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ABSTRACT

Simultaneously projected multiple-images with sound communication--Audible Multi-Imagery (AMI)--was investigated in terms of its capacity to promote student learning and retention of subject matter in a formal instructional setting. A population of 253 high school psychology students were randomly assigned to one of three AMI treatments--each differing in the length of the program--or to a control group. Each AMI group viewed their program segment, and then all subjects responded to a written test, both immediately after viewing the program and one week later. The control group saw no programs and responded only to the immediate posttest. Results indicated that subjects in all AMI treatments had significantly higher scores on the posttest than did the control group, and that the shorter instructional episodes were most efficient in retarding information loss over time. Appended are narration scripts of AMI programs, a log of materials costs for 30 minutes of AMI programming, a log of preparation activities and time expended in each for 30 minutes of AMI programming, and a selected bibliography. (SH)

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AUDIBLE MULTI-IMAGERY:

INFORMATION LEARNING AND

RETENTION CAPABILITIES

by

Pascal Louis Trohanis

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CHAPTER I

INTRODUCTION

General Statement of the Problem

Simultaneously projected multiple-images with sound communication, known as Audible Multi-Imagery (AMI), has rapidly grown since its inception in 1927. The Frenchman, Claude Autant-Lara, is credited with being the first to use multiple screens by depicting a gold hunting expedition to the far North. Gradually, the medium of AMI has found its way into the programs of world fairs, federal government agencies, businesses, universities, schools, and the Association for Educational Communications and Technology conventions.

There are many reasons for the increasing use of AMI. It stimulates viewer interest. It facilitates side by side visual comparisons. It gives movement and continuity to still pictures comparable in many instances to a motion picture. AMI can be produced and presented using conventional slide, audiotape, and motion picture equipment. Production time is short, and (compared to motion pictures) production is relatively easy and inexpensive. Finally, the medium has the potential for being optically and acoustically provocative to both audience and producer. To actualize its potential, a wide range of existing and newly produced pictorial and auditory materials can be incorporated for large multiscreen projection. Parts of existing motion picture films, audiotapes, slide sets, and filmstrips can be used. Illustrations from books, magazines or original artwork can be converted easily into 2 x 2 slides by copying the originals.

Hence, for these various reasons, AMI has been successfully used in the fields of entertainment (Kappler, 1967), information dissemination (Trohanis, 1971a), persuasion (Reid, 1970), and formal instruction (Brydon, 1971).

As the applications of AMI continue to increase, serious questions are being raised by researchers about the instructional effectiveness and efficiency of the medium. Fleming (1970) suggests that "perhaps these media are appropriate when their intent is not to inform in the usual pedagogical sense but to overwhelm, impress, exhilarate, or 'send' [p. 157]." Allen and Cooney (1964), reflecting on the research evidence available at that time, cast serious doubt on the ability of AMI to produce modifications in learner behavior or thought which are significantly different from conventional (single screen) media.

The users of AMI claim various advantages including reduced time for the presentation of an idea, and/or significant increase in learning (Hubbard, 1961; Lawson, 1971; Perrin, 1969; Trohanis, 1971b). There is relatively little research to prove these claims, or to answer the related questions regarding AMI program design, program length and retention, and program cost (Bollman, 1971; Brydon, 1971; Fisher, 1969; Kilmartin, 1969; Lombard, 1969).

This study examines the topic of AMI program length and its effect on learning and retention. It compares the amounts of information students learn and retain for AMI programs of 10, 20 and 30 minutes duration. This research topic was stimulated by conjecture and debate among producers regarding the useful length of AMI programs for cognitive learning. Hopefully, the findings from this study will be helpful to producers and "contribute directly to the formulation of educational policy and to the improvement of educational operations [Hoban, 1965, p. 122]." More specifically, the derived research information might nurture improvement in AMI programming so as to increase its instructional value. After all, "the use of multiscreen and multimedia presentations is no longer revolutionary of itself, but it is still a new enough technique that much remains to be learned about its proper application and implementation [Multiscreen, 1967, p. 38] ."

Statement of Research Questions

Three main research questions were posed for this study on AMI information learning and retention:

1. If an instructional AMI program were presented to a group of students, would their mean raw score of correct answers from an immediate retention test be significantly different from the mean score of a student group who did not see the program?

2. If an instructional AMI program of variable length (10, 20, or 30 minutes) were presented to student groups, would their percentage of correct answers from an immediate retention test be significantly different for variable program lengths?

3. If an instructional AMI program of variable length were presented to student groups, would their percentage of correct answers on a delayed retention test be significantly different for the various program lengths?

Definition of Terms

There are several terms in the preceding chapter sections which require clarification and definition. Each term is underscored in the following description.

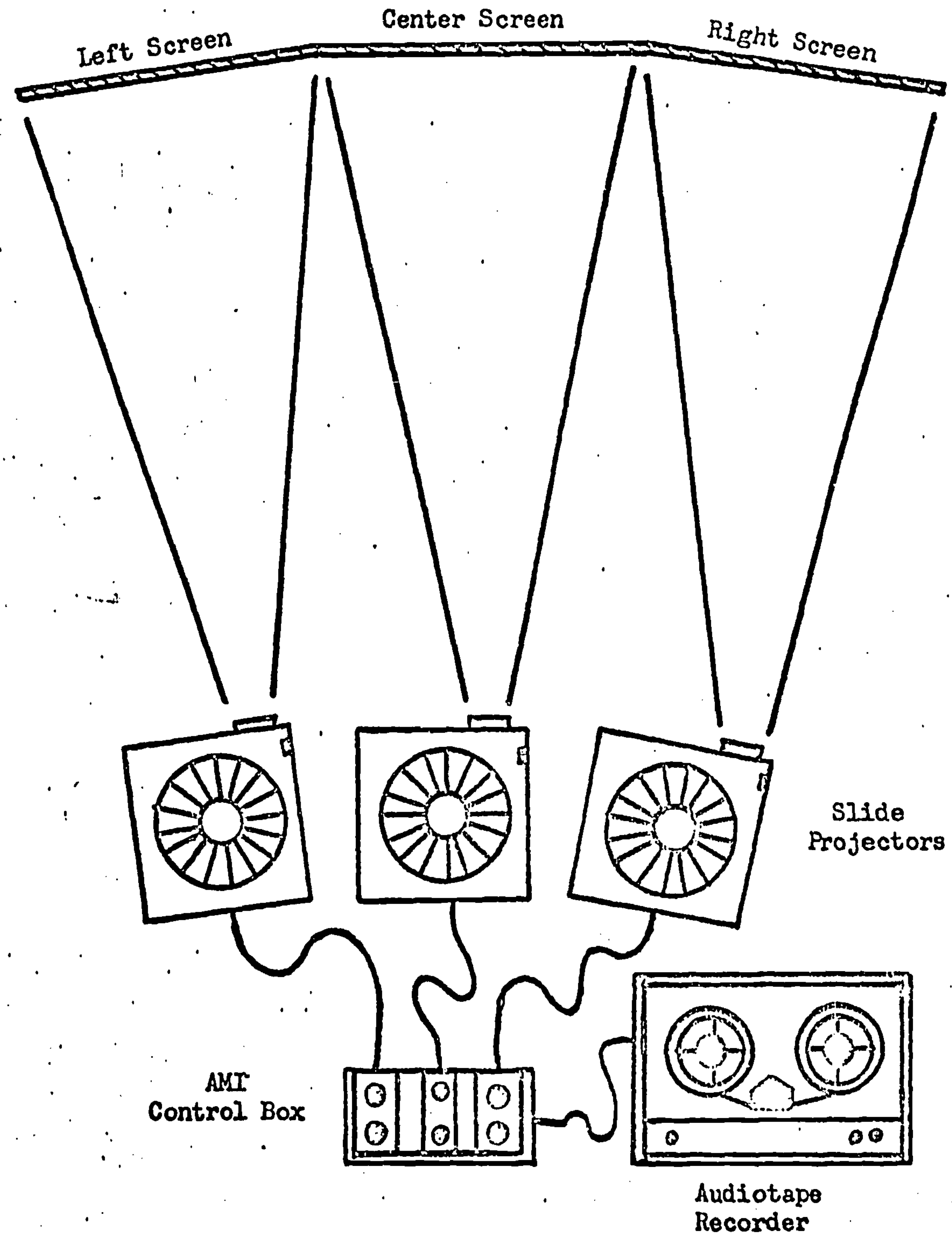
AMI, which stands for Audible Multi-Imagery, is the integral display of two or more simultaneously projected visual images. Coupled with the imagery is the corresponding sound or audiotrack. The images may include the following media singly or in combination: filmstrips, 2 x 2 slides, motion picture film, lantern slides, and/or overhead transparencies. The sound, from live and recorded sources, is usually prepared on audiotape and is played concurrently with the displaying of the pictorial material.

Since 2 x 2 slides and audiotape are the predominant media now in use, this study limited itself to the configuration depicted in Figure 1. It comprises three slide projectors, an audiotape recorder, three separate screens, and a control system to advance the slides.

The software or instructional program is transmitted to a specified audience using the AMI equipment configuration shown in Figure 1. The program was designed to include cognitive information in the area of high school psychology. A retention test was prepared by the researcher to measure the amount of AMI program material retained by students. The tests were administered directly after the AMI presentation (immediate) and one week later (delayed).

FIGURE 1

AMI CONFIGURATION



The final areas to be clarified and defined are the related functions of the terms learning and retention. Learning is recognized as a "change in human disposition or capability which can be retained, and which is not simply ascribable to the process of growth [Gagné, 1965, p. 5]." Implied herein is that some sort of inner connection or association is made between the input (AMI stimuli) and the output (responses to retention test). These bonds are usually facilitated by such instructional techniques as repetition, pictorial and audio vividness, transfer and informational redundancy. The bonds are facilitated also by variables of human ability, motivation, perception, and memory. Thus, new learning, new thoughts, or new information appear to be continually mediated by, or assimilated to, old learning because the learner is always in transfer (Caron, 1966).

Retention reflects the existence of a sensory impression and forgetting reflects its decline. Consequently, memory must somehow be demonstrated; otherwise one will not be sure if learning has taken place. Most frequently, inferring that learning has occurred is measured by deriving a differential index between an individual's performance before and after instruction. Therefore, one must insure that learning first took place before any AMI program information could be recalled from memory.

Ultimately, learning represents an interaction between a learner's environment (the AMI program) and his inner, intervening variables. Thus, a change in the student may be ascribed to retentive learning as an index of the degree of cognitive information acquired.

Organization of the Thesis

Chapter I describes the problem area, research questions, and definition of terms. Chapter II provides the general theoretical background information on the factors of human information processing and motivation which relate to AMI learning and retention. Review of previous research and pertinent opinion are included.

Chapter III discusses selected AMI capabilities and structural properties which pertain to the theoretical considerations of the second chapter. Also, a survey is reported on the progress and state of the art in the AMI field.

Chapter IV discusses the methodology for the AMI learning and retention experiment while Chapter V describes the findings of the study. Finally Chapter VI consists of summary, conclusions, and recommendations.

CHAPTER II

GENERAL THEORETICAL FACTORS THAT SUPPORT AMI

Overview

AMI, like other instructional media, is a "means or mechanism for recording, storing, distributing and presenting stimulus materials to those who would learn [Carpenter, 1962, p. 303] ." Implied in this outlook is the notion that the medium of AMI consists of both equipment and devices (hardware), as well as materials and programming (software). Presumably, by combining these elements, student learning can be encouraged.

In order to fulfill effectively its communicative role in formal instructional settings, AMI depends upon the nourishment and support of general theoretical factors. In view of available research, this investigator proposes that the most important factors for facilitating student learning and retention from AMI are human information processing and motivation. Chapter II describes each of these factors and how they relate to one another and to AMI learning and retention.

Human Information Processing (H.I.P.)

In order to promote cognitive learning and retention, the human information processing system must be penetrated by the AMI medium. According to Haber (1968), human information processing involves a multistage or multiprocess set of operations. To reflect this type of thinking, a model of H.I.P. was sought out and found in the Norman (1970) model which incorporates two subsystems — perception and memory. (See Figure 2.) From this figure, it is clear that learning and retention are very closely related with perception and memory. The perceptual component concerns mainly the processes of acquiring and discriminating sensory information. In like fashion, the figure shows that the memory system involves the multiple processes of information storage and retrieval.

Numerous other models (Broadbent, 1958; Crouzy, 1971; Haber, 1970; Shiffrin and Atkinson, 1969) indicate similar processing steps, but the names for components and exact number of stages may vary. The essential components of H.I.P. are:

- —information transformation;
- —information encoded into new formats and retained temporarily;
- —information, if rehearsed and/or properly organized, transformed into a more permanent system; and
- —information retrieved by decision rules.

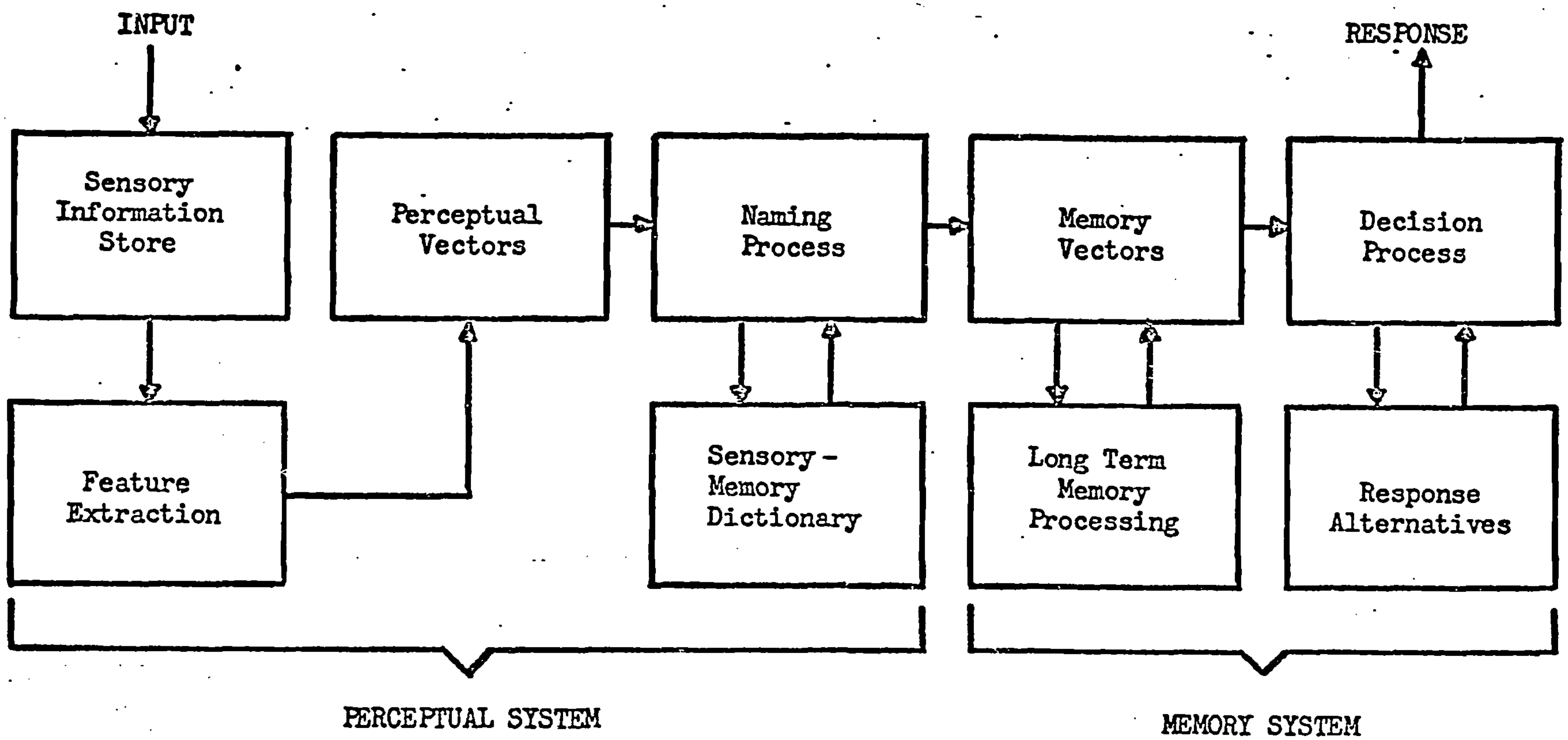
While the actual mechanics and specific components of this system are not discussed in detail, those perception and memory functions which relate to the learning and retention of AMI information will be discussed here.

Perceptual System

Basing much of his categorization on the work of Gibson, Travers (1970) outlines five basic exploratory systems which seek-out information from the environment. These include the basic orienting and haptic systems,taste, vision, and audition. Instructional media aim their stimuli (messages) at these systems, either individually or collectively.

FIGURE 2

A MODEL OF HUMAN INFORMATION PROCESSING (Norman)



As much as possible, these stimuli are produced with the goal of changing a person's capabilities or thoughts. Hence, "if modification of human behavior is to occur, there must be shared meaning between the producer of the stimulus and the respondent [Fearing, 1962, p. 80] ."

Of these five exploratory systems, discussion emphasis will center on the implications of the auditory and visual systems as they pertain to AMI perception and the processing of information. To better understand these implications, a brief overview about man and perception is offered. This is followed by a viewpoint on perception and information processing. Finally, an examination of the auditory and visual entities, both separately and jointly, is furnished.

Perception activities play a crucial role in influencing and determining human learning. As Cherry (1970) observes: "A man has remarkable powers of learning. Every communication, every perception, adds to his accumulation of experiences; he is continually becoming a different person, for his every experience is part of a continuing process [p. 16] ." With perception, organs are stimulated by energy with an emergence of some sort of resulting response, whether covert or overt. Furthermore, "perception involves not just the passive reception of stimulation, but rather an active process of seeking out, analyzing, and interpreting that stimulation [Wrench, 1971, p. 17] ." Whether this activism in searching the environment for information is innate, learned over time, or a combination of these is still not certain. Some theorists believe perceptual initiation and termination is subject to an internal reduction of uncertainty (Gibson, 1969), or cognitive dissonance (Festinger, 1957), or drive reduction (Maslow, 1943).

Additional evidence is recognized for this continuing activity in three different areas. The first concerns man's belief that there is always a rich, information potential in his environment. Of course, much of this richness is dependent upon the rate and amount of information perceived. A second reason surrounds the notion that stimuli tend to raise the level of activity in the central nervous system for purposeful action. Hence, perceivers apparently like to attend to selective stimuli. Finally, the receiver seems to vary his inputs and thereby achieve novelty through some other stimuli. Thus, he combats fatigue and habituation.

In these ways, the perceiver strives to have his perceived stimulus features become better differentiated and more precise in relation to previous distinctive patterns or relationships. Consequently, the creation of associational linkages may be facilitated.

From this sketchy background on man and perception, the discussion becomes more specific. Now topics on perception and information processing must be surveyed. Various items like information loss and figure-ground are examined.

While the idea of "shared information" - identical information received as exported - is a most worthy goal, AMI producers must be aware of some limitations, like noise. As Crouzy (1971) states: "According to the unavoidable presence of noise, there can never be a message transmission without loss of a certain quantity of information. This is one of the fundamental laws of the universe [p. 229]." Presumably, input to and through the senses or decoding can be interrupted by several factors. Among these are human mistakes, fading of a stimulus signal, exceeding capacity, and interference of other messages. Fleming (1970) cautions that any original message is changed at a number of points; it is transduced, translated and transformed. Travers (1967) even estimates that only one information part in a 1/4 of a million makes it to the higher center of the brain. Thus, it appears that information loss is a universal phenomenon. To help combat this phenomenon, one must estimate how much information loss is acceptable and then try to optimize the learning episode considering this limitation.

Allied to this phenomenon of loss is the function of an interesting perceptual mechanism. Since a learner is in receipt of much stimulus material, there are many specific information components he never remembers or even notices. Somewhere and somehow in the perceptual system, there appears to be an overall information capacity-limiter or priority system. Some refer to this as "cognitive style" which reflects "individual preferences in the mode of perceptual organization and conceptual categorization of the external environment [Kagan et al., 1963, p. 75]." In essence this overall frame of reference selects those stimuli which will be noticed and remembered. Expanding upon this notion is Sheehan (1967), who feels that encoding processes provide important sources of variation in perception and memory. Apparently learners use varying styles in coding information. Hence, differences in retention between good and poor imagers seem related to individual differences in the way information and perception are organized. Kintsch (1970) even believes that this priority mechanism or style greatly determines what an individual finds easy, hard or impossible to learn. Thus, the pertinent and attended-to stimuli reaching the individual should facilitate the formation of connections between the stimulus and responses which are evoked when the stimulus reappears.

Related to information loss and style is a final trait which concerns the ability to bring a stimulus into figure (focus) from the ground (that not in focus.) Somehow learners are able to perceive and select the desired (and hopefully intended) stimulus from the maze of surrounding stimuli. For example, individuals are more likely to see and hear congenial communications than neutral or hostile ones (Berelson and Steiner, 1964). Just how this figure-ground acuity occurs within the perceiver is not fully known. Candland (1968), for instance, reports that this capability may be an innate characteristic of the central nervous system. Gibson (1969) on the other hand feels that this activity is accomplished by uncovering distinctive features, finding invariants, and finding structure. Whatever reason prompts this activity, evidence suggests that the perceiver strives toward simplicity, constancy, and unity in processing information. As Biggs (1969) points out, the perceiver transforms a message into maximally economical units for operation and eventual storage. When these are optimized, efficient and effective coding takes place.

Thus, the perceptual system with its exploratory vehicles is vital to the functioning of H.I.P. As integral components, these vehicles abide by and share several principles - i.e., information loss, cognitive style, and figure-ground.

Up to this point, a generalized view of man and perception has been briefly examined along with a discussion of a few components of perception and information processing. Now a comparative description of the auditory and visual modes of perception is related to the acquisition of information. This outlook is then followed by an inspection of the effects of when audio and visual vehicles are combined with one another to form AMI.

While the visual and audio vehicles operate by the same principles of perception as were mentioned earlier, each has special capabilities which appear to facilitate the acquisition of information. (See Table 1 which compares selected neurophysiological and other capabilities of vision and audition.) Of course some of these features are alleged, while others are based on more substantial evidence. Despite the disputability of some of these, the listing of features hopes to sketch out the potentialities of each perceptual mechanism. A brief survey of the table encourages the impression that vision is the more powerful of the two. Candland (1968) has said: "It is probably fair to say that, for the human being, most of the information received about the external world comes by way of the eye [p. 214]."

Producers must be cautioned not to generalize this capability to all audience members. As was indicated earlier, the role of cognitive style must not be overlooked since learners may fluctuate in their ability to recall information. The reason for this fluctuation is thought to relate in part to the modality or sense through which the information was originally learned. Hence, some may learn better in terms of visual imagery; others, audio (Woodworth and Schlosberg, 1954).

The question arises, what happens if we combine these separate perceptual systems for purposes of an AMI learning episode? Will this merger be an asset or a liability in terms of learning cognitive information?

Unfortunately, no widely acceptable approach concerning this problem has been discovered. As Hsia (1968) observed: "Ever since TV became a teaching instrument, the battle of channel superiority of one channel over the other, or that of a single channel over dual and multiple channels or vice versa - has been even more fiercely fought [p. 325]." Apparently, the controversy began in 1894, when Munsterberg and Bigham first began examining the phenomenon of information transmission by using aural and visual modalities. They found that the combined AV

TABLE 1

A COMPARISON OF SELECTED NEUROPHYSIOLOGICAL AND OTHER CAPABILITIES OF VISION AND AUDITION

Vision	Audition
1. Eyes constantly move, scan, or inspect with help of head movements.	1. Ears remain stationary.
2. Eyes carry 430 times more information than the ears.	2. Ears carry less information than eyes.
3. Optic nerve has 900,000 fibers.	3. Auditory nerve has 30,000 fibers.
4. Some information processed in the retina.	4. Some information is processed in cochlea or nerve.
5. Left field priority system.	5. Omnidirectional priority system.
6. Simultaneous or sequential capability for receiving information.	6. Sequential information reception capability.
7. Unfamiliar, difficult, and non-organized material	7. Meaningful and more organized material more effective.
8. It is easy to avoid reception of visual inputs; turn head away or close eyes.	8. It is more difficult to avoid an aural message.
9. Eyes are good for seeing space or for long messages.	9. Ear is good for getting immediate attention.
10. Vision may have its own processing system or is based in verbal audition.	10. Audition may have its own information processing system that is based in verbal.
11. Short term memory favors visual.	11. Long term memory favors audition.
12. Regular eye blinks every 3 seconds and about 1/4 of a second needed to extract information from a stimulus array.	12. No interruptions like blinking.
13. Vision handles word reading speeds of about 500 wpm; trainable to 2000 wpm.	13. Audition cannot usually handle above 275-300 wpm.
14. Vision deals with non-coded materials from natural world.	14. Audio is filled with abstract or symbolic material (speech).
15. Eye can transmit 18 x 240,000 bits/sec.	15. Ear can transmit up to 10,000 bits/sec.
16. Eye has 4.3 million bits per second capacity.	16. Ear has tens of thousands bits/second capacity.
17. Vision does not appear to have rehearsal capability.	17. Audition has rehearsal capability.

presentation was most effective.

Gradually, three theoretical positions have evolved. One favors a single communication channel format. Another argues for a dual or multi-channel information processing format. The third is a compromise between the two. On the single channel side are such theorists as Broadbent (1958) and Travers (1970) who generally believe that one message at a time is optimally processed by the organism. When the same information is transmitted simultaneously through both aural and visual modes at normal rates, the tendency is for this type of processing not to be effective. This ineffectiveness is based on two propositions. The first deals with the widely known Hernadez-Peon Effect which is thought to block signals in other channels when one is occupied for higher nervous system functions. The second deals with the P-system model developed by Broadbent. This system suggests a limited capacity that handles only a certain amount of information at a time. However, at varying rates of information presentation (either very slow or very fast), these researchers have found that simultaneity of redundant information can be handled. Simultaneity occurs apparently because of a holding mechanism which can accommodate the larger amounts of information. If the information amount exceeds the capacity of the holding mechanism, the P-system can no longer handle both sources. But as Travers(1970) says: "Only in rare instances is the rate of relevant information presentation so rapid that the learner might be forced to function as a single channel system [p. 104]."

On the other hand, researchers like Hsia (1968) and Hartman (1961a) lean toward the multiple channel processing of information. Their experiments have suggested that identical information can be presented to the audio and visual systems. Hsia believes that the "dimensionality of information generally increases and one channel provides cues and clues for the other, provided that information to be processed has not reached the capacity limit. Second, information processed through bisensory modes usually possess a certain amount of redundancy [p. 327]." Hence, more efficient learning is achieved in a so-called cue summation manner whereby both senses are presented with the same information that does not exceed the capacity of either. Meanwhile, Hartman found that simultaneous information was more effective than a single modality. However, he warned that the majority of information is probably learned from the audio channel.

In between these somewhat extreme views is a position that sees processing as more single channel than multiple. Testing this position are a group of studies which have examined the perception of two different, but related messages. Here one message was audio and the other was visual. Interestingly enough, a great number of subjects were able to retain the content of both messages (Hill and Hecker, 1966; Mowbray, 1954).

This compromise position may provide a justifiably theoretical rationale for AMI instructional presentations. The experiments involving two different, but related messages seem to give rise to those "rare instances" where fast or normal information rates can be processed. Consequently, it seems that most sight-sound instructional programs would fall within acceptable presentational rates. Admittedly, neither the blistering T-scope speed of experimental settings nor the material of nonsense syllables are used consistently in classroom instruction.

Further assurance for mixing the optical with the acoustical in AMI comes from Travers (1964) who said: "Sometimes auditory information is used to hook up visual information with previous knowledge. Very commonly the auditory information represents a name for a visual display. Another frequently found relationship is where auditory cue indicates that part of the visual display which the viewer should single out for inspection [p. 377]." Another factor which reinforces the preceding description is information compression by the perceiver. Apparently this compression is done in order to facilitate a simpler, more efficient, economical and more complete processing of information.

It appears that compression can be enhanced by capitalizing on redundancy, cue summation and channel switching. With redundancy, the perceiver obtains the same or similar knowledge about an instructional topic through different systems, for instance auditory and visual. Since perceivers enjoy exploring their rich perceptual environments, stimuli are fairly equivalent, though of course, not identical in redundant circumstances.

While redundancy is desirable, one should not rely on merely increasing available cues and thereby assume that greater learning will take place. As Hartman (1961b) found:

> A common practice among multiple channel communicators has been to fill the channels, especially the pictorial, with as much information as possible. The obvious expectation is for additional communication to result from the additional information. However, the probability of interference resulting from the additional cues is very high. The hoped-for enhanced communication resulting from a summation of cues occurs only under special conditions. Most of the added cues in the mass media possess a large number of extraneous cognitive associations [p. 255].

Further facilitating the processing of information is the perceptual mechanism of channel switching. Although according to Travers and Reid (1968) rapid alternating visual and audio modes can account for lost time in learning, channel switching can also be recognized as a valuable asset. As Travers (1970) points out, switching allows for novelty and fights the monotony of informational familiarity. Also, "the point must be made that the rapid channel switching back and forth represents a highly novel situation not ordinarily encountered in daily life. There is a possibility that an increase in speed of switching might occur if a person were given practice at engaging in this kind of activity [p. 108] ."

Hence, it appears that perceivers would enjoy and thrive on the multiple inputs offered by AMI. Dornbush and Basow (1970) recognized this aspect when they observed that "when the child moves from the stage of concrete operations which occurs at about 11 to 12 years of age, he becomes able to handle multiple stimuli and to attend to various aspects of the environment [p. 1043] ."

In concluding this section on the Perceptual System of the H.I.P. network, several generalizations seem to emerge:

--some AMI information will undoubtedly be lost as it is transmitted to a receiver;

--cognitive style appears to greatly coordinate much of the perceptual activities;

--perceivers seek to consume information as economically as possible;

--perceivers appear very selective;

--while both eyes and ears are potent vehicles, the eye appears to be more flexible and accommodating to a variety of inputs;

--perceivers like novelty;

--perceivers seem to enjoy extracting information from environments;

--within limits of capacity and presentational rates (which are not clearly defined as yet), perceivers appear to be able to handle simultaneous audio-visual inputs;

--redundancy, cue summation, and channel switching seem to encourage AMI perception.

Memory System

Closely intertwined with the perceptual system is that of memory and its related functions. This relationship between acquisition and retention is explained by Greeno (1970): "Learning to recall is sometimes viewed as the formation of connections between responses and some general stimuli. And recognition is sometimes said to depend at least partly on a learned connection between a stimulus and some recognizing response which is evoked when the stimulus reappears [p. 258]." Ultimately, the utilization of information recall can serve as the indicator of an efficient and dependable instructional program.

This section on human information processing examines memory, its mechanisms and its operations. In addition, a discussion on forgetting is presented.

Memory, which appears to function in the brain stores of multiple locales, is an individual's record of an event.(Underwood, 1969). To facilitate this recording, structural changes and activity occur among the neuron mechanisms. Thus, memory allows media audiences to retain numerous bits of information:

> a vast symbolic structure, including among other things a full repetoire of phonemic, syntactic, and semantic codes, complex textural reading habits, nonverbal symbols of objects, events, attributes and their interrelations which constitute the referrents of words, in short an intellective record of all events, pairings and contingencies experienced [Caron, 1966, p. 199]."

Naturally, this milieu is greatly influenced by numerous factors such as perception, motivation, and intelligence. Furthermore, as the memory task increases in length, the learner usually must expend more time and effort in learning (Garrett, 1957).

Like perception, there are many perspectives about the structure and functions of memory. Most theorists agree that there are two, three, or four types of storage systems. The types range from short-term memory, holding mechanism, long-term memory to sensory information store.

Generally, the transformed information (in some sort of physical form) is passed from a perceptual system where messages may be held to a short-term store. Researchers have frequently studied how a learner stores material as well as the errors he makes. Norman and Rumelhart (1970) suggest that material in the short term area decays rapidly so that it almost disappears if eight to ten new items enter the memory after it or 10 to 20 seconds elapse. Similarly, Shiffrin and Atkinson (1969) report: "Information in the short term store, if not attended to by the subject, will decay and be lost in a period of about 30 seconds or less, but control processes such as rehearsal can maintain information in short-term memory for as long as the subject desires [p. 180]."

From the shorter termed component or perhaps holding mechanism, some theorists advocate the existence of a rehearsal loop to facilitate information or signal rehearsal. Apparently rehearsal and even extra rehearsal tend to retard the fading of a signal thereby saving the signal for further transmission into an even more permanent storage facility. This is usually accomplished by some very personalized sub-vocal rehearsal resembling talking to oneself, a sort of verbal meditation (DeCecco, 1968). This rehearsal may take place either during a presentation of material or during the time between presentation and recall. Some think that rehearsal is linked to a form of auditory information storage (Flavell et al., 1969).

Transfer of information into a more permanent storage system appears to fluctuate in terms of time. Travers (1970) suggests that transfer is a slow process taking up to 20 minutes, while Morris (1969) believes that transfer can occur very rapidly. Regardless of time, the long term storage of information occurs at the synapses, the positions where the extensions of the one nerve cell come into proximity with the extensions from other nerve cells.

Some theorists even believe that the long-term memory system is primarily aural-verbal oriented with printed verbal material coded in this auditory-like memory system. As for visual information, it too is thought to be recorded into the audio (Dornbush and Basow, 1970; Travers, 1970).

Disagreeing with this proposition is Haber (1970) who calls for two separate memory systems. These include a linguistic store for linguistic material (numbers, words, symbols) and a non-linguistic store for non-linguistic material (pictures). Evidence to substantiate this belief is based on an experiment in which subjects were shown 2,560 photographic slides at 1/10 second. From this number, a sample of 280 slides was selected and paired with distractor slides. The results showed that subjects were able to recognize 85% to 95% of the original slides. Haber elaborates that "although a person may remember almost any picture he has seen, he frequently is unable to recall details from a specific image when asked to do so [p. 104]." This phenomenon seems to occur due to the individual's need to compress and thereby simplify his initial information input. Regardless of its non-linguistic or linguistic base, "long-term storage is, in fact, learning: the process by which information that may be needed again is stored for recall on demand [Peterson, 1966, p. 90]."

Facilitating the calling-forth or recovery of stored information is the component of retrieval. Somehow within the vast storehouse of information, a piece of information is quickly located and selected. However, the manner in which the information is reproduced is quite uncertain. As Sheehan and Neisser (1969) point out about visual reproductions, it is possible that the subject uses the image directly and reads from it; the subject uses the image and audio; images come from some place else.

Presumably, information flows through the type of memory system depicted earlier (Refer to Figure 2) or some facsimile of it. Unfortunately, the realities of information loss must not be disregarded. As Crouzy (1971) relates:

> In practice, this output message is never a faithful image of the input message for two reasons: on the one hand, in the course of traveling through the channel, the two following events may happen simultaneously -- 1) the fading of certain signals whose energy is dissipated and 2) the spontaneous appearance of new signals which mix with those originated from the message [p. 229].

Implied in Crouzy's statement are the elements of forgetting. There are several explanations for this process. Time, for example, is a variable in information decay and, therefore, is thought to be sufficient for explaining forgetting. Another account stresses that memory traces are eroded by interference. Interference results from two related processes: the first, called retroactive inhibition, reflects that the learning of new material makes the recall of older material more difficult; the second, known as proactive inhibition, suggests that exposure to one item becomes a barrier to learning succeeding material. Garrett (1957) emphasizes that "interference and association confusion seem to be better explanations of memory loss than decay resulting from passage of time [p. 105]." Being even more specific, DeCecco (1968) believes that proactive inhibition is the real cause of forgetting. In addition to time and interference explanations, another type of forgetting occurs when the retrieval system does not function. This explanation closely resembles Bruner's (1962) belief that the main problem of human memory is not storage, but retrieval. Two factors which appear to assist in overcoming forgetting include the practices of distributed learning, instead of massed learning, and meaningful learning, instead of meaningless activity.

In closing this H.I.P. section on memory systems, several generalizations seem to emerge:

--perception and memory functions are closely related;

--storing of AMI information appears to proceed through steps or stages. These begin with a shorter stage and lead to a more permanent one;

--rehearsal seems to prolong the potency of a message;

--while there may be separate memory systems for audition and vision, it appears that AMI information reaching long-term memory is coded in a linguistic format;

--meaningfulness, distributed learning, age, ability, motivation, and other factors seem to influence retentivity; and

--interference and association confusion probably explain more memory loss than simply the passage of time.

Motivation

The second general theoretical factor which supports and nourishes AMI is motivation. This factor includes the summed effects of attention, arousal, vigilance, drive reduction, motives, and drives. By blending these together, motivation is referred to as the energization, direction, and equilibration of an individual's behavior toward some instructional goal.

Motivation as an energizer is greatly influenced by intrinsic and extrinsic factors. Intrinsically, anxiety, the desire to achieve, self perceptions, needs, aspirations, and expectations are among the crucial activators. In general, these motives may be biological, psycho-social, and/or learned. Most frequently, these motives cannot be reached by instruction in a predictable manner. Extrinsic factors of energization are environment, socio-cultural norms, and social reinforcers. In the instructional setting, these factors include such things as a stimulus situation, an AMI presentation, and content of the presentation. These extrinsic factors are more easily manipulated and arranged so as to prepare and direct the learner toward the outcome specified in the instructional objective. In essence both inner and outer influences dynamically interact to heighten the attentiveness of the learner for the imminent directed action.

While energization is important for learning and retention, how much is necessary and optimal? Unfortunately, no specific guidelines are offered. For example, Bruner (1960) believes: "Somewhere between apathy and wild excitement, there is an optimum level of aroused attention that is ideal for classroom activity [p. 72]." Likewise, Eyesenck (1963) states: "In general, highest performance is achieved by subjects with an intermediate amount of motivation or drive. As tasks increase in difficulty, peak performance is achieved by subjects with less and less drive [p. 131]." One researcher even believes that by causing too much energization, the learner tends to sample fewer cues from within the stimulus array (Esterbrook, 1959).

Similarly, Maltzman, Kantor, and Langdon (1966) found that (by using auditory stimuli) higher motivation relative to lower was related to a decrease in retention over time. Finding somewhat different results, Kleinsmith and Kaplan (1963) used visual stimuli and discovered that higher arousal (relative to lower) was related to an increase in long term retention. They also found that low motivation was better for short term memory. The work of Levonian (Kleinsmith and Kaplan, 1963) replicated these results. Levonian used a driver education film with 83 subjects and found that material presented during high arousal showed poor short term retention but enhanced long term retentivity; low arousal, however, showed just the converse. Generally, evidence suggests that some degree of energizing is important for activating the learner. Apparently too much energizing fails in this purpose.

Most frequently, energizing creates tension within an individual previously in a temporary state of intrinsic and/or extrinsic equilibrium. For example, after making an important decision or after being exposed to discrepant information, an individual senses that a form of dissonance, "cognitive dissonance", occurs within himself. Because of this disturbance, forces within the organism seek to eliminate the exciting state. As Allport (1955) suggests, the more severe the disturbance, the greater is the urgency to decrease tension.

Since the audience experiences tension, the tendency is for this to trigger a corresponding sense of doubt. As Cherry (1970) suggests: "Information can be received only where there is doubt, and doubt implies the existence of alternatives [p. 170]." Apparently, the alternatives arise in terms of those potential solutions to which the individual can resort in order to alleviate the dissonance. Attitude change, acquiring consonant information to counteract the dissonant or discrepant, and avoidance are among some of the alternatives before an individual. Usually, individuals continually engage in making selections from alternatives and thereby direct their behavior. Therefore, it should be kept in mind that AMI program messages are presented in a way which can potentially assist the audience in making selections to help eliminate some internal tension.

Gradually over a period of time, the individual develops a repertoire of dependable ways of reducing tensions and thereby returning to an equilibrium state. Hopefully, the old habits allow new information to penetrate to the cognitive realms.

Thus, in order to motivate, i.e., energize, direct, and equilibrate, with AMI, there are several things which may be helpful to remember:

--AMI designers probably have more influence over extrinsic factors of energization than intrinsic ones. However, by understanding an audience, one should get an understanding of some inner qualities to maximize one's plan, design, and production efforts;

--while the amount of motivation may vary for individuals, research suggests that a position between high and low arousal is most effective for influencing overall retention of information;

--acquiring and working on information can direct the organism back into equilibrium and thereby reduce dissonance; and

--internal dissonance and doubt appear to be closely linked with the operations of perception. Apparently when doubt increases, the perceptual system seeks out a positive alternative to relieve dissonance and doubt.

Conclusion

This chapter sought to provide background information of some general theoretical concerns that support instructional AMI. Since the medium is used for instructional purposes in this study, one must take into account the factors of human information processing and motivation as they relate to learning and retention.

AMI seems to provide a vital basis for an external environment that can interact with a learner's inner, intervening variables. Usually the interplay between the external (AMI program) and internal factors (needs, self perceptions) brings about a change in the students' knowledge or disposition. Frequently, this change is ascribed to learning with retention as an index of measuring how well information is acquired.

In a comprehensive examination, human information processing was investigated from two points of view. The first view concerned perception. Since AMI is an instructional medium, its existence and potential depend greatly upon perception. It appears that AMI can complement the perceptual needs of viewers who enjoy novelty and extract information from environments. Also, AMI appears to provide audiences with multiple, audio and visual inputs which they can adequately process. Closely related to the acquiring functions of perception was that of memory which stores the AMI messages in various retentive storehouses for later retrieval. Research has yet to clarify the controversy of whether the pictorial material is stored in its own memory system or in one with a linguistic base.

Motivation was the final theoretical factor discussed. It seems that motivation is required for learning activity to take place. In view of this need, AMI could assist in energizing student groups to want to learn. Furthermore, the medium could direct viewer attention to the important program material that was to be learned. A position between high and low arousal appears to be most beneficial.

CHAPTER III

AMI CAPABILITIES, PROPERTIES, AND STATE OF THE ART

Overview

While the preceding chapter described some of the general theoretical factors that support AMI, this chapter investigates the properties that form the medium, as well as its capabilities. By undertaking this more specific examination, this researcher hopes to reinforce and expand upon how the theoretical factors uphold and give substance to AMI.

Following a discussion on capabilities and structural properties, a survey is furnished on the progress and state of the AMI art. This survey was done by describing the settings within which the medium has operated.

Capabilities

Four broad capabilities characterize AMI. The first involves flexibility. While incorporating at least three screens, the medium can operate with a variety of projectors and visually projected materials, i.e., 2 x 2 slides or motion picture film. The audio component also represents flexibility. It may be done "live" or it may be pre-recorded in either reel, cassette, record, monaural, stereophonic, or quad-sound formats.

Depending upon the overall format selected, a variety of locations may be used to present the AMI program. A typical school classroom, auditorium, multimedia laboratory, and gymnasium are some possible places. In addition, a variety of projection screens may be utilized. These may range from wrap-around commercial screens to simple, white-painted classroom walls. Finally, in the area of regulating the AV equipment to present an AMI program, either manual procedures or automatic control systems may be used.

In addition to its flexibility, AMI is capable of functioning on many different levels. By combining the elements of sight and sound, AMI can nurture any of the three general functions of media -- provide information, mobilize, and/or socialize (Janowitz and Street, 1967). More specifically, AMI can:

--create a very special viewing environment;

--show large panoramic, pictorial views across many screens;

--display comparisons by comparing objects or subjects, exhibiting right and wrong approaches to solving a problem, showing an old view and a new one, and displaying a specific action with a concommitant reaction;

--motivate by providing novelty, exalting the sensorium and offering optical and acoustical variety;

--be interactive with perceivers by presenting a question on one screen and provide the proper answer on an adjacent screen;

--deliver content material.

Another capability of AMI concerns perceiver involvement and participation. The medium can capably entice the normal perceiver and satisfy the high information demanded by him. AMI seems potently to extend eye and ear search, as well as to enhance an individual's information extracting behavior.

Beyond the participation generated by AMI with the syncopation of imagery with sound, additional forms of audience involvement can be recognized. For example, the audience can be asked to observe a particular screen: "Look at the left screen. What do you see?" Following a brief two to three second pause, an answer can be provided verbally along with a visual reinforcement on the center screen. Audience responses may be covert or overt.

Especially for instructional settings, AMI participation seems crucial. As Myers and Reynolds (1967) have suggested: "A fundamental and thoroughly verified principle of learning is that active participation in the learning process increases the speed and amount of learning [p. 60]." Amplifying this involvement notion are the findings of Hoban and Van Ormer (1950) who found that subjects respond most efficiently to a film when the learners become more involved in the media presentation.

A fourth and final AMI capability involves message control. While the medium may appear disjointed, uncontrollable, and confusing, producers can exert control over it. Depending upon the program objectives and function, AMI may permit either a wide range of audience selectivity or promote a narrow range of selectivity to those messages transmitted. For example, if subject matter information is to be transmitted to an audience, one will more closely control or direct the perceivers through the AMI program so that the essence of the message is received.

Thus, AMI is characterized by four broad capabilities: flexibility, manifold functions, perceiver involvement, and message controllability.

Structural Properties

While the preceding discussion described the medium's capabilities, attention must be focused now on some of its structural properties. The properties that will be considered include: visual information, audio information, simultaneity, screen size, and program length. By working with these properties along with the previously mentioned capabilities, AMI producers must somehow meld these items together in order to derive an effective instructional program. Unfortunately, there are very few practical rules that are based on research to guide this type of message construction. As a consequence, designers often find themselves torn between aesthetic or artistic concerns and inadequate empirical concerns of scientific communication. Therefore, to create an instructional program, AMI capabilities are interwoven somewhat arbitrarily with the five structural properties.

Visual Information

By compressing raw data, thoughts, feelings, and other information, projective pictorial displays give a viewer quick and efficient access to the ideas being transmitted. Serving as a prime property of AMI, projected imagery appears in four styles: realistic, line/scheme, cartoon, and abstract (Trohanis and DuMonceau, 1971).

Unfortunately, very few guidelines are available to aid an educator in selecting the most appropriate style to complement the desired learning objectives and content. For example, in the realm of realistic pictures, opinions vary. Some researchers believe: "Realistically bold illustrations are more effective than abstract or line illustrations and that lack of simplicity and clarity stand as chief barriers against complete understanding [Fonesca and Kearl, 1960, p. 2]." On the other hand, Dwyer (1970) observes: "The additional stimuli contained in the realistic drawings and photographs may interfere with the information to be transmitted, thereby reducing the effectiveness of the realistic photographs as efficient learning media." Thus, one must try a variety of pictorial styles and select the best which seems to bring about such effects as figure-ground relationships and meaningfulness. Another structural property that subsidizes pictorial style encompasses specific traits such as visual shapes, line directionality, color vs. black and white, arrangement or layout, symbols, brightness, pictorial dynamicism and fidelity.

Pictorial multiplicity is another closely related property. Since three separate screens are connected together to form one continuous span, AMI has in fact three visual panels or frames. Here it is possible to display one picture on one panel, two pictures on two panels, three images on three panels, or a panoramic scene appearing on all screens. Perceivers appear quite able to handle a multiplicity of images. Evidence for this multiplicity task comes from Neisser, Novick, and Lazar (1963) who found that searching for a particular target from multiple ones can be easily done. Neisser (1964) later discovered that subjects, after practice, could search for 10 different targets as rapidly as they could for a single target. Gibson and Yonas (1966) observed that young children could search for two target items at the same time just as easily as for one. Finally, Gould and Schaffer (1967) found that subjects could easily monitor 16 alphameric displays.

A final structural property is visual information density. (For background information in this area, the reader may refer to Table 1 located in Chapter II.) Since there are three pictorial panels, the amount of information (e.g., the use of realistic images which contain greater amounts of information than line/scheme; the number of visuals incorporated) and its rate of presentation are critical concerns. While no numerical specificity has been ascertained, it appears that the eyes can adequately handle three screen information.

Hence, the AMI property of visual information is made up of several concerns. These include items such as pictorial style and multiplicity, layout, and color.

Audio Information

Like its visual counterpart, the audio for multi-imagery has certain crucial traits--pitch, harmony, rhythm, melody, volume, instrumentation, and vocalization. Usually these traits are organized so that sound can point, underline, link, explain, reinforce, control, emphasize, provide rhythmic continuity, support visual imagery, interpret, suggest further associations, and become part of the total program structure.

Often, theorists divide audio into different categories or styles like verbal, musical, and sound effects (Whitaker, 1970). Naturally, all or each separately can constitute an AMI episode.

Verbal audio, such as dialogue, soliloquy, narration or commentary, may provide program structure. While this generally involves talking and words, intelligibility or articulation, voice quality and fidelity seem to combat auditory fatigue and noise. Verbal audio can provide redundant descriptions with complementary pictorial material,as well as enhance subvocal restating or rehearsal, which can assist in information learning and retention as previously discussed.

Additional audio structuralism is expressed by music. While music can help to distract audience attention from the noise of the audio-visual equipment, music is involved in more important tasks. For example, music corresponds easily with visual vitality and content. That is, a variety of music, jazz, blues, soul, rock, folk, folk-rock, classical, symphonic, and ethnic, can establish atmosphere or context and build a sense of continuity. It can add emotional color and strengthen dialogue or narration. Copeland (1957) suggests its use as "neutral background filler" to fill in pauses or empty spots in narration as well as to express a state of meaning, serenity, exuberance, regret, delight.

Consequently, music that is unobtrusive, relevant, and pertinent to the visual scenes should be selected. Manvell and Huntley (1957) believe that music is a very powerful stimulant which, when used, "adds tremendously to the impact a film has on those who see it [p. 8]."

A final audio component is sound effects. The wide range of sounds available for use greatly help to interlock the sound components with the visual. Sound effects may create a quality of leitmotif, underscore a scene build-up, or express an association.

For the property of audio information density, the reader is once more requested to refer to Table 1 in Chapter II which compares the capabilities of audition and vision. Unlike the visual area, the auditory suggests a density range above which spoken words can no longer be deciphered by the perceiver. It is improbable that AMI producers will reach these high density ratios of 275 to 300 wpm.

Thus, the property of audio information is vital to AMI. Such items as audio categories, structuralism, and density were examined. Once more, there is little empirical data to guide AMI producers in the optimum utilization of this property.

Simultaneity

Another AMI building block is simultaneity which operates on two levels. The first deals with the merging of audio and visual components to create an AMI program. The second concerns visual simultaneity which is closely linked with visual multiplicity.

On the first level, simultaneity is expressed when the visual and audio information components are integrated for simultaneous playback. This integration seems most appropriate and consonant with the earlier discussion which sought to provide evidence that audio-visual simultaneity was feasible for instruction. Friedman (1971) supports and elaborates upon this view by stating that "sounds suggest sights and sights suggest sounds. Both depend on and stimulate each other. Alone each is one dimensional. Together, they create an image far more powerful than the sum total of their parts [p. 47]." Finn, Hoban and Dale (1949) urge the utilization of composite sensory experiences for instruction. They warn "against any breaking down of dynamic mental life into discrete, unrelated elements [p. 253]."

On the second level, simultaneity embodies the projecting and changing of images. One, two or all three images may be changed at desired points and intervals. In addition, simultaneity includes the use of blank or black screens. These are created by using opaque 2 x 2 slides which contain no pictorial information. For example, it is possible to have an image appearing alone on the center screen with both left and right screens black. Thus images can be syncopated, even to the extent of emulating a montage effect.

As for the audience's ability to absorb so many simultaneous changes, Fleischer (1969) states: "I can only say that the mind and eye have proved to be capable of tremendous speed and versatility in accepting multiple impressions--to a far greater extent than most people would believe possible. The eyes see everything and the mind takes it all in [p. 203]."

Low (1968) affirms that simultaneity is important for association building and memory. Low states: "Our awareness of several sensory simultaneous stimuli is probably one of the reasons why memory seems locked in the mind in such a peculiar manner. Perhaps no single impression triggers certain memory combinations but a group of impressions received simultaneously often may trigger long forgotten memories [p. 185]." Likewise Kappler (1967) argues: "Two or three pictures seen together, and often with continually changing juxtaposition, conjure a complexity of ideas and relations in which the whole...is more than the sum of its parts [p. 28]." Thus, because these individualistic tendencies of associational conflict and missing the point may be unleashed by AMI, Perrin (1969) calls for careful control over the factors of relevance, specificity, and simplicity.

Consequently, by being able to blacken specific visual areas, project and change simultaneous imagery, and blend sight with sound, the designer should begin to be more appreciative of the versatility of AMI. The following list is a sample of expected outcomes from the operation of simultaneity:

--invites viewer participation;

--encourages extensive eye movements, searches, and head movements;

--nurtures the perception of comparisons, relationships, questions and answers, old and new;

--appears to facilitate efficient and economical processing of optical and acoustical information;

--allows for redundancy and repetition;

--capitalizes on the role of peripheral vision;

--provides motivation;

--establishes a sequencing framework and control for the program design.

Screen Size

Since audiences must derive and extract their pictorial image information from a screen surface, it seems appropriate to include screen size as an AMI property. This is because of two factors -- "visual impact" and "visual task" (Schlanger, 1968). Generally, as screen size increases, relative to audience size, the "visual impact" or motivation of a presentation tends to increase. Related to impact is "visual task" or the work a viewer must do to extract vital pictorial information from the screens.

These two factors are further related to the fields of vision. Generally, perceivers have a central zone where both eyes view a 60° horizontal field, as well as a binocular zone with a field of 120° (Logan, 1948). Conventional projection screens utilize a maximum of 42° when sitting at the closest acceptable distance to the screen. With such a wide range of view available, it seems clear that the use of two or more screens permit the perceiver to fully use his central zone of vision and even to capitalize on his wider zone of vision. Control of the larger field of vision facilitates the perceiver's ability to attend to the information being presented and work more actively in extracting meaning. Hence, the size of the screen appears to be related to viewer motivation and involvement in extracting information.

Program Length

The length of an instructional program is the final structural property of AMI which will be examined. This feature usually emerges because of the interplay from such areas as audience, content, and learning objectives. Time length is increasingly important for cost/ effective considerations since much effort and resources are utilized to prepare AMI learning episodes. Consequently, instructional designers must somehow optimize student learning and retention for every minute of instructional programming (Allen, 1970).

Several studies in advertising and educational media have examined the relationship between program length and retentivity. These indicate that efficiency and proven results are becoming very important concerns in a variety of communication disciplines.

In the field of advertising, prior to 1970, many firms began compressing their ads from 57 seconds to 37, from 30 to 20 seconds or even 15. Yankelovich (1967) reports: "There is no real difference in the communication values of 60-second and 30-second commercials [p. 27]." Recall tests showed that the shorter commercial was almost equal in effectiveness. Utilizing this information, some advertisers are saving between 20 - 25% cost by using 30 second time slots instead of the 60 second slots. Starch readership averages found a similar result. They found that a 1/2 page newspaper ad has 78% of the readership value of a full page advertisement. Furthermore, retentivity is comparable (Costa, 1971).

Using the Teleprompter Telemation System, a media program that combines such items as a lectern, 16mm film and 2 x 2 slides, the military found that instruction time could be reduced 19.5% to 41% for a similar level of achievement (U.S. Army, 1959). In another Telemation effort at the University of Wisconsin, Hubbard (1961) reports that a "tape lecture of 50 minutes could be boiled down to 20 Telemation minutes with no loss of learning by students [p. 438]." A final example of time savings comes from Brydon (1971). He found between 17% to 44% savings in time was achieved by AMI when compared with a single screen version of the same program.

Some researchers have investigated lecture length and its relationship to the promotion of subject matter learning and retentivity. McLeish (1968) divided a lecture on child development into 25, 40, and 55 minute parts. One group of students heard the 25 minute lecture; another the 40 and a third group listened to 55 minutes of the lecture. While discovering that about 42% of the lecture material was recalled on an objective test after the lecture, McLeish did not find any relationship between length and retention. Using a similar research design, Trenaman (McLeish, 1968) divided a 45 minute lecture on astronomy into three 15 minute portions. He uncovered that the "spoken word" failed to communicate anything after the first 15 minutes. Consequently, Trenaman found a strong relationship between the time length of a lecture and retentivity. A final example on lectures comes from Barabasz (1968) who compared a 21 minute lecture on human behavior and development with a shorter 14 minute one. True-false test results showed that there was no difference in retention between the two groups.

As for the optimal lengths of AMI programs, a variety of opinions exist. Kilmartin (1969) hints at three minutes while Lawson (1971) suggests between 20 - 25 minutes. Trohanis (1971d) found the following information from an informal questionnaire distributed among 22 AMI producers: 12 respondents felt that an AMI program of 15 minutes in length was optimal with all other factors being equal; 6 respondents felt that 30 minutes was optimal; 3 believed that 45 minutes was optimum; 1 person did not respond.

Thus, five structural properties of AMI have been discussed: visual information, audio information, simultaneity, screen size, program length. It is these properties that must interact with the medium's capabilities of flexibility, manifold functions, perceiver involvement and message controllability. Due to little empirical data in all of these areas, AMI programming largely depends upon the personal judgment and intuition of its producers.

Progress and State of the Art

Since Allen and Cooney (1964), Perrin (1969), Lombard (1969), and Brydon (1971) have very effectively surveyed the history of AMI, this author will not replicate these efforts. Instead, four current settings for AMI will be used to depict the progress and the state of the art. These settings are: entertainment, information, persuasion, and formal instruction.

Entertainment

Simultaneously projected multiple-images with sound communication has rapidly grown from its inception in 1927. The Frenchman Claude Autant-Lara is thought to have been the first to use multiple screens when he depicted a gold hunting expedition to the far North. Gradually, the medium in numerous formats has found its way into entertainment programs of world fairs, federal government agencies, film companies, businesses, and universities. Unfortunately, no formal research on AMI effectiveness in this setting has been done. Hence, one can only infer entertainment value from the large audience drawing power which typically occurs with the medium.

Perrin (1969) traces in detail the developmental phases of numerous multi-image techniques. These include anamorphic imagery, Cinerama, Cinemascope, 3-D films, 360 Cinema, Polyvision, and Kino-Automat. Some of these techniques have recently been incorporated into entertaining films such as The Thomas Crown Affair and The Boston Strangler.

Knight (1969) describes some multiple image uses: "In Charley a divided screen permitted the audience to watch both Cliff Robertson and Claire Bloom as she administered a psychological test. And in The Thomas Crown Affair, director Jenison flamboyantly conveyed the swirl and impact of a polo match by splitting the screen into as many as 54 separate images [p. 71]."

Apparently the field of entertainment, especially world fairs, has most favorably received multi-imagery. Favorable financing, competition, and a willingness to experiment have enhanced its acceptance.

Information

Like the previous setting, AMI use for disseminating information has had no formal research done. Even so, growing use is indicated in this area. For example, the Rouse Corporation utilizes a three screen program to inform visitors about the layout and structure of the new city, Columbia, Maryland. Perrin and Trohanis proved that reports can be effectively transmitted by AMI with The Six Million, an interim report on a USOE Planning Grant for the proposed National Center of Media and Materials for the Handicapped. In a like manner, Demer and Fentnor (1970) advocated AMI utilization in presenting "technical paper" information.

Likewise, numerous advertisers, marketing agencies, and business communicators are heavily involved with the medium in communicating information to specific clientele. One producer, Melandrea, describes the AMI phenomena as not allowing the audience to take a mental vacation between the message points. In addition, "the mixture of media and the multiplicity of screens keep the mind constantly occupied and on the alert [Melandrea, 1971]."

Persuasion

This setting allows, so believe many producers, the AMI medium to display its greatest value and potential. Unfortunately, there is little research to support this belief. Two studies report negative results, one reports mixed results and one study describes positive results.

Trohanis and West (1971), in an exploratory study on attitudes toward Brotherhood compared a post-test only to a control group in order to evaluate the potency of an AMI program. Results indicated that AMI had no impact of shifting attitudes toward a positive outlook on Brotherhood. Lack of firm positive results also emerged from Bollman's (1971) non-cognitive AMI examination. He compared a 10 minute, single screen presentation with a comparable AMI one.

Reid in 1969 prepared two forms of a religious film <u>That All May Be One</u>. One was in the AMI format while the other used the conventional single screen. Reid hypothesized that the AMI presentation would produce more attitude change than the conventional format. The dependent variable included signed commitments of time and money donations to a church. His findings showed that AMI was more effective with two of three audiences.

Firm positive results finally emerged from Brydon's (1971) experiment on affective shift in which he compared a single screen version with an AMI format on the topic of drug abuse. Using a test, Brydon found that the mean difference between the two groups significant at the .01 level of probability. He also substantiated that the subjects changed their attitudes in the direction desired by the producer.

Formal Instruction

Numerous attempts have been undertaken in the classroom setting. Almost all deal exclusively with the cognitive domain and the transmission of subject matter information. Furthermore, AMI here seems to follow the similar utilization path of other instructional media. That is, AMI programming is used as an integral part of instruction, as a highlight, or as supplemental information (Godfrey, 1967).

Regardless of how it is used in instruction, AMI use appears to be increasing. Support for this trend can be found in some research that has reported generally favorable results.

Multi-imagery and large screens have been used extensively in formal situations called simulation. Here, instructors strive to create an artificial environment which closely approximates the real one. The most common example is the planetarium. Others are used for military training. Carey (1964) describes AMI simulation for flying low over land masses at supersonic speeds and guiding space vehicles.

Since 1961 at the University of Wisconsin, a variety of courses such as history, math, health, educational psychology, and art were presented using the Telemation system. The U.S. Army Ordnance Guided Missile School of Alabama incorporated a similar system. Several interesting results were revealed at the 1959 D.A.V.I. Convention at Seattle. Newhall (1959) suggested that the Telemation method turned out a better trained person in a shorter amount of time. Also, learning improved, i.e., the Telemation group scored 3.3 points higher on knowledge tests than the control group. On retention tests, the Telemation students averaged 3.8 points higher than the control group.

In the area of art, Nelson (1954) pioneered some work in mixing simultaneously projected multiple images (2 x 2 slides and motion film) with audio. He claimed good information retention and comprehension. In some cases, artworks on slides were compared side-by-side.

Using AMI at the U.S. Military Academy, Lawson (1971) feels that he has pinpointed the medium's unique application for formal instruction. Lawson says: "More instructors...are considering its use as either a spectacular means of introducing courses or blocks of instruction, or as an attractive method of overhauling large group sessions that have failed to adequately stimulate the cadets' interest in the past [p. 56]." Presently, over 13 AMI presentations, covering a variety of disciplines, help in formal settings.

Two in-depth studies on AMI have been done in instructional settings. Both suggests that information can be effectively transmitted. Lombard (1969) compared a three screen program with a single screen version of an 11th grade history lesson. Although information could be effectively transmitted, some inconclusive results were reached. Interestingly, Lombard suggested that girls did better than boys on the three screened version. In a similar comparative study, Brydon worked with 31 trainees at the Lockheed Corporation Training Department. Here, one group experienced a three screen version and the other group participated with a single screen program. Both programs were designed to examine knowledge gain. Structurally, both programs differed in running time and number of slides. Brydon discovered that AMI was extremely effective. In fact, mean differences were statistically significant at the .01 level of probability.

Hopefully these settings provide sufficient evidence about the progress and state of the art for AMI. Available evidence suggests that AMI is an effective tool for entertainment, information dissemination, persuasion, and formal instruction.

Conclusion

Using available research and pertinent opinion, this chapter sought to reinforce and expand upon the relationship between the theoretical factors of learning and retention, human information processing, and motivation with selected AMI capabilities and structural properties. In addition, an examination of the progress and state of the art for AMI was included.

Of the capabilities discussed, two seem critical for subject matter learning and retention. The first involves manifold functions. AMI appears capable of doing many things to facilitate retention. It nurtures comparisons and provides motivation. The second vital capability for learning seems to rest with AMI participation and involvement. The medium appears to capably entice and satisfy the large information demands of perceivers.

Five AMI structural properties were identified: visual information, audio information, simultaneity, screen size, and program length. While related to one another, each property contributes uniquely to learning and retention. The visual information appears to the learner in one of four pictorial styles. From these styles, the learner must extract the information so as to understand the ideas being transmitted. The audio information helps to explain, reinforce, emphasize, and support the visual imagery and even suggests further associations. Simultaneity encourages eye movements, invites viewer participation, and appears to facilitate efficient and economical processing of both audio and video information. The property of screen size seems to be closely linked with "visual task and impact." Finally, program length appears important for optimizing student learning and retention.

This chapter closed with a survey of the progress and state of the art for AMI. While multi-imagery techniques have been most favorably received in the entertainment field, others are beginning to make greater use of the medium. This appears to be especially true for formal instruction. In an attempt to examine the effectiveness and efficiency of the medium in instruction, the next chapter describes the methodology for this study's experiment on AMI learning and retention.

CHAPTER IV

METHODOLOGY

Overview

This chapter describes the instructional AMI program used in this research and measures utilized to evaluate the program's effectiveness and efficiency. In addition, Chapter IV outlines the research procedures including the type of designs, audiovisual equipment, and standardization methods used. Finally, it describes the sample of the students employed in this investigation.

AMI Instructional Program

Topics related to an introduction to high school psychology, divided into three equally timed segments, served as the basis for the AMI program that was used in this study. Acting in this introductory capacity, the program sought to inform students about three different areas of psychology. This content area was selected for two reasons: it seemed to lend itself to the AMI format; local high school psychology classes and teachers were willing to cooperate with the researcher.

Three program segments of 10 minutes each were prepared by the researcher for use in this investigation. The rationale for the 10 minute segments was to enable the longest AMI presentation with its test to be completed within a school class period. Otherwise, no empirical research guided this decision about program segment length. The following topics made up the program segments: Psychology: Past to Present (first 10 minutes) traced the early non-scientific developments in psychology to more recent scientific ones; Behaviorism and Gestalt (second 10 minutes) compared these two different approaches to studying psychology; Applications of Psychology (third 10 minutes) examined the different areas in which psychology is involved.

Each AMI program segment was a self-contained introductory instructional module that could be shown alone or in combination with other parts. No material in one program was duplicated in another. Hence, treatment groups in this study saw either all three program segments totalling 30 minutes, the first two programs of 20 minutes, or the first program segment of 10 minutes.

The overall program content encompassed ideas and information, e.g., terms, facts, proper names, methods of procedures, and major theories. Much of the program's audio and visual content was based upon and selected from the 1966 curriculum guide of the schools which participated in the study. Other reference sources, together with suggestions from the American Psychological Association and classroom psychology teachers, were consulted in carrying out such tasks as content delimitation, authenticity, and scripting. (Refer to Appendix A which contains the narration scripts from the three program segments.)

The actual design and preparation of the AMI program followed no systematic procedures that were based on research evidence. This action was largely due to the lack of research on how to wisely arrange, design, and present information for student learning (Allen, 1971; Bollman, 1971; Bruner, 1960; May and Lumsdaine, 1958). Consequently, this AMI producer informally and intuitively dealt with such variables as motivation, meaningfulness, perceptual clarity, repetition, audience involvement, and production quality in the preparation of the AMI psychology program.

After the program was produced, all segments were previewed by a group of 12 classroom psychology teachers. Also, two high school students and two University of Maryland personnel saw selected segments. Their suggestions concerning program revisions were noted and acted upon prior to the actual experimentation date.

Evaluation Measure

In order to evaluate the immediate and delayed efficiency of the AMI programs of differing lengths, as well as program effectiveness, a paper and pencil recognition test was used. This test contained both true-false and multiple-choice questions. These item types were used to enhance objectivity and thereby lessen the chances for subjective evaluation. Test scores would not affect a student's course grade.

Three separate, but identically structured, instruments were prepared by the researcher, one test for each 10 minute AMI program segment. Each instrument was comprised of 10 questions, five multiple-choice and five true-false. The students in the treatment group that saw 30 minutes of AMI received all three instruments of 30 questions; the students who saw 20 minutes received two tests of 20 questions; the 10 minute AMI student group received one test of 10 questions; the control group received the 30 question instrument. A mean score was computed in terms of percentages and raw scores of correct answers achieved on the recognition tests by all student groups.

The subject matter, to which the program was addressed, was sampled for testing by using three main objectives as guidelines. These objectives were generated to correspond with the Bloom (1956) taxonomic level of knowledge. Hence, students who saw the program should be able to: 1) identify knowledge of specific facts about psychology events, persons, terminology, places, and dates; 2) exhibit knowledge of psychological techniques, procedures, and major theories; 3) recognize knowledge of psychological processes and movements of phenomena through time. By using the knowledge level of the Bloom's work, it was believed that retention could be measured more efficiently by a student's recognition of ideas or material.

With these goals in mind, test items were selected that were appropriate and representative of the content material in each program sequence. In most instances, the investigator selected terms, facts, dates, processes, theories, and names that were spoken in the program narration and/or its visual referent was projected onto one, both, or all three screens. Examine Tables 2, 3, and 4 which depict the table of specifications that were used in preparing each AMI test.

TABLE 2 - SPECIFICATIONS FOR AMI TEST ON PSYCHOLOGY: PAST TO PRESENT

	Content				
Outcomes	Names of Psychologists	Terms	History	Processes	Total No. of Items
Identifies specific facts, dates, etc.	1			1	2
Exhibits knowledge in theories, etc.	2	1	1	1	5
Recognizes processes, etc.		1	1	1	3
Total Items	3	2	2	3	10

TABLE 3 - SPECIFICATIONS FOR AMI TEST ON BEHAVICRISM & GESTALT

Outcomes	Names of Psychologists	Terms	History	Processes	Total No. of Items
			Content		
Identifies specific facts, dates, etc.			1	1	2
Exhibits knowledge in theories, etc.	2	1		1	4
Recognizes processes, etc.	2	1		1	4
Total items	4	2	1	3	10

TABLE 4 - SPECIFICATIONS FOR AMI TEST ON APPLICATIONS OF PSYCHOLOGY

Outcomes	Names of Psychologists	Terms	History	Processes	Total No. of Items
			Content		
Identifies specific facts, dates, etc.	1		1		2
Exhibits knowledge in theories, etc.	2	1		2	5
Recognizes processes, etc.	1	1	1		3
Total items	4	2	2	2	10

Other than these somewhat arbitrary selections (displayed in Tables 2, 3, and 4), no other systematic method of selecting program material for testing was employed.

Two University of Maryland social studies personnel and three classroom psychology teachers were surveyed to assess the degree to which the instruments paralleled the AMI material in the program. Consensus suggested that the measures would provide the desired information. No high school students took the test prior to the experimentation.

Drawing upon the evaluation experiences of the National Assessment of Educational Progress, this AMI study incorporated the use of audiotaped directions and the reading of test questions. The purpose was to optimize understanding of the task to be done or the question asked (Finley and Berdie, 1970). The assessment program discovered that many low achievers, were often unable to respond to a test question because they did not understand a phrase or word that was read. The audio test material was identical to the print material in the paper test.

In addition to overcoming potential student reading problems in the study sample, this audiotape seemed to further assist recognition in another way by bringing a part of the original presentation stimulus back to the student in his testing environment. Fleming (1970) suggested that it was worthwhile to try to incorporate the same medium for testing as was utilized for initial instruction.

Research Procedures

Type of Research and Design

An applied type of research was selected to evaluate the earlier
An applied type of research was selected to evaluate the earlier
mentioned research questions on instructional AMI program effectiveness

and program length and retentivity. The specific form of research used was known as "classroom experimentation." This strategy facilitated the examination of "methods of teaching actual pupils a part of the actual curriculum by methods that seem feasible under actual classroom and school conditions [Gage, 1967, p. 98]." Therefore, the medium was not presented as an isolated fragment of instruction; instead, it sought to be a part of the regular instructional setting of each high school class participating in this study.

As a consequence of using this type of research, some scientific control and precision were sacrificed. However, findings related to the originally posed research questions in Chapter I would hopefully provide useful information, in spite of design deficiencies. Furthermore, answers would be a useful guide for the development of future AMI instruction.

Two designs assisted in implementing the "classroom experimentation" type of research. The first was the posttest-only control group design (Campbell and Stanley, 1963). In its basic form, one group receives the experimental treatment and a posttest, while the second group of subjects receives only the test. This design was used to gather data on research question one, which asked: "If an AMI program were presented to a group of students, would their raw mean score of correct answers from an immediate retention test be significantly different from the mean score of a student group who did not see the program?" The posttest-only design was used for two reasons: the administration of a pretest to all treatment groups seemed awkward and inconvenient; the design avoids undesirable sensitization by the pretest (Lumsdaine, 1967).

By utilizing this design, three comparisons were made by using the groups' mean raw score of correct answers. First, the 30 minute group (N=71) raw score mean was compared with the control group (N=31) score for the 30 minute test. Second, the 20 minute AMI group (N=77) raw score mean was compared with the control group (N=31) for the 20 minute test. Third, the 10 minute AMI group (N=74) score was compared with the control group (N=31) score for the 10 question, 10 minute AMI segment test. In each comparison, the control group remains the same; only their test scores varied.

A second design was selected to collect data on the second and third research questions which concern the percentages of cognitive material retained by students for the programs of different time length. The design was patterned from McLeish (1968) who used it for examining the immediate and delayed retention of lecture material.

This design involves the division of subject matter material into three equally timed program segments, which are then transmitted alone or in combination by some medium to students. One group of subjects experienced segment one of the program material and then received a recognition test to determine how much material was remembered. A second group of students received the first two segments of the program and then took a test over both segments; group three experienced all three program segments and then received a test that covered all three segments. Consequently, all three groups were compared to determine which length of presentation was most efficient in terms of immediate and delayed retention. Efficiency was computed by the percentage of correctly recalled information by groups.

For this study on AMI, three different program lengths were compared on the basis of percentage of information correctly recognized by student groups. The 30 minute AMI group (N=71) percentage was compared with percentages of the 20 minute AMI group (N=77) and the 10 minute AMI group (N=74). This comparison was for both immediate and delayed retention.

Audiovisual Equipment and Other Materials

A variety of audiovisual equipment and related materials were utilized in this study. Three Kodak 760 Autofocus Carousel projectors with zoom lenses were used along with three large portable screens and two audiotape recorders. Providing the syncronization between slides and sound was an AMI control box. The program materials on psychology were stored in three Kodak 140 slot trays and one program audiotape. For testing purposes, an audio test tape was used in conjunction with mimeographed test materials.

Standardization

By taking certain precautions, the researcher attempted to control potential threats to internal validity that may have seriously contaminated the "classroom experimentation." Each instructional program segment was 10 minutes in length. Also, audiotaped instructions, test question reading, and the program narration used the same male voice. The projected imagery was the same size on the screens for all program presentations. The experimentation took place in comparable large classrooms in participating schools during the study. Classroom teachers (whose classes participated in the study), during the week between initial and delayed testing, covered content material in class not directly related to the AMI presentations.

Sequencing of slide changes and pacing within each program segment was held constant throughout the experimentation by means of the AMI control box. The arrangement of the program segments for the presentation remained the same throughout the experiment. When three program segments were shown to students, the presentation always followed this pattern: <u>Psychology: Past to Present</u> was first, <u>Behaviorism and Gestalt</u> was shown next, and Applications of Psychology was shown last. When two program segments were shown to students, the presentation always followed this pattern: Psychology: Past to Present was displayed first and Behaviorism and Gestalt was shown second. When one program segment was shown, Psychology: Past to Present was always used with the student groups.

Description and Assignment of Subjects

For this study, permission was obtained to employ high school psychology students in two different Washington, D. C. suburban schools. These two institutions provided a population of 253 students for participation. These schools will be identified here as School A and School B.

School A, with a total student population of 1445, is 20 years old and located in an above average socio-economic area. It serves a bedroom community with a predominance of military, governmental, professional personnel with some rural workers. The racial composition of the school is 98% white and 2% black. Over 60% of the graduates attend some sort of post-high school education. The approximate mean scores of juniors for the 1970 SAT were 506 for the verbal portion and 522 for the mathematics. School A contributed seven classes totalling 183 students to the study sample.

School B, located about 15 miles away from A, is two years old. School B, with an enrollment of 1358 students, serves a slightly below average socio-economic area. Approximately 36% of the students are white and 64% black. The 1970 SAT mean scores earned by juniors were approximately 373 verbal and 421 math. Since the school is in its second year of operation, no community profile on occupations was available. Likewise, there was no information on graduates because a senior class had not been graduated. School B contributed three classes of 70 students to the study sample.

While the background information suggests that Schools A and B are different, some aspects of the class composition were found to be similar. In both schools, students were heterogeneously assigned by the administration to their psychology classes. This meant that each class found in the sample contained a mixture of students who had diverse ability and achievement levels, race, sex, ages 15 - 18 years, and grade levels 11 - 12. Consequently, the investigator worked with seven heterogeneous classes of 183 students from School A and three heterogeneous classes of 70 students from School B. Further random assignment of students or combining classes was not possible for this experiment.

To best utilize the ten available classes, the following assignment of treatments was decided upon. Since a control group was to verify the validity of the tests, as well as establish a base level to calculate gain, one group was randomly selected for these purposes from School A. With this decision made, six treatment groups were established in School A and three groups in School B. There were three experimental treatments of 10, 20, and 30 minutes in length. Thus, in School A, there were two classes for each treatment and these were randomly assigned by drawing numbers from a hat. School B had one experimental group per treatment and these were likewise randomly assigned. Table 5 indicates the final assignment of students to AMI treatments.

TABLE 5 - PATTERN OF SUBJECT ASSIGNMENTS TO AMI TREATMENTS AND CONTROL GROUPS

Treatment Group	Classes from School A	Classes from School B	Total No. of Classes	No. of Students Sch. A	No. of Students Sch. B	Total
10 minutes of AMI	2	1	3	46	28	74
20 minutes of AMI	2	1	3	56	21	77
30 minutes of AMI	2	1	3	50	21	71
Control No AMI	1	0	1	31	0	31
			10			253

The classes from School B saw the AMI programs on the third day of school, fall 1971. School A classes participated in the experiment on the fourth day of classes.

This chapter has described the methodology used in this research. It has outlined such topics as procedures, measures, and sample of students. In the next chapter (V), the study findings are reported. Finally Chapter VI consists of the summary, conclusions, and recommendations.

CHAPTER V

FINDINGS

Overview

This chapter describes major, related, and other pertinent findings from the classroom experimentation on AMI learning and retention. Following these descriptions, the researcher cites the limitations of the study and interprets the findings with respect to the questions to which this study was addressed.

Major Findings

As mentioned in Chapter I, this study addressed itself to three main research questions. This investigator reports below the pertinent findings for each question.

Question One

The first question asked: "If an instructional AMI program were presented to a group of students, would their raw score mean of correct answers from an immediate retention test be significantly different from the mean score of a student group that did not see the program?" The analysis of variance procedure was used to test the following null hypotheses related to question one:

$$Ho : M_{10} = M_{10c}$$

$$Ho : M_{20} = M_{20c}$$

$$Ho : M_{30} = M_{30c}$$

where M_{10c} represents the raw score mean of the 10 minute control treatment population; M_{20c} stands for the raw score mean of the 20 minute control treatment population; M_{30c} represents the raw score mean of the 30 minute control treatment population. Analogously, the symbol M_{10} stands for the raw score mean of the 10 minute AMI treatment population; M_{20} for the raw score mean of the 20 minute AMI treatment population; and M_{30} for the raw score mean of the 30 minute AMI treatment population. The null hypotheses were tested using the .05 level of significance as the criterion.

Table 6 displays the analysis of variance for the raw score test means of the 10 minute AMI and control groups. The F ratio of 88.6 was significant at the .05 level. Consequently, the results suggest that the 10 minute AMI program means were higher than the control means, and the null hypothesis was rejected.

TABLE 6 - ANALYSIS OF VARIANCE OF 10 MINUTE AMI AND CONTROL GROUPS

Group	Mean	S.D.	Source	df	SS	MS	F	F critical (.05 level)
AMI 10	6.9	1.5	Between	1	201.2	201.2	88.6	3.9
Control	3.9	1.5	Within	103	233.8	2.3		
			Total	104	435.0			

Table 7 exhibits the analysis of variance for the raw score test means of the 20 minute AMI group and the control group. The F ratio of 105.8 was significant at the .05 level. Therefore, the null hypothesis was rejected.

TABLE 7 - ANALYSIS OF VARIANCE OF 20 MINUTE AMI AND CONTROL GROUPS

Group	Mean	S.D.	Source	df	SS	MS	F	F critical (.05 level)
AMI 20	13.3	2.9	Between	1	770.8	770.8	105.8	3.9
Control	7.4	2.2	Within	106	772.4	7.3		
			Total	107	1543.2			

Table 8 presents the analysis of variance for the raw score test means of the 30 minute AMI group and the control group. The F ratio of 92.8 was significant at the .05 level. Therefore, the results suggest that the 30 minute AMI program mean was higher than the control mean, and the null hypothesis was rejected.

TABLE 8 - ANALYSIS OF VARIANCE OF 30 MINUTE AMI AND CONTROL GROUPS

Group	Mean	S.D.	Source	df	SS	MS	F	F critical (.05 level)
AMI 30	18.9	3.8	Between	1	1260.0	1260.0	92.8	3.9
Control	11.2	3.4	Within	100	1357.4	13.6		
			Total	101	2617.4			

The results in Tables 6, 7, and 8 report that the AMI mean scores were significantly different from the control ones. This finding appeared for all three AMI program circumstances surveyed for question one.

Question Two

The second research question asked: "If an instructional AMI program of variable length (10, 20, or 30 minutes) were presented to student groups, would their percentage of correct answers from an immediate retention test be significantly different for variable program lengths?" The analysis of variance procedure was used to test whether the 10, 20, and 30 minute AMI percentages were different from one another. In order to utilize this statistical procedure, the researcher translated the research question into the null hypothesis format. Using the treatment population symbols as previously defined for the first question, the following designations were used for the mean AMI percentages: M_{10}, M_{20}, and M_{30}. The null hypothesis is thus written: $Ho : M_{10} = M_{20} = M_{30}$.

Table 9 exhibits the analysis of variance for the percentages of material retained by students in the 30, 20, and 10 minute groups. The F ratio of 4.5 was significant at the .05 level. These results suggest that there is a difference among the percentages of the three treatment groups.

TABLE 9 - ANALYSIS OF VARIANCE OF IMMEDIATE PERCENTAGES FOR 10, 20, AND 30 MINUTE AMI GROUPS

Group	Mean	S.D.	Source	df	SS	MS	F	F critical (.05 level)
AMI 30	62.2	12.2	Between	2	1743.8	871.9	4.5	2.9
AMI 20	66.6	14.3	Within	219	42647.8	194.7		
AMI 10	69.1	15.1	Total	221	44391.6			

To locate the significant differences, the Scheffe method was used. The first comparison was made between the AMI 30 and 20 groups. An observed F of 3.7 for the comparison was not significant at the .05 level. The second comparison was made between the AMI 20 and 10 minute groups. An observed F of 1.2 was not significant for this comparison. The final comparison was executed between the AMI 30 and 10 minute groups. An observed F of 8.9 was significant for this comparison. Consequently, there appeared to exist a difference between the 10 minute AMI program percentages and the 30 minute group percentages, but not between the 10 - 20 and 20 - 30.

Question Three

The third research question that was posed earlier in the study asked: "If an instructional AMI program of variable length were presented to student groups, would their percentage of correct answers from a delayed retention test be significantly different for the various program lengths?" The analysis of variance method was utilized to determine whether the 10 minute, 20, or 30 minute AMI program percentages were different on a delayed test. To use this statistical method, the research question was translated into the following null hypothesis format: $Ho : M_{10} = M_{20} = M_{30}$.

Table 10 discloses the analysis of variance for the percentages of AMI subject matter material recalled one week later by students. The F ratio of 1.8 was not significant at the .05 level. These results suggest that there was no difference among the percentages of retention for the 10, 20, and 30 minute AMI groups.

TABLE 10 - ANALYSIS OF VARIANCE OF DELAYED PERCENTAGES FOR 10, 20 AND 30 MINUTE AMI GROUPS

Group	Mean	S.D.	Source	df	SS	MS	F	F critical (.05 level)
AMI 30	55.9	12.7	Between	2	919.3	459.7	1.8	2.9
AMI 20	57.4	17.4	Within	219	56934.9	259.9		
AMI 10	60.8	17.6	Total	221	57854.2			

Related Findings

In the course of preparing and executing this study, additional data were collected on related AMI concerns. In particular, the related findings concern AMI test reliabilities and retention differences.

AMI Test Reliabilities

The reliabilities were computed for the 10, 20, and 30 minute AMI recognition tests that were used in this study. The Spearman Brown Correction formula was utilized to derive a split halves reliability coefficient. For the first 10 minute AMI test, an r_{tt} of .73 was computed. An r_{tt} of .87 was determined for the 20 minute test and an r_{tt} of .75 for the test sampling all three program segments.

Retention Differences

One related finding concerns a comparison of information retained by AMI groups over time. Table 11 depicts the immediate and delayed percentages and differences for each program segment. These percentages are based on the number of correct answers. (See Table 11.)

TABLE 11

COMPARISON OF IMMEDIATE AND DELAYED PERCENTAGES FOR AMI PROGRAM SEGMENTS

Group	N		Percentage of Information Retained: First 10 Minute AMI Segment	Second 10 Minute AMI Segment	Third 10 Minute AMI Segment
AMI 30 Immediate	71		68.6	61.7	56.3
AMI 30 Delayed	71		63.5	52.1	52.1
		Loss	5.1	9.6	4.2
AMI 20 Immediate	77		71.7	61.4	---
AMI 20 Delayed	77		63.1	52.1	---
		Loss	8.6	9.3	
AMI 10 Immediate	74		69.1	--	---
AMI 10 Delayed	74		60.8	--	---
		Loss	8.3	---	---

From the immediate and delayed comparisons in Table 11, the data suggests that approximately 4 - 10% of the information tested was lost between the two testing periods. In addition, it appears that the percentages of information retained ranged from 71.7 to 56.3% for the immediate and 63.5 to 52.1% for the delayed test.

In addition to the examination of the differences among AMI program segments, the researcher compared the overall information retained immediately and one week later for each AMI group. Table 12 shows the percentage of correct answers for each group, as well as corresponding information losses.

TABLE 12 - COMPARISON OF IMMEDIATE AND DELAYED PERCENTAGES FOR INFORMATION RETAINED BY GROUPS

Group	N	Percentage Retained on Immediate Test	Percentage Retained on Delayed Test	Percentage of Loss
AMI 30	71	62.2	55.9	6.3
AMI 20	77	66.6	57.4	9.2
AMI 10	74	69.1	60.8	8.3

From the comparisons between the immediate and delayed testing that are shown in Table 12, it appears that the amount of information lost among AMI groups ranges between 6 - 10%.

Other Related Findings

Additional data were gathered. Findings concerned student reactions to the AMI programs seen in the experimentation, producer preparation time for the psychology series, and financial cost for the three screened presentation.

Student Reactions

In an informal discussion after the delayed testing, the investigator asked students for their impressions or reactions to the AMI programs that they had seen. Some of the student observations are mentioned here. In the judgment of the researcher, the students expressed very favorable opinions about the overall program series. This feeling was supported by a variety of comments. Many students reported that the medium always projected a feeling of movement and little waste of time. Some students advised that AMI captured and held their attention very well. Other high school participants enjoyed the music and audience involvement sections of the program segments.

Regarding unfavorable opinion, one student reported difficulty in following the three simultaneous images on the screen. Apparently, the student felt that the slide changes were tooverpowering and that the information could not be processed with any comfortable degree of continuity. Another person suggested that the three screens were tiring to the eyes. As for student impressions about the audiotaped presentation of test questions, reactions were mixed. Some students believed that the audiotaped test was distracting to their reading of the test; others suggested that they simply tuned it out and read the printed test; a few students said that they liked it. Because these student impressions were collected in an informal fashion, no attempt was made to quantify them.

Preparation Time and Cost

The investigator kept a log of material cost and time expended in AMI program preparation for the three 10 minute segments. The total, from the sales receipts, was slightly over $100.00. Appendix B contains a list of materials used and their cost. Production time exceeded 200 manhours. The researcher, who has previously produced nine AMI programs, averaged approximately seven and one half hours of time for each minute of final programming. Appendix C outlines producer preparation activities and time expended.

Study Limitations

Before the study findings are interpreted, it is necessary to consider study limitations which may present internal and/or external threats to validity. Usually, these limitations endanger the validity of experimental types of research that require close scientific control and precision. Although a classroom type of applied research was used for this study, it was believed necessary to examine a number of potential and real threats.

Several threats to internal validity may have confounded the influence of the AMI treatments. Some of the extraneous influences described were not sufficiently controlled within the context of the experimentation.

In an experiment in which the treatments are offered to groups, the appropriate statistical unit is considered by many authorities to be the group mean rather than the individual student (Cox, 1958). This factor is especially important in experiments in which the treatment is of brief duration, as is the case in this study. Ideally, the treatment in this study should have been administered to perhaps as many as 30 groups, with the datum used in the subsequent analysis being the mean of each group. For very practical reasons involving time and money, this rigorous standard was not met in the experiment reported here. Accordingly, there is a possibility that any significant F ratios are unduly influenced by the interaction of students within each treatment group. Such interactions tend to reduce the within group variance of the F ratio and thus act to inflate the observed F ratio. It follows that none of the null results reported here is affected by this situation but that the significant results reported for questions one and two need to be viewed with some caution due to this limitation in the design.

The recognition testing procedures presented some potential threats. Since the test was taken by most students twice, they probably became test sophisticated. This sophistication may explain for the small decrements in information loss after one week listed in Tables 11 and 12.

Most of the test material was based on verbal or linguistic stimuli (facts, dates, names) presented through the narration or projected onto the three screens. There were no pictorial items on the test. Consequently, the instrument appeared not to be truly representative of the mediated stimuli presented to the students in the study. Another testing limitation concerned student guessing. Since the recognition tests were in an objective format with true-false and multiple choice questions, there seemed to exist an unknown element of success created through student guessing. No corrections for guessing were made with the test results.

Another serious threat to internal validity emerged when individual high school students could not be randomly placed into treatment or control groupings. Consequently, there is some question as to the equivalence of the 10 heterogeneous groups used in the experimentation. The arbitrary assignment made by the researcher of the general treatment and control groups introduces the possibility of sampling bias. This bias may occur even with the large sample size (N=253) which sought to decrease sample variability and error.

Another threat involved the variability of the AMI programs themselves. While each psychology program segment was easily held constant at 10 minutes in length, it was very difficult for the producer to maintain equality in other areas. For example, he could not adequately resolve equal content difficulty or interest; he could not maintain equal numbers of 2 x 2 slides in each program segment; equal audio portions were also difficult to achieve. Hence, with such variablity, each program segment appeared a little different.

In addition, sequencing of program segments may have contaminated the findings. This procedure is mentioned since segments were presented to students in just one way. Perhaps, if the sequence of the segments were changed, results may have been different.

While these preceding factors concerned internal threats, there appeared a few threats that involved external validity. The generalizability of the effects of the AMI treatments to other programs and other populations would not be entirely justified by this single piece of research. Novelty from the AMI medium may have caused excessive enthusiasm among students and influenced their test scores.

Thus, a number of internal threats and some external ones were prominent. These may have sufficiently contributed extraneous influences that endanger the findings of this experiment.

Interpretation

So far, this chapter has reported the major findings for each of the three research questions which gave rise to this study. Interpretation of the results will be made in terms of each question. Wherever possible, the findings will be related to previous research or to some theoretical framework. These interpretations consider fully the study limitations mentioned previously.

Question One

For the first question, which compared immediate AMI treatment group raw score means with those of the control group, a significant difference was found for each of the 10, 20, and 30 minute comparisons. In view of these findings, it appeared that all three AMI psychology programs used in this study were effective in promoting the learning of subject matter material. This positive effectiveness corroborates the findings of Nelson (1954) in art, Newhall (1959) in Nike-Hercules missile electronics, and Brydon (1971) in blueprint reading. Hence, the combination of sights with sounds in the AMI format seemed to effectively "present stimulus materials to those who would learn [Carpenter, 1962, p. 303]."

The probable reason for the learning and retention effectiveness of the AMI programs on psychology rests upon a theoretical base. As was mentioned earlier in this document (See Chapters II and III), the researcher believed that the existence and potential of AMI was supported and nourished by the factors of perception, memory, and motivation. The AMI psychology program seemed optically and acoustically provocative to the high school audiences being instructed. As Friedman (1971) suggested about the merger of sights and sounds: "Both depend on and stimulate each other. Alone each is one dimensional. Together, they create an image far more powerful than the sum total of their parts [p. 47]." Perhaps the communicative power for AMI was in the interplay among its properties: visual and audio information, simultaneity, screen size and program length, along with the concepts of perception, memory, and motivation. Presumably, the interaction of these properties and concepts assisted the high school audiences in an active process of seeking out and examining information. In doing so, the medium appeared to promote student learning and retention.

Several specific perceptual factors seemed to assist student learning. First, AMI provided novelty in stimulation which some viewers reportedly enjoyed. Perhaps this factor helped to combat perceptual fatigue. A typical source of AMI novelty came from pictorial multiplicity where viewers perceived up to three images at the same time. This multiplicity would not present a difficult task since researchers have found that individuals can adequately handle multiple pictures in learning (Gibson and Yonas, 1966; Neisser, 1964). A second perceptual factor concerned figure-ground relationships. The medium appeared to permit viewers to easily bring instructional material into appropriate figures from the ground. AMI may have facilitated figure-ground relations by drawing upon its multi-faceted functions, such as exhibiting right and wrong approaches to solving a problem and comparing objects or subjects. This researcher is led to believe that providing the viewers with helpful figure-ground relationships assisted learners in their processing of incoming information from the classroom AMI environment. A third factor of perception which may have assisted the students in learning and retaining was simultaneity. Results of the study suggested that students could handle two different, but related, AMI messages through two senses. This information processing appeared enhanced by the notion that audio information, such as narration and music, could link the visual information, as well as name the visual display on the screens (Travers, 1964). Furthermore, the redundancy, cue summation, and channel switching qualities of simultaneity seemed to facilitate the effectiveness of these AMI programs.

A few factors in the area of memory may have been influential in promoting efficient learning and retention. Perhaps there were sufficient rehearsal times to allow learners to vocalize what they were learning from the soundtrack and corresponding visual information. Also, the audiotaped test, as well as the recognition test itself, may have facilitated the storage and retrieval of numerous bits of subject matter material.

Some factors of motivation may have been beneficial to learning and student retention. First, the medium itself appeared to provide sufficient extrinsic energization to direct the learner toward the learning of the psychology material. Presumably the program contained motivational properties that were "somewhere between apathy and wild excitement [Bruner, 1960, p. 72]." Second, the motivational feature of audience involvement seemed quite helpful for learning. This program feature sought to entice students to watch a particular screen and actively participate in what is asked by the narrator. As Myers and Reynolds (1967) point out: "A fundamental and thoroughly verified principle of learning is that active participation in the learning process increases the speed and amount of learning [p. 60]."

Hence, the factors of perception, memory, and motivation may have contributed significantly to optimizing the effectiveness of the AMI psychology programs. These theoretical factors appeared to closely interact with the medium's properties of visual and audio information and simultaneity.

Question Two

The second research question that was originally raised in this study sought to discover whether differing lengths of AMI programming nurtured different percentages of retention on immediate tests. Results of the experiment revealed a significant difference among the three group mean percentages. The difference was isolated between the 10 minute segment and the 30 minute presentation. Otherwise, there was no significant difference between the 10 and 20 minute AMI programs nor between the 20 and 30 minute programs. Hence, the findings suggest that the length of the psychology AMI programs seemed to effect both learning and retention. This interpretation is seemingly reinforced since the 10 minute psychology segment appeared most efficient, the 20 minute presentation less efficient, and the 30 minute AMI presentation least efficient. These findings seemed to coincide with the experimental results of Trenaman (McLeish, 1968) and Barabasz (1968) who found that the shorter lecture lengths were more efficient than the longer ones. The AMI findings for this research question are also relevant to the marketing research in the retention of advertisements.

However, it should be noted that the other AMI program lengths promoted student retention. When examining the percentage figures among all three program lengths (as outlined in Tables 11 and 12), the overall percentage of material immediately retained for any program length appeared rather high. Basically, over 60% of the program material sampled in the tests was recognized by the 10, 20, and 30 minute AMI groups. With over 60% retentivity, the investigator felt compelled to compare these results with other similar research on the lecture medium. McLeish (1968) reports that, in general, students came away from his lectures with 42% of the material retained. (This figure was corrected for guessing.) Trenaman, a colleague of McLeish's, discovered that 40% of the lecture material is immediately retained. (This figure was not corrected for guessing.)

In addition to the time element as a determinant of efficient information retention in AMI programming, other explanations are feasible. For example, program structure, style, or sequence may have accounted for the differential percentages of student information retention. Further, some feature within the 10 or 20 minute program may have contributed significantly to making that program segment more effective than the 30 minute presentation. Perhaps there was too much music and too few audience involvement features; perhaps sufficient differences in the content influenced the retentivity of some material over some other. Unfortunately, the effect of structural or style differences and program sequence on learning and retention of material in this AMI instance is not known.

In addition to the influence of time or program style, another explanation for the results to this second research question should be examined. Another feasible reason for the efficiency of the shorter program may be the appearance and functioning of proactive inhibition among the 20 and 30 minute groups. It may be that lower percentages of recall on the second and third segments were due to interference which stimulated less retentivity over time. Apparently, the associations learned in the first 10 minutes of AMI interferred with the retention of program segments later experienced (see Table 11, which depicts percentages for all program segments). This interpretation follows current thinking in the area of forgetting. As DeCecco (1968) states: "...not everything we have learned in the past makes it easier to learn new things in the present since learning is not an additive process, the simple accretion of knowledge; we are both slaves and masters of our previous learning [p. 354]." Perhaps related to proactive inhibition is the existence of novelty during the first 10 minutes. That is, no matter what material was shown in the first segment of the AMI program, there would generally be a higher retention score.

A partial explanation for the relatively high AMI retention percentages may lie in the procedure of measuring retention. Luh (1922) reports that recognition measures yield generally higher results than free recall or relearning measures. While the AMI study used recognition tests, as did the studies on the lecture method (Barabasz, 1968; McLeish, 1968), this researcher was not convinced that the measurement technique was significantly influential on retention. As Kintsch (1970) observes: "To date, the problem of comparing the amount recalled with the amount recognized has not been solved adequately [p. 333]."

Hence, the findings for the second question suggest that the shorter AMI psychology program was most efficient in transmitting cognitive material for immediate retention. In addition to time length, program style, sequence, proactive inhibition, and novelty may have contributed to this finding.

Question Three

The findings for the third research question showed that there was no difference in percentages of information retained by students on the delayed AMI tests. Apparently, the amount of subject matter retained was identical among students who saw 10, 20, and 30 minute presentations. Overall percentages of retained material appeared to be about 50 - 60% of the delayed test. Whereas the immediate retention percentages suggested that the 10 minute program seemed more efficient than the others, the delayed data suggest that all programs were similar in influencing long-term retention.

If after a week, there appears to be no difference in student retention for the different length programs, may one assume that the shorter program should be selected in preference to the longer programs? This question seems pertinent in terms of savings in instructional time. For example, Hubbard (1961) reports about the Telemation multimedia program at the University of Wisconsin wherein a: "tape lecture of 50 minutes could be boiled down to 20 Telemation minutes with no less of learning by students [p. 438]." Newhall (1959) discussing the Telemation effort conducted at the Redstone Arsenal, Alabama, suggests: "We can turn out a better trained individual in a shorter period of time by use of this technique." Brydon (1971) discovered that he could deliver his cognitive material via AMI in a shorter amount of time, thus allowing him to save 17 - 44% of a student's learning time. Hence, the length of a program as well as student time in learning are important variables to be considered when retention is being measured. Of course, AMI production costs and preparation time must be considered.

While the length of an AMI program seemed to be the main determinant for assisting long term retention, it is suggested other reasons may have caused the small decrement in information loss. First, there is no apparent difference among the three AMI program lengths because students were test sophisticated, having taken the test a week earlier and probably easily recognized some of the items. Hence, the small loss of information (as depicted in Tables 11 and 12) may be attributable to retesting effects and not normal memory loss. Second, in accordance with the immediate results which suggested the existence of proactive inhibition, the percentages (reported in Table 11) seem to reinforce the appearance of the interference factor. Third and finally, classroom psychology teachers participating in the experiment may have inadvertently discussed material covered by the program with their classes.

While these reasons present possibilities for explaining the relatively high delayed retention percentages, it seems doubtful that the reasons mentioned were of much importance. Instead, the researcher believes that the length of the instructional AMI program more than likely influenced learning and delayed retention.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The Audible Multi-Imagery (AMI) medium was investigated in terms of its capacity to promote student learning and retention of subject matter information in a formal instructional setting. Three main research questions were posed for this study:

1. If an instructional AMI program were presented to a group of students, would their mean raw score of correct answers from an immediate retention test be significantly different from the mean score of a student group who did not see the program?

2. If an instructional AMI program of variable length (10, 20, or 30 minutes) were presented to student groups, would their percentage of correct answers from an immediate retention test be significantly different for variable program lengths?

3. If an instructional AMI program of variable length were presented to student groups, would their percentage of correct answers from the delayed retention test be significantly different for the various program lengths?

In order to examine these questions, a classroom experiment was conducted. A population of 253 high school psychology students was identified and assigned to three AMI instructional program treatments and one control group. One group of students (N=74) saw 10 minutes of AMI psychology programming. A second group (N=77) saw 20 minutes of AMI programming, and a third group of students (N=71) saw 30 minutes of programming. An additional group of students (N=31) comprised the control group.

A paper and pencil recognition test of true-false and multiple choice questions was administered to all students. The AMI program material that was sampled for the test included knowledge items on such things as psychological facts, procedures, and major theories. The written test was complemented by an audiotape which presented the test questions to the student participants.

Members of each AMI group viewed their program segment or segments. The subjects were then tested immediately thereafter. A raw score and percentage score of correct information retained were determined. The control group who viewed no programs, was also tested. Hence, the AMI treatments were compared with the control group on the basis of immediate raw test scores. One week later, all AMI treatment groups were retested. All group percentages of information retained were compared.

Major findings were reported for each research question. For the first question, all AMI programs appeared to be effective. The analysis of variance procedure, at the .05 level of probability, suggested that the 10, 20, and 30 minutes of AMI programming yielded significantly higher raw scores than the control group. For the second research question, it was found that the percentage of retained material for the three AMI treatments were significantly different. On the delayed recognition comparisons for research question three, it was discovered that there was no significant difference among the percentages of the three AMI treatments. The analysis of variance was used for questions two and three at the .05 level of probability.

In an informal manner, additional related AMI findings were gathered. Students reactions and impressions appeared favorable toward the programs viewed. Cost of materials for preparing 30 minutes of instructional AMI programming was slightly above $100.00. This figure did not include labor costs. Another finding showed that over 200 hours of preparatory time was needed for constructing the psychology series. Finally, the amount of information that was lost between immediate and delayed testing appeared rather small, 6 - 10%.

The effectiveness of the psychology AMI programs corroborated the findings from other research. It confirmed that AMI was effective for cognitive learning. Moreover, several perception, memory, and motivational features seemed to enhance the effectiveness of these programs. For example, these perceptual features may have been important: novelty, pictorial multiplicity and simultaneity, and figure-ground relationships. Rehearsal time and the use of the audio-taped test may have contributed to refreshing memory. Finally, it was suggested that AMI may have been a sufficient energizer to motivate learners to encounter the program material.

Concerning immediate retention in terms of percentages, it was suggested that the shorter AMI program appears to be the most effective. This pattern coincided with research in the areas of educational media and advertising. Perhaps proactive inhibition or program style may have influenced retentivity in proportion to length of the AMI program. Although the 10 minute segment appeared to be most efficient, other program lengths yielded notable results. Ultimately, over 60% of the program material on the test was recognized by the 10, 20, and 30 minute program groups.

The findings of the third research question suggested no apparent relationship between program length and delayed retention. One week later, the retention scores were comparable for all three groups. Thus, the critical question arises as to whether the longer program offers any significant advantage over the shorter. While the shorter program segments appear more efficient for instruction, overall percentages of retained material for all program lengths seemed to be about 50 - 60% on the delayed tests.

Conclusions

The evidence from this study corroborated that AMI program length appeared important to student subject matter learning and retention. Even with the study limitations, it seemed that the shorter instructional episodes were most efficient in retarding information loss which typically impairs the communication process. (Refer to Chapter II for discussion on information loss factors.) Presumably, the shorter programmed segments permitted easier information processing and storage of information than the longer ones. In addition to the time length factor, it seems that proactive inhibition was prominent and may well have influenced the results of the longer instructional programs.

Hence, if indeed the shorter instructional programs are more efficient than the longer ones, future design of AMI programming would profitably consider the issue of instructional savings of time. Furthermore, designers must be concerned with the most effective uses of the medium in instructional settings. Consequently, this means that audiovisual designers must become more acutely aware of time required for AMI production activities, cost, learner traits, and learner time consumed in a learning activity for particular results and program lengths.

If decisions regarding savings of instructional time and utilization are to be made, audiovisual and instructional designers must necessarily have more information on AMI to facilitate decision making. In addition, designers need to discern and refine knowledge about AMI in order to nurture improvements in programming so as to increase its instructional value for learners. It is hoped that this study has made some modest contribution toward facilitating the awareness of the potential of AMI in formal learning settings.

Recommendations

A few specific recommendations are presented that may assist future work in AMI and cognition. First, AMI program segments should be rotated when shown to different groups. Hereby, the potential contaminant of presentation sequencing may be better controlled. Second, program styles should be examined in greater detail. For example, it may be worthwhile to include one or all AMI program segments that contain only narration and no music, sound effects, or audience involvement portions. It may also be valuable to probe more deeply the audience involvement property. Third, it may be helpful to report how audio - visual materials were selected for inclusion in an AMI program. Fourth, the testing instrument should be embedded within the medium itself. This test inclusion might improve the assessment of the visual information. Fifth, one might adopt the National Assessment of Educational Progress testing procedure to possibly control for guessing on objective tests. It is suggested that a category "I don't know" be added to the other response options. Sixth and finally, it is recommended that delayed retention tests should take place only after a week has passed since the treatment. That is, the subjects would only receive the test once. This procedure may tend to decrease test sophistication influences.

As for providing general directions for future research, a number of questions are suggested in the following outline:

1) Is AMI most efficient with a specific age group?

2) What is the most efficient screen size for AMI learning?

3) How can AMI be utilized in helping children with reading problems?

4) In what subject areas is the medium most effective?

5) Is an AMI presentation most efficient when experienced with or without class discussion?

6) What type of eye search and scan pattern can be determined for various pictorial styles that are projected onto three screens?

7) How is AMI related to individual differences such as intellectual and reading ability?

8) What is the role of incidental learning in AMI?

9) What is the role of production features such as music and pictorial multiplicity on learning and retention?

Regardless of the direction pursued, personnel working with AMI and other media must generate instructional materials for optimum student learning and retention. Certainly, the design of instruction involves the arrangement of stimuli to create desired learner responses. Moreover, design involves funding and materials. Further, instruction involves listing objectives and the development of assessment measures. Finally, and perhaps most importantly, instructional designers must carefully and seriously think about what is to be done with AMI and other media in education and why. Perhaps in this way, media mindlessness can be transformed into media mindfulness.

APPENDICES

APPENDIX A

NARRATION SCRIPTS OF AMI PROGRAM SEGMENTS

Psychology: Past to Present Script

For thousands of years, psychology has constantly observed, discussed, and theorized into man's thoughts and actions. What's more, psychology has sought to examine man - his motivations, his relationships with others, his place in the universe, and how he adjusts to his surroundings. Psychology as an ancient study, includes these concerns and more, as we explore "the past to present" of this modern day science.

During the 6th and 5th centuries B.C., the amazing Greeks posed many philosophical questions about key problems in psychology. Some questions concerned memory functions while others involved reasoning and learning. Plato, for example, a Greek philosopher and psychologist, raised a crucial question about whether there existed a split between man's mental functions and his physical or body functions. In other words, Plato wondered if the body ruled the mind or was the mind in control of the body?

Since raising key questions about man's nature was characteristic of Greek psychology, it unfortunately could never uncover adequate answers to many of the questions posed. This unfortunate circumstance occurred because the Greeks lacked two important things -- vital information on how man's body worked and scientific methods and materials.

So, the real scientific progress of psychology was delayed for a number of years until information in these two areas was discovered. In the meantime, however, man made the best of studying his mental and physical worlds by using and depending upon several somewhat unscientific ways.

Phrenology, the first area, was the art of describing a person's mental abilities from feeling the contours and bumps on his head and skull. The phrenologists (those who studied and practiced phrenology) conceived of a human brain as having some 37 independent powers or functions. Each of these 37 powers was located in a different region of the brain; as each power developed, a bump would emerge on the skull and thus indicate a well developed mental faculty. As an example of phrenology, look at the "observing and knowing" region of this person on the left screen.

How else did man unscientifically examine his human nature? One of the most ancient attempts has been through palmistry or the study of the hand. Each hand has its own markings - small lines, creases, and crossings. General categories of lines could be described such as the line of head, referring to one's mentality and the line of life or how long one would live. A palmist would of course describe these traits. Notice where the love area is located on the hand in the left screen. In addition to the markings on the hand, palmistry would examine the shape of the hand. Look at the slide on the left screen. This hand is called an active hand. It displays enthusiasm, action, and energy. This active hand belongs to great navigators, explorers, mechanics and engineers.

Now examine the hand in the slide on the center screen. This is called an artistic hand. Persons with these hands enjoy beauty, luxury, music and art. Usually actors, singers, and actresses have these hands.

Hence, palmistry involves the study of the hand to better understand man's nature.

From palmistry evolved the study of handwriting analysis. It was felt that each person wrote with certain expressive movements and that a person's handwriting was as individual as his palm.

An emotional expression chart showing the slant of the handwriting enabled a handwriting expert to theorize about a person. Look at the chart on the center screen. Now look at the left screen. Writing that is vertical (line A) or slants a little from A to B shows that judgement will rule. This type of writer will remain very calm in an emotional situation and will be ruled by head rather than heart. These are only very general rules the writing expert uses in analyzing handwriting.

Thus, phrenology, palmistry, and handwriting were all early somewhat unscientific rumblings in psychology that emphasized the importance of the body in explaining the nature of man.

From the earliest of recorded history, man has been trying to find meaning in the stars and their effect on human life. In particular, astrology attempted to find this meaning of the spirit or mind through the effects of the stars.

It was felt that the exact time, day, year, and location of one's birth and the location of the stars and planets at that time, explained much of man's present and future behavior.

With the dawning of the Renaissance from 1300 - 1600, a phenomenal "scientific revolution" captivated mankind. In fact, this revolution sought to overpower the many previous unscientific ways of studying man.

The sciences of biology, physics, chemistry, and mathematics emerged as did new theories about the universe and the way planets circled the sun in a predictable and orderly manner. Thus, scientific experimentation, exploration, new ideas and a spirit of unrest prevailed.

Into this dynamic period of change entered the genius of a Frenchman, Rene Descartes. As a psychologist, Descartes established the first adequate conception about human reflexes. He was able to do this because man's nature was now being viewed as that of an orderly machine. Like the universe, Descartes believed that man acted and behaved in a very orderly manner.

Not long after Descartes' ideas were made known, thinkers like Leibnitz violently opposed this body oriented or machine-like perspective of man. Leibnitz and others felt that man's mind and body worked together. They rejected the idea that man's body actions ruled his behavior.

As psychology passed through the 1700 and 1800's, it found itself concerned more with the machine-like notion about man than the more humanistic one of Leibnitz. This happened mainly because of the growth of the other sciences - such as chemistry, biology, mathematics, and the coming of the industrial revolution.

Along with these general changes came, of course, the newer experimental and research methods. Now, scientific approaches had to use control, precision and exact measurements in order to understand man's nature. After all, man's behavior was predictable and orderly. As these new scientific ways allowed for experiments on how the body operated, a German philosopher-psychologist by the name of Wilhelm Wundt thought to try out these new ways with psychological problems. So, in 1887, Wundt established the first laboratory for experimental psychology. Here in his lab, Wundt began to examine, experimentally, some of the psychological problems about human perception, habits, thinking, and learning. Of course, Wundt would make use of the experimental method. That is, he would always prepare a measureable stimulus, he would apply it to an animal or human under precise and controlled conditions; finally, he would measure the resulting response.

From these crude beginnings, the newer, scientific type of psychology spread throughout the world. As it grew, it naturally displaced many of the old, unscientific ways of palmistry and phrenology. Eventually, this newer form of psychology has come to dominate the 20th century, even though other, so-called humanistic approaches have arisen.

Behaviorism and Gestalt Script

When studying the science of psychology, one becomes aware that psychologists often favor or prefer to study and work in different areas. For instance, some like to work in areas of behavior, experience, and perception, while others prefer the areas of personality and emotions. Usually, the area they choose almost always reflect how they view human behavior and living.

Today, there are two widely held views about how human beings operate and live. On the one hand, there are those psychologists who lean toward the Gestalt point of view, and then there are those who lean toward the behavioristic ways. What philosophy guides each category and who are some of the people associated with each? Let's first look at the behavioristic point of view.

The science of psychology has spent most of its recent time analyzing very specific behaviors and actions. This was done because man has been viewed as tending to automatically react when stimulated. His actions were thus seen as a slave to stimuli from his surroundings. Gradually through time, these very specific behaviors are added together to form more complex behaviors.

Most behaviorists then, assume the existence or presence of a stimulus will set off some sort of response. Furthermore, they will only work with observable stimuli and observable responses, which can be measured. For example: Miss Peg shows the class a picture of a U. S. president (the stimulus) and then she asks the class to name the president. The class responds "Kennedy". Hence, psychologists who lean toward the behavioristic point of view concentrate upon the stimulus and responses and very little (usually nothing at all) on the central thinking processes of the organism.

With this general background in mind, let's examine an example of behaviorism. Our example deals with a Russian psychologist of the early 1900's. His name was Ivan Pavlov.

Have you ever felt your mouth water at the sight or smell of a tasty bit of food? Pavlov observed this mouthwatering when he fed his dogs in his laboratory. He decided to examine this mouthwatering phenomenon under controlled experimental conditions. Pavlov built a sling arrangement that held the dog in one position. A tube attached to the dog's cheek near one of the salivary glands drained off the saliva and permitted accurate measurement of the flow. The dog could not see Pavlov, who was behind a one-way screen and the room was sound-proofed.

Powdered meat was placed in the mouth of the hungry dog and saliva flowed. The flow of the saliva was called the unconditioned response - it occurred normally with no learning necessary. The meat Pavlov called the unconditioned stimulus because under normal, unlearned conditions it caused salivation. Next Pavlov sounded a bell just before meat was delivered to the dog. Several more times he sounded the bell and presented meat to the dog immediately. Then, when he sounded the bell without giving meat, he found that the dog's saliva flowed. The dog had been conditioned to salivate at the sound of the bell. The sound of the bell had become a conditioned stimulus and the salivation at the sound of the bell a conditioned response. This method of conditioning is called classical conditioning.

Of course, there are many behaviorists around today. One of the foremost spokesman of behaviorism is psychologist B. F. Skinner. It is fitting that we close our examination of behaviorism with some of his comments: "I think the main objection to behaviorism is that people are in love with the mental apparatus. People won't accept that man is a complex machine. If you say that the mental apparatus doesn't really exist, that it's fiction and let's get back to the facts, then the mental apparatus lovers have to give up their first love. The Freudian business is dying out and as for the Gestalt, that never was anything. They are not doing anything, they are not getting anywhere, and the behavioristic people are."

A second and different point of view toward man can be found among the group of psychologists who emphasize the Gestalt. Starting out as a group of German psychologists, the Gestaltists weren't too impressed with the mechanical orientations of the behaviorists. Instead, the Gestaltists were very interested in the territory between the stimulus and the response -- the organism.

Let's see more specifically how Gestalt differed from behaviorism. The word "Gestalt" reflects an outlook which deals with a person's perception, mental patterning, and organization. Moreso, the Gestalt refers to an individual being able to self-regulate much of how he acts. Hence, man is viewed as a very active person who is the main source of his actions. Notice that what happens inside the person is much more important than what happens outside of him -- the stimulus which the behaviorists highly regarded.

Historically, Gestalt psychology began with phenomenon of vision as a psychological problem. For example, Gestaltists would ask questions like:

1) What do you see in this pattern on the left screen? Gestaltists would use this drawing to demonstrate that an individual organizes visual sensations into perceptions. This pattern can be organized into two ways; either as a goblet or vase or the viewer may perceive two silhouettes.

2) Now look at the picture on the center screen. What do you first see? A man or a mouse?

3) Now examine the picture on the right screen. What do you first see? A young lady or an old woman?

For the Gestaltist, the responses to these visual stimuli can't be explained as a mere adding up of experiences. Rather, man discovers the organization in the visual stimuli as well as imposing his own mental organization or pattern upon the stimuli. Hence, perception is primary to the Gestaltist for understanding the way man acts.

One of the great Gestalt psychologists was a German named Köhler. Köhler, between the years 1912 - 1917, did some fascinating work in an area of thinking called insight -- you know, the "Aha! I have it!" feeling when you've suddenly solved a baffling problem. Insight usually produces some novel or different way for solving that baffling problem.

In some classical experiments by Köhler, a chimpanzee in a cage was given a hoe to reach a banana outside the cage beyond arm's length.

Most chimps explored and played with the hoe. But occasionally, a chimp would suddenly run toward the hoe, put it on the further side of the banana and pull it in.

In another case, Köhler suspended a banana from the ceiling of a cage too high for normal reaching or jumping. Köhler also placed a wooden box in the cage. The chimps looked for a way of getting to the banana. Suddenly, the box instead of being a toy was perceived as a jumping stool. After the perceptual solution was reached, the action of dragging the box closer to the banana, climbing on the box, and jumping for the banana came very quickly and efficiently.

Hence, Köhler found that once the chimp (and even human) saw the relationships in a problem, his behavior toward the problem changed. Once the chimp (and even human) saw the solution to the problem, he immediately engaged in behavior appropriate to that solution.

Having this brief introduction to behaviorism and Gestalt, how do you view man?

Applications of Psychology Script

In the United States, psychology was quite popular in the early 1900's. However, it was still thought of as a sideline of philosophy and not really a subject to be studied in its own right.

Then during World War I the military needed some means of finding the right type of job or skill for each man. They called upon psychology to develop a number of aptitude and intelligence tests in order to properly place each person. From this necessary application of psychology to solve an important social problem came many other branches of psychology that make up the field as it is today.

Let us take a brief look at some of these areas.

The largest area of specialization within the field of psychology is clinical psychology. This area does research in mental illness, diagnoses of patient problems through the use of psychological tests and interviews, and then tries to treat the problem. A clinical psychologist primarily gives tests and then interprets the results while a clinical psychiatrist (a medical doctor) prescribes treatment for any physical ills that may be causing the mental illness.

Another important area within psychology is counseling. Found in many schools and colleges, the counselor works with persons who have only minor emotional, vocational, and academic problems. The counselor is also trained to give intelligence and aptitude tests, interest inventories and personality tests and helps explain the results from these tests.

Closely related to counseling is another important part of psychology called educational psychology. Here new methods of teaching are studied so that students will learn as much as possible with a better understanding. There is also an attempt to identify the student's emotional needs and what program of study will best suit each person. The student's rate of progress is also measured.

One of America's largest employers today is the United States government and here too are found many psychologists. Their job is an interesting one -- ranging from testing the effects of weightlessness on the senses before each moon shot to counseling injured war heroes for the Veterans Administration in V. A. hospitals. They also work in an area called "human engineering" that attempts to design equipment with man in mind to run it. The governmental psychologist also measures public attitudes concerning economic affairs.

Did you ever wonder where all of those ads came from on the radio and television? Why do some ads stay on longer than others? Why do you remember some and forget others? All of this and more is important to the industrial psychologist. The industrial psychologist must find out what products will sell and evaluate the effectiveness of a company's advertising. Along with advertising, psychologists working in industry also help place men in specific jobs, improve training programs for new employees, and help build better communications between employer and employee.

But what about all those stories you've heard about the psychologist and his rats, or cats, or chimps...Yes, those are all very important and every psychologist has had some training in this area -- experimental or comparative psychology. Here the comparative psychologist tries to study the behavior of animals in order to predict man's behavior. Animals are used primarily because human behavior is so complex and extremely difficult to study. Furthermore, human beings cannot be used experimentally if there is any possibility that the experiment might be harmful.

Closely related to comparative psychology is physiological psychology. Physiological psychology deals with how our behavior is affected by physical ailments, drugs, and other medicines. Much work has been done recently by using electrical probes on various parts of the brain to find out which areas stimulate certain behavior patterns. In this area too new drugs and medicines are tested.

Another fascinating area of psychology is that of social psychology. Here workers attempt to explain the behavior patterns of many different types of people. Many social psychologists can be found working in jails, penitentaries, and half-way houses. The social psychologist can also assist in solving social as well as economic problems.

Lastly, and one of the most important fields in psychology is the developmental psychologist. This person specializes in learning about how children develop, how learning abilities can be improved, how personality develops, and how behavior can be modified.

These then are many of the areas that make up modern psychology. It's field is vast and touches each person daily. Ultimately, studying psychology can give one a better understanding of oneself and how one relates to others. As one famous psychologist, Rollo May, said: "My own interest in psychology has always been to achieve an understanding of man's temperament -- what makes people strive for something, what makes people become neurotic, what makes people commit suicide, what makes people become alcholics, what makes people paint pictures, what makes people fall in love..."

APPENDIX B

LOG OF MATERIALS COST FOR 30 MINUTES OF INSTRUCTIONAL AMI PROGRAMMING

I. Graphics	
A. Lettraset letters	$ 6.00
B. Illustration board	4.00
II. Film	
A. 1 roll of High Contrast Copy with no processing	1.15
B. 2 rolls K-135 with processing	10.82
C. 10 rolls KPA-135 with processing	54.08
III. Blank Slides	
A. Ready mounts for blanks and High Contrast film	3.00
B. Construction paper	.50
IV. 3 - 140 Carousel Slide Trays	12.00
V. 3 rolls of 1200 foot audiotape	9.75
TOTAL	$ 101.30**

** Cost does not include dark room processing of High Contrast film nor duplication of testing materials.

APPENDIX C

LOG OF PREPARATION ACTIVITIES AND APPROXIMATE TIME EXPENDED IN EACH FOR 30 MINUTES OF INSTRUCTIONAL AMI PROGRAMMING

Phase	Time in Hours
I. Preplan A. Identify a need. B. Outline some broad learning objectives. C. Examine human nature and learning philosophies.	9
II. Plan A. Select and organize content. B. Read about topical area. C. Talk with specialists. D. Specify objectives. E. Examine audience. F. Look at constraints. G. Set up evaluation procedure.	31
III. Probe AMI Background, Properties, and Capabilities	5
IV. Design A. Storyboard audio and video. B. Check questions for evaluation; prepare test. C. Gather materials (audio-visual) for later production.	59
V. Production A. Audio scripting — write, rewrite and type. B. Photography. C. Graphics preparation -- titles, graphs. D. Audiotaping -- voice, mixing material, and test taping. E. Blank slide production. F. Editing of slides to complement audio. G. Scripting visual portion. H. Putting it all together.	106
VI. Preview Program and Make Revisions; Pulse Program Tape	13
VII. Set-up and Tear-down Time	2
TOTAL	225

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