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COGNITIVE-COMPLEXITY AND MEDIA DESIGN

By

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B.A., University of Montana, 1974

Presented in partial fulfillment of the requirements for  
the degree of Master of Arts

UNIVERSITY OF MONTANA

1977

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## INTRODUCTION

Occasional reference is made in educational literature to "knowing the students" as one step in preparing instructional materials (Brown, 1972; Wittich, 1973; Vaughn, 1976). A concern for this step was made over twenty years ago by Likert (1954) in alerting educators to match audiovisual content to the target audience. One aspect of knowing the student will be discussed in relation to designing instructional media programs. Essentially program planning must be directed to the manner in which humans process information to be effective from the standpoint of both source and user.

The concern for using media in education is evidenced by its widespread adoption at all levels of education. Media planning involves many considerations in preparing material for classroom use, but one issue not looked at is cognitive-complexity and how it applies to students, teachers and instructional media producers. This paper offers the premise that the most effective instructional media messages are those having a complexity level aligned with the cognitive-complexity of the user when presented in simulation of a dyad between source and user.

The cognitive-complexity level of the information

user governs the individual's ability to receive, assimilate and apply the stimuli available in the learning environment. Message design for media programs must be compatible with characteristics of the information processing level of the user. A media program is an extension of the information source taken to the user's environment. The consideration of message design incorporates the source's verbal and nonverbal elements in a manner most compatible with the cognitive-complexity of the user. This approach to message preparation will be most effective when developed considering the dyadic relationship between source and user, the information processing character of the user, and characteristics of human audio visual perception.

The most familiar educational setting is a dyadic environment of the teacher-student-classroom concept. Our fundamental communication relationship is the dyad (Wilmot, 1975). With technology we can bridge the gap of distance and time attempting to reconstruct a dyad when a true dyadic situation does not exist. Certain media such as videotape, film and audiotape, lend themselves to conveying both audio and visual message elements to permanent storage and easy retrieval. This solves the problem of time and distance, but not that of the characteristics in a dyad's face-to-face relationship.



The ultimate goal of a person's message must be to have ideas completely understood as expressed to the other person. In a dyadic relationship the speaker designs the message to fit the other person and is influenced by the receiver and the physical environment. In instructional media this may be intended though it is generally much less effectively accomplished.

## DISCUSSION

### Human Information Processing

A discussion of human information processing will establish a foundation for its importance in designing any type of mediated instructional information. An understanding of how these cognitive traits affect perception of a message will enable media producers and teachers to relate materials more closely to the student.

The uniqueness of an individual expressed through personality largely determines the effectiveness of a communication transaction. The environment in which communication is occurring also plays a vital part. Personality is the internal dynamic organization of an individual's psychophysical systems determining his characteristic behavior and thought (Allport, 1961). Environment includes all influences external to the person that enter into the communication situation.

Human information processing (IP) is described by three general theories. These theories serve to categorize individuals on their ability to discriminate between dimensions and to integrate dimensions into new relationships of complexity. Bieri (1955) is concerned with discrimination in his Cognitive Complexity-Simplicity Theory, while Harvey, Hunt and Schroder (1961) in their Conceptual Systems Theory are concerned with integration. Schroder, Driver, and Streufert's (1967) theory of Human Information Processing is similar to Harvey's and will be the basic reference throughout this paper. Schroder's interest is in the ways individuals cognitively receive and integrate external stimuli. Table 1 is a brief comparison of characteristics of Harvey's and Schroder's theories.

The number of dimensions on which a person perceives a stimulus is differentiation, and integration is the relationship of these dimensions as they are combined to generate new or different meanings (Schroder, 1967). A third concept, discrimination, involves distinguishing differences or gradations along a single dimension.

To further explain these three terms, an example is given. The variable of quality of an educational television program will be measured by four of many possible dimensions, value, accuracy, productions and storyline.

TABLE 1

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 THEORIES OF COGNITIVE-COMPLEXITY
 

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Harvey's Conceptual Systems Theory

Individuals are categorized to these systems or combination of systems on a basis of abstract-concrete behavior. This is taken in part from Greaves (1971).

<u>Systems</u>	<u>Attitudes and Behaviors Correlated to Systems.</u>
1	extremely set in his ways and judgmental in his thinking; tending to weigh everything important to him against an externally imposed set of rules. He has a high need for structure and external guidance.
2	dwells on the negative aspects of authority and is closed to any potential for good it might have.
3	has a greater cognitive-complexity and flexibility than systems 1 and 2, and more independent than 1 and 2, but not as much as system 4.
4	autonomous, confident, and high self-esteem. Believes there are many routes to the same goal. Opposes external elements defining the terms of his existence.

Schroder's Human Information Processing Theory

This theory is based on integrating rules in construing ones environment as it affects attitudes and behaviors.

<u>Levels</u>	<u>Attitudes and Behaviors Correlated with Levels.</u>
Low	categorized in black and white thinking. Minimizes conflict by excluding information that doesn't fit. Behavior anchored in external conditions.
Mod. low	slightly less rigid than low level. There is ambivalence and lacks consistency in decision making and judgment.
Mod. high	views a situation in terms of more than one point of view. Functioning is decreasingly dependent upon immediate external stimulus conditions. Behavior is decreasingly predictable from a knowledge of the individual's past.
High	increase in degree of diversity the system can generate and handle. Greater discriminations between stimuli within dimensions. Increased potential for generating alternate patterns of interaction and new schemata without the imposition of new external conditions.

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Value	informative	x . . . .	uninformative
Accuracy	correct	. . x . .	wrong
Production	poor	. . . .	x excellent
Storyline	slanted	. . . .	x unbiased

Differentiation refers to recognizing a relationship of "quality" to the four dimensions of value, accuracy, production, and storyline. Discrimination refers to where a judgment "x" is made along a dimension. Integration is relating the several dimensional judgments about the program's quality into new meanings or relationships (Schroder, 1967).

Persons having a high ability to discriminate stimuli and integrate into new concepts are classed as high level processors distinguish differences in form of processing rather than in intellectual ability. In fact, there is no correlation with IQ (Schroder, 1967). Neither being a high nor a low level processor is better than the other, but each is different and people fall into blends of the two extremes rather than all being sharply divided. There are four broad categories of processors in Schroder's theory (Table 1), but for ease of explanation most reference will be to the high and low processors.

The low processor, in assigning meaning to information, tends to categorize along extremes of a dimension rather than using a variety of gradations between the extremes (Streufert & Fromkin, 1972). The low level information processor construes his environment in a more structured manner with a more rigid use of rules or systems in processing information. Conflicting information adversely affects this person more than higher level processors or

more complex individuals. The low level processor is less apt to generate new relationships along different dimensions than is the high processor. Where the low IP deals more capably with specific and concrete information, abstract concepts are difficult to process.

The complex individual responds to multiple cues in a message. Given a simple structured message the high level processor may find it insufficient to hold his interest, but will be able to use the message as effectively as the low level processor (DiSalvo & Seiler, 1974). Prolonged exposure to a simple message may lead to boredom or disinterest by the complex individual, this person would prefer a more complex message.

In contrasting the two extremes of the information processing continuum, the high level IP assigns meaning using a variety of dimensions applied to new relationships (Schroder, 1967). The high IP individual is more likely to use all of the available information, while a low level processor might utilize only part of it in making judgments.

Humans process information in quite dissimilar ways and at different levels of thought. Similar events will stimulate dissimilar types of information processing (Mortensen, 1972). Not only do individuals differ in processing levels, they will process at different levels with changing circumstances (Schroder, et al. 1967).

Stress is one circumstance that will affect the individual causing a change toward low level processing. Even a high level processor will tend to be more rigid under stressful conditions than he would otherwise.

High level processors will perform better with messages of greater complexity which includes increased rate and density of audio and visual information. They also seem more adaptable to variations in message complexity than the low processors (DiSalvo & Seiler, 1974).

This discussion implies that everyone has his own maximum capacity for processing information. A person's mind is continually active with or without an external stimulus input, but the degree of mental activity fluctuates. The total information being processed at any given time must be a combination of the external stimulus and the internal thought. Theoretically, the internally generated stimuli are inversely related to those externally generated, with the external stimulus the dominant ones.

Just one stimulus can be attended at a time (Weaver, 1972) and an individual has no control over external stimuli. If the stimuli are strong enough, they will influence the person's mental activity by reducing the amount of attention given to internally generated thought. As the external stimuli increase or decrease, they exert an opposite effect on one's internally generated thoughts.

The external stimulus can create additional thought relative to itself virtually removing all unrelated mindwandering. Internal thought cannot activate external stimuli, but external stimuli does activate internal thought process. This does provide the implication that external stimuli controls the activity of human thought process by causing the person to respond.

The mental process by which a person reacts to a stimulus is reflective of personality and personality determines a person's cognitive-complexity. This in turn is the structure through which all audio and visual stimuli are perceived.

A person's attention is easily attracted, but holding that attention and helping the student to understand what is being presented is the challenge for the media producer. The characteristics of the high and low level information processor are indicated as reflecting individual personality. These characteristics form the personal structure used in perceiving information. The challenge for the media producer is in designing material to mesh with these characteristics of cognitive-complexity applicable to the intended audience.

Human learning and understanding of educational materials is improved if students are presented information in a manner compatible with their information processing levels. Material presented without depth of explanation

may lead to inappropriate conclusions by low level processors while the high level processors may be able to assimilate it, although they too, could form inaccurate assumptions. For example, if in the opinion of an audience the style of background music in a film seems to clash with the content, low processors may ignore the point of the message. High level processors are less likely to reject the entire content because of incompatible message elements.

#### Message Complexity

A media designer's intent is to have the intended audience reach appropriate conclusions from the message. For optimum processing of information the message elements must appeal to the audience's cognitive-complexity characteristics. In any given audience a mixture of all information processing levels can probably be expected. Where an audience cannot be analyzed before hand another method is needed. One way to achieve better audience integration of information is to use a more complex message design within the user's capacity of complexity (Marsh, 1973). This procedure resulted from research conducted by Marsh (1973) where he developed several combinations of message-complexity and surveyed audience reaction with an integration level scale described later as table 3. In Marsh's research a message complexity



level 7 of a maximum of 9 was indicated appropriate for an audience of undefined cognitive-complexity. Message complexity is comprised of specific relationships of diversity, a measure of the medium; density, a measure of the signal; and set as a measure of the human capacity. Various combinations of diversity, density and set will attain comparable complexity to the level 7. These definitions are derived from a discussion of environmental complexity by Schroder, et al. (1967) and are presented in table 2.

Message design achieving complexity level 7 should have a high diversity, low density and a high set. High diversity includes using many forms of visual information and a variety of audio such as sound effects or music plus voices. Low density is typified by a voice speaking at a normal rate with an overview and summary of the material. Set deals with organizing information to arouse an emotion toward the message content. This is accomplished in high set by including delayed conclusions in chunks, planned shock effects, transitions between all chunks, and identifying all points. A chunk of information is an abstract point supplemented by one or more amplifying supports. All uses of visual and audio should be considered on their merits of contributing to the authenticity of the media production. For instance,

TABLE 2

## MESSAGE COMPLEXITY

Message complexity is comprised of levels of diversity, density, and set as used in Marsh (1973).

Message Complexity Score	Composition		
	Diversity	Density	Set
3	Low	Low	Low
4	Low	Med	Low
5	Low	High	Low
6	Low	Med	High
7	High	Low	High
8	High	High	Med
9	High	High	High

## Definitions of Complexity Factor Levels

<u>Low Diversity</u>	Recorded voice, black and white visual verbal display, black and white schematic drawings.
<u>Med Diversity</u>	Recorded voice, visual verbal display, schematic drawings, photographs, multi-colored visuals, handouts, recorded music.
<u>High Diversity</u>	Recorded voice, visual verbal display, schematic drawings, photographs, multi-colored visuals, handouts, recorded music, montages, sound effects, simultaneous audible channels, cartoons.
<u>Low Density</u>	Slick magazine difficulty, uncompressed speaking rate, overview and summary, 3 slides/minute (average), 8 seconds between chunks.
<u>Med Density</u>	Academic journal difficulty, 80% compression, summary only, 6 slides/minute (average), 4 seconds between chunks.
<u>High Density</u>	Scientific difficulty, 60% compression, neither overview nor summary, 9 slides/minute (average), no pause between chunks.
<u>Low Set</u>	No delayed conclusions in chunks, no planned shock effects, no affronts, 2 encouragements, neither transitions nor point identifications, no programmed responses.
<u>Med Set</u>	Two delayed conclusions in chunks, one planned shock event, one affront, one encouragement, transitions between all chunks, points not identified, one programmed response.
<u>High Set</u>	Four delayed conclusions in chunks, two planned shock effects, 2 affronts, no encouragements, transitions between all chunks, all points identified, 2 programmed responses.

any visual that fails to add value to the production should be omitted to avoid ambiguity.

It is not necessarily the number of different stimuli in a message that creates complexity, but the extent of interaction of stimuli that makes the difference. An audio message lacking, but needing visual support, may be more abstract than with visuals. Visuals that clarify a point of an audio narrative may be very specific, and just what the low level processor would prefer. On the other hand, if the audio is making somewhat vague statements and visuals fail to specify the main points, the low level processor will do less well than the high IP individual in assigning meaning to this message.

#### Audio and Visual Perception

Perception involves an act of categorization. We stimulate an organism with some appropriate input and response is by referring the input to some class of things or events. Bruner (1968) summarized the relevant variables in audio and visual perception as follows: "The threshold of recognition for stimuli presented by visual, auditory, or other means is not only a function of the time, intensity, or 'fittingness' of the stimulus input, but also varies massively as a function of the number of alternatives for which the perceiver is set (p. 646)."

Prior experience establishes the categories for aligning the audio and visual stimuli of communication and the organizational patterns of information assist in processing the information. Both audio and visual stimuli are sequential inputs requiring time for assessing them and for assigning meaning. A minimum time is needed and if the perceiver is not able to process all stimuli then an overload situation occurs.

Human sight functions with certain limitations. For instance, we don't always see all that is before us. Rapidly flashing lights may appear steady and excessively intense visual stimuli are reduced in intensity during processing (Haber, 1969). This serves as a limited automatic overload control. The duration of seeing a stimulus often exceeds the actual time the stimulus is visible (Posner, 1969). This is possible through immediate sensory memory. Humans process visual and auditory information separately with a brief visual storage separate from a brief auditory storage. In comparison, a large quantity of visual information can be retained for a very short time; a smaller amount of auditory information is held for a longer time.

Williams (1969) indicated that instructional set aids the viewer to remember a dimension when it is included among other dimensions. Visual searching for an item in a group of items is estimated at about 10 milliseconds

each and the search ceases after the item is identified. Instruction given a person prior to viewing will condition the person to focus on specific items. Viewers trying to find an item from among a number of similar items all simultaneously visible might use characteristics of shape, size, color or other criteria to aid in identification. The person will tend to avoid items not fitting the assigned specifications. If color is specified, items not of that color are minimally attended. The person rapidly sees what has been specified without equally dividing searching time among all of the available items.

Similarly, where the objective is to aid a person to remember what has been seen, as in a picture that will be shown again at a later time, giving that picture a name aids in recall. Seeing the picture without it being previously cued with its name reduces the chance of recognition (Madigan & Hamovitch, 1976). This suggests that audio information should precede the visual when desiring the viewer to identify an object of interest within groups of visual stimuli. However, when a person is presented with the audio and visual simultaneously originating from the same source the visual will be perceived first.

Media producers can apply these perception characteristics in preparing audiovisual materials. The users can be directed to discover a particular component

within a picture for instance, by preceding the viewing with a brief verbal clue. This will reduce scanning time by the viewer. If scanning time is irrelevant to the message, then prior direction can be omitted.

When an individual is not told what to look for eyes are attracted to the high information areas without having visually scanned the entire picture. The eyes appear to search for unusual or different information from among all that is available (Mackworth & Morandi, 1967).

Consider some differences in effects between the visual presence of people in conversation and people not in visual contact. Those meeting face-to-face tend to be more spontaneous in their comments and more responsive to the personal relationship of the conversation to the issue rather than to the people (Stephenson, Ayling & Rutter, 1976). The effect of an audio medium is to remove the influence of the visual element, so conversation is better focused on the topic and less likely to stray to other topics. In this way the characteristic of the medium is a control on the content of the communication. An audio medium has a restrictive effect by eliminating visual input that could detract the participants from the main purpose of their conversation.

The variable of information rate is common to every-

one but unique to each of us according to our processing characteristics. Everyone's mind works at its own speed. If the information input lacks sufficient rate of delivery, the receiver's mind makes up the difference in quantity to satisfy the optimum rate. Research suggests that a variety of rates between 125 and 190 words per minute are effective in enhancing message reception (Thompson, 1967). Studies on speech rate compression reveal that people can build up their listening speeds well above 190 words per minute and still have adequate comprehension (Carver, 1973). Within these ranges of speech rates, each person has an upper limit, a lower limit and an optimum rate. Rate of information flow is one of the variables that interact with an individual's information processing level. Individuals with different processing levels will function more effectively at different optimum speech rates, if all other variables remain constant. The variable of a person's processing rate influences the quantity of information a person can process in a given amount of time. There is no absolute answer because of other variables which may interact with rate when a person receives a stimulus.

Attending a stimulus is difficult when there are competing stimuli present. Stimuli that are closely similar in frequency, intensity or in content make it very difficult to discriminate the stimuli. Two voices

of like characteristics on an audio tape would be difficult to separate. In this situation the maximum effective rate may be far below that of listening to a single stimulus without interference. A person can manage more than one unrelated task at a time but it seems impossible to process more than a critical or optimal amount of information in a given time. Because the human nervous system has a limited capacity, similar, but undesired information arriving simultaneously can overtax the communication system involved (Broadbent, 1959).

The implication here is that an effective message design requires a proper rate of information in respect to the audio and visual modes of delivery, the form and quantity of undesired stimuli, and abstract level of content. All must fall within the optimum range for best results at a given level of cognitive-complexity.

Marsh (1973) attempted a measure of the maximum capacity of adult processing through a series of message complexity designs. Other than his, very little has been done with this type of research. Measuring adult processing capacity was used in testing Schroder's u-curve hypothesis, the main objective of Marsh's efforts.

Visual and audio information is processed in relation to one's cognitive-complexity level. The information stimuli are obtained primarily through channels of sight and hearing and with the influence of a person's cognitive-



complexity. Thus one assigns meaning to the external information according to one's prior experiences and information processing level. For specific effects the relationship of the audio and visual elements must be coordinated, not left to chance in designing mediated material. Also of importance is the medium and its influence on the message. A message via an audio medium must be complete without needing a visual element. This is a decision for the media designer to make in coordinating the audio and visual elements into a message compatible with the natural process of human audio and visual perception.

Individuals have an optimum level or capacity for processing information and this implies an optimum rate and complexity for presenting information to the individual. These variables are closely related, also being influenced by the cognitive-complexity of the person. Media designers must avoid audio and visual rates that exceed the audience's ability to process the messages.

#### Cognitive-Complexity and Media Design

The traditional classroom finds a teacher dominating information flow mainly from the teacher to the students. The teacher generates most of the audio and to a lesser degree the visual information. Efficient classroom communication requires integrating three elements: a

knowledge of student cognitive-complexity, the relationship between student and teacher, and the characteristics of the selected media. Most typically this is easily accomplished when the teacher is the medium in a dyadic situation in the classroom.

Likert (1954) noted that relatively little attention had been given to the matching of content to the target audience in the preparation of audiovisual materials. He stressed the need for audiovisual material to penetrate the psychological environment of the audience if it is to have any instructional effect. When material fails to penetrate their psychological environment the students either walk out physically or psychologically.

Likert referred to this concept as distinguishing between the environment of the same individual as others see it. Near the core of this environment are the interests, needs, problems, objects and events of most concern to the individual. Any item of information on matters of greatest concern to the individual will have the greatest influence on his ideas and behavior.

Instructional audiovisual materials furnish an effective way to extend the range of vicarious experience. Yet, no amount of clever instructional materials can assure learning if a student cannot discover a reason for learning. The message has to seem important to the student before a sincere interest will occur (Dale, 1969) and

with this, learning results when a personal meaning can be assigned to the information.

This implies that learning is largely dependent on the personality of the student. Personality is influenced by the information and the environment under which it is received, and the manner of accepting and using the information is affected by a person's information processing characteristics (Bieri, 1971).

Because of the differences in IP levels, people see their environments differently. Those of a more cognitive complex nature are less dominated by their environment. Their ability to highly discriminate on a variety of dimensions indicates a willingness to perceive their environment from many points of view. This person is not likely to categorize people, circumstances or events under common labels, but rather judge each individually on its own merits. This individual is somewhat independent, tending to create rules of his own for making judgments unlike the low level processor who is a strict conformist to the rules of society.

For example, an instructional film made with teenagers in the 1950's might be poorly received by today's teenagers because of the clothing and hair styles worn by the cast. The outdated dress will cause more of an adverse effect on the low level processors than on the higher processors in accepting the message. The highs

will be more concerned with the issues of the message and can overlook a minor point of dated dress. Low level processors will tend to discredit the film because of the cast's appearance. For the low complex person, all parts of a message must seem currently authentic if any of the message is to be perceived as valid.

The low level processor is strongly influenced by the environment attempting to make absolute judgments with few discriminative variations. Consider an example from commercial broadcasting. Network television advertising frequently relies on two methods of presenting commercials. These are testimonial statements of a "typical" person in a realistic setting and famous people speaking in favor of the sponsor's product. Both are means of appealing to the low level processor through the speakers and their depicted environment. Whereas the high level processor is more concerned with information content than with the prestige of the speaker, the reverse is true for the low complex person. The low level processor is impressed by the speaker and less by content. The low level processor is caught up in his environment while the high level processor tries to remain independent of his.

Some theorists are committed to the position that personality is to some degree learned and that personality change is possible (Spence, 1963). The cognitive-complex-

ity of an individual is a part of the person's personality describing how information is processed (Kelly, 1955; Schroder, 1967).

During a dyadic transaction the speaker uses the reactions of the listener as cues to organize or reorganize what is being said. Also, the need to change pace and to modify content by adding or deleting detail can be determined by the listener's verbal and nonverbal cues. The listener is communicating to the source the desired rate of delivery for the complexity of the information being transacted. The media producer lacks this feedback from the audience so only an estimate is possible based on knowing the cognitive-complexity of the audience.

Most research measures the speaker's effectiveness by evaluating the listeners' responses. Indirect communication is unable to provide this kind of feedback to the speaker anytime the listener is not visible to the speaker. Message prepared for a given medium must be designed to allow for the weakest informational element. Radio or audio taped information requires a more descriptive audio to compensate for the missing visual element. By contrast, a silent film must have very explicit visual information to make up for having no audio. A Charlie Chaplin comedy film is an excellent example of using clearly presented visual information without an audio element.

The amount of detail, the sequence of information,

rate of flow should fit the user's cognitive structure. An audio-slide program might use several slides of similar information rather than a single representative slide to adequately convey the needed detail. The sequence of the slides must give a visual flow with the audio information. A long sequence of brief exposures of the slides may be inadequate for the viewer to see the detail and mentally put it all together.

If the users are low level processors, abstract information will need greater detail and specific explanation. A slower pace will aid comprehension. The individual's capacity to process new information is important and relates to both pace and density of the information.

Everyone organizes incoming information according to their own cognitive process. Loosely structured information will be more readily accepted by the high level processor. This person has a greater facility to organize and use what would be insufficient for a low level processor. This would apply to audio and visual information equally.

Nonverbal information in conflict with the verbal in a dyad can create confusion in meaning for the listener and the same can be expected in instructional media. Visual and audible stimuli aid processing when applied in proper relation to one another. When these characteristics are in conflict, the results can be disrupt-

ive for the user as a hindrance in assigning proper meaning to the stimulus received. However, the high processors can tolerate more conflict and uncertainty in information than low level processors. Conflict and uncertainty may even aid high level processors in processing information at their optimal level.

People in conversation rarely plan the nonverbal element because it is an integral part of the verbal. A speaker likely pays more attention to what he is saying than to the related nonverbal information that happens spontaneously along with the verbal. The listener is aware of verbal and nonverbal information from the speaker. In media design producers must coordinate both elements ensuring they are in agreement as they form a desired message. A film showing children immaculately clean when they have just completed a baseball game is unrealistic. Visual agreement calls for dusty rumpled clothes and dusty faces along with appropriate narrative.

Communication media are extensions of human sources bringing information to the user in a manner compatible to the user and source. When the user is being directed to viewing complex information, audio establishes a set for the viewer by pointing out what to find, thus helping the person to avoid random searching by quickly bringing attention to the desired item. The objective of the communicative experience is to make a visual identification;

the verbal description is supportive and used to explain the item. In this way the person's visual attention is directed to and held on the object during related audio explanation. The reverse use of visuals to support a complex audio is also appropriate. The audio and visual information should be complementary, each in support of the other element just as the verbal and nonverbal elements in a dyadic transaction.

In face-to-face communication the speaker adjusts the presentation according to the reaction of the listener. Content can become more or less complex or even completely revised at the time of delivery. Placing a medium in between source and user eliminates this flexibility for change. Therefore, a greater understanding is needed of how the user will perceive and process information of differential complexity.

Since human audio and visual perception functions in a known process, designers of instructional media will create the most effective messages by relating design to the characteristics of human audio and visual perception and human cognitive-complexity.

#### RECOMMENDATIONS

The discussion of cognitive-complexity and media design has considered three components: the media designer as the source, human information processing character-



istics of the user, and the dyad representing the relationship between source and user.

A primary consideration in preparing instructional media is to convey information in a manner most closely agreeing with the user's cognitive processing structure. This discussion offers recommendations for those designing mediated educational materials that apply equally to commercial producers and to classroom teachers.

#### Recommendations for Media Designers

The design of instructional media usually includes reference to age and grade level among the criteria of knowing the audience (Dale, 1969; Wittich, 1973). Added to this criteria should be human information processing. Knowing the processing levels of a specific audience before planning a program would be ideal however, this rarely is possible for large scale distribution. Programs made for a class by its teacher can be designed using the guidelines discussed. In lieu of precise measuring of individuals in a known audience, reference to research may prove suitable. Research in cognitive-complexity has established that people react to information with relatively specific behavioral patterns. Individuals are included into one of several patterns as discussed previously and presented in table 1.

The design of instructional media should avoid the

attempt to be universally appealing. In attempting to reach too broad an audience, the audience may never be found, because the material may lack depth, or it may be so general in its coverage that little information is really presented. Trying to appeal to a nationwide audience prohibits planning for specific curriculum purposes, because of the individuality of teachers and their teaching methods.

Material designed for regional use should be preferred to that of a nationwide audience. Material for a local audience should be preferred to a regional audience. The closer the program approaches a specific audience the better the opportunity of having an effectively designed program. Teachers have found that adapting certain parts of a program has proved useful where the entire program may not have fit in the classwork. This indicates that the program as a whole was not suitable for that particular audience. A program's usefulness can be improved if design has related the user's environment to the production. An important step in design is to involve the student through personalizing where possible.

The dyad is descriptive of a personal relationship. In a film or television program the student is one person listening to one voice or seeing one speaker. The speaker in turn should speak as if the one person, the one who will use the program. In personal conversation eye contact is

commonly accepted as showing interest between participants. This interest is also indicated by speakers looking into a film or television camera lens. During production the camera is the viewer and during viewing the screen is the source for the user.

Audio narratives are personalized by choice of words and tone of voice speaking as if the users were present. A person's eyes move about while in conversation. This is true for both the speaker and listener. The camera should also move frequently, not hurriedly, but smoothly in simulation of the viewer's changing eye movement. A fixed camera picture held without change is unnatural. In planning the audio and visuals from the standpoint of the user, the information can be presented in a natural manner as if the source and user were in conversation.

Steps to involve the viewer preconditions the person and through this technique attention will be gained and held. This must be accomplished before learning can occur.

A student seemingly disinterested may do better with material of less detail presented at a faster rate. This also involves the student by appealing individually to the person's own rate of information processing. Speech rate is increased through specially recording an audio tape in a speech rate compressor. This introduces some distortion but is still effective for listening at speeds greater than

225 word per minute. The concentration required to listen to these high speeds would make viewing of visual material difficult at the same time. Therefore it would be unsatisfactory to combine speech rate compression with visual material on film or videotape.

The process of increasing the speed of visual information is to reduce the time for each viewing. Using a number of pictures or cuts of the same visual subject from different angles or framing size will change but not remove the visual content for a related audio element. The rapidly changing pictures will increase density which may better satisfy the high level processor.

The advice given above has dealt almost exclusively with the processing characteristics of the user and how this person perceives the message. However, these processing characteristics apply to the information source as well. An audio visual program is an expression of the person who produces it and if the producer is a low level processor, a complexity level may result that is insufficient for a high complex audience. Of course, the opposite may result if a high level processor was the only person involved with making a program, the low complex individuals may find the information too abstractly presented.

The writing and design of the entire program should be a group effort so as to minimize the influence of one person's cognitive-complexity level. Those characteristics

of the moderately high level processor indicate the persons best able to recognize and meet the processing characteristics of all other levels of information processing.

#### Recommendations for Teachers and Librarians

The teacher is more directly concerned with student learning than the media designer unless the teacher is also the designer. The teacher and media librarian will find a knowledge of characteristics of cognitive-complexity useful for selecting material for classroom work. They could confidently select a program for a specific purpose, such as a remedial explanation for an individual, if the cognitive-complexity level of the person was known. Knowing of the characteristics attributed to high and low level processing should lead to recognizing that a possible cause for confusion or boredom is a mismatch of message design and cognitive-complexity of the students.

An instructional presentation that makes several main points with minimal explanation can confuse the student especially if the student is a low level processor. Misunderstanding may occur if the student assigns inappropriate meaning to the audiovisual information. The high level processor will stand a better opportunity of keeping up with this kind of material. When a teacher is fortunate enough to have two films or programs on the same

subject, showing the more complex version after having previously shown the less complex will aid student integration of information. This works with a time delay between viewings (Marsh, 1973). This approach is similar in process to a less complex audio element establishing a set for the more complex visual as discussed earlier in this paper (Williams, 1969).

Librarians and teachers can evaluate instructional programs for message complexity as part of the previewing process. Assessing program complexity and noting the results on the program's catalog card will be a continuing help for teachers when selecting material for student use. The Scale of Integration Level, table 3, could be used for measuring the complexity level. This scale helps the observer to distinguish simple and complex messages.

#### SUMMARY

This paper has shown that the creation of instructional media entails more than just preparing the ideas of the designer into a medium for distribution. Since the purpose of instructional materials is to convey information to students to aid learning, attributes of the students should be applied in designing the programs. Certain traits of audio and visual perception are true for people regardless of their cognitive-complexity levels. The relationship of audio to visual information

TABLE 3

## SCALE OF INTEGRATION LEVEL (from Marsh, 1973)

Scale Point	Description
1	I perceive only one interpretation of the concept. I tended to ignore differences, similarities, and gradations.
2	I perceived more than one interpretation of the concept, but I tended to accept one interpretation and reject the others. The rejected interpretations were easily dismissed. I saw no relationship between the rejected and accepted points of view.
3	I was able to differentiate two or more views clearly. I could see similarities and differences between the different viewpoints. Although I rejected certain views, I feel I understood them.
4	I responded as in 3 above except that I began to "consider" the similarities and differences. That is, the simultaneous effects of alternate views became apparent.
5	I considered alternate and conflicting reasons for perceived similarities and differences between views.
6	I began to consider relationships, not only among direct similarities and differences between interpretations of the concept, but also relationships between alternative reasons as to why the differences and similarities occur.
7	I considered notions which include relational linkages between alternate views. I attempt to see conflicting components as parts of a more inclusive "construction" of the concept.

is important for anyone preparing instructional media and this was discussed in an earlier section. The focus of this paper is directed towards making the media designer aware of the need to create a message so the user will assign appropriate meaning to it. The assignment of meaning to messages is helped by matching the message design to correspond to the cognitive-complexity of the users.

Cognitive-complexity has no correlation to IQ, but rather refers to how individuals perceive information stimuli. In the main discussion of this paper reference was made to the low level information processor as one who assigns meaning by categorizing along extremes of a dimension and who will use fewer dimensions in reaching conclusions. A high level processor utilizes a wider variation in discriminating stimuli and responds to multiple cues in a message. The more subtle or underlying themes of a program are likely to become apparent to the high level processor where they may not be recognized by the lower complex individual.

Individuals function best within their own capacity for processing information. This places a demand on media designers to prepare messages to fit the cognitive complexity structure of the intended audience.

This paper indicated that the use of audio and visual elements should be coordinated in a message so that one



supports the other somewhat comparable to the verbal-nonverbal information in a dyadic transaction. It was also proposed that the basic communication relationship of the dyad should provide a basis for instructional media design. The dyad represents the most personal relationship between participants. Developing a personal approach to media design can stimulate interest for the message. Interest can be maintained and learning opportunity improved when the message design conforms to the characteristics of human information processing. By varying the degree of message complexity abstract or simple information can be designed for a specific audience. Various levels of complexity are derived through combinations of density, diversity and set as developed by Marsh (1973).

This paper has indicated through a number of studies that the most effective mediated message utilizes the natural traits of audio and visual perception and the characteristics of cognitive-complexity in respect to a known audience.

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