. The triviality of much of the content of these three media, plus the "entertain-me" attitude with which an audience approaches these media, may also tend to militate against optimum influence of even the best-made film.

It is evident from the research data that if strong attitudes are to be changed, information is to be understood, skills are to be taught, and action patterns aroused and structured, it is not enough simply to make and show one movie on the subject. The concept of a motion picture as a unique determinant of human behavior is a contradiction of the American concept of the dignity and integrity of the human personality.

3. If motion pictures are to teach, they must be made as tools of teaching, rather than merely as examples of cinema art.

Whatever the origin and whatever the explanation, it is evident in some instructional films that the concept of teaching and the role of the "teacher" have not dominated their production. Sooner or later, it seems that the making of an instructional film turns into a major movie production. Deep in the soul of many producers of films, including instructional films, is the bright hope of recognition and award at some Film Festival or by some Academy dedicated to the Art of the Cinema.

The solution to the problem of the Art of the Cinema probably does not lie in abortive attempts to eliminate the hope for recognition and

award, but rather to base recognition and award on the effective performance of the teaching mission of the documentary, informational, training, and educational film.

4. If the effectiveness of motion pictures in instruction is to be increased, improvement must be made by all involved, not simply by the producer.

This observation assumes that effectiveness of motion pictures in instruction, i.e., in teaching, can be improved. The research evidence demonstrates that film effectiveness can be substantially improved at both the production and the use levels.

Two things are required to effect this improvement. First, the concept of the ultimate use of the film must dominate the entire planning, production, and distribution of the film. In turn, the concept of organized instruction, organized information, or organized training must constitute the frame of reference for thinking on the use of the film. If and when this is done, the motion picture can and will be accepted as a tool of teaching, rather than a determinant of human behavior. The emphasis is shifted, then, from the film as a movie production, to the film as one of the several instruments, devices, and procedures to be employed to achieve a desired change or enrichment of the behavior pattern of the target audience.

Second, much more and much better staff work in pre-production planning is required. An effective film is not likely to be produced unless and until its performance requirements are spelled out, its audience defined, and the use situation carefully described. There is not enough genius and sheer talent in the film production field to compensate entirely for inadequate staff work in pre-production planning and analysis, and for inadequate training in utilization.

NEEDED RESEARCH IN EDUCATIONAL MEDIA

Edited by Wesley C. Meierhenry

University of Nebraska

Research findings have long been used to guide practices in the audiovisual field. Fortunately, the increased research activities supported in the last several years both by major educational foundations and by the federal government--especially under Title VII of the National Defense Education Act--include a good many studies on the use of audiovisual materials in the learning process.

A review of these studies, however, indicates that to give teachers and administrators better recommendations for the use of specific media, much more needs to be known. The group of researchers who were invited to consider the status of this field and to identify areas in which fruitful research might be undertaken included members of the Research Committee of the Department of Audiovisual Instruction.¹ The suggestions they agreed upon are set forth here. Not intended to be completely definitive or inclusive, they can help focus the attention of those who are interested in AV research--all the way from the graduate student to the full-time researcher--on especially important problems in this field.

It is recognized that the mere listing of research problems will not automatically produce new and better research findings. It is also recognized that the ability to ask the right questions is a prime requisite for any researcher. It will be necessary, therefore, for individual researchers whose interest is fired by any sample question presented here to raise further questions himself, and to think through the relevant hypotheses. Both of these preliminary tasks are among the most difficult in the whole realm of research.

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¹Other members of the group were William H. Allen, Lee Cochran, Jack V. Eding, Roy Hall, Charles F. Hoban, Anna Hyer, Armand Hunter, John A. Molstad, Loran Twyford, A. W. VanderMeer, and Paul W. F. Witt. Teaching Film Custodians, Inc. provided financial support for the meetings May 19-20, 1961.

The inventoried material is grouped into three large categories of needed research: (a) Learner and Media Characteristics and the Interactions Among Them; (b) Extension and Verification of Theoretical Formulations; and (c) Equipment, Facilities, and Dissemination. To some degree these headings correspond with the terms basic research, field studies, and operational research. The reader will note considerable overlapping and interrelationship among the questions raised in each of these categories. Both should be expected since any change within a system's concept has implications for the remainder.

Each of the three large categories includes general statements and a series of broad questions which in some cases might be considered assumptions and in other cases, hypotheses. Following these general questions, a considerable number of specific projects are also listed in question form. As phrased, many of these questions are still too broad for specific research studies, but some are near to researchable problems.

Learner and Media Characteristics and Interactions

Learner Characteristics

Certain basic characteristics of the learner may not necessarily influence results of audiovisual instruction. Some, however, are patently significant for media researchers as they seek to find out what differential results growing out of the use of media depend upon differences in learners. Topics of profitable study for these researchers include:

- Such aptitudes or capacities for learning as (a) audio vs. visual vs. verbal vs. tactile vs. affective aptitudes; (b) individual interests.

- Such variables as (a) the grouping of learners by ability (gifted, average, slow, homogeneous, heterogeneous, etc.); (b) personality factors; (c) identification factors; (d) aspiration levels; (e) levels of creativity.

- Specific Projects

1. What new media are useful in teaching the gifted?
2. What research on individual characteristics as they relate to learning has been analyzed? What strategy has been developed to apply the findings to learning from new media?
3. Assuming that audience variables affect learning from the media, how can they be identified? Under what conditions do they operate? How do they interact with the media and content variables?
4. What are the general principles of "learning to learn" from the media? Can technique be developed?

5. What principles can be identified which relate students' interests to the different media? Do various types of learners especially like certain media? If so, why?

6. What method would be used to select or identify audiovisual and/or tactile learners in order to relate instruction toward each?

7. What studies deal with organizational, procedural, and motivational patterns appropriate to the increasing audiences that the new media serve? For example, open-circuit television?

Interactions of Teacher, Student, Media

• Roles of Teachers

1. What are the functions of the teacher in the selection and use of various types of educational media: (a) as a mediator between the student and the media and with various kinds of learners? (b) at the several levels of education? (c) with reference to different environments?

2. What is the most effective relationship of the classroom teacher and the teacher in the studio (television or film)?

3. How can the teacher provide a humanizing element in the presentation of instructional materials? In what other ways--if not through content--can the teacher provide for the personalizing of subject matter and learning experiences generally?

• Interaction in Learning

What are the nature and significance of the interaction in teaching and learning between learner and teacher, learner and learners, and learners and educational media? Can learning proceed satisfactorily without interaction? What is the place of participation and feedback in learning?

• Functions of Media

1. What are the basic functions of the media?

2. What are the functions of media in exploratory-cooperative types of teacher-pupil learning activities?

• Specific Projects

1. How does the teacher act as mediator between the student and the media?

2. Margaret Mead has said that one of the best instructional settings is one in which the teacher and the learner explore and learn together. Do media provide an acceptable means of presenting the "mass of experience" in which this joint process might operate? How?

3. What is the most effective relationship between the classroom teacher and the studio teacher in the production of motion pictures or instructional television programs?

4. What are some of the dimensions of interaction in learning? To what extent and under what conditions are participation and feedback necessary in learning? When, if ever, can learning proceed satisfactorily without interaction?

5. What are the essential functions of the teacher, the media, and the students in attaining specific types of educational objectives?

6. What interaction takes place between the learner and the medium?

7. Does the presentation of instructional materials by, or under the direction of the teacher, provide a humanizing element, or are there better ways to personalize the subject matter and the learning experience generally?

Media Combinations

- Given certain well-defined instructional objectives, can a certain medium meet and fulfill those objectives and purposes better than any other medium?

- What characteristics of the individual elements of a medium are distinct from its totality or effect of the whole? Is the effect of the message and medium a sum of the parts or greater than the sum?

- What are the principles for combining the media to produce the best learning (systems approach)? What are the advantages or disadvantages of overlap? Does the use of combined or multiple media overload and distort the learning process and environments? What are the principles of relationships (a) between media? (b) between media and teacher? (c) between media and different learning needs and objectives?

- Specific Projects

1. Can we identify specific media or design of media which will fulfill certain instructional objectives and purposes better than any other material or design?

2. How may we weave together two or more types of media to get the best learning? What are the principles?

3. Can the use of multiple media clutter up the learning environment and actually provide a negative factor for the students?

4. What is the interrelatedness of instructional media to each other and to the different learning objectives?

5. What materials and equipment are most essential, considering that some overlap?

6. From a study of media in detail, what findings differentiate elements from the totalities? What makes a particular stimulus communicate or fail to communicate?

Media and Communication Process

There is reason to believe that the skillful use of any type of audiovisual material will improve instruction. There is also reason to suspect that for many purposes the appropriate use of a combination of media will facilitate learning more than the use of only one type. Much more evidence is needed, however, to determine which medium, utilized either alone or in combination with others, will contribute to specific educational objectives.

- How can media which contribute to such objectives as generalizations, transfer of learning, concept development, creative thinking, and values be developed and utilized?
- How do various media complement and/or conflict with each other in teaching certain instructional goals? Granting that there may be interference among several media when used in consort, that one medium may best meet a specific instructional objective, and taking account of economic factors, varied teacher competence, and related factors, what equipment and materials are critically essential?
- What principles pertaining to readability, redundancy, and idea density should govern the preparation of materials to stimulate desirable learning in the shortest possible time?
- To what degree, if any, is local involvement in production of instructional materials necessary to meet appropriate educational objectives?
- How might pertinent developments in such fields as semantics, communications, and cybernetics be integrated and applied to AV research and practice?
- To discover whether many more educational objectives are attainable through use of the newer media, can a taxonomy of their use as related to an eclectic set of educational objectives be developed?

- Specific Projects

1. How can media best be employed to provide for greatest transfer of learning?

2. How can existing media and personnel be employed to create optimum learning situations for various kinds of learners?
3. What new kinds of learning situations can be created with new media? What newer media, not yet invented, are needed in education?
4. How effective are critical introspection, observation, and evaluation of student learning that involves teachers, teaching machines, and other AV materials?
5. What research is needed to help define the most useful role for television and teaching machines in American education?
6. What are the unique contributions of different instructional media and teaching methods?
7. How might studies of the integrated use of textbooks, teaching machines, projected and non-projected visuals, language laboratories in ideational learning, motor type activities, attitude development, and problem solving be developed?
8. Is it possible to program purely verbal materials by means of teaching machines and tapes, and still develop meaningful concepts and principles?
9. Do media have inherent advantages in giving vast backgrounds of needed information in the several subject matter areas so as to permit greater concentration on more recent materials and events? What are they?
10. To what degree must learning materials, including media, provide for immediacy, intimacy, and rapid changes to accommodate daily happenings?
11. Can fast-speed reading techniques be applied to audiovisual materials?
12. What are the various elements in the communication process?
13. What are the principles to guide readability and redundancy in the preparation of materials for various media and learners?
14. What principles can guide the development of limits for idea density to provide optimum learning conditions for various learners?
15. How can interference among channels on a multi-channel message be reduced?
16. How could research in semantics be applied for the improved use of media in education?

17. If visual materials alone were used as the experience for a restricted learning task such as driving a car, what would be the result of an intensive study of that learning? This situation probably would involve a feedback loop for continuous evaluation of every innovation.

18. From a trend analysis, what should be known as to the effect of the introduction of new media on the quantity and kind of production and on the use of older media, including changes in format and structure of content?

Extension and Verification of Theoretical Formulations

Certain models or theoretical formulations for many problems relating to the use of media need to be verified, modified, or rejected through actual field activities. As part of such activities, however, there is the corollary problem of preparing more sensitive instruments to measure the results of using the media.

Models, Theories, Instrumentation

There is need for a thorough assessment of the status of research in the media field including studies on:

- The degree to which models and theories are used or are being developed.
- The level of sophistication with reference to objective methods which include instrumentation--tests, designs, concepts, definitions, and assumptions.
- Causes of errors, unreliability, lack of validity, and other weaknesses of present research efforts and activities.
- Applicability of techniques from other social science fields.
- Criteria for judging effectiveness of experiments.
- Study of unique methods and techniques, such as the film analyzer techniques, content, emphasis analysis, and semantic differential analyses.
- Media for simulating teacher behavior.
- Media for simulating instructional processes.
- Specific Projects

1. What studies are needed to refine various techniques--such as film analyzer techniques, various content and emphasis analysis, and semantic differential techniques--that are especially useful for certain types of research in AV communication?

2. What factors are contributing to the large error variance now characteristic of most media research? How may more sensitive and valid measures be developed?

3. How many various aspects of teacher behavior be defined, analyzed, and measured? What are the criteria for determining the degree and direction of actual behavioral change?

4. How can media be employed best to study the instructional process?

Relevant Visual and Verbal Symbols

- Study the basic elements of learning from verbal materials as contrasted with learning from visual materials. To what extent is the verbal mode self-sufficient? What are the contributions of various visual characteristics? Do we "learn to learn" from visuals--a type of visual literacy?

- Appraise and demonstrate the most important contributions of the new media in practical educational situations. This project could include demonstrations of economy, methods to bring about new media innovations, the use of devices to replace grading, and longitudinal studies of the effect of these innovations.

- Specific Projects

1. Visual and audio literacy: How do people learn from film, television, sound recordings, and other media?

2. How much information can visuals handle? What kinds of information can they handle best? These questions obviously involve basic research on information content of visuals.

3. What experimental studies and theoretical analyses concern learning from pictorial stimuli? Of what importance in learning from pictorial stimuli are these specifics: (a) quality of the visual image? (b) color? (c) style? (d) optimum redundancy level for various types of visual presentations? (e) effectiveness of analogical and digital cues in various presentations? (f) motion? (g) animation?

4. What unique contributions have been made by the audio and video means of teaching machines as a research technique?

5. What basic elements in learning from sounds and pictures may be identified through a study of the rhetoric of audios and visuals?

6. What would a study of verbal vs. visual vs. audio modes of programming for teaching machines reveal?

7. Do we need to develop visual literacy in learners? If so, how may we do it?

Motivations and Attitudes

- Are the new media intrinsically motivating? That is, are attempts to provide extrinsic incentives for learning unnecessary when an optimum instructional method is employed? What are the characteristics of such a method?
- What are the effects of the new media on creativeness, on the ability of students to transfer learning and to solve problems, and on other higher thought processes? What new production and utilization techniques would enhance their effectiveness for these purposes?
- To what extent can the media be utilized to teach the consequences of holding various systems of values?

- Specific Projects

1. What is the impact of attitudinal and motivational material, including that presented by the new media, as contrasted with factual presentations?

2. If studies of new approaches and techniques to make media presentations more effective in developing student creativeness, problem-solving abilities and greater transfer of learning were conducted, what would they reveal?

3. What effects do new media in various types of usage have on creativity and higher-thought processes?

4. How could the newer media be used to teach values?

5. How can media be employed to develop increased motivation for learning? How can they be made more intrinsically motivating?

Systems Analysis

Systems and operation studies concerned with the cumulative effect of all media, teachers, teaching method, organization of instruction, and logistical supported are needed. Especially helpful would be studies assigning weights to relative contributions of each factor in the total product or outcomes of the instruction, and relating each to costs, time distribution, etc.

- Other studies are needed on how media may be used to provide students non-didactic experiences which are socially useful and desirable within the rhythm of the formal school organization; for example, assemblies intended to increase group cohesiveness and pupil activity when normal instruction is interrupted during the school day.

- Do self-instructional devices develop habits of study which will persist and operate when the individual needs to solve new problems? How?

How may these devices be used to provide new instruction needed when the individual confronts new problems that he is not otherwise equipped to deal with in an orderly way?

- Specific Projects

1. What is the percentage contribution of such various sources of learning as books, associates, teacher and teaching aids?

2. What implications would operations research on the total instructional process reveal for the new media?

3. How are the new media used to supplement other instruction?

4. How are self-instructional devices used to provide needed instruction when they are required rather than materials stored up years in advance?

Equipment, Facilities, and Dissemination

To introduce new techniques and procedures into any ongoing enterprise obviously requires varied adjustments not only in equipment and facilities but by staff members. Before these adjustments can be made, appropriate information must be disseminated to help all individuals who are concerned with the operation of the system understand the desirability and feasibility of the proposed changes.

Operational Problems

- To utilize the new media effectively for educational objectives, research and experimentation are needed to develop guidelines for the determining of desirable organizational patterns, personnel requirements, provision for equipment and material, physical facilities, and budgetary needs. Variables to be considered are school systems of different sizes, school systems utilizing varied curricular and/or organizational patterns (large group instruction, conventional groupings, team teaching), and systems with different economic potentials and educational aspirations.

Other studies need to be undertaken to provide similar guidelines for various types and sizes of colleges and universities.

Such guidelines would provide direction to practitioners faced with these kinds of problems:

1. What factors are involved in the introduction and use of new media including in-service education needs, equipment and facilities needed to accomplish instructional goals, budget guidelines? How can we best overcome resistance to change and definitely promote acceptance and use of new technological media in instruction?

2. What types of instructional materials, production facilities, and dissemination devices--such as closed-circuit television and language laboratory facilities--should be added? When and to what extent should these be developed?

3. What types of competencies are required of the various instructional material personnel and of the staff building coordinator on the elementary, junior high, and senior high school levels? Of the system-wide director? What time allotments are needed by each of these personnel categories? What salary ranges are required? What specific media facilities are needed in the classroom, the individual buildings, the system-wide installations, and in colleges and universities?

4. How can we evaluate the extent to which new media utilization is improving student learning?

• Specific Projects

1. What would be the results of a comparison of several methods for bringing about new media innovations in education?

2. What would be the value of the establishment of a school to demonstrate economy in education, keeping teachers and facilities as variables?

3. What would the development of action research projects at classroom level reveal?

4. What would a longitudinal study of the entire school program organized on a rational level considering objectives, media, and learners include?

5. How would an organization of materials and materials services in school systems and colleges be beneficial?

6. What will it take to get an adequate level of financing for audiovisual programs, and what will be the method of assessing costs?

7. How might the new media be used to establish a school in which learning rather than endurance is the goal?

8. On the basis of what we know and what we can reasonably predict, what would be included in an attempt to project a picture of the form of education and a model of the schools to 10, 25, and 50 years in the future?

9. What might a media-oriented school look like, and what effect might this orientation have on the products of education?

10. What should be considered in the establishment of a school in which student learning determines the required structure, staffing, learning materials, and organization?

11. Physical and environmental factors unique to television, film, and film strip projection, use of overhead transparency projection, and other machines may affect students' eyesight, postural and muscular stresses, and fatigue. What would be the outcome of studies of these possible effects?
12. How is the preparation of leadership personnel in media fields conducted.
13. How do you identify, educate, and interest researchers competent to work in media? What procedures would increase productive media research?
14. What is the value of seminars for research training?
15. What do job analysis studies of studio and classroom television teachers, audiovisual coordinators, audiovisual directors, and instructional materials specialists reveal which might help provide a guide for the development of appropriate training programs?
16. What is the nature of the changing roles of the educational media specialists, and how can the nature of these changed roles be communicated to them?
17. Is there a process for translating research findings into practice? How may all teachers be qualified to use new media?
18. What are the most effective ways of disseminating educational information for the different segments of the audience?
19. What should studies investigating the best method to compile and summarize existing research in audiovisual communication yield so that results and recommendations can be communicated to the lay public, teachers, school administrators, and research specialists?
20. How can a useful, unbiased, and complete compendium of research evidence be prepared in various areas of investigation such as television, teaching machines, systems, teacher education, and methodology?
21. How can logistical studies on costs, personnel, physical conditions, etc., be developed to support instruction optimally? How much do we need to spend to do the most effective job using all known types of human, technical and material sources?
22. How are studies of the economic and administrative aspects of programming film series via in-class projection, closed circuit television, and open circuit television developed and used?
23. What has been accomplished in research and development on new kinds of equipment and, particularly, on a low-cost, light-weight, self-teaching device that will display moving or still visual material, have sound, and possess random access capabilities?

24. What studies of deterrents and factors are responsible for the slow acceptance and development of audiovisual communication training programs in colleges and universities? How?

25. What do research studies disclose as to how we can overcome resistance to change through use of new technological media in education--resistance by the lay public, college and public school teachers, and administrators?

26. How do you most feasibly attempt to change the attitudes of students, teachers, administrators, and the lay public toward innovation? What techniques will create an atmosphere of acceptance so that students may be exposed to new experiences and patterns of learning? How do you overcome fear of the mechanization of part of the learning process?

RESEARCH ON FILM USE:
STUDENT PARTICIPATION

by William H. Allen

University of Southern California

During the past decade no single variable of film use has been studied as intensively as that of "participation." And no other variable has elicited such general confirmation as a means of facilitating learning from audio-visual communication materials.

Participation cannot be described as a single technic of film use. It is rather a name that has been attached to a group of technics, all having certain elements in common. The conditions for participation require that some kind of overt activity consciously be engaged in by the learner as he is exposed to the communication and that this activity be systematically evoked either by the communication itself or by some other person or device. Therefore, participation, as used in this sense, requires more than the kind of incidental audience involvement that might arise from identification or familiarity with the communication.

The number of these technics that might be devised is still unknown, but the following have already been investigated and will be considered in this discussion: recitation, "mental practice" (both overt and covert), rehearsal or practice, the knowledge of results, verbalization, discussion, and note-taking. Possibly some of these technics are but different names for the same psychological mechanism, but a clear-cut definition of each and its placement within the pattern of participation as such awaits further evidence and experimentation.

Contributions of Research in Learning

Different investigators account for the superiority of participation technics in various ways. Hoban and van Ormer (10, pp. 8-16) consider it to be one of several "audience involvement" factors, the others being identification, familiarity, subjective camera, anticipation, and dramatic structure and cartoon form. Hovland, Lumsdaine, and Sheffield

Reprinted from "Research on Film Use: Student Participation," AV Communication Review, V (Spring 1957), 423-450.

(11, pp. 264-265) suggest that the factors of "direct rehearsal," "motivation," and "practice under stimulus conditions of the response subsequently to be performed" are the determining ones. Michael (19, p. 39) concludes that the main factor in responding to discrete items of factual information is "practice"; but that where principles or methods are practiced there is "transfer" to non-practiced items, the transfer being in terms of generalization phenomena rather than in motivational terms. Roshal (23, p. 10) supports the "practice of the response to be learned" position. Gibson (5, p. 148) supports the principle of "overt response with reinforcement of right and wrong response."

It appears that much of the film research with the participation variable has been either made or interpreted within the conceptual framework of Clark Hull's theory of learning. An application of his principles of "stimulus generalization" and "response generalization" leads to Roshal's (23, p. 4) hypothesis that "film-mediated perceptual-motor learning will be facilitated as the learning situation approaches an accurate representation of the learner himself actually performing the task or skill to be learned." If the learning situation is to be designed to approximate the performance of the response to be learned, actual practice of the response is required. Such practice is achieved by means of a participation technic.

Hovland, Lumsdaine, and Sheffield conclude that "The most obvious advantage of active participation is that it insures rehearsal of responses which are to be learned" (11, p. 264). This rehearsal of practice calls into play the law of exercise, providing opportunities for experiencing the skill or association to be learned. Although this law of learning may be the dominant psychological mechanism operating in any participatory film-learning situation, McGeoch and Irion (18, p. 224) point out that "instruction and set to learn are much more effective for learning than is the set merely to observe." This would indicate that repetition alone will not insure learning.

There is psychological evidence that the law of readiness may be operating in the situation where there is participation. The act of participating in a communication may increase the motivation or "set" to learn or attend to it as a whole, not just to the material practiced. McGeoch and Irion (18, pp. 227-228) conclude on the basis of their review of motivation research that "an active set to learn, with its accompanying selective process and active response to the material practiced, is a powerful determiner of learning."

The law of effect will probably operate in those learning situations where "knowledge of results" or "feedback" is used. McGeoch and Irion (18, pp. 267-268) state that "when information of results is given, learning occurs and becomes more efficient over wide limits as the precision of the useful information increases. . . . The conclusion, derived from the general principles of learning, is that, for most efficient learning, knowledge of results should be administered as quickly and as specifically as possible."

Based upon studies of verbal materials, McGeoch and Irion (18, p. 510) draw the following conclusions relative to the effectiveness of recitation during practice:

1. Recitation furnishes the subject with progressive knowledge of results. This information (a) acts as an incentive condition, (b) brings the law of effect directly to bear, (c) favors early elimination of wrong responses, and (d) by informing the subject which items have been learned, promotes a more effective distribution of effort over the material.

2. Recitation favors articulation of the items and leads to the utilization of accent and rhythm. 3. It likewise promotes grouping of the items, localization in the series, and the search for meaningful connections. 4. In recitation, the subject is practicing the material more nearly in the way in which it is to be tested and used--that is, without direct stimulation from the copy. It constitutes, therefore, a more immediately relevant form of practice.

It is clear, therefore, that the three principal laws of learning are operating in participatory learning situations. To what degree they are operating, with what kinds of communication material, and under what conditions of stimulation when audio-visual communications are used is the problem toward which the remainder of this paper will be devoted.

Review of Communication Research

The experimental studies conducted with films that employ participation technics as a variable of use are reviewed below. Because the actual technics used vary, the reviewers will be organized into the following five categories: (a) verbalization of response, (b) perceptual-motor responses, (c) knowledge of results, (d) mental practice, and (e) note-taking. Only the portions of these studies that compare the application of the particular participation technic with other participation technics or with other instructional technics will be discussed here.

Verbalization of Response

Hall Study (6). In an early study, Hall recognized the importance of participation. He varied a testing procedure for 74 general science high school students being shown three geology films in the following ways: (a) test announcement followed by film and then a test, (b) no test was announced or given, and (c) test announcement followed by film during which a slide containing the test questions was projected below the film throughout the showing, the students being instructed to write their answers as soon as they could. The same test was used as pre-test for all groups two days prior to the film showing, as part of the experimental variable for the first and third methods, and as a retention test for all groups two weeks after the film showing. Results indicated that the use of the test immediately following or during a film presentation produced significantly greater student learning when they were re-tested two weeks later. However, there were no significant differences

in retention between the group that participated in the test during the showing and that which participated in the test immediately after.

Hovland, Lumsdaine, and Sheffield Audience Participation Study (11, pp. 228-246). A sound filmstrip on the teaching of the Signal Corps phonetic alphabet and pronunciation of numerals was shown to 16 groups of Army recruits totaling 742 men under four conditions of presentation: (a) a "standard" filmstrip in which review lists of each phonetic name with its corresponding letter were pronounced by the narrator; (b) a "participation" filmstrip in which these letters were followed by a question mark, the names to be pronounced by the audience; (c) the announcement of a test preceding the "standard" version; and (d) the same test announcement prior to the "participation" version. A sampling of men were given individual oral tests of their ability to recall the phonetic names, and the remainder of the men were given written tests. Figure 1 shows the results. Total Results may be summarized as follows: (a) The men who had active participation recalled 68 percent of the phonetic names within the 2 second recall time period, and those who had no participation recalled only 48 percent, a learning difference of 20 percent, significant at the 1 percent level. (b) When a comparison was made on the effects of participation between the easy and difficult phonetic symbols, it was found that the participation version was most effective with the difficult material, the difference being a highly reliable 20 percent. (c) Active participation was most effective when men were not motivated to learn by the announcement of a test, the difference being almost 13 percent, significant at the 4 percent level; but the announcement of a test produced almost as much learning as the use of participation technics alone. The two technics together raised the learning only an additional 5.2 percent. (d) Participation benefited the less intelligent men, being 16 percent (reliable at 5 percent level) superior. (e) Taking the conditions of difficulty of material, motivation to learn, and learning ability into account, active participation was most effective with the less intelligent, non-motivated men, learning the more difficult material (23 percent increase). Conversely, it was least effective with the more intelligent men learning easier words, regardless of motivation (3 percent increase).

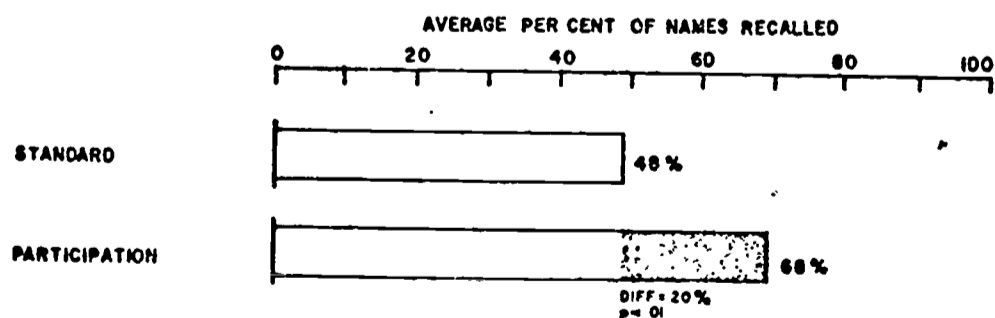


Figure 1. Effect of participation on number of phonetic names recalled.

Michael Study (19). This important study was designed to investigate the relative effectiveness of several conditions of participation and to continue the work on audience participation made by Hovland, Lumsdaine, and Sheffield in their "audience participation" study (11). The experiment was conducted with 640 high school juniors and seniors, using an edited version of "Pattern for Survival," a film on civil defense against the atom bomb, which was stopped periodically to permit the audience to answer questions on the factual materials they had just viewed. Half of the eight experimental groups participated "overtly" (wrote the answers) and half "covertly" ("thought" the answers). Half were given "feedback" knowledge of the correct answers, while half received no "feedback." To half of the groups a test was announced in advance, while the other half received no test announcement. Half of the test questions were on material used in participation, and the other half were on material not previously practiced. In addition four control groups were used, varied to control the different factors studied. Immediately following the film, the experimental groups were tested on the factual material. No retention test was given. The results follow: (a) Figure 2 shows the overall gains produced by audience participation as compared with merely viewing the film. The gain of 7.3 percent was significant at the two percent level, and confirms the Hovland, Lumsdaine, and Sheffield findings. (b) The significant superior effect of the participation technics, however, held only for those items specifically practiced, no difference being apparent between the two groups on non-practiced items. (c) The results on the "feedback" and mental practice variables will be reviewed below, and the effect of the test-announcement variable was discussed in an earlier paper (1), indicating that the test-announcement resulted in no significant learning. One of the most significant outcomes of this study was the finding that the increase in learning seemed to be due primarily to practice effects and not to effects of changes in motivation to learn.

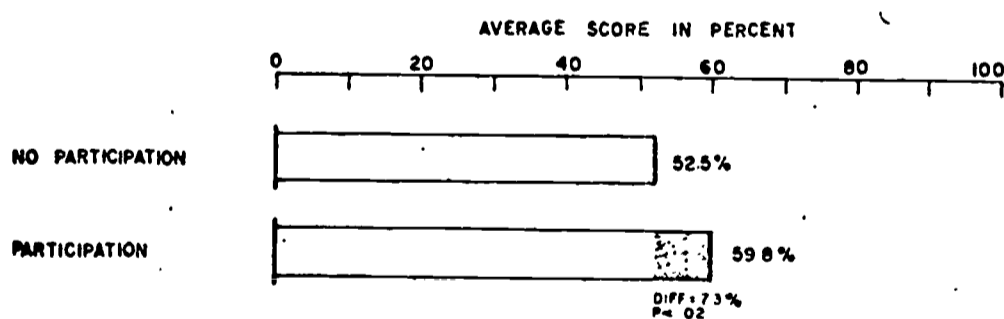


Figure 2. Effect of participation of factual information scores.

Kurtz and Hovland Study (16). Although not a film study, this experiment dealt with the observation of objects. Sixteen familiar objects were presented to 72 elementary school children, half of the group finding and circling on a sheet of pictures the appropriate object pointed to and the other half finding and circling on a sheet of names of the objects the appropriate one. This second group also pronounced

each name aloud as the demonstrator pointed to it. The groups were tested for retention a week later. Figure 3 shows that the group that had verbalized at the time of presentation recalled more items correctly and made fewer incorrect responses than the non-verbalization group.

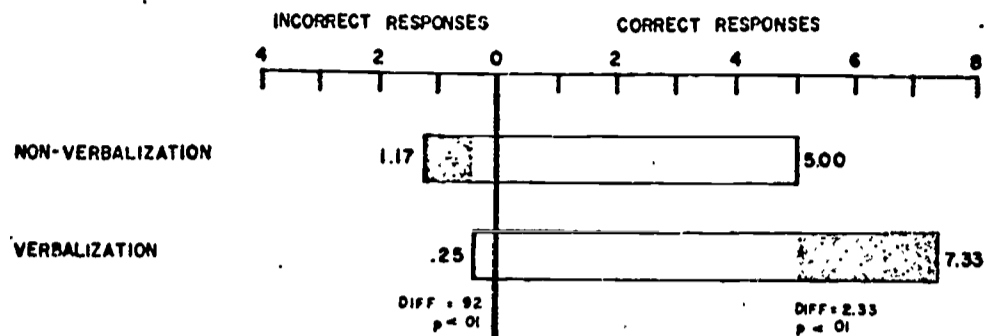


Figure 3. Recall responses by non-verbalization and verbalization groups.

Slattery Study (24). Slattery compared the effectiveness in teaching informational and conceptual social studies material to 422 fifth grade students, using three methods of presentation: (a) sound motion pictures, (b) filmstrips with participation, and (c) filmstrips without participation. The participation was achieved by having the students read aloud the verbal content of the filmstrips. The procedure was to pre-test the students, present the film or filmstrip the next day, and immediately re-test them on the same test. No retention test was administered. Both filmstrips with and without participation were significantly superior to the motion picture, and the same results held for the various levels of intelligence. Although the filmstrips with participation were slightly superior to those without, the differences were not statistically significant.

Kendler, Cook, and Kendler Study (14). This study attempted to determine whether the effectiveness of repetition of review sections in a film could be increased by means of overt audience participation. The experimental film used was a military film on conventional map signs and consisted of an introductory section plus either one, two, or three consecutive presentations of a review. The subjects were seven groups of four high school classes each. Three of the groups were instructed to call out the names of the map signs as they appeared in the review, and three groups were given no such instructions. The groups viewed either one, two, or three of the reviews. They were tested immediately after the film and again four weeks later. The results showed that the overt oral audience participation increased the amount learned on all reviews, but that the increase was statistically significant only for the increase on the first review. However, the size of the increase was fairly constant for every repetition. This superiority for the technic of audience participation decreased with time, as did the amount learned.

Perceptual-Motor Responses

Roshal Study (22). Eight experimental versions of a film were designed to teach 3314 naval recruits how to tie three knots, the films differing in the variables of camera angles, motion, inclusion of hands, and participation. The participation versions of the film required the learners to tie the knots simultaneously with the film demonstration. After the demonstration on each knot was presented, the film was stopped, and the men were tested by actually tying the knot. The results showed no significant advantages for the participation technic, but Roshal attributed this result to the possibility that insufficient time was allowed during the film showings for effective participation.

Jaspen Study (12). Jaspen investigated further the suggestion made by Roshal's study that a slower rate of development in the film was needed to provide time for participation. Using films demonstrating the assembly of the breechblock of the 40 mm antiaircraft gun with 1818 naval trainees, he tested audience participation in the assembly of the gun under the following experimental conditions: (a) a slow rate of development of the film with participation, (b) a slow rate without participation, (c) a fast rate of development with participation, and (d) a fast rate without participation. Figure 4 shows the results of the experiment. Audience participation was found to be a very effective procedure to use when the rate of development of the film was slow enough to permit participation. At the slow rate of development, participation was significantly superior to no participation; but at the fast rate of development, participation had a negative effect upon the learning, being slightly inferior to the no-participation method.

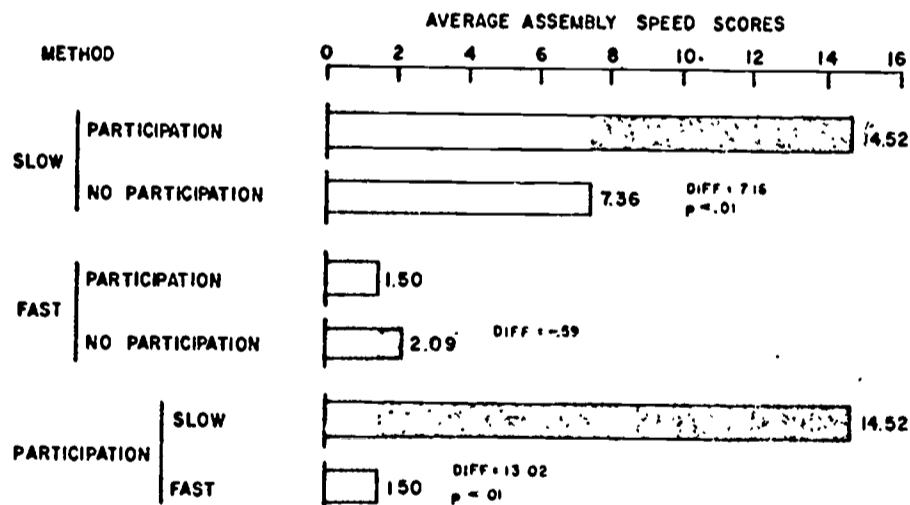


Figure 4. Effect of participation on assembly of breechblock.

Ash and Jaspen Study (3). Still further experimentation was made upon the effects of rate of development, repetition, and participation as employed under special conditions which used the rear projection of perceptual-motor films on the assembly of the breechblock of the 40 mm antiaircraft gun. About 1100 naval trainees took part in the experiment.

Ash and Jaspen used the same films employed by Jaspen (12) and compared the effects of audience participation (concurrent practice) with films that varied in rate of development (fast vs. slow) and in the number of times the films were repeated (one, two or three). The data were analyzed separately for (a) a pass-fail score and (b) if he passed, a time score in seconds. The study confirmed the earlier findings of Jaspen (12) that audience participation was helpful with a film that had a slow rate of development and detrimental with a fast film. This positive contribution of the slow film to participation was even more greatly apparent in the speed score data. In the case of the relationship of participation to the number of times the films were repeated, no significant relationship was found in pass-fail scores. However, the speed scores showed a highly significant relationship between participation and the combination of one and two repetitions of the films.

Harby Study on Interspersed Practice (7). The effectiveness of using continuous film loops interspersed with practice and coaching in teaching tumbling skills to four college physical education classes was studied. Four teaching procedures were used: (a) three massed live demonstrations of two minutes each, followed by six minutes of practice, (b) the same procedure but using massed movie demonstrations, (c) interspersed live demonstrations in which each demonstration of two minutes was followed by two minutes of practice, and (d) the same procedure but using movie demonstrations. In a substudy the regulation of the interspersed practice was compared with free choice of practice. Four different tumbling skills were taught, and the learning was measured by actual performance tests. The technic of interspersed practice was slightly superior to the massed technic, but not significantly so. When this practice was regulated as compared with permitting the learner free choice in whether or not he practiced, the learning of the skill was also greater, but not significantly.

Murnin, VanderMeer, and Vris Study (20). Using 263 students in basic electricity from two naval training schools, three methods of teaching principles of electricity were compared: (a) "regular" method by means of lecture and demonstration, (b) "wiring board" method, in which students practiced exercises on a mockup of an electrical system, and (c) the "diagram" method in which the students practiced the exercises on paper drawings of the wiring board. The groups were tested by means of a paper and pencil test on their ability to solve electrical circuit problems, the theory of Ohm's law and the theory and use of D.C. electrical testing meters. Results showed that there were no significant differences among the three methods on the overall learning. On the three subtests in the two schools, however, the "wiring board" method was superior to the "regular" method in one case (out of six), and the "diagram" was superior to the "wiring board" in one case and the "regular" method in two cases (out of six). If the "wiring board" and "diagram" methods can be considered to be applications of the participation principle, they can be said to be little more effective than non-participation. However, the superiority of both of these methods to the "regular" method in one school and of the "diagram" method to the "regular"

method in the other school on the "meter" subtest (an area of more structured, restricted, and clearly defined content than either "theory" or "problems") may indicate that the nature of the content taught might have influenced the effects of the participation techniques. It may also be true that participation was not the overriding variable in these experiments.

Rimland Study (22). A series of interrelated experiments investigated several ways of employing repetition in perceptual-motor films on knot-tying. The participation variables studied were the effects of (a) inserting a brief practice session between the two film demonstrations and (b) practicing the skill during the film demonstration. The test population for the entire study consisted of 2680 naval recruits. The films used were those employed by Roshal (23) in his experiments; therefore, it is no surprise to discover that practice in tying the knots during the film demonstrations resulted in no increased learning. In this case, the result may have been a function of the film itself, which allowed insufficient time for participation. However, the practice in tying one knot between the first and second presentation of the film indicated that participation of this kind was not an effective teaching procedure either.

Knowledge of Results

Gibson Study on "Differential Reinforcement in Aircraft Identification" (5, pp. 145-149). This study was conducted with 280 aircraft trainees and investigated their ability to identify airplanes from slides, using two methods of presentation: (a) "unreinforced method," in which each of 20 slides of foreign planes was shown for 5 seconds, the name of the plane being announced just before it appeared on the screen and repeated while it was on the screen, the entire exhibition being made three times, and (b) "reinforced method," in which the first presentation was like the "unreinforced method," but on the second and third presentations the slides were exposed for only 2.5 seconds, after which the trainees identified each on a numbered answer sheet and then received the correct response, correcting their papers. The fourth presentation of the slides

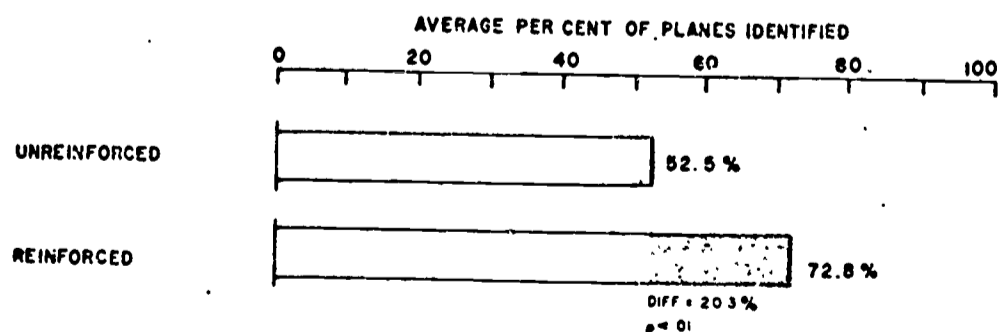


Figure 5. Effect of reinforcement on number of planes identified.

was a recognition test. Figure 5 shows that the gains for the "reinforced method" were highly significant, this method increasing the learning by over 20 percent and resulting in almost 14 percent of the trainees getting all the slides correct (as contrasted with about 3 percent by the other method). Gibson concluded that, "The experiment showed clearly that the principle of overt response with reinforcement, the effectiveness of which had been demonstrated many times in learning studies, was applicable to the special form of visual learning required for the successful recognition of aircraft" (5, p. 148).

Yale Motion Picture Research Project Study (27). This study investigated the effects upon 150 high school pupils of "motivation" and "participation" questions inserted into a film on the heart and circulatory system. Five methods of presentation were used: (a) factual presentation of the film without questions, shown once; (b) the factual version plus "motivating" questions in the form of printed titles preceding each unit of material in the film; (c) the factual version plus "participation" questions to be answered by the pupils on a worksheet after each unit, the correct answer then being presented on the screen; (d) the factual version supplemented by a combination of "motivation" and "participation" questions; and (e) the factual version, shown twice. A 40-item multiple-choice test measured the pupils' knowledge of the subject matter taught. This test was given a week before the film showing and again immediately after. Figure 6 shows that the "motivation" questions made a

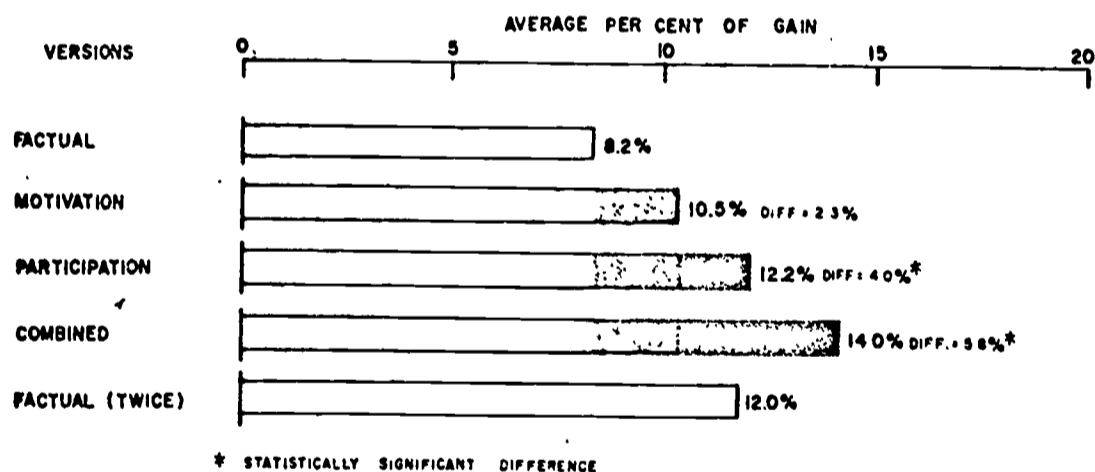


Figure 6. Effect of motivation and participation questions with knowledge of correct answers.

slight contribution to the effectiveness of the film, but that the "participation" questions made a greater and significant contribution. When the two types of questions were combined, the "participation" questions, again, were shown to increase the learning significantly. When the learning from the participation version was compared with that from two showings of the factual version, it was found that a 54 percent increase in time required resulted in a 49 percent gain in correct answers, whereas the double-showing required a 100 percent increase in time and resulted in only a 46 percent gain. As might be expected, the major gain

from including "participation" questions was on the test items directly covered by the questions (7.3 percent) as contrasted with those items not directly covered (1.2 percent).

Kurtz, Walter, and Brenner Study (15). This study compared six methods of teaching factual information to over 3000 tenth grade students, using two films, "The Care and Use of Hand Tools--Wrenches" and "Snakes." The six methods of presentation were: (a) original film, used as a control version, (b) the original film, shown twice, (c) a "persistent questions" version in which a number of multiple-choice questions were inserted, (d) a "persistent statements" version that had reinforcing statements inserted instead of questions, and (e) and (f) "medium questions" and "medium statement" versions in which only half as many questions or statements were inserted. The students were allowed 8 seconds to answer the questions on an answer sheet, and then the incorrect answers faded away from the screen leaving the correct answer. The commentator then also repeated the question and correct answer. The "statement" versions required no such participation. The results between the two films and for boys and girls separately were inconclusive and showed no consistent superiority of any one method. Generally, showing the film twice seemed to be about as effective as inserting either questions or statements.

Michael Study (19). As reported in the section on "Verbalization of Response" above, half of the groups studied in this experiment were given "feedback" or knowledge of the correct answers to questions asked. Figure 7 gives the results of this comparison. The "feedback" of results was the most sizable contributor to learning studied, gaining an average of 16.3 percent over the condition of "no-feedback." These differences held equally for both high and low intelligence groups. The author concludes, "It seems safe to propose that here is a highly general finding: the proposition that superior learning will occur when the learner is given the opportunity to rectify an error by knowing that an error has been made, what the error was, and what the correct behavior should be, has not only empirical support of this experiment but considerable support from various theories of learning and previous experimentation in other media as well as films" (19, pp. 30-40).

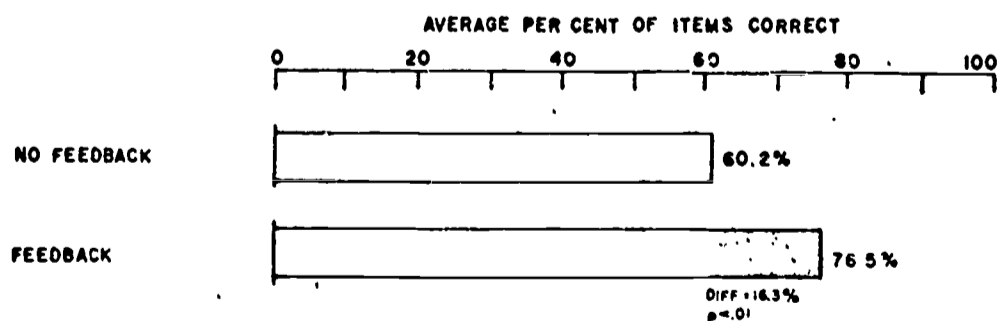


Figure 7. Effect of "feedback" on factual information scores.

Harby Study on Interspersed Practice (7). In a substudy of the experiment reported above in the section on "Perceptual-Motor Responses," the effect of coaching during practice was measured. It was found that when the college students learning tumbling skills were coached during practice (either interspersed with the continuous film or on a free choice basis) significantly greater learning took place. This coaching consisted of the pointing out of errors to individual students by a skilled instructor.

Hirsch Study (9). Using the Classroom Communicator, a device developed by the Instructional Film Research Program at Pennsylvania State University to enable immediate and continuous communication between the instructor and any student in the class, the effect of knowledge of test results upon the learning of meaningful material was studied. Six technical naval training films were used with 138 midshipmen in the NROTC at Pennsylvania State University. The following six methods of presentation were compared: (a) no knowledge of results, (b) knowledge only that answer was "right" or "wrong" for each individual, (c) same as "(b)" plus the number of the correct answer for all students, (d) same as "(b)" plus the repetition on the screen of the questions with all alternatives removed but the correct one, (e) same as "(d)" with addition of the second showing of the film, and (f) two showings of the film without knowledge of results. The knowledge of correct responses was not interspersed during the film showing, but was given during the immediate test following the film. The men were then retested three weeks later on a 120-item composite test. Figure 8 shows the differences between the post-test and immediate test scores (delayed post-test minus immediate test). It will be seen that all methods were superior to the method that showed the film once with no knowledge of results. These differences were statistically significant. The method that followed knowledge of results with a second showing of the film "(e)" resulted in the greatest retention, but this method added considerably to the time used and the gain was not significantly greater than Method "(d)" in which the film was not reshown. In general, knowledge of test results was found to have a significant effect upon learning, particularly when

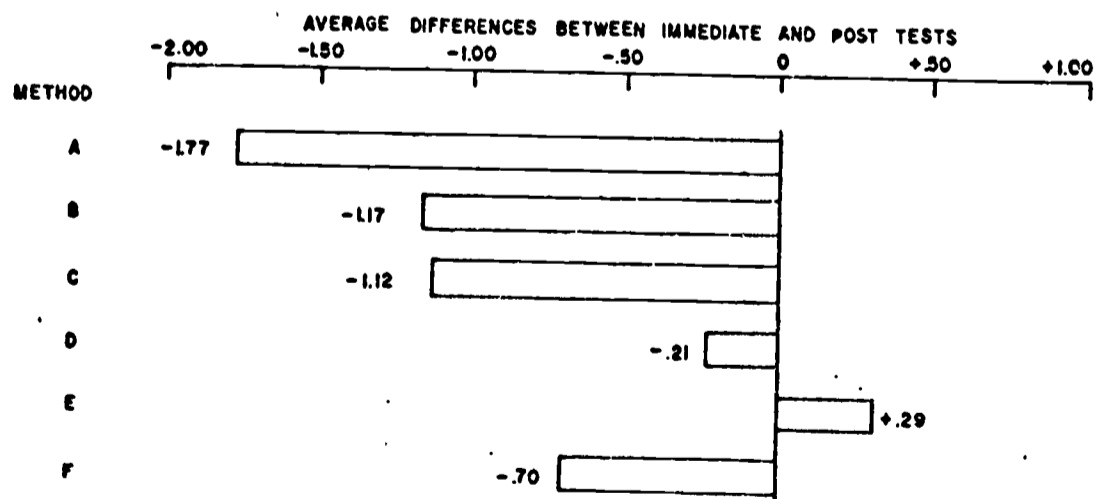


Figure 8. Effects of knowledge of results upon retention of factual information

the entire question and answer was provided. However, a double-showing of the film appeared to be as effective as knowledge of test result technics.

Stein Study (25). This study made an effort to discover whether a pre-film test with knowledge of results, followed by the showing of a film, would produce more learning of factual content than showing the film either once or twice without the test. Seventeen groups of about 100 seamen recruits each were shown the films, Weather and Measuring Instruments under conditions which provided "complete," "partial," or "no" knowledge of test results. The tests were given prior to the film showing and varied by presenting the information in the same order as that in the film (compared with a scrambled order) and by being either "identical" with or "comparable" to the final post-film test items. It was found that a pre-film test, which had identical, sequentially-ordered items, and employing complete knowledge of results, immediately followed by the film, produced significantly greater learning and retention than any other method investigated. The findings held true for men of high and low intelligence. Stein concluded that, "The effectiveness of a pre-film test depends on (a) giving the learners items in the pre-film test which are identical with the items in the post-film test in combination with (b) giving the learners the answers to those items immediately after they have attempted to answer them" (25, p. 13).

Kale and Grosslight Studies (13). Kale investigated a number of variables relative to the learning of Russian language vocabulary. He compared five methods of teaching lists of verbs and nouns, including the use of words only, still pictures, silent and sound motion pictures, and a sound motion picture with participation. This participation version contained a provision for the audience to repeat each Russian word aloud after the word had been presented by the narrator. The subjects were 409 men and women introductory psychology students at Pennsylvania State University. The presentational procedure deserves careful description as the method itself utilized a participation technic. The 20 word pairs (English-Russian) were shown in their entirety as titles only. Then the first English word was shown followed by a period of 10 seconds during which clear film ran through the projector enabling the subject to write the Russian equivalent. The subjects then turned over this page, and the English and Russian words appeared on the screen. This procedure was followed for all 20 words, and then the entire procedure was repeated six times. One week following the pre-test utilizing the technic outlined above, the subjects received one of the five experimental versions, following essentially the same procedure used in the pre-test, but with different words. The participation version, in which students pronounced Russian words, was found to inhibit significantly the learning of the ability to write the words. The author concludes that this finding was "not necessarily in conflict with the accepted idea that participation usually aids learning because in this study the kind of participation studied had to do with the pronunciation of the words, and the subjects were not tested for this." The writing of Russian words was not a variable in the study, but it is important to note that all subjects "participated" in this sense, as this technic was part of the learning-testing procedure.

Levine Study (17). This study investigated in greater detail Michael's (19) conclusions that learning increases from participation during active review were the result of practice effects rather than an overall increase in motivation. The subjects were 939 Air Force trainees who viewed a film on world maps. Half the group were shown the film with active participation, which consisted of having the groups write the answers to questions on the previous section with knowledge of correct answers being furnished after the practice. The other half received no such review. Within each of these groups half were presented under conditions of high motivation and half under low motivation. Ten of the 35 test questions were practiced during the review sessions. Results showed that as in previous experiments larger gains occurred on practiced than on non-practiced test items under conditions of both high and low motivation. However, significant gains occurred on non-practiced items in the active participation groups under conditions of low motivation, leading the author to conclude that "under conditions of low motivation active review procedures can result in gains due in part to motivation."

Mental Practice

Harby Study on "Mental Practice" (8). Harby compared "mental practice" with "physical practice" in teaching the shooting of the basketball free throw. The subjects were 250 college physical education men students. The population was divided into the following seven groups on the basis of a pre-test of 20 underhand basketball free throws: (a) control group, which took pre- and post-tests, but received no intervening instruction; (b) physical practice group, given a 1-minute demonstration by an instructor followed by 20 free throws per day for 20 days; (c) mental practice Group I, shown the film six times (15 minutes) per day for seven days, while subjects "mentally practiced" the skill, followed by post-test after seventh day; (d) mental practice Group II followed same procedure, but for fourteen days; (e) mental practice Group III followed same procedure, but for twenty days; (d) mental plus physical practice Group I, shown film once each period followed by 20 free throws each day for 20 days; and (g) mental plus physical practice Group II, followed same procedure as mental practice groups for fourteen days, and then received seven days of instruction same as for physical practice groups. The film used was a 2.5-minute "loop" (the beginning spliced to the end) of film demonstrating the basketball free throw. It was projected on a rear-projection screen in subdued light in a room adjoining the main gymnasium. The results shown in Figure 9 indicate that the twenty periods of physical practice were significantly more effective than twenty periods of mental practice, but were not significantly more effective than fourteen periods of mental practice. The group that mentally practiced for 14 periods and then physically practiced for an additional seven made the greatest gains in the skill, but the small number (eight) of students in this group prevented the gains from reaching a significant level of confidence. In general, the results present strong evidence of the efficacy of mental practice in teaching perceptual-motor skills.

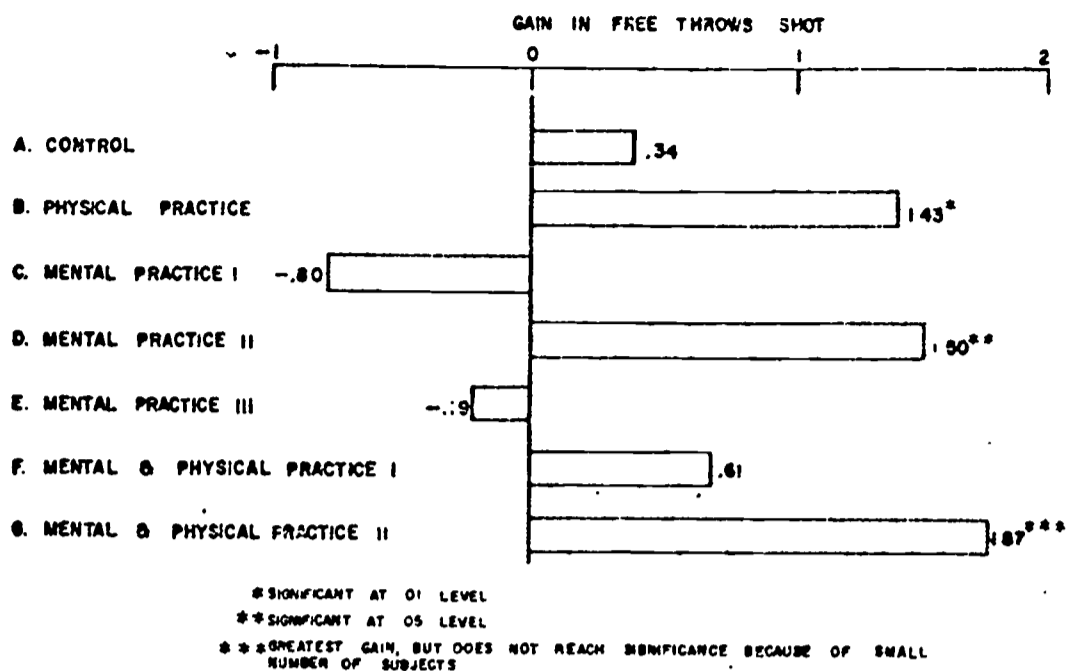


Figure 9. Comparison of mental and physical practice on basketball free throw skill.

Michael Study (19). As reported above in the section on "Verbalization of Response," one of the variables studied by Michael was that of mental practice. One group participated "overtly" by writing answers to questions that were asked as the film was stopped periodically. Another group participated "covertly"; that is, they "thought" the answers to the questions. When tested, the mental practice group was found to have learned the factual content of the film as well as did the group that wrote the answers.

Patterson Study (21). In an exploratory study, Patterson studied mental practice technics in teaching San Diego State College teacher education students how to thread and operate a Bell and Howell motion picture projector. One group was taught in the usual way, receiving three hours (three separate sessions) of individual laboratory instruction and practice on the projector. The other group received several showings of a film demonstrating the procedure, mentally practicing the steps during and between the showings, but never actually threading a projector. The results showed that the mental practice group learned to thread and operate the projector as well as the actual practice group as measured by a performance test. However, the actual practice group took a shorter time to perform this skill.

Note-Taking

Vernon Study (26). Vernon studied the use of a film and a filmstrip to teach British seamen to comprehend and learn facts about taking soundings with a lead line. The 774 seamen comprised 22 classes in all, and the effect of the instruction was measured by a written test. Two comparisons involving note-taking as a variable were studied: (a) filmstrip shown for three periods with notetaking and a showing of the film, and (b) filmstrip shown for two periods without note-taking and a showing of the film, but with one period of ordinary practical instruction on the

skill. So it may be seen that this comparison was not between taking notes and not taking notes, but between spending an extra hour on note-taking during the filmstrip and spending that time on practical instruction. The results showed no difference between the two the note-taking procedure in aiding understanding as measured by comprehensive questions. The investigator concluded that note-methods in teaching memory for details, but a slight advantage to taking did not appear worthwhile in teaching this skill and also pointed out that it was difficult to light the room for the note-taking.

Ash and Carlton Study (2). The effectiveness of note-taking was studied, using 216 freshmen college students as subjects and two Navy kinescope film recordings on "High Altitude Flying" and "Ocean Survival and Safety." The films were shown in a dimly-lighted room which had enough light to permit note-taking. The groups were tested with multiple-choice factual information tests. Three experimental methods and a control were employed: (a) Film Only, in which the film was shown without note-taking; (b) Film plus Notes, in which students took notes while seeing film; (c) Film plus Notes plus Review, in which students took notes while seeing film and then reviewed the notes for ten minutes after the showing; and (d) Control which took the test without seeing the film. The results in Figure 10 show that the Film Only group earned the highest mean percent score on each film, the results being statistically significant at the 1 percent level on the "Ocean Survival and Safety" film. Although the extra 10 minutes devoted to review of the notes produced a slight increase in learning over the Film and Notes only group, this advantage was not a statistically significant one. The conclusion may be made, under the conditions of this experiment, that note-taking actually interfered with learning. Although the review technic aided somewhat in the recall of the points written down, it did not compensate for the interference caused by taking notes.

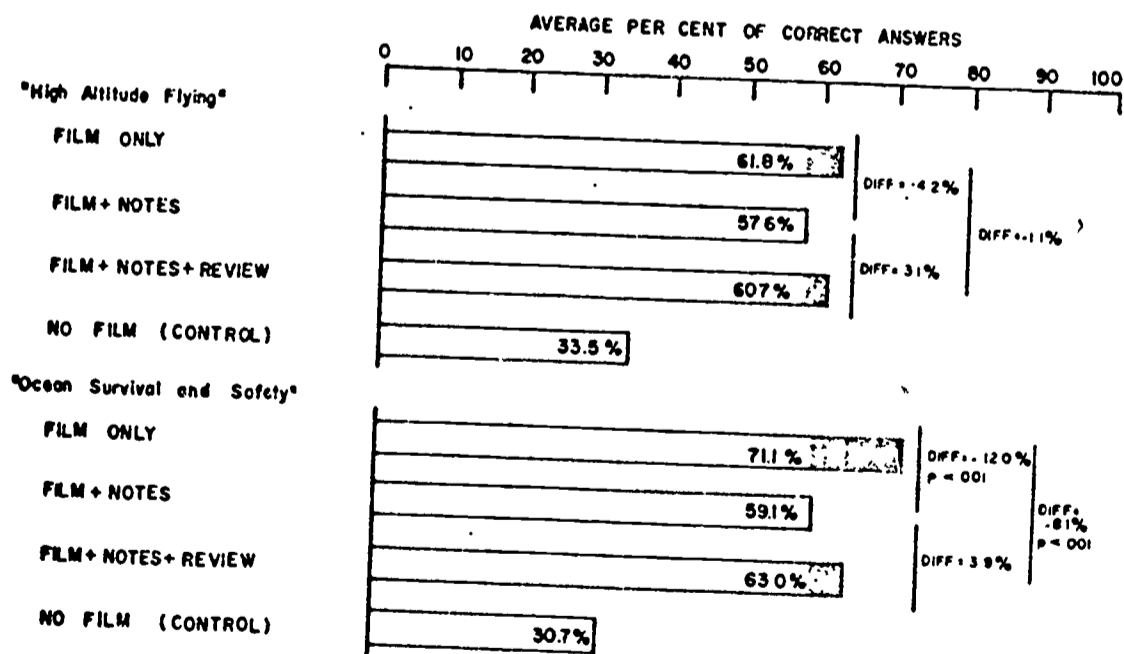


Figure 10. Effect of note-taking on learning during a film.

Discussion of Results

Summary of the Findings

Of the 26 comparisons in the studies summarized relating to the use of participation technics, 13 favored participation and only two favored nonparticipation. The remaining 11 comparisons showed participation to be at least equal in effectiveness.

As revealed by the results, "verbalization of response" and the furnishing of "knowledge of results" appeared to be the most effective participation technics. Only "note-taking" was shown to be of doubtful value.

Verbalization of Response. Of the six comparisons made using verbalization of response as a variable, five were shown to favor participation and one was inconclusive. Such an advantage would seem to point to this utilization technic as an important one in increasing learning from instructional films. On the basis of the studies made, the following kinds of verbalization appear to increase learning: (a) verbalizing the communication content during interspersed reviews, (b) answering questions during the film presentation, (c) describing action during a perceptual-motor activity, and (d) verbally describing the content during the presentation.

Perceptual-Motor Responses. Of the six comparisons made using participative technics during the learning of a perceptual-motor skill, two favored participation and four showed no advantage to either participation or non-participation. Therefore, the evidence is much less clear regarding the value of participation in learning motor skills. Two kinds of participation were used: during the actual film presentation and interspersed between repetitions of a demonstration film. The four comparisons that studied the effect of participation during the presentation of the film pointed up the fact that such participation contributed to the learning of the skill if the film was slowly enough paced to permit performance of the skill without distracting the viewer from the film content. The two studies that investigated the effect of interspersed practice showed participation of no significant value in increasing ability to perform the skill when the film demonstration was presented two or more times.

Knowledge of Results. Of the nine comparisons made using knowledge of results as a variable, seven showed an advantage to this participation technic, one was inconclusive, and one found that knowledge of results interfered with learning. However, this last study used participation in the pronunciation of Russian words in order to teach the ability to write the words; so this could account for the results. It seems clear that the furnishing of knowledge of results during or after participation during the showing of a film is an important contributor to learning from that film. On the other hand, the two studies that compared the furnishing of knowledge of results with a double-showing of the film

showed no advantage to either technic. It should be remembered, in interpreting these results, that the "knowledge of results" variable also used participation of other kinds during the film presentations and that these other variables may also have been operating.

Mental Practice. The three studies on mental practice strongly suggest that such technics may be highly effective learning devices under certain conditions. It is significant that two studies found "mental practice" technics to be as effective as actual overt physical practice in learning perceptual-motor skills, and that one study found "covert" verbalization to be as effective as "overt" participation. Although these few studies present rather dramatic evidence on this variable, additional research is needed.

Note-Taking. Two studies furnish evidence on note-taking, only one of which investigates the variable in an uncontaminated form. The preliminary evidence indicates that note-taking is not an effective instructional technic with the particular films used. Whether or not different films used under other conditions would show note-taking to be an adjunct to learning remains for future investigation.

Practice vs. Motivation

Is increased learning during participation due to actual practice during the participation or to increased motivation resulting from the activity? Several studies directed attention to this question with no conclusive answer. Michael concluded that the increase in learning was due primarily to practice effects and not to effects of changes in motivation to learn. Levine, on the other hand, attributed such findings to the fact that previous research was conducted under conditions of generally high motivation which might mask any motivational effects of participation upon non-rehearsed material. He found that significant gains did occur for non-practiced items as a result of participation under low motivation conditions. The Yale study found that the material directly practiced during participation was learned to a much greater degree than that not covered in the participation questions, thus supporting Michael's findings. In discussing this question, Hovland, Lumsdaine, and Sheffield suggest that both the practice and motivation factors may, in fact, achieve their effects through the same mechanism--the rehearsal of the response to be learned. They feel that the response to be learned should be actively practiced during the film and that such participation may motivate the learner by providing periodic examination of the material just presented.

Participation and the Nature of the Stimulus

The effectiveness of participation technics appears to be related to the nature of the stimulus presented. The research furnishes evidence on two types of stimuli in particular: (a) easy vs. difficult material and (b) the rate of presentation of the filmic material.

Easy vs. Difficult Material. Hovland, Lumsdaine, and Sheffield found that active participation is most effective when the material to be learned is most difficult. When the level of difficulty was related to motivation to learn and learning ability, they found that active participation was most effective with the less intelligent, non-motivated learners, learning the more difficult material.

Rate of Presentation. The studies that investigated this variable came to the same conclusion: that the learning of perceptual-motor skills of practicing them during the film was a function of the rate of presentation of the material. Roshal and Rimland, using the same films on knot-tying, found no advantage to the participation technic and concluded that insufficient time was allowed in the film to permit the skill to be performed. Studying this speed variable, Jaspen, and Ash and Jaspen found that practice in gun assembly during the film showing facilitated learning when the film developed at a slow rate of speed and retarded learning when the film developed at a fast rate of speed. This factor of rate of presentation may also have been operating in the Ash and Carlton Study on note-taking. It may be that where some form of overt physical activity takes place during a film presentation, the film must be so designed as to permit time for the activity to take place without interfering with other material in the film.

Relationship to Intelligence

Hovland, Lumsdaine, and Sheffield reported that participation benefited the less intelligent men, being 16 percent superior to non-participation. Slattery, on the other hand, found no differences by intelligence level between the results of the use of filmstrips with or without participation. It appears that insufficient evidence is yet available to permit a generalization in relation to this variable.

Participation vs. Repetitive Showing of the Film

The question has been raised: Why include complicated participatory technics into a film or film showing if the same learning gains can be accomplished more easily by showing the film twice in succession? This problem was investigated in four of the studies with the general conclusion that a double-showing of the film is about as effective as using participation technics. The Yale Study found this to be true, but with some sacrifice in time, it taking about 46 percent more time to achieve the same level of learning with the double showing. Kurtz, Walter, and Brenner found the film shown twice to be as effective as the insertion of either questions or statements into the film. They found also that material not specifically emphasized either by questions or statements was generally learned better when presented two times than when presented in any of the experimental versions. No time comparisons were reported in the study. Hirsch found the second showing to be as effective as using knowledge of test results technics. And Stein found the double-showing at least equal to all methods of knowledge of results tested ex-

cept that which preceded the film showing with a test which had identical, sequentially-ordered, and complete knowledge of results.

Mental vs. Physical Practice

The comparative effectiveness of mental vs. physical practice, particularly in the learning of perceptual-motor skills, deserves careful attention. The research findings appear to contradict the popularly-held notion that activity, to be effective, must be gross overt action. It may come as a surprise, therefore, that perceptual-motor skills may actually be learned (sometimes very well learned) by merely rehearsing in one's mind, or mentally practicing, the movements involved in performing the skill. Carpenter (4) points out that gross overt action may actually interfere with some kinds of learning and that "covert" activity (mental practice) may be more or less effective than "overt" activity under certain conditions. The important thing to remember seems to be that thinking, seeing, hearing, the making of generalizations, and the like, are activities that are probably more essential in learning than gross skeletal muscle activities; and, therefore, they doubtless play an important role in the learning even of physical skills. It appears that instructional films present a model which permits the learner to practice these skills mentally as well as physically.

General Conclusions

On the basis of the present evidence, the following general conclusions can be made with a reasonably high degree of certainty:

1. Learner participation during a film showing will result, under most conditions of instruction, in greatly increased learning from the film.
2. The overt verbalization of responses by the learner during the film showing results in increased learning.
3. The furnishing of "knowledge of results" of the learner's overt response during a film also has a positive effect upon learning.

The following conclusions can be advanced as tentative hypotheses subject to further investigation:

1. If participation during a film showing requires the practice of a skill demonstrated, the taking of notes, or the performance of any other activity that may divide the attention between the observation of the film and the performance of the activity, the film must be slowly enough paced to eliminate the distraction caused by such division of attention.
2. Mental practice of skills demonstrated, information communicated, or questions asked during or after a film showing will increase the learning under certain conditions.

The technics of participation, therefore, appear to be important contributors to learning from instructional films. Teachers may apply them in their use of films within the classroom, and educational film producers may utilize the findings by "building into" films such technics where appropriate.

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CHOOSING MEDIA FOR INSTRUCTION

by Leslie J. Briggs
Robert M. Gagné
Mark A. May

American Institutes for Research
Palo Alto, California

In this chapter, the recommended procedure for choosing instructional media is presented in three degrees of detail. First, the various steps in the procedure are simply listed in brief outline form to provide a first overview of the total procedure. Second, a general account is given of how the steps are followed through for the six forms of learning thought to be required most frequently in educational courses. Third, a detailed discussion of each step is presented to show more fully the significance of each step in reaching the media decisions.

The Steps in the Procedure

1. State the behavioral objectives for the course or unit of instruction in the sequence in which they should be taught.
2. For each objective, identify the type of learning involved.
3. Using the required conditions of learning as a guide, design a "media program" for each objective which lists the instructional events, identifies the characteristics of required stimuli, and states the media options which would be acceptable.
4. Prepare a summary of the media options for a group of objectives making up a sequence of instruction, and scan these to identify frequently occurring media options.

Excerpted from Instructional Media: A Procedure for the Design of Multi-Media Instruction, A Critical Review or Research, and Suggestions for Future Research. Palo Alto, Calif.: American Institutes for Research, October 1965. Final Report for Contract No. OE-5-16-011, Department of Health, Education, and Welfare, Office of Education, Title VII-B, National Defense Education Act of 1958. Pp. 50-90.

5. Assign the media in which the instruction should be packaged to achieve the best trade-off in respect to effective stimulus display, convenience in changing from medium to medium, and economy in terms of size of unit in which each sequence is to be prepared in the given media.

6. Write specifications for the preparation of the instruction by the various media producers.

A General Account of the Procedure

For purposes of this description, media refers to any and all physical means of representing the entire set of stimulus conditions required in the instruction of a learner. Thus media include, as important and often-used varieties, arrangements for printed communication (such as printed pages) and for oral communication (such as a teacher). Also included are actual objects (rocks, leaves, manufactured products, etc.) when these can be directly observed by the learner, and special devices and materials, such as films, teaching machines, and workbooks.

It is assumed that what is being designed is a course of instruction (like geography, American history, plane geometry), or at least a substantial portion of a course, such as "trade winds of the earth," or "origins of the American Revolution." The designer proceeds to do this, however, in a topic-by-topic fashion, where each topic may be considered to reflect a unitary course objective.

The general rationale is this: When stated in terms of human performance, objectives imply a requirement for certain types of learning. Occasionally, these types are as simple as verbal associates, simple motor chains, and multiple discriminations. Much more frequently they are concepts, principles, and problem solving. Each type of learning requires its own external conditions of learning. These conditions, which may be conceived as a sequence of events in instruction, are in turn established by stimuli presented by various media. Each of the events (or steps) in this sequence may be accomplished by more than one medium. Accordingly, the most basic choices of media are made at this detailed level of analysis of the instructional process. When the designer makes these choices, he is in a sense "programming" the conditions for learning each objective of the course or course segment.

When the "media programs" are examined for an entire set of objectives contained in a course segment, one can make a determination of the kind of medium which might be desirable, in terms of economy or other criteria, to use for the presentation of the course segment. Thus, if several objectives in a row require the use of pictures, it may be desirable to design a film, film strip, or a set of slides for this particular portion of the course. The advantage of the procedure outlined lies mainly in the fact that it permits a determination of the applicability and desirability of one or another medium in portions of

the course that may in turn be only part of a course segment. It permits the identification of what these portions are which would profit from the use of particular media, as well as where they fit into the course as a whole.

Step 1

This is the description of the course segment in terms of "behavioral objectives," which means simply stating the performance to be expected of the student at the end of instruction. The advantages of such description are mainly two: (a) the statement is unambiguous (or, in a sense, reliable in that two observers of the performance would agree on it), and (b) the statement carries a clear implication of the capability to be acquired (whether concept, rule, or whatever) and therefore identifies the conditions of learning involved (as determined by reference to particular research findings or to a summary of conditions as presented by Gagné (2)).

Step 2

Identifying the type of learning involved. The most frequently occurring types of learning in school subjects are concept learning, principle learning (including "fact learning"), and problem solving. It should be remembered, however, that simpler forms of learning do occur in school subjects. For example, memorization of short or long verbal sequences may be required. Simple motor chains may occur in such activities as pronouncing the sounds of foreign words (or English words, for a young child), or in children's printing or writing. Multiple discriminations may have to be established, for example, in distinguishing squares, rectangles, triangles, or in distinguishing printed letters.

The problem of what shall be called a "concept" is worthy of mention. The most basic kinds of concepts are "concepts by discrimination," which require the presentation of a suitable variety of stimuli, either in actual or pictorial form, as a part of the learning conditions. Triangle is an example. Other "concepts" are, however, learned by means of verbal media of instruction. These might be called "concepts of definition," and an example is the concept of universal gravitation. In terms of Gagné's conditions of learning, these are the same as principles.

It may also be noted that the learning conditions necessary to establish principles are subject to variation in what has been called "amount of guidance." When this amount is small, the conditions are usually said to characterize "learning by discovery." When the amount is extensive, one sometimes speaks of "didactic instruction." Actually, these two sets of conditions do not differ as much as most people seem to think. At any rate the evidence that one method is superior is scanty.

Step 3

Designing a "media program" or "media schedule." In taking this step, one needs to describe the sequence of events that represents the learning conditions required for each form of learning determined in Step 2. It is noteworthy that certain conditions are common to all varieties of learning (for example, presenting the stimulus, directing attention, appraising), whereas others are peculiar to particular types.

Chaining

<u>Instructional Event</u>	<u>Medium</u>
(1) Presenting cue stimuli in sequence.	Practice with actual equipment. (Note that we are dealing here with response-generated as well as external cues.)
(2) Appraisal.	

Verbal Association

<u>Instructional Event</u>	<u>Medium</u>
(1) Presenting cue stimuli in sequence.	Practice with oral or printed verbal units presented in sequence. (See note above.)
(2) Confirmation of responses.	Oral or printed verbal units.
(3) Appraisal.	Oral or printed verbal units.

Multiple Discrimination

<u>Instructional Event</u>	<u>Medium</u>
(1) Presentation of individual stimuli one by one.	Actual object or pictures.
(2) Progressive part practice.	Actual object or pictures.
(3) Confirmation.	Actual object or pictures.
(4) Appraisal.	

Concept

<u>Instructional Event</u>	<u>Medium</u>
(1) Presenting the stimulus examples.	Actual objects or pictures.
(2) Stimulating recall of individual (specific) links, usually verbal.	Oral or printed word.
(3) Appraisal.	Actual objects or pictures.

Principle

<u>Instructional Event</u>	<u>Medium</u>
(1) Inform learner about performance required.	May require objects or pictures (depending upon objective).
(2) Stimulating recall of component concepts.	May be done by oral or printed speech; actual objects or pictures may be desirable (depending upon objective).
(3) Verbal cueing.	Oral or printed words.
(4) Appraisal.	May require objects or pictures (depending upon objective).

Problem Solving

<u>Instructional Event</u>	<u>Medium</u>
(1) Inform learner about performance required.	May require objects or pictures (depending upon objectives).
(2) Stimulating recall of component concepts.	May be done by oral or printed speech; actual objects or pictures may be desirable (depending on objective).
(3) Verbal guidance.	Oral or printed words.
(4) Appraisal.	May require objects or pictures (depending upon objectives).

Step 4

Having made the analysis described previously for each single objective, one then needs to look at the course or course segment in some total sense. This might be done by making a table to facilitate review of the individual media options stated for the individual objectives in order to identify the best medium for some reasonably sized unit of instruction.

Step 5

Determining appropriateness of media for portions of the course is the next step. This is a complex decision which cannot be done in cookbook fashion. For example, if the introductory portion of a course in science requires the learning of a number of concepts, as well as the application of principles involving these concepts, the need for pictures (or actual objects) may be frequent. In such a case, an instructional sequence emphasizing pictures might be an efficient way to present this part of the course. In practice, a sequence of slides or a film might be designed, and might be the medium of choice provided it could include the other modes of presentation required (accompanying oral and printed speech).

At the other end of the spectrum, there will be portions of a course which need pictures to only a limited degree. For example, if the student already knows the required concepts, a presentation of the principles related to the "powers of the Presidency" is simply not going to be helped by many pictures, if any. The reason is that the objective, stated as "State the limitations of the powers of the President, as defined by the Constitution," implies the learning of principles in which each instructional event is accomplished by presentation of oral or printed speech.

When a series of analyses of objectives indicates need for a mixture of diagrams, still pictures, verbal descriptions, and decisions to be made by the student after studying these elements, a format like programmed instruction would be appropriate.

If movements of objects in space and time relationships are involved, as in understanding what causes night and day, a motion picture showing rotation of the earth and its revolution about the sun, accompanied by sound narration of the principles involved, would be relevant.

Further Discussion of the Steps in the Procedure

Stating the Objectives

This is the description of the course segment in terms of "behavioral objectives," which means stating the performance to be expected of the student at the end of the instruction. Two advantages of such description have been previously stated: (a) the statement is unambigu-

ous, and it indicates how the student's learning could be evaluated; and (b) the statement carries the basic information needed to identify the required conditions of learning. A third advantage of the behavioral objectives is that they represent a convenient way to consider and determine the sequence in which the objectives should be taken up in the instruction.

Structure of the course. For some courses, the objectives may be arranged in a pyramid type of structure, as in the analysis of mathematics instruction by Gagné and Paradise (3). In such a structure, "layers" of competencies are identified. Options exist within layers as to sequence of acquisition, but acquisition of one layer in its entirety is called for before presentation of the next higher (or more complex) layer.

Campbell (1) has reported a mathematical-empirical procedure for obtaining an index of dependency among test items covering the objectives of instruction. The index of dependence-independence reflects the extent to which passing or failing one item is related to passing or failing another. This index reflects abilities related to the items, and differences in ability among learners. The results of the computations are used to determine whether by-passing (branching) or fixed linear sequences of instruction are indicated. The index also reflects, among other things, the extent to which the objectives appear to represent a hierarchy or a flat structure. It is only when objectives are stated in terms of competency (performance) that the structure of the learning has much meaning in the design of instruction. Elements of subject matter might be arranged in a "logical" order in the opinion of some person, but the arrangement would have no particular empirical basis as concerns the process of learning, until the subject-matter elements are related to behavioral elements.

While research on the structure of courses in terms of the necessary learning sequences is meager, the two studies mentioned above at least suggest that some courses represent "hierarchies" of skills, but others may be "linear" or "flat" in structure, so that great latitude would exist for many ways of sequencing. Such a degree of latitude in sequencing often would make media choices easier to arrange for the size of segment which is economical and convenient, and thus fewer compromises from the "media program" would be made necessary. In both hierarchical and flat structures there may be many options possible in the sequencing of the objectives for the course. Whether some courses represent structures other than these two kinds appears uncertain.

At any rate, one reason for arranging objectives in a sequence of some sort at the outset is to consider the extent to which learning of one may facilitate learning of another, or may at least have a bearing upon the media to be used in each case. Another reason is that, even if objectives in a series transfer heavily, one to the next (e.g., they have a high dependency index), whichever objective comes first needs

to be examined in terms of assumed prior knowledge at the start of the formal instruction. Pretests of pre-requisites probably need to be more extensive for independent objectives than for interdependent objectives.

The nature of behavioral objectives. In a sense, behavioral objectives, stated for the small units of instruction referred to here, often do have both a "behavioral" and a "content" element. In contrast to a behavioral objective, however, a statement like "Learn about the radius of a circle" is not a behavioral objective at all as it does not imply either what the student must be able to do after the instruction (or how he would be tested), nor does it say anything about the instruction needed concerning the concept of radius. But there are a number of behavioral statements which could be made for this element of instruction. Some alternatives the course designer could consider, possibly finally choosing more than one, are as follows:

1. Given several drawings of circles, some containing radii, some diameters, and some tangent lines, the student must be able to point correctly to all the radii.
2. The student must give a verbal definition of the radius of a circle.
3. The student must respond correctly to the request "Draw a circle and its radius."
4. The student must be able to state a formula showing the relation of the radius to the area of a circle.
5. The student must be able to solve problems in area, with the radius given.

Perhaps teachers would say that a student must be able to do all the above things to show he "really understands" the concept of radius. But the point is that instruction could be designed (including identification of the media to be employed) and tests could be developed on the basis of any or all of the numbered statements, but not upon the basis of "learning about the radius of the circle" (see Mager, 4, for a further expansion of this topic).

The numbered statements are of value, primarily, because they are stated in behavioral terms for a small unit of instruction. Admittedly, they involve subject-matter content because they deal with "radius" and "circle," but the nature of the instructional content, and hence the conditions of learning needed, hinge around the behavioral distinctions. For example, statement No. 1 could be taught by discrimination training in which the teacher points to circles and their lines and says "radius" or "not a radius," and the student could learn by watching. But for statement No. 2, the conditions for verbal association, or chaining, must be established, primarily by repetition. Performing statement No.

5 would require use of concepts and principles to solve problems, a much more complex and lengthy instructional procedure.

It may be now agreed that educational objectives are usually stated in much more general terms. The generality of the terms acceptable hinges upon the purpose for stating objectives. For purposes of deciding upon the general scope for a liberal arts college, it may be necessary only to list the instructional departments or courses which will be included. For purposes of identifying the primary nature of a high school, it may be called "vocational," "college preparatory," or "comprehensive." But for designing instruction with respect to the best use of media of instruction, much more specificity is needed in both the behavioral and the content components of the statements of objectives.

For those who find it difficult to write behavioral objectives, as for beginning students in programmed instruction workshops, one practice in use is to have the students write the "criterion frames" for a programmed sequence before they concern themselves with "teaching frames." Others find it helpful to think in terms of "what the student must do, upon what command, with what givens, with what result, to what standard of acceptance."

Stated differently, it may be said that acceptable statements of objectives for present purposes contain two principal elements: do (point to), and what (the circle that shows a radius). These may be labeled the behavioral and the content elements of the statement of the objective. In some cases at least, the statement also should indicate the acceptable standard--cases in which performance other than all correct or all wrong may be anticipated, or cases in which time limits should be set.

But as to the making of statements of objectives which separate the kind of performance from the subject-matter referent, this would be a step away from, rather than a step toward, defining instructional conditions and the relevant media. Any separate list of either type of element (e.g., area of a circle, diameter of a cylinder, the verbs in sentences, on one hand, and say, do, compute, state, explain, on the other hand) may conceivably be useful for some purposes, but not for the purpose of this project. (Special cases may consist of one action word and several content words, such as "be able to spell the following list of words," or perhaps the opposite case of doing several kinds of manipulations, using a single concept.)

To round out this phase of the discussion, consideration may be given to the familiar objective of "learning for its own sake" rather than for some utilitarian, performance purpose. Upon closer examination, two comments may be relevant: (a) one might not wish to go through the type of analysis here being considered if there are no objectives other than learning subject matter for its own sake; and (b) probably behavioral objectives could be stated in place of "learning for the

sake of learning," even if only in terms of such general criteria as "learning generalizable study habits useful in later learning," "learning to use a library," "learning to like music," and "wanting to read more Shakespeare." For objectives closely relating to enjoyment rather than to more specific performance capabilities, probably some important conditions are to "let the student stop studying when he wants to," "make interest first and specific learning objectives secondary," "don't require the course," and other such conditions which, as desirable as they may be from a "learning for enjoyment" point of view, might at times conflict with learning conditions for basic skills needed by all children.

While the global statements of educational goals may be useful for policy and general educational planning purposes, goals like "good citizenship," "moral conduct," "vocational competency," and "appreciation of cultural values" have to be broken down into much more detailed form for the purpose of pre-planning of instructional packages. Even goals stated in different general yet skill-oriented terms, such as "command of the language," "ability to communicate," "athletic competency," and "human relations" are not the terms in which the details of instruction can be planned.

A final, explicit reason for not employing subject-matter classifications which are separate from behavioral statements for the present purpose is that they do not alone represent a step closer to specification of media. That is, a concept in economics is not necessarily any more different from a concept in physics than are two concepts in economics or two concepts in physics, in terms of the instructional media needed. The general conditions for learning of all concepts are the same, except for the distinction previously made between those learned by discrimination and those learned as verbal statements. The media for instruction, however, must be considered separately for each particular concept to be taught, regardless of their belonging together in a particular course. At least that is the conclusion which has been reached during the course of work on this project.

The basis for evaluation. One reason for stating objectives in behavioral terms, of course, is to furnish a basis for deciding when objectives have been met. In other words, the behavioral objective clearly implies the kind of test question or exercise which would be administered to determine that the instruction was successful for that objective. For many objectives, the relevant test is a test which involves "transfer." That is, if the concept "triangle" has been taught by use of wooden objects, strings, and wires which are of this particular shape, other materials and objects would be used for a test to be sure that the concept, not the particular stimuli, has been learned. Further, if the teaching situation employed the discrimination between triangles and squares, the test situation should require other discriminations by use of hexagons, etc. Changes in sense modality and other variations would play a part for some transfer test situations. In any event, one criterion for evaluating a statement of

a behavioral objective is that several informed persons could easily agree upon a suitable test.

The basis for planning instruction. Another principal reason for stating objectives in behavioral terms is to insure that the instruction is relevant. For example, a statement to "learn about the Civil War" is obviously inadequate as a basis for planning instruction, although it does imply, to citizens of the United States at least, that the course is in American History. Clearly, more information is needed to decide whether the student is to memorize dates, identify the principal reasons for conflict between the North and South, or use economic concepts and principles in a discussion of economic factors which influenced the military outcome of the struggle. The latter objective would require the conditions for problem-solving, while the others would require the conditions for formation of verbal associations and chains. While it is clear that teachers of history should have a voice in choosing which objectives are to be sought, the decision has to be made explicit before the relevant instructional media can be planned.

Identifying the Type of Learning

For each individual objective stated, the next step is to classify it in terms of some classification system which consists of statements as to how the different kinds of learning may be acquired.

Several possible ways of categorizing types of learning were considered. Conventional distinctions employed in the past by research workers include the following: learning of meaningful vs. meaningless material; rote learning vs. conceptual learning; paired-associate vs. serial learning; motor vs. verbal learning. None of these classifications appeared relevant and usable for the present purposes. Likewise, the distinction between "didactic" instruction and "discovery" learning, often used by teachers, seems too little researched to provide useful guidelines for designing media, except in that research findings regarding some of the components, such as degree of prompting and size of step may be useful at specific points in planning instruction. Furthermore, the media research literature does not provide clear-cut categories of learning for which particular media have been found successful across subject-matter areas. Statements of categories of educational objectives were also considered, but none reviewed included statements of procedures by which the various categories might be taught. Finally, reviews of research on single variables in learning, such as contiguity, reinforcement, distributed practice, etc., appeared relevant only for some instructional events, and for certain special kinds of tasks, and hence could not become the basis for sorting of educational objectives for the purposes of planning media of instruction.

The above digression is made to indicate that a search was conducted for the most useful classification system in terms of purposes of the present project. As said before, the categories outlined by Gagné (2) appeared the most promising of all alternatives considered.

In an earlier portion of this Chapter there was presented a listing of the types of learning most frequently found in public education, although all eight of the types outlined by Gagné should be kept in mind when classifying objectives.

Ideally, each behavioral objective would be stated in terms of a sufficiently limited scope of instruction so as to involve only one kind of learning. It is to be noted, however, that the more complex types of learning encompass the less complex types, as discussed in detail in Gagné's book. Instances may be encountered, of course, in which it may be difficult to state a meaningful objective which does not cut across learning categories. In such an event, presumably one would plan the instruction in terms of component aspects of the total objective which can be identifiable as one type of learning, and then proceed with the analysis in much the same fashion that several objectives in a sequence are handled. A desirable precaution, however, could consist of a second attempt to state the objective by breaking it down into two or more objectives which are unitary in respect to the type of learning. Also, general behavioral objectives may often first be stated, and then more specific ones which meet the above criteria.

At the time of this writing, then, it appears that the eight types of learning identified by Gagné represent best, for present purposes, a set of categories which are defined in terms of different sets of conditions for learning, and these conditions have been identified by study of empirical findings. While the writers may have wished for a simpler basis for identifying the kinds of learning represented by educational objectives, no simpler method appears to have the same degree of experimental verification. Conversely, the writers tend to feel that almost any method of categorizing is, in many respects, an oversimplification when one thinks of all the external variables which may influence learning. The categories adopted here, then, appeared best in terms of scope covered, the degree of simplicity attainable, and experimental support.

The eight types of learning identified by Gagné (2) are:

1. Signal learning
2. Stimulus-response learning
3. Chaining
4. Verbal association
5. Multiple discrimination
6. Concepts
7. Principles
8. Problem solving

It is beyond the scope of this report to discuss these types of learning

separately in detail, and this has been done by Gagné (2). However, some references have been made in this report to particular features of some of these types of learning as to their importance in education.

The remaining point to be mentioned here, on the topic of identifying the type of learning represented by a given behavioral objective, refers to a suggested aid in making such classifications. The suggestion is that some brief outline of the eight types of learning may be used as a reference when trying to decide which type of learning is represented by a given objective. One such outline for several types of learning is presented earlier in this chapter. The author, when making the analysis presented there, made a chart consisting of eight sections, one for each type of learning. In the chart, for each type of learning there were entries consisting of (a) the category name, (b) alternate names (like shaping, connection, and discriminated operant, for the stimulus-response learning category), (c) examples of such learned behavior, (d) the general conditions required, and (e) the instructional steps implied. Such a summary chart may be most meaningful if prepared by the person who is to do the analysis while he studies Gagné's book. Probably different cue words would constitute the maximum aid for various persons doing such analyses, depending upon their prior backgrounds and orientations. It is for this reason that the particular summary chart mentioned here is not reproduced in this report.

Designing a Media Program

This step involves the examination of each objective, in turn, in order to state the explicit instructional steps and the media by which the required conditions of learning could be established.

One first notes the type of learning represented, as identified by the previous step in the process. He then recalls (perhaps with the aid of a summary chart, as discussed in the previous section of this chapter) the (a) general conditions of learning for that category. For example, for chaining, one condition is to provide contiguity of one link with the next. One next identifies (b) the content to be dealt with; in this example it would be the two links to be chained, like "sodium chloride." One next asks himself (c) how he will provide contiguity, and (d) in what exact stimulus form the two links are to be presented contiguously. Probably he would decide upon point (d) before point (c) in this instance, as he would wish to decide whether the student should see the words in printed form, or hear them spoken, or see or hear them in further contiguity of the notation NaCl. If printed words are chosen, he then decides how these stimuli (printed words) are to be presented in contiguity. Alternate choices are in the form of a book, flash cards, projected slides, teaching machines, or films, and probably many others. The actual media choice will probably hinge on the instruction that precedes and follows this item of instruction.

The above example probably would constitute only a part of a be-

havioral objective, but it was chosen to show the degree of minute detail which may often be involved. Statement of the instructional events, for this example, in addition to identification of a way for presenting the stimuli in such a way as to provide contiguity, would further hinge upon the estimate of whether more than one presentation is needed, whether only two, rather than more stimuli, are to be presented in a single presentation, and whether overt responses and feedback are required. These decisions, in turn, would hinge in part upon whether the student is to spell the words or only pronounce them as a chain, and upon pre-requisite knowledge, such as whether the words, used separately, are already words which are recognized and spelled correctly.

As indicated above, this degree of detail in analysis may be necessary for several component parts of a behavioral objective such as "Be able to say either the words or the symbols for the following chemical compounds, whether the words or the symbols are the given terms." In this instance, all such components of the objective appear to fall into the same kind of learning, except for compounds of elements in unequal proportions, in which case the use of subscripts as principles is also required, in connection with suffixes such as -ic and -ous. (Later on in the instruction, of course, new or unfamiliar compounds may be identified without direct instruction as simple cases of problem solving.)

It is recognized that a teacher may not wish to teach the above objective as a set of chains to be formed. This would make a great difference in how the instructional events, as well as the media, would be arranged. For example, if students are to induce such chemical expressions by first learning to apply the principles by which such designations first came to be constructed, then it is likely that motion pictures, using animation techniques for showing how elements combine into compounds, might constitute the media for early instructional events. This basic decision is essentially a curriculum approach decision, and it must be made before the media schedule is drawn up, as different types of learning would become involved. (It may be noted, in passing, that the arguments for or against "discovery learning" should probably be broken down into two different and independent sets of considerations, rather than seeking a general "answer." Education involves both (a) learning what other people already know, and (b) preparation for achieving new discoveries. Education also involves several kinds of learning. Discovery learning should be considered in the light of these factors.)

At this point, the reader may wish to inspect examples of media programs for specific objectives. Each objective may involve some variations in the exact order in which one makes notations regarding (a) general conditions for the type of learning, (b) the instructional events, (c) the content, (d) the nature of the stimuli, and (e) the alternate available media of presentation.

Also, as noted earlier, some of the instructional events are the same for several kinds of learning, and some are different. That is,

presentation of stimuli (words, pictures, etc.) and appraisal (and feedback for the student) are common requirements, while progressive part practice, stimulating recall of relevant concepts, and confirmation of overt responses are requirements special to some kinds of learning.

It is noted that, at this step, one may make note of possible media options without making media decisions. Thus the media schedules, for each objective, are the raw materials from which media decisions are later made, in which sequencing, economy, and other factors are taken into account. In this sense, the present step is the most analytical step, and it is best made in terms of technical knowledge about the conditions of learning, temporarily divorced from other practical considerations.

Finally, it should be noted that, depending upon how general or how minute are the statements of behavioral objectives, the media program may be made for an entire objective, or for only a component of an objective. In the above illustration involving "sodium chloride," a rather minute segment was chosen in order to illustrate some of the details which could be involved. It may be noted that the media program, for some objectives, is made in as much detail as would be given in the final lesson as presented by a medium of instruction. In this sense, the media schedule is the "program," used in the way meant in "programmed instruction." In other cases, the media program could represent only the guide to the programmer on how the lesson is to be prepared in the medium chosen.

The functions of stimuli. All that the instructional media can do is to provide external stimuli. However, these stimuli may, or must, for various kinds of learning, serve many instructional functions, such as: (a) set a goal in terms of performance desired, (b) direct attention, (c) present instructional content (also stimuli), (d) elicit responses, (e) provide feedback, (f) direct the next effort, and (g) help the student evaluate his performance. Other special functions of stimuli are to (a) provide the degree of cueing or prompting desired, (b) enhance motivation, (c) aid the student in recall of relevant concepts, (d) promote transfer, and (e) induce generalizing experiences. A general discussion of the capabilities of various media in providing these instructional functions has been presented by Gagné (2, Chapter 10). The task of considering the possible media alternatives for each required instructional event for each objective takes place when designing the media program.

Sensory modes and dimensions of stimuli. For most of education, the eye and the ear are the primary sensory modes stimulated by instructional media. However, for young children and for special purposes, the senses of touch, taste, smell, and kinesthesia may be quite important. These include impressions of hot, cold, rough, smooth, pressure, pain, etc. In athletics, for example, movement-produced stimuli are highly important, and since these are internally produced, the instructional events are arranged to make more probable the experiencing of

the desired internal stimuli which accompany successful physical acts. Thus the learner's hand may be guided by the teacher primarily to produce, for the first time, the "correct" skeletal movement which produces the desired internal stimuli in the only practical way they can be produced. However, these instances are more the exceptions than the rule, when all of education is considered.

Nevertheless, an important consideration in the preparation of the media schedule is the decision of whether to stimulate the eye, the ear, or another sense organ, since media alternatives obviously are directly related. In spite of the amount of research conducted on visual versus auditory stimulation, not many generalizations appear useful for the purpose of designing the media schedule. For example, children could learn to recite poetry by reading and prompted recitation trials, or by hearing and prompted recitation trials. The instructional decision would probably be made on the bases of convenience and age of the child, e.g., whether he can read or not. In some instances, especially when one performs with the aid of prompts in the criterion situation, the instructional media should probably provide the prompts by stimulation of the same sensory modes as stimulated in the criterion situation.

Normally, however, the determination of the sensory mode to be stimulated does not, in itself, necessarily identify the media to be chosen. For example, visual stimuli may consist of printed words, natural objects, pictures, drawing, or moving objects. These may be presented in the form of books, slides, motion pictures, programmed instruction, or as real objects. Sounds may consist of words spoken by the teacher, or sounds recorded on tape, or sounds from natural sources (e.g., sound of bells). Thus, visual and auditory stimuli may be presented in various degrees of size, intensity, duration, etc.

The choice of the medium often may rest upon the convenience of incorporating a way to automatically evaluate the student's response and provide feedback. That is, a drawing may be placed on a wall chart, but its instructional function may be enhanced by an explanation by the teacher or by responses elicited by cues in a programmed instruction booklet.

The choice of the medium also may hinge upon the best means to attain the particular dimensions desired for the stimuli. One dimension may be the choice of audio, visual, or audiovisual channels. The form may consist of words, symbols, pictures, or signals. A third dimension is size, area, and amount of presentation to be given in temporal sequence, including intensity, color, or pacing of successive stimuli. The schedule of interruption of "content" stimuli to allow for responses, feedback, goal setting, and evaluation is another dimension in selecting media of presentation. Exposure rates, as in fast or slow motion, and size of step in terms of rapidity of progression from simple to complex, constitute another dimension. Other factors in the final media choices are discussed in the following section.

Preparing Summaries of Sequences of Media Alternatives

Once a media schedule has been prepared for each objective in a sequence of instruction, it is necessary to inspect them all in some overall fashion in preparation for making final, practical media decisions. It is useful, then, to first prepare some kind of summary of the media alternatives from the media schedules for the individual objectives. Such a summary, for a short sequence, may be made implicitly by simply reviewing the options in the individual media schedules. At other times, a written summary may be helpful.

The purpose of this step is to review the media options previously noted, in order to identify the best medium (or media) for some reasonably-sized unit of instruction. If a given medium option appears only once or twice in the summary, whereas another medium appears very frequently, consideration could be given to the possibility that the second medium could also serve the purpose of the first. In the process of such deliberations, one could determine that one option noted has a critical capability no other medium appears to provide. In this case, a quite brief presentation in one medium could be justified in spite of the greater convenience of simply adapting the entire sequence to the most frequently appearing option in the summary.

Another reason for preparing such a summary sheet is to detect the possibility of changing the sequencing within a segment, or between segments, to make the presentations by the various media flow more smoothly, or with less inconvenience or lost time in the classroom.

Just how often one should pause to make such summaries cannot be stated with confidence. In some instances, a major course objective may be represented by the content of the summary. In other cases, one may note a definite change in the particular options recorded at a particular point in the individual media programs, and be able to clearly recognize when a major medium change can be anticipated in advance. In any event, these summaries may be considered as aids in taking the next step in the procedure.

Selection of Media

It is at this point that one seeks ways to plan to use a single medium for the optimum length of time for the most appropriate set of objectives, without doing serious violence to the ways of providing the instructional events indicated as needed in the media schedules, and with minimum violation of cost and convenience considerations. It is at this step that final compromises and changing in sequencing may be considered.

It is also at this point that one must decide among the alternatives of group instruction, individualized instruction, teacher-con-

ducted instruction, and automated instruction, with further specification of allowable assumptions regarding costs and equipment to be available. Of course, if one has a clear view of these factors at the outset, and if stated limitations in these respects must prevail, this would influence the work done at earlier steps in the analysis.

For purposes of discussion however, it is assumed that a group of educational specialists is conducting the analysis with the view that it would be possible to provide specifications for alternate packages of instruction in a widely-required course, so that different media packages might be prepared to suit local budget limitations, or to permit more latitude in the local options based on preference for automated or non-automated, and individual or group instruction. Stated differently, the analysis at this point could be based on either the assumption of (a) unlimited funds and the possibility of designing new equipment for this instruction, (b) presently available equipment and techniques with cost not an over-riding consideration, or (c) some more limiting set of assumptions. In Chapter III, the effects of such alternate restricting conditions are shown in terms of packaging options for the instruction.

In any event, it is at this step in the procedure that the choices of media are reviewed in terms of such practical matters as how many items requiring the same set of learning conditions can be sequenced in a row to provide a long enough period of use of a given medium to make it economical to make a small instructional package. This factor interacts with the flexibility of the medium. For example, it is easier to alternate between presentation of information, student response, and feedback in a programmed instruction sequence than in a motion picture sequence.

Suppose flash cards are good for establishing certain verbal associations, and programmed instruction is effective for establishing certain concepts. Can the sequence be arranged to permit use of flash cards for a period of several minutes before using a programmed instruction sequence taking several minutes, or must the student learn one verbal association and one concept alternately? If so, a "compromise" medium will probably be selected.

Again, if one needs to present high-fidelity music for a few seconds at a time, interspersed with short spoken statements, will a high-fidelity recording be unnecessarily used for the spoken statements to get a smoothly-packaged sequence, or will the teacher start and stop the record frequently to interject the commentary?

Such practical considerations will often force a choice between adopting an "awkward" way to switch from one chosen medium to another rapidly, and choice of a less effective or less economical "compromise" package for the sake of convenience. Ideally, and possibly in the future, practically, improved budgets and new kinds of equipment will make such compromises less frequently necessary.

The degree of latitude in choice possible at this step rests, in part, on the fact that most media are "general purpose" devices, e.g., they are not designed for any specific subject matter. (It is necessary, of course, to recognize a further distinction between equipment and the instructional material. Projectors and teaching machines are general-purpose devices, while the films and programs used in them are designed for specific instructional purposes. The ambiguity in the definition of "media" is that both kinds of items are included by this term as used, e.g., "media are physical means of presenting stimuli.") Exceptions, however, include laboratory equipment, simulators, and other specialized "training devices." Most media are also "general-purpose" devices in that they may be programmed to teach facts or principles, as well as concepts and problem solving. Exceptions may be flash cards (used for memorizing) and tuning forks (to teach pitch discrimination). A further aspect of the flexibility of some media is that they permit considerable latitude in stimulus dimensions--spoken words, pictures of action, diagrams, printed words, etc., as in TV and motion-picture films, and words, pictures, diagrams, and provision for eliciting explicit responses and of providing feedback as in programmed instruction.

For these and other reasons, if only presently available equipment and techniques are considered, there is seldom any one ideal way to present a very lengthy sequence when all factors known, relating to learning conditions and practical constraints, have to be viewed in a trade-off fashion. Nevertheless, the closer the final media choices can adhere to the media shown in the media programs for the individual objectives, the greater the likelihood that the result of the analysis will be a multi-media package of significantly greater effectiveness than could be achieved by a less systematic approach to the design of instruction.

While the present writers see no simpler way of designing instruction while preserving the analytic framework upon which the procedures here recommended are based, it remains for future research efforts to reveal whether present knowledge can be cast into a simpler structure for this purpose. In fact, when one considers the possible addition of individual difference variables and situational variables to the present treatment of learning condition variables, one must expect a more complex, rather than a less complex, improved version of the method of analysis. Whether the increasing uses of computers in education could become the key to the application of a more complex, semi-automated system of analysis will not be speculated upon here. However, the writers do wish to reiterate that the solution to this problem should rest upon the most dependable and relevant research findings available, and that resort to the all too familiar "media comparison" study, which does not classify and identify the learning objectives in a generalizable fashion, cannot result in the kind of improvements sought. Such studies would have usefulness, however, in the field testing of the present procedure in comparison with any proposed alternate procedure.

Preparing the Specifications

After the above step has resulted in identification of the specific instructional sequences (of whatever size) which are to be presented by the various media, specifications are then prepared to serve as guidelines for the text writer, the self-instructional programmer, the motion-picture producers, and the other production specialists whose skills in working in the various media are to be utilized. As noted earlier, in some cases, these specifications may consist of the actual words and pictures to be presented, so that the remaining task is simply that of reproduction of the material. In other cases, the specification would leave developmental work to be done by the media specialists. For example, a specification may call for use of animation and three-dimensional models of the sun and the earth, with motion, shadows, and narration to enable the student to learn how the seasons and night and day come about. Criterion questions would be furnished, but the producer might be given the task of writing the script he believes would enable the student to pass the criterion test.

Conducting Tryout and Revisions of the Materials

Whether the specifications are actually verbatim scripts or directions for scripts, they should include criterion tests and directions to the classroom teachers. Then, empirical tryout and revision procedures could be employed before general use of the products. For the teacher's use, some guidelines could consist only of the sequence in which automated segments are to be presented, plus suggestions for appraisal and generalizing experiences. For teacher-conducted sequences, more detail would be needed.

Individualized sequences. One rather natural advantage of the approach here recommended is that sequences of instruction are delivered in relatively small packages because of the use of various media. This fact fits in nicely with the idea of individualized flexible curricula, in which not all students would take all sequences, even in a required course. For example, a course might begin with instruction and review of arithmetic, so that all the pre-requisites for business arithmetic and algebra are achieved by all students. Then special sequences could be used in a branching fashion so that students in a vocational program would receive somewhat different instruction from that received by those in a college preparatory program. Less radical differences in content could further be introduced within the two sub-groups, based on individual goals and achievements.

Thus, while planning of instruction is accomplished by a single body of educational specialists, implementation of the instruction could rest not only upon local options within school districts, but also upon individual variations in curricula (and perhaps also teaching method) within a classroom.

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Experiments also differ in the degree of generality of findings across a variety of learning and teaching conditions. Media research has long suffered from the selection of media materials and instruments on the basis of purely local administrative considerations. For example, many studies measuring the effects of a particular film or set of films have been erroneously generalized to the broader class of films as media instruments--evaluative studies in which the permissible conclusions are limited to a single film or set of films in general. Thus, another judgmental matter in assessing a body of research literature is to assign accurately appropriate degrees of generality to the reported results.

Experiments differ further in the stability of their findings. One replicated finding may carry the same interpretive weight as numerous studies which report statistically significant but unreplicated results. A distinguishing feature of media research is the absence of replicated findings, but the criterion of stability is a crucial determinant in judging the true impact of experimental conditions.

Thus, differences among experiments in sensitivity, generality, and stability all introduce judgmental elements in the survey of the literature on the role of new media in teacher education. It is obvious that any number of poorly designed studies yielding negative results of restricted generality will be outweighed by one well-designed, precise study yielding positive results of broad generality. Somewhat less apparent is the fact that any number of poorly controlled studies, even when they generate positive results, will be outweighed by a truly rigorous, sensitive experiment which, nonetheless, produces nonsignificant results.

Other judgmental factors are interjected into a research survey by the administrative need to balance educational costs and payoff. An instructional approach of limited cost (in expense, equipment, maintenance, and personnel demands) may be more justified despite its restricted yield than a more costly arrangement. In an applied area such as teacher education, the research must be reviewed with both hypothesis testing and potential implementation in mind.

In the light of these many subjective judgments which intrude into a research survey, no highly detailed or refined evaluation will be offered for each of the individual studies reviewed. It will, however, be clear that all studies are not given equal weight; indeed, some relevant studies will not appear at all because of obvious defects. Other studies may not appear because only a small proportion of media studies in teacher education have appeared in the published literature, and unpublished research and mimeographed copies were not always made available. Also excluded from coverage are subjective testimonials to the utility of media in teacher education, studies of attitudes toward media, and research which does not bear directly upon the teacher education process. We shall also ignore studies concerned with what education students must learn to utilize and forward the results of audiovisual technology.

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The Present Status of Media Research in Teacher Education

In surveying the current status of media research evidence, these questions are asked: (1) What is the present general status of media research in teacher education? (2) What are the prominent methodological characteristics of this research area? (3) What degree of conviction can be placed in the demonstrated or potential stability of the reported results? and (4) What degree of confirmation or contradiction exists within the body of media research for our proposed theoretical statements describing the possible correspondence between the functional characteristics and requirements of teacher education and the functional properties of new media?

Scarcity and Recency

Rigorous empirical research on the applications of new media in teacher education is scarce, and the studies which do exist are primarily of recent origin. Given both the scarcity and recency of media research, few replicated findings have as yet accumulated. The absence of replication and cross-validation of results is perhaps the most conspicuous characteristic of research on media usage in teacher education.

The scarcity of empirical research is somewhat surprising in view of the considerable number of organizations in which technical and professional resources are now available. Recent publications (17,39,87,144) describe formidable lists of institutions with various media facilities. It is not clear why so little systematic research has emerged from these many sources, but it is perhaps true that when the installation of expensive equipment precedes rather than follows the demonstration of its value, subsequent discussions tend to contain justification and testimonial rather than objective assessment.

Inherent Complexity of the Functional Characteristics of Both the Teacher-Education Process and the New Media

It has become apparent that productive media research in teacher education must go further than the rudimentary study of the single medium as a separate instructional entity. Certainly, such research must study the manner in which several media can be combined to produce the maximum impact upon learning. In this area of multimedia use, there are complex problems of patterning of instruction that have received little empirical study.

Media research must focus not only upon the methods and procedures used in teaching, but upon the nature and structure of the subject matter and skills to be learned. The potential values of media in preparing teachers to instruct children in the use of a second language may be quite different from media used in training teachers to communicate Archimedes' Principle. Both of these applications are, in turn, probably radically different from the way media find optimum use in prepar-

ing teachers to interpret accurately the nonverbal classroom communications of their students. Here again is a little-explored area of complexity.

But the potential complexity of media research extends well beyond these complicated problems of multimedia use and the variations in application demanded by the differing structural properties of subject-matter areas. For example, the teaching function is dependent upon the desired educational objectives; the composition of the group to be taught; the skills, attitudes, personality, and methods (including media use) of the teacher; and the major features of the learning environment. The interactions among these complex, multidimensional variables must all be viewed within the context of the ongoing, continuous learning process if we are to discover the optimal combinations among these variables within the instructional setting which will maximize learning for particular students. If the ultimate aim of media research is to produce meaningful educational insights, a concentration upon the enormously intricate interactions among numerous instructional forces will be compulsory. To study the effects of weaving combinations of media experience into this intricate web of instructional forces and then to study the operation of all these variables simultaneously is a monumental experimental task.

Media research has responded to the inherent complexity of the phenomena it studies in much the same manner as research on complex social and educational problems has done in the past. The issues become atomized, divided for detailed analyses into small segments extracted from the general problems. Media studies have avoided the complex problems of teaching and learning, focusing instead on research susceptible to study in the routine fashion of the early investigations in psychology and education.

In the face of enormous complexity, this compartmentalization is perhaps adaptive. But, then, the studies of small components begin to wander in many directions, with the particular emphasis at any moment being determined by the most powerful or faddish sources of public or scientific influence. Few efforts are made to synthesize the research evidence which does accumulate in these component studies in order to reconstruct the total complex matrix of instructional variables.

In common with much scientific research, media studies are thus beginning to face this traditional puzzle: How can a complex phenomenon be subject to observation and analysis without losing the meaning of the phenomenon in the analytic process? How can analyses of intricate media effects within complex learning contexts retain enough of the inherent complexity so that the essential significance of the phenomenon is not destroyed?

Lack of Systematic Theory

Despite several cogent efforts (18,19,20,40,45,61,65,86,89,96,120)

to develop systematic theories of learning, perception, and communication to guide research, media studies still tend to be discrete, atheoretical efforts which fail to contribute to a cumulative analysis of the role of media in the teacher-preparation process. The early history of interest in educational media strongly reflected an administrative orientation--the need to expose large number of students to instructional materials in shorter periods of time and with fewer demands upon educational personnel. With regard to teacher education, the exploration of the use of new media was instigated by the dual administrative needs to provide for the instructional demands of inservice teachers through devices which could be used when the teacher was free from her full-time teaching assignment and to make available as widely as possible the services of the limited supply of teacher-education specialists.

This initial administrative orientation was a great distance from our present needs for theory construction and data collection in media research. Until administrative concerns are at least momentarily set aside and our attention given to the development of theoretical propositions which systematically and simultaneously encompass both the functional characteristics of teacher education and media operation, cohesive empirical information will emerge only sporadically.

The task of building a collection of empirical facts is, of course, the most compelling immediate problem in media research in teacher education. But while the additional accumulation and analyses of empirical data are certainly necessary, the most crucial continuing tasks will be to solve the logical, theoretical problems of combining small, discrete units of facts and propositions into systematically ordered knowledge and at least to approximate the true complexity of the instructional process in this theoretical model. The problem of coordinating and synthesizing facts and propositions derived from diverse levels of media research will remain our major unresolved task for some time to come.

Technique Orientation

Research in new media in teacher education has been basically technique oriented rather than problem oriented. Being technique oriented, media researchers begin the examination of the educational utility of a particular set of instructional devices and never depart from the study of these tools even when the educational problem has been resolved or deemed unsolvable. Gilbert states:

While research is always in the business of testing techniques, when the techniques take precedence over the problem, much is lost. The questions of the greatest social interest are: How can neurosis be alleviated? How can arithmetic be efficiently taught? How can a schizophrenic be made normal? How can reading deficiencies be overcome? (53, p. 565)

To Gilbert's list of problem-oriented (rather than task-oriented)

questions, the guiding inquiry of this paper may be added: How can teachers be trained more effectively? While we are attempting to estimate the value of the new media in preparing teachers, it is not the methods which supply the base of the inquiry. The instructional problem to be solved must be the essential focus, and yet media research has long suffered from excessive devotion to its tools rather than the problems to be solved, possibly but not necessarily, by means of its tools.

Prevalence of "Nonsignificant Differences"

Beyond the scarcity of theory-directed investigation, one recurrent problem of data interpretation aptly illustrates the inadequacy of media research at the theoretical level and the confusion introduced by the desire to draw immediate administrative conclusions--this is the problem of interpretation of the "nonsignificant difference" result which abounds in media research. For example, significant differences are conspicuously absent in studies of student learning in courses taught with the use of new media as compared with courses taught conventionally. Also, these nonsignificant differences are not remedied dramatically when associated variables, which might be expected to condition the effectiveness of instructional media, are introduced. As illustration, two-way communication between television classrooms and the studio was not superior to simple television reception, studying the attention level of students receiving televised instruction does not seem to help, varying the size of the viewing group does not seem to add to television effectiveness, and adding supplementary visual aids to televised instruction seems equally fruitless. To date, media research in teacher education has harvested a rich crop of nonsignificant findings.

The weight of these nonsignificant differences gains magnitude when viewed against a common obstacle in drawing conclusions from research--the nonreported result. There appears to be a general tendency to regard negative results as less interesting, less illuminating, and less worthy of publication than positive findings. Researchers often make no effort to publish nonsignificant results, and this may terminate in the appearance of a greater proportion of positive results on a particular topic than were indeed obtained.

The general lack of motivation to report nonsignificant differences is perhaps augmented in new media research by the consequences of the fact that costly equipment is often installed before definitive research has documented its utility. When subsequent nonsignificant differences are discovered in experimentation with these elaborate and expensive devices, serious embarrassment may ensue. Once the equipment is installed and is in operation, it is difficult for media investigators to reverse their commitment and advise discontinuing or limiting its use. Granting the operation of a general lack of interest in publishing negative results and the special sources of embarrassment in media research, the heavy predominance of negative findings in reported studies is especially impressive.

The emergence of negative results can, at times, be almost as meaningful to research progress as a series of positive findings, if proper interpretations and explanations are sought conscientiously. But how have the recurrent nonsignificant differences been interpreted in media research? Generally, they are said to signify (1) the equal effectiveness of the devices compared and (2) the fact that all of the media studied are effective instructional devices. The further illogical conclusion is usually drawn that since inequality of effectiveness has not been experimentally observed and equality presumably exists, decisions concerning media selection should be made on such extra-scientific criteria as administrative ease and economy.

These conclusions are theoretical misinterpretations of the absence of media differences in effectiveness. It is logically indefensible to interpret the failure to conclusively demonstrate that conditions are unequal as proof of their equality. Failure to reject the null hypothesis provides no positive evidence that all media are effective and equal in their impacts. If it were true that the usual classroom procedures (with which instructional media are often compared) represent the worst possible methods, what is gained by demonstrating a nonsignificant difference between these classroom methods and the use of instructional media?

Given the prevalence of negative results and the theoretical misinterpretations assigned to them, few empirical media studies have emerged that seem sufficiently exciting or illuminating to generate a progression of follow-up studies, starting with the replication of the original discovery.

Unstudied Processes

The trend to date in media research has been to perform comparative effectiveness studies: measure some initial status variable, introduce media experiences, measure final status in order to assess change, and then compare the degrees of change among the groups with different media experiences. These analyses of gross input-output changes ignore the intervening processes involved in the interactions between the learner and media material which result in the observed overall change. Although some audience response or feedback devices have been used in teacher education to provide a continuous record of student response to media, few studies attempt detailed, intimate descriptions of the intervening processes of learning which may not be reflected in pre-post change appraisal. We have concentrated upon the overall gross effects while ignoring what goes on in the mind of the learner to produce them.

Profusion of Testimonials

The literature on media use in teacher education is more often composed of testimonials for its use than reports of empirical evidence regarding its effectiveness. When criteria beyond the author's own impressions are applied, these are often the subjective impressions--or in-

direct testimonials--of students and teachers. An era of evangelical testimonials often appears in the early phases of a developing field of knowledge; hopefully, this era is passing for media research in teacher education.

Absence of Replication

The scarcity and recency of research, the inherent complexity of the phenomena, the lack of attention to developing systematic theory and studying intervening processes, the profusion of nonsignificant differences and testimonials--all contribute to the scarcity of replicated, established findings on the contribution of media usage to teacher education.

This absence of replicated information not only affects the degree of confidence to be placed in the stability and reliability of media outcomes, but also indicates the paucity of data on the parameters of effectiveness of various single media or combinations of media. Certainly, it is clear that no single pattern in the use of new media will be identified as most effective under all conditions. The questions thus become those of exploring the various parameters of effectiveness: Under what set of conditions does a particular medium or a specified combination of media produce discernible effects upon learning or performance? What sets of conditions maximize such effects, or cause them to disappear? The establishment of such parameters describing the gradations of impact upon a variety of learning variables of a variety of media combinations is unfortunately well beyond the current state of maturity of media research.

The issues related to the use of instructional media in teacher education are important and complex, but the absence of cumulative efforts which build successively upon each other permit few definitive empirical answers.

Organizational Characteristics of Media Research

Counterbalancing this unpleasant picture of the current status of media research in teacher education is the fact that several organizational advantages are operating to produce a potentially less-scattered accumulation of scientific work in this area than in many other newly emerging fields of research. While the research efforts to study new media and teacher education are well distributed among universities and other organizations throughout the United States, many of these activities are currently sponsored by a single federal agency, the Educational Media Branch of the United States Office of Education (under Title VII of the National Defense Education Act). Distribution of media research information is also centralized by the agency. In addition to the dissemination activities of the U.S. Office of Education, at least one professional journal (AV Communication Review) acts as a clearinghouse for media research studies by publishing supplements that summarize recent

findings in addition to its regular articles on media research. Furthermore, the AV Communication Review also presents collections of contributions emerging from conferences or group reports (86,89,96). The profusion of scientific meetings hardly assures integration of research, but several valuable working conferences have been conducted by researchers to acquaint one another with current progress.

Thus, the present general status of media research in teacher education does not provide dazzling illumination. There are signs, however, that cumulative progress may emerge from efforts to make this research more cohesive and comprehensive.

Research Evidence on the Role of New Media in Teacher Education

Considering the delimitations stated earlier concerning the role of new media in the teaching function, studies will be surveyed under the following general headings. Categories describe the new media as a means of:

1. Providing more efficient observation of classroom behavior for teacher education
2. Providing more efficient self-instruction and supervised practice experiences for teacher education
3. Presenting college-level courses related to teacher education
4. Establishing clearer, more commonly accepted, and applicable standards of teaching performance
5. Conducting basic research into the teaching and learning processes which underlie teacher education
6. Studying combinations of new media, organized into systematic sequences of instruction, as providing more efficient means of producing teacher competencies

Two essential components of the teacher-preparation process are classroom observation of teachers and children (30,93,108,118,140) and the practice- or student-teaching experience (13,16,28,30,36,68,113). Observation and student teaching should contribute to all of the teaching skills enumerated in our analysis of the teaching function: the ability to define and analyze teaching goals, knowledge and communication of subject matter, insight into the characteristics of the child and the teacher, and the recognition of environmental influences upon learning.

To what extent can media technology be used in carefully guiding the observation and student-teaching experiences? The following two sections describe the research evidence which demonstrates the outcomes

of using new media in connection with systematic classroom observation and student teaching.

The Role of New Media in Providing More Efficient Observation of Classroom Behavior for Teacher Education

A compelling logical argument can be mustered for the use of the new media in providing systematic and detailed classroom observation for teacher-education students. Both closed-circuit television and prepared films have been explored as means of supplying classroom observations in place of student visitation to the classroom. Before reviewing the research evidence on the role of new media in providing classroom observation, the logical justification for expecting productive results from the use of media will be developed. This theoretical analysis is adapted from Stoller and Lesser (130) and Stoller, Lesser, and Freedman (131).

Availability of Cooperating Teachers and School. The college instructor using visitation and direct observation in the classroom must select cooperating teachers and schools within a limited geographic area to minimize travel time between college and school. He may not find teachers who either use precisely the methodology he wishes to exemplify or provide instruction worthy of observation. The instructor using either closed-circuit television or prepared films as the observational technique need not confine himself to the small geographic area used in direct observation.

Availability of Appropriate Classroom Lessons. (1) Correspondence between college and elementary school programs. Using direct classroom visitation, the instructor often finds it difficult to establish proper correspondence between the order of topics in his syllabus and the instructional program in the school. Since the instructor using television can involve a larger number of schools, there is a greater likelihood of his finding teachers whose instructional programs correspond with his course syllabus. The use of films completely eliminates this problem; the film can merely be shown at the proper place in the college syllabus.

(2) Lesson planning. Using direct observation, college instructors and public school teachers generally do not have sufficient time in advance of demonstrations to discuss each lesson in every particular. Since television permits simultaneous observation by more than one college class, a number of sections of the course may be scheduled at a common meeting time, thus reducing the number of necessary planning sessions. When films are used, lesson planning (both by the teacher alone and by the teacher and college instructor jointly) is particularly refined because the lesson is to be recorded only once.

(3) Lesson execution. Using direct classroom visitation, neither the college instructor nor the teacher can predict the interaction in

the classroom once the lesson is in progress. As a result, the college instructor can only orient his students in general to the kind of lesson it will be, the subject matter, the characteristics of the pupils, and the teacher's approach. If the lesson moves into an acceptable but unplanned direction, the college students view this situation without advance preparation. Even with television, the instructor cannot predict precisely how the lesson plan will be executed. However, when prepared films are used, the instructor faces no problem in predicting the interaction in a recorded lesson. He previews the film and can tell his students precisely what they will see and what to look for. Also, the film can be edited to eliminate undesirable educational as well as technical features. Many more lessons can be recorded than are actually used, giving the instructor the opportunity to select lessons or lesson segments for final use. In this way, a single film can contain segments from lessons taught by a number of teachers for comparing their instructional techniques.

Availability of a Common Lesson for All College Students. Because of classroom limitations, the use of direct visitation divides college classes into two or more groups. Since each group observes in a different school room, it is impossible for the entire class to see the same lesson. Using either television or film, all members of the college class are able to view the same lesson simultaneously.

Role of the College Instructor. (1) Availability of the instructor. Because the college class must be divided into small groups when direct observation is used, the instructor cannot accompany each group to its classroom. He cannot, therefore, be as effective in elaborating upon instructional procedures he has not observed in person as he can be when he shares the experience. Using either television or film, the instructor views the observation simultaneously with all of his students, eliminating this difficulty.

(2) Instructor as commentator. During the direct observation itself, the college instructor remains a silent observer. Consequently, he cannot direct the attention of his students, from moment to moment, to what he regards as the significant features of the lesson. With television, the instructor need not remain silent. Although the lesson is in progress, he can direct the technical staff to focus their cameras on any aspect of the interaction, point the attention of his students to particular segments of the television screen, and reduce the volume of television sound so that he can comment on the lesson in progress. (This is especially valuable when the lesson seems to be moving in unplanned directions.) With film, the instructor has all of these advantages of television and, in addition, he can stop the projector at any point to make comments without losing any of the ongoing classroom activity as he would if he were using television. He may also repeat any portion or all of the entire film.

Student's Field of Vision. When observing in the classroom, the student may focus on any aspect of the entire classroom situation, rele-

vant or irrelevant to the instructor's purposes. The television student is provided with a limited number of television screens, thus restricting his freedom. This restriction may, however, be an asset since the student is thus provided with selected views of the lesson which should aim him to grasp its essence with greater ease. The film observer has only one view of the lesson. Although this severely restricts his freedom, it also provides him with the particular focus which the instructor had built into the film.

These comparisons among observational conditions lead to the logical conclusion that films provide a more effective medium of observation than television, which is, in turn, more effective than direct observation in the classroom. What does research evidence indicate about the validity of this theoretical analysis of differences among observational methods in their comparative capabilities to provide college students with meaningful opportunities to observe classroom teaching and learning? For the most part, current research is not sufficiently detailed or precise to reflect upon each separate point in the logical formulation. However, several studies exist which indicate the overall comparative value of direct classroom visits, television, and prepared film as observational devices.

With a few exceptions, the "nonsignificant difference" is once again the primary finding. Despite the compelling theoretical arguments for the advantages of television and film in providing classroom observation, research evidence of their utility is not promising. Rogers (105) and Woodward (145) compared in-person observation supplemented with various percentages of televised observation with in-person visitation without additional media observation; nonsignificant differences in both course achievement and student teaching are reported. Chabe (25) and Rumford (107) also report nonsignificant differences between groups observing by television and those viewing directly in the classroom.

Clemens (27), however, describes an important qualifying condition in these comparisons between television and direct observation, indicating the value of a sequenced combination of observations. This study reports that television observation conducted before in-person observation is significantly more effective than television observation only, in-person observation only, or television observation after in-person observation. The theme of considering the operation of media in combination will be recurrent in the remainder of this research survey.

Mixed evidence also characterizes comparisons between film observation and direct visitation. Painter (100,101) found that some differences (between film and direct observation groups) which appeared early in the semester dissolved by the end. Van Horn (138) failed to locate any significant differences at all between film and direct observation in subject-matter knowledge. Fulton and Rupiper (49,50) continue the succession of nonsignificant differences between film and direct observation in courses in Human Growth and Development and Educational Evalu-

ation and Guidance, but they do succeed in breaking the unrelieved monotony of negative findings by reporting that in the course in *The School in American Culture*, film observation (plus slides) was significantly superior to direct classroom visits. Wedberg (142) adds somewhat to this hopeful sign by reporting that two experimental groups (observing in part or entirely by films, sound filmstrips, and slide-tape presentation) showed significantly greater gains in a course entitled *The Teacher and the School* than control subjects who observed in the classroom. Wedberg attenuates this encouraging report, however, by further indicating that judged on an absolute basis, none of the three groups really gained a great deal from their observational experiences.

Patrick's (102,103) results do provide ground for less-guarded optimism for the use of prepared film in classroom observation for courses in educational methods. Although an objective test revealed no difference between film and live observation groups, an essay examination showed that the film group gave greater evidence of understanding teaching processes and expressed a more creative approach to classroom observation. More impressive are the facts that students trained by the film method performed significantly better in their student teaching (102) and in their first year of inservice teaching (103), at least on the classroom techniques which had been depicted in the films.

Several studies (1,2,55,95,130,131,134) simultaneously compare all three observational approaches (direct observation, television, and film). Once again, the results are not auspicious. Abel (1) reports no differences among the groups in subject-matter knowledge (in a course in *Introduction to Secondary Education*) or in the ability to apply knowledge (in a course in *Introduction to Secondary Education*) or in the ability to apply knowledge to classroom teaching. Neale (95) finds no difference among observational tactics in course examinations or among measures of attitudes toward child behaviors and the teaching profession. Gould (55) reports that the three media of observation were not differentiated for the accuracy of the students' perception of teacher behavior, and Adolphsen (2) repeated this failure to locate differences in the acuity of student perceptions. Adolphsen does report, however, that no observation at all was significantly inferior to all the forms of observation combined in developing accurate perceptions of classroom behavior of teachers and children. This finding is perhaps not startling, but this set of University of Minnesota studies (1,2,55,95,134) does contain an essential element which is often missing in media studies--a "zero" control group which receives no observation at all.

Stoller and Lesser (130) and Stoller, Lesser, and Freedman (131) also simultaneously compare direct observation, television, and film. One measure of the students' response--an objective multiple-choice measure of information about teaching methods--failed to differentiate the observational conditions. However, another measure--an essay examination assessing the ability to critically evaluate an observed classroom lesson--revealed strong confirmation for the view that prepared films provide a more effective medium of observation than closed-circuit

television, and that television observation is, in turn, more effective than the traditional procedure of direct visitation in the classroom.

In summary, while the overall picture of comparisons among film, television, and direct observation is rather bleak, some promising directions are indicated. Both Patrick (102,103) and Stoller and Lesser (130) found that vicarious media observation of classroom behavior does not improve objective test scores of gain in subject-matter knowledge but does improve the students' ability to understand and critically assess an observed lesson as measured in an essay test. Even more provocative are Patrick's reports (102,103) of the greater long-term gains produced by media observations in direct expressions of teaching ability (both practice teaching and first-year teaching performance).

In addition to these relatively hopeful signs, several suggestions may be offered for increasing both the power of the observational experience and the sensitivity of the experimental test of these effects. Perhaps the most cogent suggestion is that the various observational techniques be studied as supplements, rather than substitutes, for each other. If the different educational objectives served by each medium were specified in detail and verified empirically, optimum combinations of media experiences could be explored.

As one means of increasing the power of classroom observation, Kersh (70,71,72) has proposed simulation training procedures which provide a method of exposing students to classroom observation and, in addition, supply a means of inducing active student participation in response to these observations. This media technique may satisfy the most common objection to the value of observation in teacher education--that in conducting any form of observation, the student plays an essentially passive role.

Extensive application of simulation techniques (often using high-speed electronic computers) has been made in military training, industry, and economics. Social science uses of simulation have included the study of a great diversity of phenomena: voter behavior, problem solving, concept formation, information processing, personality development, neurotic processes, diplomatic relations, brain functioning, the development of perception and language, and juvenile delinquency (11, 104,136). The reasons are not clear for the lack of use of simulation in education--a field to which these techniques should be especially well suited.

Kersh (70,71,72) however, has introduced simulation into teacher education by adapting motion picture techniques to simulate classroom situations to which the teacher in training may react. Multiple projection techniques are described by Kersh to present realistic classroom problems to which the prospective teacher is asked to respond as if he were actually in a classroom. Depending upon the reaction of the observer, a supervisor projects a selected "feedback sequence" in a short film showing the pupils' predicted response to the observer's reaction.

Thus, classroom simulation presents prepared observations on film and, in addition, provides opportunities for the student to respond actively to these observations.

Kersh (71) indicates that the essential components of classroom simulation are (1) that a suitable (filmed) stimulus situation be presented to the learner, (2) that the physical practice situation be sufficiently realistic to give the learner the experience with some degree of psychological fidelity, (3) that the prospective teacher be required to act out the response just as he would in a role-playing situation, and (4) that the feedback provided by the supervisor and the film presentation of predicted pupil response serve to confirm immediately the adequacy of the prospective teacher's response to the observed classroom situation.

Although Kersh (70) does present some preliminary results of experiments with classroom simulation, evidence regarding its utility in teacher education has not accumulated as yet. However, classroom simulation apparently can provide the teacher in training with planned observational experiences, coordinated opportunities to respond actively to the observation, and immediate feedback about the adequacy of his response.

Thus, despite sporadic positive results and the emergence of some promising new directions in studies of media as a means of providing classroom observation, the overall appraisal remains discouraging. It is possible, however, that the unimpressive status of these research results lies not in the inadequate power of the media of observation but in the inadequate sensitivity of the experimental tests. Some educators argue that if discernible effects are not discovered even with relatively gross tests, then the impact of the observational method cannot possibly be great enough to have any real educational utility. On the other hand, it is also true that even the most powerful teaching methods will be masked or submerged if the experimental appraisal is imprecise or inappropriate. Stoller, Lesser, and Freedman (131) have specified some minimal conditions of experimentation to provide an experimental test of the relative impacts of several observational conditions; these requisite conditions can be derived from the description of common methodological obstacles in media research.

General Characteristics of the Observational Conditions. (1) For all observational conditions, a sufficient number of experiments should be conducted over a sufficient period of time for the consequences of differential effectiveness of the observational techniques to emerge.

(2) For all observational conditions, there should be a balanced discussion of observations, focusing upon positive aspects of teacher and child behavior as well as upon deficiencies.

(3) When films are studied as an observational device, they should be selected from a large pool produced and edited to fit the teaching

methods of the college instructor and the objectives of the college course.

(4) When any form of media is studied, experimentation should not proceed until technical imperfections and disruptions can be held to an absolute minimum.

Role of the College Instructor in the Observational Conditions.

(1) For all observational conditions, the content of the classroom lessons to be observed should be carefully prescribed by the college instructors to fit precisely into identified points in the college course syllabus. (The assumption here is that novices in teaching need a structured framework about the nature of the instructional process both to guide their individual observations and analyses of lessons and to promote effective intraclass communication.)

(2) For all observational conditions, the observations should be designed by the instructors who use them in their college teaching. Planning should include as much detailed consultation as possible among the college instructors, classroom teachers, and the television production staff.

(3) For all observational conditions, college instructors should attempt to maximize the value of each observation by preparing their students for the observation and conducting discussions during and after the observation.

(4) When films are being studied, the college instructor should plan and direct the production of all films in consultation with technical personnel.

Criteria of Change Resulting from Observation. (1) Dependent variables should be selected which are linked rationally to the capabilities of observational media. While numerous claims are made for media as providing a means of observing a great variety of performance skills and information, only those variables which logically are expected to change through exposure to observation should be designated for study.

(2) Attempts should be made to obtain a broad assessment of the differential effects of observation by measuring, for example, not only informational gains made by the student but also his ability to apply such information to the critical evaluation of classroom behavior, his ability to transfer knowledge in other courses and situations related to the observation, and his gains in actual teaching proficiency.

(3) These criterion behaviors should be operationally defined, and reliable measuring instruments should be constructed to provide an objective appraisal of change.

Experimental Design. (1) Multivariate designs should be used whenever possible to determine not only the influence of the main treatment

effects (e.g., observational conditions, instructor differences, differences among college students in general scholastic ability, semester differences, etc.) but also the interactions among these independent variables.

(2) Random assignment of subjects to experimental conditions should be conducted (or some other adequate system of sampling should be employed), and a substantial sample of subjects should be insured by the use of a sufficient number of sections of the college course.

(3) Replication should be conducted over several semesters.

(4) Provision should be made for the control or systematic variation of factors (other than the observational condition) which are potentially associated with changes in degree of college learning, e.g., intelligence or general scholastic ability, instructor differences, class size, and skill in responding to examinations irrespective of their content.

(5) When feasible, pre-post measures of change or covariance control should be used to account for initial differences among teachers in training in status on the dependent variables.

(6) When feasible, "zero" control groups should be used to answer the question of whether any or all of the forms of observation studied are superior to no observation at all.

(7) When feasible, continuous, ongoing assessment should be conducted over the course of the experiment; since the effects of observational techniques are expected to be cumulative, it should be productive to observe the progressive effects in detail through continuous evaluation.

(8) Long-term follow-up should be conducted when possible to study whether differential gains due to observational conditions are temporary or stable.

The Role of New Media in Providing More Efficient Self-Instruction and Supervised Practice Experiences

Teacher-preparation programs have rarely attempted to supply systematic means of providing for individual differences among teacher trainees. General discussions of the need for individualizing teacher education have occurred, and interesting preliminary efforts to individualize teacher education programs have begun (9). However, few teacher-preparation efforts have either the resources of the necessary acumen to custom-make or modify more than minor aspects of their training procedures to coincide with the particular abilities, needs, and previous experience of the individual prospective teacher. It is to remedy this failure to individualize instruction that self-instructional

techniques and individualized supervision seem to hold such great promise for teacher education.

Information concerning media use in self-instruction and supervised student teaching comes primarily from television and film applications, programmed instruction, and language laboratories. What have been the teacher-preparation outcomes of using these devices for self-instruction or supervised student teaching?

Encouraging results have been obtained in teacher education using several types of "feedback" techniques (8,14,46,51,52). In addition, effective use of television and video tape film apparently has been made in such closely allied fields as counselor training (69,75,141). It is therefore somewhat surprising to find equivocal results for the use of television and film in providing feedback in teacher education.

Schueler, Gold, and Mitzel (114) studied the growth of student-teacher performance under three conditions of supervision. In the control condition, the supervisor observed the student teacher in the classroom in person and conducted a conference with him as soon thereafter as practicable. In the first experimental condition, the supervisor did not visit the student in person but viewed his performance on a monitor in the television control room and reviewed a kinescope recording with the student a few days later. In the second experimental condition, the supervisor visited the class in person, and a kinescope was made simultaneously for later review by the supervisor and student together. Changes in student-teacher classroom behavior were assessed for 35 variables, such as problem structuring, maintaining classroom order, command of language, creative and conceptual teaching, introducing and concluding lessons, and individualizing instruction. Although sizable overall progress in teaching performance was made by student teachers under all supervisory conditions, differences in the effects of the three methods of supervision on changes in student-teacher behavior were negligible.

Evidence presented by Tintera (135) also displays nonsignificant differences among supervisory media. Tintera compared the effectiveness of three student-teaching critique methods on both immediate and long-term teaching performance: conventional supervisor observation and conference, supervisor observation and conference supplemented by voice tape recordings made in the classroom, and supervisor observation and conference supplemented by kinescope films of student-teaching performance. Basically negative results are reported by Tintera, but there is some suggestion that after six months of actual teaching experiences, teachers prepared by video tape and voice tape recordings show superior performance when compared to those student teachers who receive only the conventional critique.

Kersh's classroom simulation efforts (70,71,72) are as promising for improving supervised practice experience as they are for improving

observational experiences. Using these techniques, classrooms are simulated through the use of motion picture films and printed materials, and the student practices certain teaching skills hypothetically in response to simulated classroom problems; immediate concern is with the student's ability to detect, diagnose, and resolve such teaching problems as confusion, inattention, distraction, and fatigue on the part of the learner. Classroom simulation also provides immediate supervisor feedback to give the student exact knowledge of the adequacy of his response. Since simulation practices have been applied so recently to education, little empirical evaluation has appeared. Such procedures, however, appear to have a fruitful future in teacher education.

The most common and universal self-instructional procedures are, of course, represented by programmed instruction. Although the many studies of applications of programmed instruction to teacher education (4) are still primarily informal in nature, there seems little doubt that programmed instruction can be applied effectively to the teaching competence of knowledge of subject matter. Whether programmed instruction also can be of value in contributing to the other teaching competencies--the ability to define educational goals, insight into the characteristics of children and teachers, and recognition of the environmental influences upon learning--is presently undetermined.

Several comprehensive surveys (48,79,80,111,122,132) describe the evidence for the conclusions that for teaching subject matter, programmed instruction is usually superior to conventional procedures, takes less training time than conventional instruction, and is uniformly superior to no instruction at all. Not only does the use of programmed instruction result in increased knowledge of subject matter, but it apparently also reduces variability in student performance (54,66,132), although this observation has been questioned (115). There are several studies (43,77,97) which failed to locate significant differences in learning between conventional and programmed instruction. However, there remains little doubt that programmed instruction can contribute substantially to the learning of subject matter by teachers in training.

Optimistic proponents find encouragement in programmed instruction for the development of teacher competencies other than subject-matter knowledge. For example, McNeil states that programing will prepare teachers to define instructional objectives (85, p. 262). Although the promise perhaps does exist that programmed instruction eventually will contribute to the teacher's ability to define educational goals, little evidence of this exists currently.

The emphasis in research on programmed instruction has not been upon global evaluative comparisons between instructional approaches but rather upon the experimental specification of the parameters which determine the effectiveness of programmed instruction (23,34,78,111). Parametric studies have examined such factors as the type and logic of sequencing of materials (e.g., linear vs. branching), sequence control

and pacing (e.g., learner vs. machine), size of step, introducing and fading of prompts, practice, review, bypassing, mode of response (e.g., recognition vs. answer construction, overt vs. covert), and the type and schedule of reinforcement (e.g., immediate vs. delayed). Considerable information is accumulating from these parametric studies, but little application has been made to understanding and improving teacher-education procedures.

Programed instruction relies upon the principles of immediate and continuous reinforcement and the progression and pacing of instruction adapted to the individual capabilities of the learner. Other principles underlying programed instruction stress active participation by the learner, presentation of programed materials in carefully sequenced small steps organized in a hierarchic form, the contingency of small units of response and reinforcement conditions, and the coordination of learning and measurement into a single set of operations. Other principles concern the nature of the feedback from learner to programmer for use in designing, adapting, and improving programs (35,47,60,76). In summarizing the operation of these principles, Skinner (121) indicates that the value of programed learning sequences is comparable to that of an effective private tutor: the constant exchange between student and teacher, the insistence that a given point be understood before the student progresses, the presentation of just that material for which the student is ready, and the provision of immediate knowledge concerning the correctness of the response (29).

No present educational procedure, including programed instruction, is without observable weaknesses. For example, students are reported to complain after completing programed materials that they have difficulty in reconstructing mentally the relationships among the main concepts covered; with material presented in very small steps, they have trouble perceiving and retaining the broad context (31). A second reservation derives from an overly rapid development in this technology--to offer programed instruction to supplant rather than supplement the teacher. A third reservation stems from the early commercialization of programming; in response to the great commercial pressure to produce programs and machines, inexperienced or inept programmers have been used and inordinate claims made for their products. These and other forces have tended to limit the potential value of programed instruction for teacher education.

Despite these and other reservations, there seems to be sufficient evidence to conclude that programed instruction can teach subject matter to prospective teachers. Because programed instruction focuses attention on the processes by which children learn, it also should be expected to contribute significantly to the development of another primary teacher competency--knowledge of student characteristics (111). There has been, however, no indication to date that progress in programed instruction has had any bearing whatever on the learning of this teaching skill.

Language laboratories also hold promise of advancing a limited number of subject-matter skills in the teacher-education process, although their contribution to other basic teacher competencies appears unlikely. Language laboratories display several counterparts of the properties of programmed instruction: all students can practice aloud simultaneously yet individually, differences in learning rates are accommodated, consistent and authentic models of speech are provided, testing of listening comprehension and speaking ability is conducted, and immediate confirmation or correction of the student's responses can be achieved. Although negative results (24) can once again be found, comprehensive reviews (62,82,98,137) leave little doubt about the value of language laboratories in developing foreign language skills in prospective teachers and in improving these skills in inservice teachers.

In summary, several new media seem suitable to providing more efficient self-instruction and supervised practice experiences, but their utility in teacher education has not been documented by empirical research. It is not clear whether this partial failure is attributable to the insufficient power of the instructional techniques or to the insensitivity of the experimental tests. Progress in improving both power and sensitivity is needed.

The Role of New Media as a Direct Means of Presenting College-Level Courses Related to Teacher Education

Research on the use of television and other media to teach college courses redounds with the overall verdict of "no significant difference" between media presentation and conventional classroom presentation. Although these negative results should not be interpreted as authentic proof of the positive benefit of media instruction, the conclusion has been drawn uniformly from these studies that the average college student will learn about as much from, for example, a televised class as from ordinary classroom methods. This predominant negative finding of "non-significant difference" usually has been assigned positive and optimistic meaning--that media do teach just about as well as the usual classroom procedures. A more pessimistic conclusion is more sound--that our failure to locate significant differences between media and conventional instruction tells little or nothing about the value of either.

There is clear consensus, however, on the failure of research to distinguish between the effectiveness of media instruction and normal classroom techniques in teaching college courses. Schramm (109) summarizes the results of 100 research comparisons of television with conventional classroom learning in colleges. Of this total, 84 studies reported nonsignificant differences, 3 favored television, and 13 found television significantly inferior to classroom instruction.

Schramm's review compares these television research results upon college samples with comparable research in the elementary schools and

finds a significantly larger percentage of results favoring television in the elementary school studies. Either television instruction has a greater impact at the younger ages or the demonstration of learning changes can be located more easily by research at the elementary school level. Studies at the college level also do not indicate any special ability of television to teach any specific subject-matter area more effectively than other areas.

Several attempts (37,74,81,116,117,126,143) have been made to go beyond the global nonsignificant differences and analyze the personality characteristics and abilities of the learner which may produce differential responses to media and conventional instruction. Most of these studies report negative or equivocal findings, but Snow describes several interesting conclusions. For example, he reports that ". . . students who are irresponsible or who lack determination perform at a higher level . . . in conventional learning situations while instructional films appear to be more appropriate for responsible, persevering individuals" (126, p. 116). Or, again, "Less emotionally stable individuals tend to retain learned material more adequately if it is originally presented by conventional rather than filmic means" (126, p. 116). These specific significant results were drawn, however, from such a large total number of comparisons that they may themselves be the result of random fluctuations. Although Snow's results do suggest some interesting dimensions of individual difference in responsiveness to various instructional approaches, it would be useful to have an analysis of the number of statistically significant results obtained as compared with the total number of statistical comparisons performed.

As a direct means of teaching college courses, television instruction appears to fare somewhat better when used for study at home. Of 32 studies reviewed by Schramm (110), 10 reported that at-home television is more effective than ordinary classroom teaching, and an additional 21 displayed nonsignificant differences. However, these somewhat encouraging results are perhaps a function of the unusually high motivation of the home-TV students rather than the capabilities of the instructional medium it self. Few studies have succeeded in controlling motivational differences between home-TV students and students taught conventionally.

McKeachie (84) summarizes the results of studies such as those reviewed in this section as follows:

Taking the results of all research on television instruction, we feel safe in concluding that television instruction for a complete course is inferior to classroom lectures in communicating information, developing critical thinking, changing attitudes, and arousing interest in a subject, but that this inferiority is probably not great. This conclusion may surprise the reader who has seen publicity releases reporting no significant differences between classroom and television instruction. In our consideration of methodological issues, we noted the logical fallacy in concluding

that no difference exists because the difference found was not great enough to disprove the null hypothesis. This is particularly pertinent here because a review of a number of studies of television leaves one with quite a different conclusion than he might draw from a review of just one. In 20 of the 26 well-controlled experiments reviewed, conventional classes were superior to television classes in achievement. Although few of the differences were statistically significant by themselves, simple application of the sign-test indicates that the differences were not random. In contrast with research comparing other instructional methods, the consistency of results favoring conventional instruction over television is unusual. When one weighs heavily the necessity for accommodating higher education to large numbers of students, however, the differences between television and conventional instruction seem very small. It may be that researchers are reluctant to report findings contrary to the hypotheses of the foundations that support them, and their reports are thus as gentle as possible. (84, pp. 1153-1154)

In contrast to McKeachie's logical interpretation, the absence of positive results in evaluating media as a direct means of teaching college courses has led to some interesting scientific reasoning. Hoban (64) and Schramm (104,112), for example, argue that there are so many good reasons for television's being a poorer means of direct teaching of college courses that it is encouraging that it does so well as to yield nonsignificant differences when compared with conventional instruction. Hoban (64) suggests that there is every reason to expect less learning from television because of the absence of interaction between teacher and student, attention to individual capabilities, and other qualities of classroom instruction.

Several questions are raised by this line of reasoning. First, if the logical disadvantages of television are so great, is it not foolish to apply or examine an instructional technique which is doomed to inferiority on a priori grounds? Second, can the nonsignificant differences between televised and conventional instruction possibly be regarded as even a partial victory for television? Neither issue allows for real encouragement to be derived from Hoban's argument.

In summary, the data on the use of media as a direct means of teaching college courses are not encouraging. The most pertinent question remains largely unexplored. Under what conditions, for which students, and in what subject-matter areas do media teach best and under what conditions is media instruction least effective? On the bases of the global appraisals available to date, however, only limited potential may be forecast.

The Role of New Media in Establishing Clearer,
More Commonly Accepted, and Applicable
Standards of Teaching Performance

Many of Conant's (30) recent recommendations concerning teacher education have stirred considerable controversy (94). One suggestion that has been widely applauded, however, is the establishment of the position of "clinical professor of education." The clinical professor of education would not necessarily be expected to make contributions by research and writing, but he would be recognized for the quality of his teaching of children and of college students. Among other assignments, he would have primary responsibility for the supervision of student teachers in their induction into classroom teaching. When the details of when and how the clinical professor would provide such instruction and guidance have not been delineated, a necessary requirement is that the goals and standards of clinical supervision be specified fully and precisely.

The value of clinical supervision of teachers in training has not as yet been demonstrated by empirical research (99). One basic cause of this lack of systematic analysis and appraisal of the supervisory process appears to be the failure of supervisors of teachers to either seek or find consensual agreement concerning the goals and strategies of supervision and the standards of teaching performance toward which they aim. While general discussions of college supervision of teachers abound (7,119), and while a rare document (129) describes in detail the goals and procedures of an individual college supervisor, few systematic attempts have been made to establish well-defined and commonly accepted objectives and standards among college supervisors. Consequently, a prospective teacher's supervision may emphasize techniques of classroom control, the organization and presentation of subject matter, the projection of a modulated voice, or the proper use of the chalkboard, all depending upon the particular college supervisor's priorities or peculiarities. Surely, the supervision of different students should emphasize different elements of the teaching process. These emphases, however, should be guided by the individual capabilities and needs of the prospective teacher and should derive only secondarily from the individual preferences of the college supervisor. To date, determination of the goals and techniques of student teachers has been almost an exclusively private and personal matter. If the clinical professor of education is to become a real force in teacher education, some degree of explicit debate and consensual agreement among college supervisors concerning the objectives and strategies of student-teaching supervision must be achieved.

The college clinical professor of education is only one member of the supervisory team. The "master" classroom teacher ("cooperating," "directing," or "supervising" teacher) is often regarded (67) as having the strongest impact of all upon the prospective teacher. Advice and admonitions have appeared for selecting supervising teachers (38,106,

133) and for planning and conducting supervisory sessions (13,16,26,68, 91,124,139). But, once again, little consensus has been reached (or apparently even attempted) on the definition and delimitation of goals and standards of classroom supervision by the master teacher.

Not only college supervisors and cooperating classroom teachers experience problems in establishing a clear and well-accepted consensus on teaching goals and procedures. The literature concerning the problems encountered by researchers in defining and measuring the dependent variables in studies of the outcomes of teaching methods reflects the extensive history of the debate in establishing definitive research criteria for the standards of teaching performance. Within this literature, there have been almost as many proposed taxonomies as there are investigators and almost as many proposed measurement approaches as there are taxonomies.

Thus, much remains to be accomplished by college supervisors, classroom cooperating teachers, and researchers in establishing their definitions of the goals of teaching and in assessing the degree to which these goals are promoted through supervision and other training practices. What seems to be needed by supervisors and researchers to work toward adequate definition and measurement of the goals of supervision is a situation affording many supervisors and researchers the opportunity to make simultaneous judgments of teacher performance. Using such common observations provided by the new media, groups of supervisors and researchers could begin to make the goals of supervision more explicit, build criteria for assessing teacher performance, and construct reliable techniques to measure the degree to which supervision produces change in teacher performance.

Among the many efforts to construct measures of teacher performance, a study by Schueler, Gold, and Mitzel (114) illustrates the potential research use of the new media. Using common observations of kinescope films of numerous student-teaching sessions, a team of six observers was able to contribute substantially to the construction of a reliable, comprehensive, and useful measure of 35 teaching variables, including classroom atmosphere, teacher personality factors, discipline and order, and pedagogical factors such as lesson planning, organization of content, and creative approaches to the teaching assignment. Similar use of the common classroom observations provided by the new media has not been made by supervisors in defining explicitly the role, function, and strategies of the clinical professor of education. Several dilemmas might be illuminated by the existence of clearer, more commonly accepted definitions and standards of teaching performance. For example, Stern (128) summarizes the evidence indicating that prospective teachers who are strongest by academic standards are least likely to persist in teaching or be viewed favorably by their supervisors on the job. Explicit knowledge of the goals and standards used by supervisors would clarify the grounds for this and other puzzling results. If the new media can be utilized effectively to establish more precise, widely accepted, and usable standards of teaching performance for application in supervision,

- h. The role of verbalization in learning
- i. Interest, incentive, and motivation in the instructional process

Miller (88,89) has presented a careful analysis of the basic principles of effective teaching and learning with the use of media of communication. This contribution to basic research stresses the operation of the fundamental learning variables of drive, cue, response, and reward in using media to study, in part, the following range of issues:

- a. Changing motivation and attitudes
- b. Developing curiosity and independent judgment
- c. Establishing better measures of motivation
- d. Analyzing the role of the teacher in arousing motivation
- e. Studying how visual cues are perceived, organized, and discriminated
- f. Establishing parameters in transfer of training
- g. Focusing attention on relevant cues while maintaining realistic stimulus conditions
- h. Teaching discrimination of cues
- i. Representing motion and perceiving movement
- j. Describing the roles of rehearsing, practicing, and participation in instruction
- k. Studying the role of labelling in learning
- l. Analyzing the effects of knowledge of progress and the results and various types and schedules of reinforcement
- m. Comparing logical and rote learning
- n. Organizing instructional materials

These and other learning and teaching issues generated by Miller's analysis ultimately will have great pertinence to teacher education. To date, this application has been made.

Perhaps an even greater variety of basic research topics on the role of new media in teaching and learning is contained in Arons and May (5). Topics range from the use of video tape recordings on closed-circuit television to study the effects of delayed visual feedback on

task performance (125), the relationship between television viewing and juvenile delinquency (12), the linkage between mass media and interpersonal communication (6), the use of programmed learning techniques to maximize active participation and feedback in televised instruction (90), and the impact of media upon taste development (63) and aggressive behavior (44) in children.

Only illustrative contributions of the new media to basic research on teaching and learning have been described here. Many other examples exist (3,73,76,83,96,110,127). We have indicated the range of basic research questions being studied with the use of new media. Very little translation of these basic research findings has been made to teacher education, and little additional basic research apparently is being planned and conducted with such a translation to education in mind. Our basic contention is that the new media will only contribute substantially to teacher education when basic research results begin to illuminate the teaching and learning operations involved in educating teachers. Until basic research on new media is done in the teacher-education setting, only limited gains will be realized.

The Role of the New Media, When Combined
into Systematic Sequences of Instruction,
as Providing More Efficient Means of
Producing Teacher Competencies

It is evident that much of the needed basic research on teaching and learning will not employ a particular medium of instruction singly but will produce various combinations of new media techniques. As the special capabilities and deficiencies of the several new media are identified, combinations of instructional techniques can be devised to maximize the unique contributions of each to the analysis and improvement of instruction. This emphasis upon combinations of media in teacher education is compatible with the "systems" concept which stresses the organization among the numerous components of any instructional system. Some studies (22) of the new media in education have elaborated carefully the interrelationships among the physical equipment, technical personnel required to operate and maintain this equipment, the methods of selecting instructors, acceptance of media instruction by faculty and students, unit costs of media instruction, educational results obtained, and the effects of media instruction on the number of required faculty members and released time of faculty members--all of these taken into account simultaneously. In this section, we are proposing an extension of the "systems" concept to include the possibilities of reciprocal reinforcement among several new media components of the system. What are the different effects of alternative combinations of media resources upon teacher education?

Examples of attempts to combine systematically several instructional procedures are just beginning to appear in the research literature (70,71,72,92,146). One illustration (21,41,47,56,57,58,59) applies programmed instruction principles to the development and use of visual

media. These efforts emphasize active student response as an important condition for learning as well as systematic efforts to create and present stimuli which would not only produce student responding but would also increase the probability that the responses made would be the specific desired responses. One of the important concepts emerging in the investigation of programmed learning is that of introducing branching operations, so that depending upon the subject's performance on given material, the subsequent training procedure can be modified appropriately. Applications of the principles of programmed instruction stress, therefore, the optimal sequencing of media material in an attempt to build into televised or filmed instruction some of the elements of instructional control that characterize programmed self-instruction: sequencing of steps in the program, the encouragement of active responding by all students to the instructional sequences, and the provision of prompt confirmation or reinforcement. This combination of programmed instruction principles and televised presentation has produced useful insights for both media.

Another example of the combination of several instructional media is the "computer-based instructional system" or the "computer-based laboratory for automated school systems" (10,15,32,33,123). These computer-based systems typically individualize instruction for large numbers of students simultaneously by treating learning as a series of decision tasks. The first is a pre-tutorial decision sequence that determines the match between student characteristics (e.g., previous information, aptitudes, motivation, personality), and the teaching strategies. This is followed by a series of tutorial decisions in which decisions about teaching strategy are made by the computer as it learns progressively more about the student. In these processes, the computer system is both a teaching machine and a learning machine, acting as a control for the whole instructional system. The teacher acts as "orchestrator" of all the elements within the system.

Computer-based instructional systems hold promise for the investigation of not only the individual learning process but also an entire integrated education system. Interactions among students and between students and teachers are studied; conventional methods of instruction can be combined with automated procedures and with media presentations. The effectiveness of different combinations of techniques, including textbooks, instruction by teachers, film and television presentations, programmed material, and so forth, would be evaluated. Such data would contribute substantially to modifying entire educational "systems."

Several other computer applications also may serve to combine various instructional resources. Simulation procedures (42), high-speed educational data processing, information storage and retrieval, information analysis and resynthesis can all be implemented by computer techniques and may act as the experimentation or demonstration apparatus for studying combinations of instructional strategies and materials. Little application of any of the computer-based instructional systems has been made in teacher education. Their potential value for teacher

education will emerge in clarifying the teaching and learning processes upon which teacher education is based.

Studying media in combination will improve our knowledge but will constitute only one step toward the most central and complex issue in the use of new media in teacher education: What can each device and combination of devices do best for different kinds of students, under different educational conditions, with respect to different educational objectives, and when used by different teachers? Obviously, no single medium or combination of media will accomplish the full job of training the teacher. No single criterion or set of criteria for successful teaching is likely to emerge, and no single best pattern for the training of all teachers is likely to be identified. In the same way, no single best pattern in the use of new media is likely to emerge as most effective under all instructional conditions.

These observations are consistent with the topic discussed earlier in this paper: the inherent complexity of the functional characteristics of both the teacher-education process and the new media. The major problem is to establish the nature of the interactions among the media used, the other teaching methods in which the media are embedded, the student and teacher characteristics, the conditions of the learning environment, and the specified goals of instruction. The use of the new media in basic research on teaching and learning provides powerful resources for studying and improving teacher education.

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CINE-PSYCHOMETRY

by Warren F. Seibert

Purdue University

Richard E. Snow

Stanford University

Many human decisions are made within contexts which are not static, not principally verbal, and not characterized by the presence of print. This would be a trivial observation if it were not for the dominant character of existing "intelligence" tests. In view of their character, however, we are entitled to wonder whether some significant human capacities for intelligent decision making have not been overlooked, not only in the great majority of marketed tests, but also in those intended principally for research use. Such possibilities appear to deserve greater attention than they have received during the sixty years of active work on the nature of intellect.

Although a recognition of variety in intellectual functioning can be easily demonstrated by reviewing prior work on human intelligence, the liberation of testing from print and, virtually, from printed language has not been immensely successful. Somewhat overstated, the point is that human intelligence has been regarded implicitly as a captive of print, of language, or of both. A broader view would be to acknowledge that past work has sampled incompletely from the range of human decisions by which the aspects of intellect are revealed. The purpose of this paper will be to review some earlier studies which, as the authors see them, reflect a broader view. In particular, it will review and seek implications from studies which have employed the medium of the motion picture (more simply, the "film") in psychological testing.

Cine-psychometry is not to be regarded as the ultimate answer to the expanded study of human intellectual variety, its nature, and its

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measurement, yet film is a medium with real and apparent capabilities, some of which relate clearly to the requirements of psychological testing. These have been occasionally recognized, thus saving tests in film form from complete obscurity, but the occasions have been rare and the resulting reports constitute little more than some spots scattered in the literature. If the reader wonders why extensive work in film testing has not developed, a partial answer is perhaps contained in the observation that educators and psychologists with interest in film have focused on demonstrating its applicability to instruction, thus overlooking or ignoring its applicability to those communications which we know as tests. This observation, however, is only a partial explanation since fair numbers of professionals have devoted themselves to the study of intelligence, not to film; they too have ignored the prospects of film testing with remarkable consistency.

General Potentials

In considering film and its candidacy for use in psychological testing, it is helpful, first, to consider the points set forth in the first paragraph above. In addition, consideration must be given to the characteristics of film (or televised film or videotape) and their adaptability to testing purposes. Some of the relevant characteristics, although not an exhaustive nor mutually exclusive set, are the following: (1) Film (and television) provide for the manipulation and control of within-item exposure time and item response time intervals, as well as the customary manipulation-control of total time limits. (2) Film can sequence stimuli within an item, thus providing not only a fixed exposure sequence, but also establishing pace, rhythm, and/or motion. (3) Film can present complementary or competitive material visually and auditorially. (4) It can simulate many of the conditions of "real" decision situations. (5) Through the use of kinesic, ideographic, or cinematographic conventions, it can pose problems that minimize or eliminate the use of written or spoken language. (6) It can employ color as cues in the statement of problems. (7) It can, admittedly with some difficulty, approximate the visual third dimension and can utilize depth cues either to add complexity to conventional problems or more simply to test abilities related to depth judgments. (8) Film can not only encompass and present the range of item stimulus materials suggested above, but it can also accomplish several functions of the test administrator, while providing excellent control or standardization of testing conditions. (9) Finally, since film controls the pace of stimulus presentation, it offers the possibility of detailed and synchronized response recordings, including the indexing of response latencies, GSR's, EEG's, and other varieties of potentially helpful yet normally unmanageable response.

In part, the film's use in testing can originate in practical needs. The most apparent of these is the need to control and to standardize the conditions of testing. Here, although precise control of individual item exposure and response intervals may be a mixed blessing, the standardization of the form, content, and pacing of test instructions must be

regarded as consistently desirable. If scores are to be useful, they must be derived under conditions that are comparable for all examinees; this comparability can be assured by means of the detailed and fully repeatable conditions which film-recorded directions provide. A second practical possibility stems from the increasing incidence of film and televised teaching, both of which may place students at some distance from their "teachers." In such settings, it may be desirable to have means for testing student progress which, like the teaching, can be managed from a distance. There is some possibility that film and/or television can contribute to the more effective management of testing in remote locations. It may also be true that the effects of audio-visual instruction can best be assessed with measures presented in the same form.

A third area of practical need relates to the testing of special, atypical populations of examinees. Two obvious examples are those populations that bear language handicaps stemming either from deficiencies in hearing or from deprived cultural backgrounds. The abilities of such populations cannot be adequately assessed with instruments that rely heavily on written or, perhaps, on spoken language. To meet such needs, special film tests could conceivably be prepared which would minimize the role of acquired language skills and would more adequately reflect the other abilities represented in such disadvantaged groups.

In addition to the practical needs and the related opportunities for developing serviceable film tests, similar tests are also promising as a further means toward the improved understanding of human intellectual organization. The likelihood of such contributions has been mentioned, directly or indirectly, by several of the most prominent figures in psychology. An indirect mention may be seen in Thurstone's discussion of spatial visualization ability (44, p. 404):

The tests by which this factor has been identified all involve the visualizing of objects which are stationary. In dealing with mechanical problems, one must be able to think of objects in motion. Their relative motions have definite restrictions that are studied in a separate discipline known as kinematics. We might therefore add another psychological hypothesis, namely, that there exist one or more abilities that are revealed in the ability to think about solid objects in motion as distinguished from thinking about them when they stay still.

Guilford has also recognized some of the potentials of tests in film form. In his discussion of decisions which precede test construction, he wrote (19, p. 414): ". . . one's approach and operations . . . will also depend upon the medium of the test, whether it is of printed form, of apparatus form, or of motion picture form." Later, Guilford suggested (20, p. 396):

One error possibly made thus far in conventional research on empathy is too much dependence on verbal material. It may be true

that there is much translating back and forth from one kind of material to another on the part of individuals in everyday life, and this would probably extend to testing operations. But there must be limitations to this. At any rate, it would be well to seek types of material that emphasize behavioral content, and this may often require motion-picture presentations.

In Guilford's discussion (21) of the abilities within the memory column of his Structure of Intellect model, he offers further indications that tests in film form could play a helpful role. He wrote:

The area of memory abilities has been explored less than some of the other areas of operation, and only seven of the potential cells of the memory matrix have known factors in them. . . . (p. 472)
Considering the blank rows . . . we should expect to find abilities also to remember classes, transformations, and implications, as well as units, relations, and systems. (p. 473)

The perceived relevance of the above is not only that we apparently know less concerning memory abilities than of other abilities, but also that the further study of memory requires instruments or tests that will not adapt readily to the medium of print. Quite likely, the pace and the sequence of item stimulus material will need to be controlled; the exposure interval should also be controllable within a range, probably, from the tachistoscopic to the extended exposure; and the interval between exposure and examinee recall or recording should also be controllable. Film offers the opportunity for these controls and others. Tests in printed form accomplish these things crudely, if at all.

The broadest arguments in behalf of film tests are those set forth by Gibson (17). He not only recognized many reasons for investigating such tests, but also contributed more than any other to their development. In discussing apparent parallels between human mental functions and motion pictures, he wrote (p. 20):

The functions which will be exemplified are directly or indirectly related to the characteristics of motion pictures, as distinct from other modes of presentation . . . namely motion, sequence, pacing, and realism. These characteristics presumably have their psychological counterparts. Human behavior, and the capacities latent in it also involves motion, order, tempo, and the experience of reality. It is reasonable to suppose, therefore, that the motion picture makes available to the test designer not only a special method of measuring known factors of human ability, but also gives him access to new and unnamed functions not accessible to conventional methods of test construction.

A further contribution that cine-psychometry might make relates to Cronbach's (11) argument concerning the need for unification of correlational and experimental psychology. Differential psychologists have tended to leave implicit the fact that performance on a single test item

involves psychological processes occurring within an interval of time. Since only total testing time is controllable on group-administered printed tests, item performances are treated essentially as instantaneous responses, summable, as "bits of ability," to a total test score. While correlations among such scores, and factors derived from them, are valuable as descriptions of functional relationships existing within or among cognitive processes, they are atemporal. By contrast, experimental analysis of cognitive processes usually involves as a central concern hypotheses regarding the temporal-sequential nature of the process's functioning components. The degree of control which film permits over the presentation of within-item stimuli may permit a closer examination of the information-processing aspects of test performance and, hence, may provide a "bridge" between experimental and correlational interests without compromising the objectives of either.

In short, present interest in cine-psychometry developed from a consideration, first, that human abilities and human decision making are frequently demonstrated in settings that are not principally static, verbal, or dominated by print. Secondly, since the motion picture medium is complex, controllable, and versatile, it offers obvious possibilities for use in the communications which we know as tests. The use of film seems practical and, if Thurstone, Guilford, or Gibson are correct, perhaps uniquely appropriate in the study of ability dimensions which do not lend themselves to other forms of testing. Perhaps, also, the use of film may aid in coordinating experimental and correlational analysis of mental functioning.

A Short History of Psychometric Film

The general psychological literature for the present century is sprinkled with varied applications of film to satisfy research purposes. Cinematography and psychometry have been associated sporadically since the infancy of each, and the first known mention of film in testing is associated with the old "fidelity of report" experiment. According to Whipple (50), the idea that accuracy in reporting details of a witnessed event could serve as an index of intelligence was originally contributed by Binet, in his 1900 La Suggestibilité. The need for objectivity and reproducibility soon suggested motion picture recording and presentation of live-action stimulus material. For clinical use, Boas (3), in 1909, described filmic vs. verbal presentation of short stories to mental defectives and the use of Ss' recount of the story for diagnostic purposes. In 1912, Boring (4) brought fidelity of report of motion picture experience into the experimental laboratory, where it has since been occasionally used. Conrad (10) has summarized a series of investigations concerned with fidelity of report. Similar applications of motion pictures have also been made by Metfessel and Warren (30) and by Ray (33).

Somewhat tangential to the studies on fidelity of report, others on gestural communication have made use of live action film. Carmichael, Roberts, and Wessell (7) reported a study on judgment of the meaning of

manual expressions; they used both still and motion picture presentation. The use of film in testing lip reading proficiency was described by Utley (47). Another noteworthy contribution in this direction was made by Heider and Simmel (24), who developed a silent filmed social episode with geometric figures in place of human actors. The technique seemed to offer a means of studying the perception of social interactions without contamination by the effects of gestural and facial expressions, clothing, etc. When the film was presented with varying instructions, it was shown that individuals differed considerably in the extent to which they attributed human values to the actions of the figures on the screen. Shor (39) has pursued this research.

In an independent development, film began to supplant apparatus in the experimental laboratory. Early experimentalists had evolved several varieties of stimulus presentation apparatus, including tachistoscopic devices using photographic materials. Film was already being used for laboratory demonstrations, and it was a relatively small next step, following Pillsbury's (32) suggestion, to the film recording of nonsense syllables and other kinds of meaningless materials for temporally controlled presentation to Ss in learning, memory, and perception experiments (Metfessel and Warren [31]; Ford [14,15]; Beck [2]). A modern extension of these applications may be found in the Averbach and Coriell (1) study of short-term visual memory, using television to obtain sequential tachistoscopic effects.

With these developments in the 1930's, some psychologists began looking toward perceptual research for new approaches in personality measurement. An objective apparatus test of color vs. form dominance, using the principle of apparent movement, had been developed by Schmidt (35). Thurstone (42), modified Schmidt's rather complex tachistoscopic presentation, later referring to it as ". . . the most ingenious test that I have ever seen" (45, p. 5), and included the test in his factor analytic studies of perception (43), noting that still another version of the Schmidt test had subsequently been produced as a motion picture. The film used colored forms that appeared to move around a clocklike circle in opposite directions, with direction dependent on whether attention was directed at the forms or at their colors. Thurstone (45) also described further modifications of the test to take account of various kinds of direction dominance. While the test was limited to individual administration, it apparently represented for Thurstone a major step toward the objective measurement of temperamental characteristics.

Prior to the 1940's, developments in the use of film as tests are of historical interest but include no attempts to investigate the general uses of motion pictures as group tests. For the most part, the early studies represent a rather restricted view of film capabilities. Film was used only in its simplest and most conventional form, either as a record of human behavior or as a convenient "container" for static information which might have been communicated as well by means of apparatus.

The "modern" use of film in group testing originated during World War II; more specifically, it originated in the spring of 1942 and grew from the necessities of the War. The responsible individuals were J. J. Gibson, J. C. Flanagan, and F. A. Geldard.¹ Subsequently, Gibson, together with R. M. Gagné and other members of the Perceptual Research Unit (later the Psychological Test Film Unit), AAF Aviation Psychology Program, conceived, designed, and produced 21 motion picture tests. These must be regarded as "modern" since they typically utilized the unique capabilities of film in developing and presenting items unlike those that might have been presented in conventional printed form. These tests were concerned primarily with aptitudes which might be involved in motion and distance perception. Frequently, they represented complex, sequential, and dynamic identification and discrimination tasks. Several of the films made use of animation techniques and/or systematically varied item exposure timing, stimulus motion, or rate of movement. Many also used subjective camera angle and mock-ups to achieve simulation of tasks faced by aircrew members. Gibson's (17) summary presentation of these developments represents the most important, and the most general, discussion of motion picture testing possibilities to date. While the concurrent, and apparently independent, work of Thurstone, Ray, and Heider and Simmel has contributed useful ideas, it is the Air Force research that must be considered germinal. It provided much of the original impetus for current interest in cine-psychometry.

In addition to the studies reported by Gibson, several of the Air Force film tests have seen additional use. Roff (34) included nine of these instruments in a large factor analysis of Air Force printed and apparatus tests of perceptual skills. Two of the 18 factors reported were composed predominantly of film tests. Fruchter and Mahan (16) followed with a further analysis of these same tests, qualifying the nature of one of Roff's film test factors. Several tests have also seen use in Fleishman's (13) factor analytic work in psychomotor abilities.

There are other more recent developments concerning psychological measurement via cinematography which should be noted for this historical record, though they are of less relevance for the purposes of this paper than work previously cited. Schur (36) first suggested that printed test questions could be spliced into live action film to serve various educational measurement purposes. Curtis and Kropp (12) have contributed a substantial body of research on the characteristics of printed items presented via timed slides or filmstrips, and Heckman (23) has recently added further to this literature. A live action, itemized film test measuring proficiency of Army mechanics was developed and analyzed by Carpenter *et al.* (8) who provided a general discussion of film test applications in proficiency measurement.

¹J. J. Gibson, personal communication, November 18, 1964.

Relative motion problems have been presented by film in research conducted by Bryan and Rigney (6). Johnson and Vogtmann (25) described their use of commercial film clips as part of a course examination in psychology. Cline (9) has used filmed stress interviews as stimulus material for the measurement of interpersonal judgment abilities. Similarly, interviews on film were used by Stoller and Geertsma (40) to test the clinical judgment of student psychiatrists. Motion pictures have also been used to present a kind of "dynamic" Rorschach (26,27) and to simulate reality in the Thematic Apperception Test. McIntyre (28,29) has summarized this latter literature. Lastly, Van Horn (48) has converted the Guilford-Zimmerman Temperament Survey to live motion picture form.

Current Developments

Research recently completed by the authors and further investigations now under way (37,38) have sought to bring several of the trends identified above together in factor analytic studies of visual and auditory cognition and memory.² These studies were planned as factor analyses because they were frankly exploratory, because they held promise for the isolation of unique abilities, and because the controlled versatility of film provided for the correlational analysis of the effects of manipulable, and traditionally experimental, stimulus conditions in terms of individual differences. It was reasoned, first, that many of the Air Force tests were not "merely" perceptual tasks. They involved sequential cognitive and accumulative memory processes which deserved to be considered in the light of present conceptions of intellectual organization, such as Guilford's Structure of Intellect (21).

Secondly, although fidelity of report research, particularly Ray's work, has shown clearly that group-administered printed tests following complex motion picture presentations are feasible and demonstrate marked individual differences, factor analytic studies of memory have not included such measures. Filmed human action, and possibly abstracted social situations like those developed by Heider and Simmel, might also be of use in exploring Guilford's behavioral content column. Thirdly, tasks typically used in experimental investigations of perception and memory can be executed on film for presentation to large groups. They deserve to be so executed both because experimental psychologists have usually ignored individual differences in such work and because the underlying nature of ability factors, long a controversy fueled without benefit of experimental analysis, might well be clarified thereby. These studies have ignored, for the present, possibilities for the objective measurement of temperament as well as several of Guilford's intellectual domains.

²The studies cited are being supported by grants from the Department of Health, Education, and Welfare, Office of Education, under the provisions of Title VII of the National Defense Education Act of 1958.

The purposes of the initial investigation were (1) to begin the exploration of individual differences in performance on tasks characterized by moving, sequential, and/or behavioral content; and (2) to examine empirically a conception of factors as information processing operations. The core reference for the study was defined as the visual, figural, cognition-memory portion of Guilford's model, but it was hoped that base-line data could be obtained which would suggest possibilities for similar studies throughout the Structure of Intellect matrix.

A total of 28 experimental film tests were constructed, some with several subparts. These tests frequently involved moving geometric figures or sequences of static figures, letters, photographed objects, or parts thereof. Some were based on recordings of real human actions or environments. Typically, the forms of response required of subjects did not differ from those usually involved in printed cognition and memory tests. Most tests called simply for recognition or recall of film content. However, reasoning involving a temporal sequence of figural changes of transformation of a temporally sequenced display into alternative forms was incorporated into some tests. Eight of Gibson's film tests, along with the newly produced film tests, were combined with printed reference measures representing known dimensions and were administered to 100 freshman engineering students at Purdue University. Analyses of these data have permitted the identification of several new factors that involve integration or closure of temporally spaced percepts into meaningful wholes, accumulation and isolation of significant details in such serial presentations, and various kinds of cognitive manipulation of remembered spatial and temporal relations. The work has provided additional factors which must be left unidentified for the present, as well as many hypotheses for further factor analytic studies.

More important than the isolation of new factors, however, are implications concerning the informational nature of intellectual performance. Guilford has previously emphasized this informational approach and has suggested that factors be interpreted as mental functions (22). In some respects, the data might be taken to suggest extensions of modifications of Guilford's structure model according to assumed underlying information-processing mechanisms. First, visual imagery seems better conceived as a strategy than as an ability dimension. An individual faced with a memory task, particularly one that is left unstructured for him by test instructions and/or that requires rapid storage of complex sequential information, may use iconic representation (i.e., imagery) for storage and a kind of "inner video tape recorder" for playback. For other memory tasks, even apparently nonverbal ones, he might apply symbolic representation (i.e., verbal abstraction) as information is received. The crucial stimulus variables would seem to be the nature of instructions, the degree of complexity of the information involved, and the speed with which the information must be handled.

Second, the serial nature of several obtained factors suggests that a discrete dichotomy between visual cognition abilities and visual memory

abilities, while helpful in discourse, is in a sense a convenient fiction. There should be an underlying time continuum along which the various phenomena of sensation, perception, cognition, and memory may be arrayed. Because visual input must travel this path and because such input is a complex stream of information, a sequence of interdependent factors can be expected which represent individual differences in reception, integration, accumulation, and storage operations. This conception of an operation series is related to the two-stage memory system suggested by Averbach and Coriell (1) and by Broadbent (5). Tests presenting treatment conditions similar to those used by Averbach and Coriell were included here. Thus, a column of serial cognition abilities was hypothesized to exist between Guilford's cognition and memory columns and some of these factors were found. Third, just as the existence of operation series across cognition and memory seems plausible, there is some justification for viewing Guilford's product dimension as an operation hierarchy. A second-order factor was obtained which seemed to suggest, for the cognition of figural content at least, that tests at the units level involve simple configuration, while tests representing higher level products require more complex internal manipulation of lower level configurations.

Such results are tentative and incomplete at present, and further analyses of the initial data plus a relatively extensive second study are planned. In addition to its confirmatory role, the second stage of this research is concerned more exclusively than was the first with meaningful memory, that is, with Guilford's semantic content category. Its purposes are (1) to explore the factors of human auditory and visual memory for meaningful information; and (2) to determine the extent to which such factors account for individual differences in auditorially, visually, and audiovisually communicated formal instruction. It is hoped that the research will lead to continued development of a conception of abilities as information-processing mechanisms, contributing to the understanding of audiovisual communication along lines similar to those recently discussed by Travers (46). It seems clear at this point, however, that the degree of stimulus control provided by film, when incorporated into traditional factor analytic research on intellect, can contribute uniquely to the study of human cognitive processes.

Some Concluding Speculations

In spite of the fact that films and their use in psychological testing cover a significant span of years, it is clear that the volume of work has been small and that the future is correspondingly difficult to predict. Nevertheless, it is not unreasonable to suppose that there will be a future. This supposition is not merely a matter of author preference, nor is it dependent only on the unsatisfied suggestions of Thurstone, Guilford, and Gibson. Instead, the available evidence, limited as it is, also argues effectively in favor of continued work. The purposes to be served are in part practical, yet the larger opportunities seem to be those associated with expansion of present work into the nature or dimensions of human intellect. If some readers are in-

clined also to see important contributions which might be made to the further study of human temperament or "personality," the authors would not disagree but would comment only that those areas of study lack the clarity that has appeared from studies of intellect and are somewhat more difficult to project forward in time.

Among the practical applications, future work should surely recognize the testing needs that are peculiar to special or atypical populations. In particular, it would seem that opportunities will be great wherever examinee populations reflect marked deficiencies in one or several language skills, e.g., the deaf or hard-of-hearing or the culturally deprived. Other populations for which useful applications might be made are aphasics, the retarded, and those with primary backgrounds in a noncommon language.

It is also worth noting that technology has now provided several serviceable 8mm projectors, both sound and silent, and these, or later versions of them, seem promising for use in individual or small-group testing. Since these projectors also provide for easy cartridge loading and are generally uncomplicated in operation, they are particularly reasonable to consider. Perhaps brief subtests could be prepared, each in a single cartridge, and could then be administered almost automatically. This kind of freedom from the more cumbersome group administrations of tests prepared in 16mm film is worth pursuing.

Apart from the practical applications, there is the continuing prospect of expanded work in the study of human intellect. Gibson, as already quoted, strongly suggests the contributions that might be made; Guilford has been inclined to agree at least in part; and Thurstone indirectly notes similar possibilities. In addition, results from the authors' study provide further support, even though these results must be described now as tentative. Within the study, at least two ability factors (currently labeled "temporal closure" or "perceptual integration" and "configural accumulation") are heavily dependent on film tests.

Furthermore, the study appears to provide evidence that conforms to major ideas of Piaget and/or Bruner. These appearances stem from two highly similar "live action" film tests that were administered adjacent in time and were preceded in each case by vague instructions; examinee responding consisted of answering several questions concerning the film contents and the portrayed events immediately after each film had been shown. The first of these tests appears in a factor composed of perceptual and visual scanning (nonverbal) tests, while the second appears in a factor with many customary measures of verbal abilities. From this, it can be suspected that examinees tended at first to process iconic or "eidetic" images, but shifted noticeably toward a verbal labeling strategy on the second test, once the nature of their task seemed predictable. If results such as these are repeatable, they would suggest again that iconic or eidetic schemes are regularly used by the young until language skills become developed. Then, in later years,

they tend to abandon these schemes and to resort instead to selective verbal labeling of visual experience. So, even though the results above are only a sample of tentative findings, they should serve to justify continued and expanded investigations.

In an earlier quotation from Thurstone, he refers to Schmidt's color-form dominance test as "ingenious"; few would disagree. It can be suggested, however, that film offers many opportunities for the ingenious test to become commonplace. Even in the absence of color and third-dimensional cinematography, the variable combinations available for use in item development are just less than limitless. Item content may, in Guilford's terms, be figural, symbolic, semantic, or behavioral. Both the auditory and the visual channels may be used, either competitively or as complements, either alternating or concurrently, with similar contents or with different.

Exposure intervals may be tachistoscopic (the exposure duration of a single film frame is approximately equal to 21 milliseconds), intermediate, or extended. The time interval between stimulus exposure and response selection can be made as brief or as long as desired. Similarly, the time allowed for response selection or decision making can be ample or abbreviated; investigators who are interested in the experimental inducement of anxiety might find that repeated reductions in response time could help in the indexing of performance under increasing pressure. In addition to controlling the intra- or inter-item time intervals and, thus, controlling the pace of stimulus exposure, motion and rhythm are two manipulable time-based variables which further expand the opportunities that are open to the best constructor. Few simple effects attributable to the use or manipulation of these variables are expected, but many effects in which they are involved seem likely.

It is hoped that future work can expand in several other directions also. There is already considerable literature relating to the abilities involved in the processing of print and other predominantly verbal material, but little is known concerning the particular abilities which may equip a learner to deal effectively with the dynamic and sometimes nonverbal materials of film, television, and other pictorial media. These abilities, which might be called "cinemacy" (as opposed to "literacy"), merit study. In the process of studying them, it is possible not only that something more can be learned about the special and functioning abilities of learners, but also that the features of pictorial media and the ways in which they influence learners can be better understood.

Earlier, brief mention was made of the detailed and synchronized responses that might be gathered in addition to the customary gross responses that serve only to indicate whether an examinee has answered an item correctly or incorrectly. At the risk of offending some film or psychometric experts, we would propose the occasional usefulness of examinee response latency measures (41), of data which index the visual scanning patterns of individual examinees (18), and even of electroencephalogram records (49). Examinees do in fact require time to process

item stimulus materials and to arrive at or select an answer. We should therefore be well advised to learn more than can presently be said about the relationship between processing time, response adequacy, item difficulty, and the many other variables of interest either to the investigator of individual differences, of learning, or of both.

Similarly, the visual scanning strategies employed in identifying critical elements within a visually presented problem seem valuable to determine, not only for assessing the simpler matters of temporal order and cues utilized, but also for relating tests within a factor to those within the same or different factors. Finally, the Vogel and Broverman article (49) suggests that there may indeed be some substantial relationships between measured abilities and the electrocortical measures provided by the EEG. If such relationships are to be established and refined, the combined use of controllable film test items and EEG open some opportunities for studies which previously were difficult to conceive.

Finally, some who know of Guilford's work are inclined not to accept his organization of multiple abilities and, particularly, his predictions of still further abilities that may be expected to emerge. For them, the predicted number of differentiable ability factors is too great. The authors are reluctantly inclined to suspect the reverse, i.e., the emergence of even more differentiable factors than Guilford has proposed. An elaborate argument in defense of this suspicion cannot be attempted, yet there are grounds for it both in the factors that seem already to be emerging from the dynamic and sequential film items and in the greater variety of novel tests, not yet prepared, that are even farther removed from conventional tests than those employed to date. The proliferation of ability factors is neither desirable nor undesirable. It may be justifiable, however, and only time will tell.

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