INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

THE EFFECTS OF COGNITIVE STYLE AND GENDER ON VERBATIM AND GIST MEMORY FOR RAPIDLY-PRESENTED MONTAGE VIDEO

By

ROBERT F. KENNY

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSPOPHY

UNIVERSITY OF FLORIDA

2002

ACKNOWLEDGMENTS

Special appreciation is extended to Jeffry Hurt, David Miller, and David Ostroff, members of my doctoral committee, for their support in this undertaking, and all their advice and counsel as I moved through the process of completing my degree. I took classes from all of them. With each course, I became more inspired and awed by their insight, knowledge, and enthusiasm for their profession. They have inspired me to be just like them.

I would especially like to thank Lee Mullally, my committee chair, for his direction and support, and especially his determination not to let me take any shortcuts, or not to give my best efforts in the many classes and seminars I took from him, the reviews and edits for the textbook I wrote, and especially this study. He has my unending appreciation for his extraordinary patience and ability to keep me focused.

I am grateful to Chuck Braverman, whose kinestasis film was used in this study. I saw it almost 30 years ago and knew then it would somehow become a part of my life. I am particularly grateful to Randolph Wright from Pyramid Media, copyright holder of *American Time Capsule*, who graciously granted me permission to use it in this study. I am also thankful to Mitchell Stephens, whose book, *The Rise of the Image, the Fall of the Word* became the catalyst for this study. Other producers and researchers in new media like Jeff Scher and Annie Lang have also inspired me with their insights into visual perception, fast-cuts, and montage video. I am happy and lucky to have met them.

I am grateful to all the many teachers and students who helped with the review of the test instruments, pilot test, and test administration, in particular Rachael Maland, James Keith, and Marshall Broitman. I am particularly grateful to Tom Wilson and Alan Smolowe, who were there with me every step of the way, with a constant watchfulness, keen insights, special interest, and concern for what I was doing.

To my family, I thank my son, Rob, and daughter, Erin, and their spouses who cheered me on, often wondering in amazement why I would attempt to go down such a path at this point in my life.

Lastly, I extend a very special thanks to my wife, Sandra, to whom I dedicate this work. I am extremely grateful for her endurance, sacrifice, and constant encouragement through this odyssey that started more than six years ago. While I often have wondered where the time has gone, I never could imagine spending it with anyone else.

TABLE OF CONTENTS

LIST OF TABLES

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

THE EFFECTS OF COGNITIVE STYLE AND GENDER ON VERBATIM AND GIST MEMORY FOR RAPIDLY-PRESENTED MONTAGE VIDEO

By

Robert F. Kenny

May, 2002

Chair: Lee J. Mullally, Ph.D.
Major Department: School of Teaching and Learning

Younger students live in a media-centric world. Researchers have shown that today's youth spend more time watching television and movies than most any other leisure-time activity. Moreover, the presentation speed of passages on commercial television has increased significantly in the past fifty years. Researchers have shown that viewers automatically learn to cope with symbolic pictorial presentation methods through repeated exposure to television and its visual patterns. Increased exposure to rapid sequence and presentation speed brought on by rapidly-presented montage found in television programs aimed at youth raises the question as to whether these individuals remember more from this type of presentation techniques than can their adult counterparts. Recent advancements in technology have changed the way viewers look at and interpret video media. Rapidly presented video media place additional attentional

demands on their viewers. Yet these viewers have been found to be able to perceive and remember content from these messages.

The purpose of the study was to investigate whether youthful viewers are able to perceive video images that are presented very rapidly and then immediately remember verbatim information and assimilate the contextual gist of the overall passages. The study also attempted to determine whether or not there are differences in the way males and females process these images. In addition, subjects were categorized as being either impulsive or reflective to determine whether cognitive style has an effect on pictorial memory.

The study revealed that memory is not significantly affected by changes in presentation speed when test results were viewed as a composite of verbatim and gist scores added together. However, when the two scores were separated, gist memories were positively affected by increases in presentation speed. The study also revealed that cognitive style had a significant impact on pictorial memory.

CHAPTER 1
INTRODUCTION

Media educators and theorists for years have been analyzing Marshall McLuhan's famous quip, *the medium is the message* (Meyrowitz, 1985). In some regard, McLuhan's statement may be considered a pre-emptive retort to later critics of educational media like Richard Clark (1983) who claimed that media are "mere vehicles that deliver instruction but do not influence achievement any more that the truck that delivers groceries causes changes in nutrition" (p. 445). Communications theorists like Walter Ong (1982) not only agreed with McLuhan, but also extended the meaning of his message to imply that the types of media people use define the way they think. Ong's notions bring to mind possible questions as to whether today's media-centric youth perceive differently than previous generations, with implications as to the kinds of mediated instructional strategies that might be successful in motivating them to learn as well as providing perceptual stimuli for recognition and recall.

The predominant types of production techniques used in today's electronic media are changing. Encouraged by the successes of early pioneers of rapidly presented music video montages on networks like MTV, VH1, and Nickelodeon, and helped by rapid advances in technology, today's television producers regularly communicate very complex messages using fast-cuts and video montage (Stephens, 1996). Significant increases in viewership of these programs may be providing fertile opportunities for today's youth to practice their ability to receive and assimilate this fast-paced message

delivery approach. According to Seward-Barry (1977), sleeping has become the only activity that occupies children's time more than watching television or playing video games.

For these reasons, a change may be warranted in the way in which educators view the role video media play in initiating learning opportunities and conveying more complex or abstract thought. This thinking appears to be incompatible with earlier communications theorists like Edgar Dale (1969), who felt that television finished somewhere in the middle of a twelve-point influence scale in its ability to convey contextual ideas. New digital media that employ visual imagery "supplemented by quick motion, sound, and computer editing" (Stephens, 1996, p. 69) may be ready to take on the same predominance as a communication medium in only fifty years that it took Guttenberg's great invention five hundred years to accomplish. Corcoran (1981) defined *intelligence* as a skill in a particular medium and suggested that the symbolic codes used in that medium that serve communication purposes and are internalized by a receiver become an authentic tool of thought. Research studies in which technology (i.e., media) was successfully used as cognitive mind tools appear to back up this thinking (Hokanson, 2000; Jonassen, 1996).

Statement of the Problem

Researchers and educators looking into the intrinsic instructional value of video media have presented conflicting views on the role visual perception plays in attention, motivation, and recall. There have been several studies that have looked into the potential affect mediated coding systems have on cognition (Davis, Scott, Pair, Hodges, & Oliverio, 1999; Nugent, 1982; Seidman, 1981; Walma van der Molen & Van der Voort,

2000). While many theorists have looked into the use of video, most of them had little good to say about its ability to bring anything new to the table with regards to using it as a communicative medium (Berlo, 1960; Calvert & Scott, 1989; Ide, 1974; Kozma, 1986). This may have been due to the limitations imposed by the technology in use at the time. Recent technological advances in commercial television production techniques allow today's producers to readily integrate fast-cuts and montage and provide new tools to more easily communicate complex thought using a pictorial narrative structure. A correctly constructed rapid-cut montage passage has been found to add clarity because of the phenomenon that the interpretive whole of a montage segment literally communicates more than the sum of its parts (Hitchon, Druckler, & Thorson, 1994; Stephens, 1996). In other words, it is the composite whole of all the visual images in a passage or segment when considered all at once that gives it extended meaning. In addition, newer editing techniques have evolved that emphasize the *perceptual* continuity of a rapidly presented image-based narrative structure, rather than the classical point of view of editing that stressed the importance of applying strict rules in order to obtain slow and smooth transitions between successive shots (d'Ydewalle & Vanderbeeken, 1990).

One of the specific problems being addressed in the current study is to update the thinking with regards to using video as an instructional medium in light of these new technological developments. A review of the literature of the past twenty years has already yielded some studies into the impact of rapid video editing in an educational setting (Stephens, 1996; Wetzel, Radtke, & Stern, 1994). However, more recent advances in technology that have superceded those studies and an increased usage of rapid-cuts and montage production techniques in commercial television programming have created the

need to update any earlier research that does exist. Lang has conducted more recent studies that have looked into the effectiveness of fast-cuts (Lang, 1994; Lang, 1996; Lang & Basil, 1998; Lang, Bolls, Potter, & Kawahara, 1999; Lang, Zhou, Schwartz, Bolis, & Potter, 2000), but hers deal with television in a casual viewing environment. The present study was designed to look at the effect of these rapidly presented visual passages in an educational setting. It is hoped that a new look at rapid visual processing brought on by this study might lay the groundwork for educational media producers to update their thinking about rapidly presented video montage by providing a research basis that appears to be lacking currently. Specifically, the questions that are being reviewed are:

1) Is it possible to remember content solely from rapidly paced visual montage that is not supplemented with some form of verbal narrative?

2) Is there a difference between gist and verbatim memories for rapidly presented videos?

3) How do individual characteristics such as gender and learning/cognitive styles affect a student's ability to process fast-cuts/montage video presentations in a classroom setting?

Need for the Study

As has been stated already, most of the previous studies into the impact of fast-cuts/montage have concentrated on commercial television viewing (Bryant & Rockwell, 1991; Lang & Basil, 1998; Lang et al., 1999; Lang et al., 2000; Zillman, 1991). There has been one attempt to look at the use of fast cuts/montage in an instructional setting (Keller, 1976). However, that investigator looked at viewers as a collective whole with little regard for individual differences in personalities and capabilities such as cognitive style. Further, this study is more than twenty-five years old and its subjects were college-level students enrolled in communications classes, rather than school-aged students studied in

their formative educational environments. The current study attempts to resolve some of these contradictions to see the effect fast video presentations have on immediate memories for their content.

Educational media researchers have had to contend with a conflicting view that holds that the relatively fast presentation speed of television programs creates an environment that may be detrimental to attention and recall (McCollum & Bryant, 1999; Neuman, 1976). To the contrary, Intraub's (1999) studies into conceptual masking have shown that humans are able to recognize and recall pictorial presentations when a minimal amount of lag time separates individual images. In addition, some of the more recent successes with children's programs have shown educational successes that are due to their rapid and rhythmical presentation speed (Anderson, Alwit, Lorch, & Levin, 1979; Anderson and Bryant, 1983; Anderson & Collins, 1988; Pearl, 1982). Still others have proposed that presentation speed in instructional media may actually add interest to otherwise uninspiring content (Canelos, 1986; Edgar, 1997; Hawkins, Pingree, Bruce, & Tapper, 1997; Hill & Lang, 1993).

Previous examinations into the effects of casual television viewing have not translated too well into an educational setting (Salomon, 1994). As Kozma (1986) stated, "viewership should not be confused with learning" (p.14). However, once one delves deeper into these studies, four possible reasons for this lack of transfer become apparent. First, the reputation that commercial television has held for being nothing more than an entertainment device has hurt its standing in educational circles and has caused detrimental pre-conceived notions about how viewers are to be properly introduced to televised content (Wetzel et al., 1994). Second, many of the schemas used in commercial

television are considered by some to be nothing more than prototypical, trite, and overly-familiar formulas that reduce attention and concentration because they have been over-learned (Anderson et al., 1979; Langer & Imber, 1979). This schema also "leads one to revert to a mindless routine in which the material is ignored or receives a low level of attention" (Wetzel et al., p. 169). This alleged over-familiarity with format has lead many educators to believe that viewers will have difficulty responding appropriately to educational televised presentations, unless some form of outside instructional intervention is also inserted (Wetzel et al.). The third reason is that many of the studies into casual viewing tended to lump all viewers into a single category (Lang and Basil, 1998; Lang et al., 1999; Lang et al., 2000; McLuhan, 1964; Neuman, 1976; Tyner, 1998; Walma van der Molen & Van der Voort, 2000). Classical instructional models tend to validate the value of classifying learners by their individual differences (Gentry, 1998; Joyce, Weil, & Calhoun, 2000).

The fourth and possibly most important reason for the lack of correlation between studies of casual viewing and those performed in an educational setting is that the learning environment is thought to present a different set of circumstances--a unique view as it were. This is based on the importance placed on the medium to be evaluated as to its unique ability to bring about some type of alteration of intellectual behavior or thinking process. Although many of the symbolic (i.e., intellectual) combinations found in non-verbal endeavors such as music, painting, and dance can be displayed directly on television, there has been some question as to the extent to which transformations in the thinking process are actually created by viewing the medium, and whether any changes that might occur are of any significance (Ide, 1974). Television has not been given credit

for yielding any new intellectual construct of its own. Previous studies into the value of using television as a medium for intellectual change have demonstrated mostly *negative progress* in that the results showed television *did not actually interfere* with learning, or that it *was not less effective* than other forms of media (Thompson, Simonson, & Hargrave, 1996; Wetzel et al. 1994). The current study attempts to clarify where rapidly presented montage might fit into the overall instructional scheme.

Previous attempts at investigating rapid video and montage presentation were limited by some incorrect assumptions as well as limitations on technology. For example, Intraub's (1999) experiments that demonstrated weaknesses in an individual's ability to understand and remember briefly-glimpsed images dealt with pictures that were not or only very loosely related. The proper use of montage implies that the pictures included are at least conceptually related. Intraub indicated that subjects might be able to hold more than one picture at a time in a conceptual buffer, so long as the "series was not too long" (p. 57). Keller (1976) tried to fix this shortcoming in his dissertation but ran into some serious technical flaws in his overall design. Intraub even admitted that his experiments might have been more successful if they included pictures that were related to one another. His intuition may have been correct. It appears that humans may have the ability to construct meaning from these types of presentations through the use of interpretive coding (i.e., the process by which meanings are put together from specific parts of visual communications). In describing their research in teaching Native Americans how to use film to communicate meaning, Worth and Adair (1997) noted that the process of coding has been neglected in the study of most of the fine arts, including film. Their comments alluded to the fact that the *form* of a medium might be what carries

its meaning. In an earlier attempt to extend this notion to television, Pearl (1982) discussed the relationship between form and content and admitted that *it is the form* (that is, the way it uses verbal and linguistic codes) --not the content-- of television that makes it a unique communicative medium. However, she also cautioned that form and content cannot always be distinguished "no more than grammar and meaning in any verbal language can" (p. 24). She went on to say that some forms are unique to a particular medium and apply syntactical meaning only in the context of that medium. For example, slow motion is not real and its meaning must be learned. Other researchers have shown that these unique formats, once learned, generally become used by people in their own thinking (Barnett, 2000). That is perhaps why, for example, when one applies slow motion to a video message, it generally carries some contextual or emotional connotation each time it is used. The current study tries to apply the same logic to fast cuts and video montage to see if this presentation format can be interpreted in such a way as to portray some implied meanings of its own.

Previous research into using increased or compressed presentation speed and movement in multimedia has been the subject of controversy in the literature. Some studies of commercial broadcast video have shown that the relatively rapid presentation speed of programs may have a deleterious effect on recall (Alwitt, Anderson, Lorch, & Levin, 1980; McCollum & Bryant, 1999). Other research has shown that the instructional value of video is aided by a systematic presentation speed of information as a presentation strategy (Comstock, Chafee, Katzman, McCombs, & Roberts, 1978). Still others have shown that presentation speed and rhythmicity in leisure-time media can actually heighten enjoyment, enhance motivation, and can "play an important part in

determining the affective or emotional response of message receivers" (Seidman, 1981, p. 49). Lang et al. (1999) and Lang et al. (2000) looked into presentation speed as its own construct, comparing/combining it to/with arousing content. They discussed the effect of adding interesting and arousing content as having a positive effect on cortical arousal, and therefore, recall and recognition. Lang et al. (2000) also alluded to future research that should continue to probe the shape of the relationship between presentation rate and recall and test even faster rates of edits to determine whether there is a point at which memory begins to decline. They suggested that producers who want their messages to be remembered should create arousing messages that are presented slowly or at medium speed, or calm messages that are presented at medium or rapid speed. They concluded that producers should not create messages that are either calm and slow or arousing and fast.

The effect of integrating increased message presentation speed directly into instructional messages in an educational environment whose content might be considered by some students as less than arousing will be examined in the current study. It should also be noted that Lang et al. (2000) considered cuts to be *fast* if they changed at a top rate of eleven to twelve per thirty-second segment (i.e., one every 2-3 seconds). The current study looks at a top rate of one cut every one-third to one-half of a second, or roughly ten times as fast. The slow messages will run roughly equivalent to Lang's top rate.

It should also be noted that the term *cuts*, as it was used in connection with commercial television research, differs from what how it was used in the current study. In those studies, a cut might simply mean a wipe or a swipe, or a change from one camera

angle to another. The content may not change at all, only the viewer's perspective. In the current study, a cut always signifies a change in content. One picture or image was replaced with an entirely new one.

Lang et al. (2000) indicated that under very broad interpretation, the speed of message presentation of motion and edits/cuts can be considered a form of cueing. Downs (1989) also referred to presentation speed in a similar way, referring to it as a message's domain "attribute" (p. 3). Salomon (1979) acknowledged that media attributes are those that are "within the mediated stimulus, possibly shared to some extent with other forms of [sic] media" and make "the presented information more comprehensible or better memorized by learners of particular characteristics" (pp. 5-6). Under Salomon's definition, *symbols* include "most objects, marks, events, models, or pictures" (p. 29). It is assumed in this study that the rhythmic patterns afforded by fast-cuts are an *event*. Where the current study varies from previous research is that it takes the interrogation of symbols and attributes to another level. The current study aims to show that rapid presentation speed (also referred to as fast-cuts) may be considered an invaluable communicative attribute of media and is, therefore, capable of being studied separately to discover its contribution to learning. This study aims to determine to what extent that rapid presentation speed of video images either aids or interferes with recognition and recall (specifically, gist and verbatim memories), taking into consideration the changes that appear to be taking place in an ever-increasing media-centric society. Even if fast, moderate, and slowly presented visual stimuli are all shown to be equivalent in their ability to stimulate recognition and recall, educational research might benefit from discovering whether visual stimuli presented at an increased delivery pace can provide

similar instructional outcomes in a more efficient and stimulating manner --something found by some researchers to be a more practical outcome measurement for using video media than achievement alone (Kini, 1994; Peck, 1987).

Background of the Study

Younger students live in a media-centric world. Researchers have shown that youth today spend more time watching television and movies than most any other leisure-time activity (Pearl, 1982). In addition, the presentation speed of passages on commercial television has increased significantly in the past fifty years (Stephens, 1996). Researchers have shown that viewers automatically learn to cope with symbolic presentation methods through repeated exposure to television and visual patterns (Abelman, 1995; Bargh, 1988; Carr, 1982). Because of their increased exposure to rapid sequence and presentation speed brought on by fast-cuts/montage found in television programs aimed at youth, it may also be assumed that these individuals might be able to comprehend these messages on a much wider scale than can their adult counterparts. One cannot continue to assume that exposure to video, regardless of presentation speed, is simply a passive viewing activity. These advancements in media technology are changing the way viewers look at and interpret video media. In addition, the widespread availability of production techniques provides easy access to capabilities that allow people to use video media to easily create their own content. It has been widely shown that these acquisition (i.e., production) opportunities also increase exponentially one's ability to comprehend content delivered in like form (Tyner, 1998).

Purpose of the Study

This study was designed to determine if there are differences in the way visual montage messages that vary only in their presentation speed (i.e., fast, medium, or slow) are perceived and immediately remembered in an educational setting. Recent reports found in the literature, (Brainerd & Reyna, 1990; Brainerd & Gordon, 1994; Reyna & Kiernan, 1994) have suggested that researchers have been able to successfully parse memory into *verbatim* (i.e., precise/literal) memory for specific details and *gist* memory (i.e., contextual or contextual remembrances similar to that which is assessed in reading comprehension tests). This study looks at immediate memory as a whole and separately, using these same categorizations. The educational setting was determined to be several ninth grade classrooms that were categorized by gender and also further delineated by the subjects' individual cognitive/learning style. The overall sample set for this study came from that population group. For purposes of this study the identification of cognitive style was limited to the reflective-impulsive scale, as originally developed by Jerome Kagan (1965; 1966), and later refined and re-catalogued by Cairns and Cammock (1984). Identical videos that varied only in their speed of message delivery were presented to three randomly assigned groups of students. The procedural requirements for implementing the cognitive style test instrument indicated that the analysis was to be performed on a smaller subset of the sample base to see if the variance in delivery speed also affects gist and verbatim memory, and if there might be any interaction with their prospective cognitive styles.

Previously, presentation rate had been found to affect immediate memory in examinations of viewers in a commercial viewing environment that compared several

contrasting theories about memory and cognition (Lang et al., 1999; Lang et al., 2000). These investigations concluded that individuals have limited capacity for processing information and indicate that a rapid influx of visual images maintains an individual's orientation reflex and stimulates cortical arousal. Unlike other forms of arousal, cortical arousal has been determined to maintain a person's ability to pay attention (Pearl, 1982; Reeves, Thorson & Schleuder, 1986; Zillman, 1991). The earlier studies also alluded to conflicting findings about the impact of the content on attenuation and arousal (Anderson, 1986; Archer, 1965; Basil, 1994), maintaining that arousing content combined with too fast a pace/message delivery would normally result in loss of retention and recall. Unlike these previous studies that included occasional highly arousing content, the current one used an educational topic that might not be considered by many students as arousing (i.e., American history) in an authentic classroom setting.

The current study also attempted to improve upon some of the various shortcomings found in the one other earlier study (Keller, 1976) that used very similar but out-dated methodologies. In his doctoral dissertation, Keller used a self-created kinestasis film (i.e., rapidly cut video montage) in an attempt to define what effects on recall are realized by speeding up transmission or information to less than one second per frame. Standards previous to Keller's study deemed a presentation to be *rapid* if cuts occurred every five to ten seconds. Keller also endeavored to derive empirical data to determine how well the kinestatic process worked on recall and how efficient visually compressed presentations might be for instruction, trying to find out whether the kinestasis technique was more than a simple artistic endeavor. However, by his own admission, Keller's research came up short because some of his methods may have been

lacking in rigor. For example, he utilized random pictures as opposed to those with similar contextual content. As schemata have been long shown to be of importance to learning (Bartlett, 1932) studies looking into recognition and recall need to use a single context. Additionally, most of the problems Keller ran into appeared to be related to production and processing techniques that reflected the state of the art of video production at the time (Keller). His difficulties ranged from dissimilar content, picture size that was too small, and brightness that caused a deviation in results based on the seat location of his subjects. Due to technological shortcomings, he utilized what are known in the industry as *wipe-ons/downs* as his motion technique. Wipes are production techniques utilized in television broadcasting in which one picture is replaced by another that is gradually *wiped* across the screen. An edit or cut, on the other hand, is where one picture immediately and completely replaces another. In this technique, the succeeding picture frame partially masked, or interrupted the previous one and vice versa, causing a potential confound. There has been some reference in the literature (Goodglass, 1971) that indicates that visual masking introduces a new, unnecessary variable into studies on visual processing. Keller also had problems in his test phase because he could not cause the pictures to replicate the movements that occurred in those same pictures when he presented them originally. He admitted that this approach was flawed in that the whole picture could not be viewed until the end of the procedure, causing a degradation of recognition and recall. The current study attempts to clarify some of those issues. Keller referred to the need to "find another motion procedure" (p. 90). The current study used a commercially-made video montage that refers entirely to the same subject matter, for

which permission has been granted by the copyright holder to modify for use in this study (R. Wright, personal communication, March 21, 2001).

Finally, Keller's (1976) subjects were college level communications students who were segregated by grade point average. He identified the need to find a more rigorous randomization variable than GPA, noting that there was a significant interaction effect among the subjects, who accounted for almost 24% of variance in picture memory recognition, while the treatment effect only accounted for 6%. The current study attempted to look at an additional classification method (i.e., cognitive style) that had been identified and validated in research subsequent to Keller's study (Green, 1985; Kagan, 1965; Okun, Callistus, & Knoblock, 1979; Ridberg, Parke, & Hetherington, 1970; Salkind & Wright, 1977; Witkin & Goodenough, 1981).

Research Questions

Following are research questions raised in this study:

1. Is there a difference between the amount remembered in terms of verbatim (specific details) and gist (contextual content) memory when changes in presentation speed occur?
2. Are there gender differences in one's ability to remember information presented in rapid video presentations?
3. Are verbatim and gist memory affected by a learner's cognitive learning style?

These specific questions are intended to lead to an over-riding question as to whether if the amount of information retained through fast-cuts/montage is found to be equivalent to more moderately paced instruction, is a faster delivery more educationally efficient, as determined by the fact that the same amount of material can be successfully presented in a shorter time interval?

Delimitations of the Study

This study was conducted with certain limitations. In previous normative data validation and reliability studies for the cognitive style testing instrument being used in this study, subjects were limited to ninth grade students from a specific geographical area. Only those students who agreed to participate and whose parents signed a consent form are included in the study. The study only looked into the amount of information that could be immediately remembered from the video passages. While immediate memory has been deemed an important prerequisite to learning, this study makes no representation with regards to whether the material is subsequently learned (i.e., retained for longer periods of time, or able to be utilized in subsequent tasks) by the subjects. The fact that *learning* may or not actually take place implies that additional pedagogical and cognitive techniques are subsequently employed, and is beyond the scope of this study.

Limitations of the Study

This study contains limitations and assumptions that may affect the generalizability of the results. The study is only generalizable to the population from which the sample is taken. In this case, subjects came from one high school of a mixed ethnographic and demographic make-up in North Central Florida. While it is understood that students who have previous knowledge of the topic (i.e., American history) might be more likely to recognize and recall the pictorial representations in the videos, it is also assumed that this knowledge base was most likely equally distributed throughout the sample set because subjects were selected at random. Also, as the students were randomly assigned to the three presentation groups, it was determined that any previous history knowledge would not materially affect the results.

It also should be noted that this study has limitations with regards to its ability to predict actual learning. The study was designed to only define certain rules about presentation speed of an initial presentation that may become one component of an overall instructional strategy. By itself, the study does not attempt to make any predictions or value judgments about those strategies. Rather, it simply attempts to support the validity of fast-paced video segments that might become building blocks in sound pedagogical patterns, as delineated in instructional models that might be subsequently proposed by future educational research.

Definition of Terms

Following are specific definitions of terms used in this study:

Cognitive style is the stable ways in which persons differ in perception and encoding of information (Wittrock, 1979). Specifically, it is Kagan's scale (1966) that was later modified by Cairns and Cammock (1984) that is used as a basis for the current study.

Conceptual masking is concept that describes the phenomenon that occurs when a new visual image is introduced into temporary memory and thereby occludes the previous one (Intraub, 1999).

Gist Memory has been successfully used as a treatment effect in several studies looking into prose memory (Biederman, Rabinowitz, Glass, & Stacy, 1974; Brainerd & Gordon, 1994; Cowan, 1998; Reyna & Kiernan, 1994; Voss, Tyler, & Bisanz, 1982). Gist memory is one of two types of determinations (the other being verbatim memory) as to the amount and quality of immediate memory. In previous research gist determination required subjects to try to identify the main idea in a passage or correlate among several

scenes. The objective of assessing gist memory in this study was to determine whether the subjects comprehend the basic contextual themes presented on the video and to compare it to subjects' ability to immediately remember specific (i.e., verbatim) details from the video presentation.

Kinestasis is a term coined by Charles Braverman (1969) that is derived from combining the Greek words for *moving* and *static*. The term refers to a film or video process that presents still and/or moving images at speeds that create the illusion that they are moving in a continuous flow. The treatment video used in this study is a video copy of a kinestasis film developed by Braverman, and whose copyrights are owned by Pyramid Media.

The term media includes films, television, and compressed motion pictures found in digital multimedia. Previous researchers into presentation speed (Wetzel et al., 1994) and compressed motion pictures (Arnold, 1996) delved into one or more of these types of media and have referred to them as virtually interchangeable in meaning. This study also refers to the term new media. This term connotes an inference about the convergence (the merging of television, computers, and the telephone) that is taking place. The current study uses *screen media* and *video media* interchangeably when referring to its capabilities to present a pictorial story. It uses *new media* to mean traditional media that are being technologically advanced due to convergence.

Minimal unit of analysis is that product of semiotic analysis which is the smallest interchangeable element that still retains the basic properties of the whole symbol system but cannot be further subdivided without losing those properties (Corcoran, 1981). Hill (1981) referred to this concept as a symbol, or the basic unitary element of intellectual

activity. In the assessment of reading comprehension, a word is often associated with the unit of analysis (Murdock, 1982). In this study, individual picture frames are considered as being the minimal unit of analysis. These may be equated to a paragraph (Corcoran) for purposes of comparing the results to reading comprehension-type assessments.

Orienting Response (OR) is the automatic response to a stimulus that helps an individual focus attention on that stimulus and is often captured through psychometric means (i.e., an attentional blink, or a look (Lang & Basil, 1998; Lang et al., 1999; Reeves et al., 1986; Thorson & Lang, 1992). An OR can also cause an overt arousal response that may be detrimental to recall. In this study the orienting response is considered to be a potential confound and is dealt with in the methodology of the study. Subjects will be provided a short preview of the video presented at the same speed in order for them to get used to the format.

Presentation speed is the rate of scene changes or edits of a video media presentation and is the operative term utilized in this study. In many studies used to support the premises in this study, *pacing* has been the operative term used to refer to the speed of message presentation (Corcoran, 1981; Hill & Lang, 1993; Lang et al., 1999; Lang et al., 2000; McCollum & Bryant, 1999; Reeves et al., 1986; Schale, 1971, December; Wagely, 1978; Zillman, 1991). The term *pacing* also carries certain pre-conceived connotations in educational circles that have nothing to do with the premise of the current study. In order to avoid confusion, all references to pacing were replaced in the current study with the terms *presentation speed*, or *speed of message presentation.*

Screen media are that which use controlled exposure of sequenced images on a screen (either on a video or movie screen), often in fixed relationships to speech, music,

and other sound (Corcoran, 1981). Much of the literature presented in Chapter 2 refers to screen media. For purposes of this study screen media and video media are considered to be identical.

Verbatim/rote memory refers to subjects being able to identify whether specific objects within a scene, or overall scenes occurred in the video that has just been seen (Brainerd & Gordon, 1994; Reyna & Kiernan, 1994). In some studies, verbatim memory also has been referred to as *object recognition* (Tse, Vegh, Marchionini, & Shneiderman, 1999). For purposes of this study, verbatim memory is assessed positively and falsely. Subjects were asked to select an image that was presented in the video display (positive identification) from a group of pictures immediately after presentation of the test video. Subjects were also are asked to decide whether any picture or series of pictures in a group actually appeared in the video (false identification).

Summary

Meyrowitz (1985) posited the idea that new media, through its ability to merge many formerly distinct knowledge situations, appear to be "breaking down the boundaries among various disciplines, opening new dialogues, and fostering the development of cross-disciplinary areas of study" (p. 327). He also speculated that these new kinds of electronic media may be "introducing our children to a different way of thinking that involves the integration of multiple variables and overlapping lines of simultaneous actions" (p. 326). This assertion proposes, among other things, that electronic video media have already greatly reduced the influence that time and location used to have on what people know. It is not, therefore, unreasonable to agree with Stephen's (1996) proposal that a transition may be occurring in the way the youth of

today think. This appears to be at odds with the linear thinking processes associated with print media. The current study, through the questions posed in the current chapter and a review of the literature found in the next, attempts to find out how significant these changes in perception of new media are.

CHAPTER 2
REVIEW OF THE RELATED LITERATURE

Perception and Knowledge

When humans learn from the world around them, they receive stimuli (information) via one or more of their five senses: audition (hearing), gustation (taste), olfaction (smell), kinesis (touch), and vision (sight) (Murch, 1973). Processing received stimuli can be automatic or be the result of some literal attempt to react to it. For example, when one smells food, it may make him or her feel hungry. This may happen with or without that person actually realizing what is happening.

Besides being the catalyst for automatic processing of bodily functions, perception has also been considered by educational researchers as a fundamental building block for knowledge and learning. Murch (1973) posited that humans must be able to perceive something before they are able to learn about it. This information may be firsthand, or via an artificial artifact (also known as a *medium*). Gibson (1969) defined perception as a process of receiving stimuli and consciously reacting to them by assigning some meaning. Accordingly, humans tend to react to perceptions individually, based on previous personal experiences, making this experience very subjective. Winn (1982) described the process of learning as a taxonomy of three procedural steps. After a person first receives information to be stored, and later when he or she attempts to retrieve it from memory, a long process of transformation, abstractions, and elaborations takes place. The first step is *perception,* generally considered an automatic operation, in

which features are integrated into complete visual displays. *Assimilation* is the next level of complexity and involves the recognizing and integrating of information into schemata for later recall. *Analogy* is similar to assimilation but is an even more complex process that involves the temporary assimilation of new information into abstract schemata that embody other concepts that are peripherally related to it. Explained in this way, Winn alluded to perception as a necessary but insufficient step in the whole learning process.

Bruning, Shraw, and Ronning, (1999) posited that the body holds perceptions in a series of registers called memory so that perceptual analysis can occur before that information is lost. When all is working well, perception allows humans to detect the incoming stimuli and allocate attention to them. Through pattern recognition, individuals may recognize a stimulus because of their previous experiences. However, on occasion, pattern recognition may be limited, thereby preventing any learning. Marr (1982) proposed a structural approach to the relationship between perception and intellectual endeavors. He imagined that knowledge is stored in the brain as a set of statements, templates, prototypes, or models of distinctive features of a particular object or class of objects that has been perceived. Bruning et al. (1999) appeared to agree, stating that using specific, structured descriptors as an approach to recall and recognize patterns may be very helpful for teaching because it suggests that perception can be a guided activity. Teachers can instruct students "the proper knowledge needed for an accurate structural description" (p. 27). Although the visual field may be partially obstructed, the mind is still able to make determinations about what it sees, using clues and mental mappings (visual patterns) from previous experiences (Seward-Barry, 1997). Gestalt psychologists refer to this process as visual intelligence and base their theories on this emphasis of the

mind being able to discriminate parts to the whole and make other spatial determinations that are described further later in this chapter. But first, to understand more fully the Gestaltist view of visual intelligence and how it relates to this study, it might be best to consider some of the literature concerning the neurological process involved with vision.

Neurology of Vision

According to Murch (1973), biologists define vision as a process where the eye sees the world through a biological process of photic radiation, an energy source that stimulates the eye. The process begins as reflected light that bounces off objects in the environment. This optic array is focused by the cornea and lens onto the visual field on one's retina that lines the back of the eye (Seward-Barry, 1997). These images are then transmitted to the brain through various routes, one being the cortex/limbic system. This system provides stimulus to the brain, including the amygdala: the sub-cortical region within the temporal lobe (LeDoux, 1991). According to Seward-Barry, researchers have identified four parallel systems involved in the different attributes of vision: one each for motion and color, and two for form. Goldstein (1989) points out that "perception is based not on direct contact with the environment, but on the brain's contact with electrical signals the represent the environment. We can think of these electrical signals as forming a code that signals various properties of the environment to the brain" (p. 50). In other words, perception as a biological function may be described as being based on a coding system that takes in the visual signal and is interpreted by the brain. LeDoux (1991) viewed this interpretation process as a dual operation. He proposed that sensory perceptual processing takes two routes. The first travels along the amygdala and readies the body to react, even before it recognizes the need to do so. The second route is through

the neo-cortex where the signal can be analyzed and then sent to the amygdala and emotional response added after cognition (Seward-Barry). This dual processing theory provides an insight as to why visual perception takes on such a personal meaning. It also introduces the idea that will be further developed later in this chapter that there can be two very different emotional reactions to perception: one helpful to cognition, and one that can be detrimental.

Visual Perception Theories

For some theorists, seeing is more than a simple biological function. According to Seward-Barry (1997), visual perception is actually taking the visual image, combining it with other data from the other senses, and synthesizing it with previous experiences. Perceptual psychologist J. J. Gibson (1979) made a distinction between the *visual field*, the image that appears on the retina, and a *mental creation* of what comprises our world, giving further credence to the fact that to an individual, reality is very interpretive and subjective. To constructivist theorists, visual reality is simply a "map-like image, the end product of a process that begins with light refraction in the environment and ends in the intricate and complex dynamics of the mind" (Seward-Barry, p. 15). Viewed this way, perception is what intercepts an outside stimulus for a person to create an individual reality. When video producers present their images in unique ways (such as utilizing rapidly presented montage) they simulate this mapping process and create opportunities for viewers to construct their own views and interpretations.

Gestalt theory, as outlined by Ellis (1938) and later by Wertheimer (1959), shares some common beliefs with constructivists. However, this theory proposes a more consistent view of perception among individuals through the concept of *idea grouping*

(Seward-Barry, 1997). Characteristics of stimuli cause humans to structure and/or interpret a visual field in certain ways or *groupings*. Wertheimer noted the following primary factors in determining these groups:

Proximity - Humans tend to group visual elements together according their spatial nearness.

Similarity - Humans tend to group together items similar in *some* aspects (i.e., their design, size, shape, textures, etc.).

Simplicity - Visual items are grouped together by humans into simpler figures, according to their symmetry, regularity, and/or smoothness.

Closure - Humans tend to complete on their own an incomplete picture or other visual entity.

Wertheimer was particularly concerned with problem solving. While problem solving per se is outside the scope of the current study, these ideas form an important basis for some of the assumptions about the affect that rapidly presented video montage may have on memory and learning. Wertheimer felt that the essence of problem solving behavior is one's ability to be able to see the overall structure of a problem through the use of one or more of the above classifications which all allude to the ability to fill in the gaps, incongruities, or disturbances that prevent one from seeing these overall structures and use an innate need to do so as an important stimulus for learning. According to Ellis (1938), other gestalt thinkers like Kofka and Köhler agreed with Wertheimer but extended these ideas to looking at visual patterns. The laws of visual organization found in these schools of gestalt thinking (i.e., proximity, similarity, simplicity, and, closure) form a strong theoretical basis for visual media like film, video, and television to be able to create its own unique sense of reality (Seward-Barry). The laws of visual organization

guide the senses to transform individual visual inputs into composite visual units made up of real and imagined stimuli, forcing one to make inferences about them (Murch, 1973).

These views of perception lend credence to a belief that a standardized or continuous view of the perceptual process can be formulated and forms the basis to the theoretical approaches used in this study as they relate to an individual's ability to remember and aggregate more complex meaning from video montage. Studies by gestalt psychologists Richard Gregory and Semir Zeki into concepts, such as *phi phenomenon* (processing movement as individual sequences separated by brief instances) and *apparent movement* (the impression of movement from two stationary stimuli), reveal that there might be two distinct systems of visual perception in the brain (Seward-Barry, 1997). They also show how specialized areas of the visual cortex work together to create a unified perception. One is responsible for perceiving movement between brief flashes and the other takes care of perceiving movement between long flashes. These two concepts provide further credence to the idea that the visual whole is made up of several independent parts which, taken together, can furnish additional meaning, as afforded by fast-cut montage found in new media technologies.

The visual process, as efficient as it appears to be, is not perfect (Seward-Barry, 1997). Much of gestalt theory is based on the *law of pragnanz* which stipulates that "psychological organization will always be good (i.e., simple, regular, symmetrical) as the prevailing conditions will allow" (Koffka, 1935/1963, p. 110). It is also the early twentieth century counterpart to Aristotle's concept of *common sense* that posited that "efficiency is achieved through simplicity, regularity, and symmetry" (Seward-Barry, 1997, p. 47). These same theoretical concepts (proximity, similarity, simplicity, and,

especially, closure) explain how humans can often be visually fooled by slights of hand or other artistic manipulations of visual stimuli, how they are able to see paintings differently, or be taken in by virtual reality. The mind tends to close off partially completed geometrical patterns, and/or create its own sense of reality based on what it thinks it sees (Seward-Barry). These same four laws also explain how montage video provides the continuity needed to be able to tell a story visually.

Fast Seeing

Evidence points to the ability of humans to be able to process visual patterns very rapidly (Coltheart, 1999; Tovee, 1998). Theory suggests that impulses processed in the visual cortex are able to process almost 87% of perceived information within 400 milliseconds. According to Tovee, clinical researchers also found that this operation is not linear. In fact, the majority of information (around 67%) is actually available within the first 20-50 milliseconds of the initial "spike train" (p. 143). The investigation of what is understood from rapidly presented *sequences* of visual stimuli began with the research of Potter and Levy, in the late nineteen sixties and Forster in the early seventies (Coltheart). Their studies suggest that most information encoded in an impulse is available to the brain to act on at the very beginning moments of reception. Forster developed a technique of rapid presentation of sequences termed RSVP (rapid serial visual presentation). Potter and Levy provided a comprehensive review of RSVP methodology, which proposed that humans possessed a natural short-term memory system (Coltheart). These researchers confirmed their studies by placing constraints on how long the visual system has to process stimulus in both forward and backward masking functions in which the masking stimulus follows very quickly the onset of the

initial pattern/object stimulus. Through studies on rhesus monkeys, researchers have been able to point out which cells within the brain are responsible for certain functions such as pattern recognition. Once identified, these brain cell studies were translated to human subjects, who were tested to determine how fast the brain is able to react, recognize, or otherwise discriminate between faces of individuals. Researchers found that after only a 20-millisecond delay, test subjects could recognize and discriminate face identity, indicating that the minimum amount of time that neurons need to be active in order to mediate recognition and discrimination is in the 20-30 millisecond range (Tovee). The next stage to processing this information is the brain reacting to these stimuli and initiating reactionary motor commands. Independent follow-up research, based on clinical tests performed on epileptic patients in preparation for brain surgery, indicates that this process takes somewhere in the 150-200 millisecond range (Allison, et al., 1994). These researchers confirmed that the whole process of pattern recognition and reaction takes in the neighborhood of 400-500 milliseconds, indicating that, not only can the visual system process information rapidly, it can also rapidly update and modify responses, based on previous experiences (Tovee). For example, people can rapidly and accurately reconstruct meaningful objects out of fragmentary or ambiguous evidence (Ramachandran, 1994). These findings appear to denigrate traditional assumptions about perception that awareness must mediate between stimulus and response. In fact, researchers now know that many responses are automatic and emotional, and may bypass cognitive processing all together (Seward-Barry, 1997). The fact that initial responses can precede cognitive processing has caused a renewed interest in subliminal research, which deals with subconscious message registration. However, results from research in this area

have been inconclusive due to the inability to date of researchers to quantitatively delineate and measure perceptual responses (Seward-Barry).

Most previous research into limits on perception and recognition of rapidly presented stimuli dealt with verbal information (Coltheart, 1999). However, Intraub (1999) worked extensively with scene recognition and memory. Citing experiments of Potter, she suggests that abstract representations of scenes are used in the interpretation of pictures and scenes. Using a technique called *conceptual masking*, she was able to show that the attentional demands of new and meaningful pictures interfere with one's ability to continue processing their predecessors. Perhaps, sharing the gestaltist view of closure, Coltheart further demonstrates this phenomenon, referring to it as "boundary extension" (p. 6). Even in rapidly presented stimuli, subjects indicated that they tended to remember information that was not shown but was likely to have been present outside the picture's boundaries. Further, Intraub produced experiments that showed that photographs, when shown in rapid succession, (at a rate that mimicked one's ability to scan them) were unable to be recognized by their viewers, even a few moments later. These studies seem to report limitations on memory, rather than perception, shown with Intraub's studies of a series of rapidly presented pictures that were separated by blank screens of varying lengths of time. It appears that the longer time lags between meaningful pictures permitted viewers to properly process, categorize, and consolidate their meaning. Potter argued (Intraub) that a picture is identified within about 100 milliseconds. Until the item is identified, it is "vulnerable to visual masking by a new visual event" (p. 52). Once identification is complete, however, the pictorial representation is maintained in short-term memory for a few hundred milliseconds, long enough for it to be consolidated and

encoded into memory. Intraub reported that the process of stabilizing integration errors can take place when pictures are presented at a rate of about three to four pictures per second. This is roughly equivalent to the presentation rate of the pictures presented to the fast-paced group of the current study.

Encoding

Perception might have been conceived of as a totally individual operation was it not for the fact that there exists some type of standardized analytical coding thesis on which to base a more stable view of the process. In reality, humans process information by breaking perceptual units down into sub-units called *symbols* and *icons* (Neuman & Prinz, 1990). Corcoran (1981) proposed the idea that symbols and icons comprise the very basic subset of cognition. He referred to them as "the minimal units of perceptual analysis" or "that product of semiotic analysis which is the smallest interchangeable element that still retains the basic properties of the whole symbol system but cannot be further subdivided without losing those properties" (p. 118). He identified several forms of icons and symbols, including (but not limited to) words, pictures, and auditory patterns. He also referred to rhythmic patterns and control as symbols of perception that can be translated to enhance learning but he did not limit his conceptualization to audition. He also claimed that visual rhythmicity is a form of symbolic representation that can be learned as a cueing system for attention and recall (Corcoran).

Humans process symbols and icons on more than one plane, depending on the structure of the input. Words, pictures, sounds, etc. are perceived and treated in similar, but distinct ways. Paivio (1986) proposed three different procedural methods: *representational*, or the direct activation of verbal (i.e., text-based) or non-verbal (i.e.,

pictorial) representations, *referential*, the activation of the verbal system by non-verbal system or vice-versa, and *associative*, the activation of representations within the same verbal or non-verbal system. These differences in method of processing of stimuli contrast in many ways. While researchers like Carr (1982) believe that a common semantic system exists that provides similar representations for words and pictures, others have suggested that differences in processing exist or that one form of symbol takes precedence over the others. For example, the structural organization of a perceived sequence can play an analogous part in its perceptual segmentation (Corcoran, 1981). Corcoran (1981) also proposed that verbal and non-verbal forms of information are processed at different rates. Still others (Archer, 1965; Gummerman & Gray, 1972; Huba & Velletino, 1980; Rettenbach, 1999) posited the idea that increasing the speed in perceptual encoding might be a learned activity that varies based on age and/or sex.

Perhaps the most significant debate with regards to the role perception has on memory has taken place between those who believe in the superiority of verbal coding over non-verbal, or vice versa. In their studies comparing the two, Smith and Haviland (1972) introduced two complimentary assumptions. The *influence hypothesis* argued that the perceptual superiority of words is due to a subjects' opportunity to use the redundancy in words for making perceptual inferences. The *unitization hypothesis* proposed that words are more perceptible because there are fewer units to process in a word than a non-word. Other researchers concluded that visual coding takes precedence. Pezdek (1977) performed an experiment in which the sentence *the bird is perched atop of the tree* was shown repeatedly at the same time as a picture of an eagle atop of a tree. After time, the participants responded to a follow-up questionnaire that the sentence

actually was that *an eagle is perched atop of a tree.* In this case, visual perception changed the actual perceived wording of the sentence. His studies were later confirmed in additional studies performed by Gwen Nugent (1982) who also found that visual images are recalled more readily than verbal texts. Her studies have been confirmed several times by those evaluating the so-called *Stroop effect* where subjects incorrectly name a text message by the actual font color of the text, rather than the color spelled out by the text message (Shalev & Algom, 2000). Plass, Chun, and Mayer (1998) were less conclusive. They developed a *generative theory* stated that learners actively selected relevant verbal and visual information, organized the information into coherent mental representations, and then integrated with one another these newly constructed visual and verbal representations. Mayer, Bove, Bryman, Mars, and Tapangco, (1996) reinforced this idea in studies of science curricula and found that there existed a coherence between the two, so long as they complimented each other and that each was specific to their purpose. Another way to look at the coding requirements between verbal and non-verbal representations is that they are simply *different* from one another, with neither taking precedence. In his studies, Singer (1980) found that verbal coding is a *sequential process*, whereas the everyday sights and sounds of everyday life is a *parallel operation* that encompasses a range of events within the same time. While its strengths make verbal encoding more efficient for memory, they also limit its functionality in non-textual (i.e., non-reading) experiences.

Another comparison in the research of relative strengths or weaknesses of the various encoding methods occurs between vision and audition; with neither being the unanimous choice of researchers. Nazarro and Nazarro (1970) tried to equate aural and

visual stimuli. They suggest that short-term memory is based on auditory encoding even when the stimuli are presented visually. They also found that learning (i.e., memory) is reduced if the presentation relies mostly on visual inputs alone. Further, many researchers (Cooper, 2000; Davis et al., 1999; Flannagan, 1998; Flowers, 1995; Moreno & Mayer, 2000; Sterrit, Camp, & Lipman, 1996) have shown how audio tracks can aide visual encoding, especially where the fidelity of the visual display suffers.

Perhaps the most conclusive studies about the relatively stronger effects of visual over aural stimulation have been offered by Gavriel Salomon (1979; 1994). He sites many studies where visualization was more effective in recall, and concluded that visual actions are often remembered over auditory have been "primarily due to the salience over action" (Salomon and Cohen, 1977, p. 29), especially moving images. Further, he cites some investigations in which visual tracks were successfully added to supplement the auditory. He concluded that there probably is no visual dominance in children but since actions are generally more memorable, visual information is normally more likely to be recalled. However, he also cautioned that "adding pictures to an already well-formed auditory presentation may provide some distraction" (Salomon and Cohen, p. 29).

Researchers have shown that words and pictures are processed on opposite sides of the brain and follow different psychological laws (Ederlyi, 1985). This fact had originally deprecated most traditional ideas about subliminal communication being an effective means of communication and learning. Most of the research done in subliminal perception had been done with verbal stimuli, based on the conventional assumptions about cognition having to precede response. Erdelyi's and LeDoux's (1991) more recent studies using visual stimuli alone have produced more pronounced results. Although their

work found that the signal is sufficient to cause an emotional response, it wasn't strong enough to reach conscious thought, and that the emotional responses are autonomous and primal, similar to those that humans, have needed for survival throughout their evolutionary process (Dixon, 1981). This inherent automatic preparation of their response to stimuli possibly explains why humans might likely be unconsciously biased towards accepting or rejecting ideas, and occasionally acting on them. It is also where researchers believe the most significant contributions to research into subliminal message processing might lie (Seward-Barry, 1997).

Relationship of Memory and Learning

Studies involving learning and memory date back more than a century (Crowder, 1976). Beginning with the Ebbinhaus' preliminary studies into brain associations during the late nineteenth century, the psychology of learning principles evolved by the mid twentieth century into Köhler's framework of analyses that addressed three processes associated with learning and memory: stage analysis, coding analysis, and task analysis. While *learning* may actually encompass many more of these analyses processes (such as habituation, acquisition strategies, operant training, etc.) --all of which are significant when taken in their entirety-- they are beyond the scope of the current study. This study deals with simple recognition and comprehension assessed in *stage analysis*, an essential pre-condition to learning, and certain aspects of *coding analysis*, a subset of the memory process that has been found to be an adequate premise on which to base assumptions as to whether learning may be taking place (Estes, 1994). Estes related the ability of individuals to complete the process of recalling information from memory to their ability to classify or categorize that information in a meaningful way. Under this definition, the

term *categorization* shares some meaning with the term *perception.* However, categorizing also implies a deeper process than simply detecting that some unit of information has been perceived. It also means that other related characteristics have been captured (i.e., location, color, or shape, etc.) to apply meaningfulness to them that aides the process of recalling that information later. Under this definition, immediate memory is looked upon as an important but insufficient prerequisite for learning. The current study utilized a cued recall performance test in order to assess the ability of the treatment to create (and the subjects to immediately remember) an initial memory trace.

Textual versus Pictorial Memory

Although much of the research into memory cited in this review deals with textual information (Crowder, 1976; Estes, 1994), a great deal of it has direct relevance to the current study. In his research into memory capacity, Sperling (1963) was able to determine that his subjects were able *to attend* to visually perceived textual characters at a rate of about 100 per second. These same subjects were only able to name (categorize) these characters at a rate of six per second. This discovery led Sperling to assume that initial information-gathering and naming (categorizing) may not be the same process, and that the task of recalling utilizes different resources and techniques for pictorial than for textual information. Durso and Johnson (1979) found that pictures benefit more when the tactic used for elaborative processing is to simply name the picture whereas words aid more when subjects perform some task to categorize them. Gaining an understanding of these differences between the textual and pictorial memory processes has served two purposes in the current study. First, it helped to emphasize the role pictorial perception can play in the learning process. Second, it reinforced the need to assess pictorial memory

with like stimuli, that is, to use pictures as targets in the test questions as much as possible because textual questions and answer choices introduces an additional translation process.

Recognition and Recall

Over the years, there has been a significant amount of confusion regarding the use of the terms recognition and recall as it relates to measuring how much learning has taken place (Sheppard, 1967). While very similar in nature, recognition and recall are not synonymous. Their difference in meaning suggests that we have different ways of retrieval once information has been stored. Studies have shown that recognition memory resides on the right side of the brain whereas recall (especially verbal) takes place on the left. Recognition implies a simpler intellectual task that does not necessarily require a significant amount of encoding and carries a longer-term residual. Sheppard describes studies in which even a quick glance was enough to assure some long-term recognition value. He showed objects from a Sears Roebuck catalog to Guatemalan peasants who had no personal knowledge of the items. They were able to recognize the pieces even several months afterwards. Singer (1980) drew several additional conclusions about the differences between recognition and recall. He suggested that the human brain is capable of storing a tremendous amount of visual material --much more than information received in other forms.

The ability of individuals to store so much visual information more rapidly is perhaps due to the holistic or gestalt qualities of the right brain where visual imagery is processed. Thus, material seen just a few times (i.e., presented on television) without any significant effort at learning it, can be recognized if it is re-presented later. The greatest

limitation of assessing learning based on recognition alone includes the fact that it is not a useful measurement when the responder doesn't have the object in front of him or her for identification. Perhaps the most significant contribution to the learning process that recognition plays relates to what Singer (1980) called the *differential affect.* In short, differential affect is an original *startle* that occurs when new and novel information is first presented. The brain processes this information on the right side of the brain in the same way it processes information to be later used in recognition activities. Singer noted that the startle effect takes some getting used to, but once the initial startle is over, the brain is better able to process subsequent information it receives. Theories surrounding the startle effect suggest that increasing recognition from stimuli used in the quick-cut imagery in today's new media is both a trainable act and is sufficient to gain viewer's attention so that they may recognize it again during future stimuli engagements. As such, it helps to formulate a theoretical basis for certain hypotheses in the current study as well as suggestions for potential future research found in Chapter 5.

Another assertion about the differences between recognition and recall is that they are basically the same with the exception that the former may be a somewhat easier process because it involves a lower capacity threshold requirement (Crowder, 1976). Crowder found that this idea about recognition and recall has been discredited by some due to its tie to a concept that recognition and recall are basically the same processes. Crowder also reports that researchers have more recently looked upon the two as linked but separate operations. Recall involves the generation of an additional process that can be tested separately. For example, a variable might improve recall while, at the same time, damage recognition. Additionally, there is evidence in experiments involving

intentional versus incidental learning that shows that recall improves when the subjects are warned of an ultimate memory test, where recognition does not change significantly and may even decrease. According to Estes (1994), recognition, might be better described as two distinct processes: *absolute* and *recognition in context*. The former relates to whether a subject recognizes a particular person, or he or she remembers ever encountering that person before. The current study attempts to elaborate on Estes' work, comparing the ability to remember verbatim facts with subjects' ability to remember contextual (i.e., gist) sequences. Estes further suggests that recognition does not "in general, provide a direct window to memory" (p. 230). Rather, it may be said that recognition provides "the best available basis for estimating memory storage", as long as "interpretations of data are guided by appropriate models" (p.230). It is the problems associated with these model interpretations where much of the on-going controversy about the recognition-recall debate appears to reside.

Verbatim versus Gist Memory

The apparently unresolved confusion with regards to the use of the terms *recognition* and *recall* led to the need to find another means to assess immediate memory in the current study. A further review of the literature led to a discovery of relatively new research on two complementary memory processes that have proven useful to the current study. The foundation of these newer ideas about describing memory in terms of a dual relationship in a bi-polar representational system lies in Brainerd and Reyna's (1990) *fuzzy-trace* theory. Fuzzy trace is consistent with many of the ideas about childhood memories but runs counter to Piaget's developmental/structuralist approach that uses *the mind as a computer* comparison (Miller & Bjorkland, 1998). Brainerd and Reyna's

method is based on a metaphor of *intuitionalism*, in which people prefer to think, reason, and remember using inexact, gist-like traces rather than more precise (but also more forgettable) verbatim traces. The concept traces memory preferences through age and personality differences, with younger children preferring verbatim, exact references, which become fuzzier as they grow older. Miller and Bjorkland describe fuzzy-trace theory as a hypothesis about representation, which posits that children of different ages are disposed to use different types of representations that are available to them. What differs between this theory and other more mainstream conceptualizations is the propensity to use different types of representations to solve problems, making it more aligned with Piaget-like concepts of constructivism. According to Miller and Bjorkland, earlier misconceptions about fuzzy-trace theory caused confusion as to how it differed from other already established conventional concepts like schema theory. Gradually, however, fuzzy-trace theory began to gain acceptance with mainstream theorists, especially when it was applied to issues of "age differences in suggestibility and false memory creation" (Miller & Bjorkland, p. 188). It was later adopted "outside of the immediate Brainerd and Reyna's [sic] sphere of influence" and began to be used to explain "basic and applied phenomena on a wide range of tasks" (Miller and Bjorkland, p. 188).

Independently, Brainerd and Gordon (1994) and Reyna and Kiernan (1994) began to evolve their jointly-developed theories on to other memory domains, concentrating on the specific differences between gist and verbatim memory traces. The concept has been subsequently been adopted by others (Cowan, 1998; Tse et al., 1999). The verbatim-gist classification has more recently been used in a variety of ways, including to

counterbalance the more traditional ideas about encoding, and the verbal versus nonverbal comparisons, and more importantly for this study, in analyses of the ability of subjects to recognize and utilize information perceived in visual presentations (Haber, 1970; Loftus, 1979).

According to fuzzy-trace theory (Brainerd & Reyna, 1990), both gist and verbatim memories are based on similar inputs, but are stored separately. Verbatim memory may be associated with higher ability students, but some researchers have shown that reasoning power can often be disassociated with strict recall of specific details. Others have indicated that gist determination is associated with reasoning powers, making it higher-level activity events (Reyna & Kiernan, 1994). It follows then that gist memory can be assessed independently without requiring that the subjects also score well at verbatim memory and vice versa. Reyna and Kiernan did point out that the only exception to the verbatim-gist independence rule is the fact that success with verbatim recall has been shown to be higher with linear text-based presentations as opposed to pictures.

Although it is a relatively new theory, fuzzy trace serves to explain an important concept of recognition and recall from non-verbal displays as used in the present study. As Brainerd and Gordon (1994) pointed out, so little is known about the developmental and functional relationships between verbatim and gist memories that it is "necessary for researchers to proceed step by step, investigating these relationships within delimited classes of inputs in the hope that general conclusions will ultimately emerge" (p. 163). This gives rise to questions that investigate the effect cognitive style and presentation speed might have on these two forms of memory determination. It is the intent of the

current study to address this challenge and extend their analyses into the pictorial memory domain.

The Effect of Arousal on Memory

Another, related topic on memory is the concept of arousal and an attempt to clarify some of the differences of opinion with regards to its perceived positive and/or negative effects on memory. Many of the research findings with respect to arousal and memory appear to be based on the Yerkes-Dodson law (Yerkes & Dodson, 1908) which predicted an inverted U-shaped relationship between arousal and performance. A certain amount of arousal can be a motivator toward change (with change equating to learning), whereas too much or too little can work against the learner. The Yerkes-Dodson law appears to be the basis for much of the early controversies surrounding arousal in mediated messages as to whether they impose a negative or positive effect their viewers (Lang & Basil, 1998). Neil Postman (1986) asserted that the presentation speed of media messages is a force that increases arousal to the point where most cognitive activity is negated. He relegated television viewing to pure mindless entertainment with little or no educative value. On the other hand, Zillman (1991) postulated that arousal can be a unifying force that intensifies motivated behavior. Further, arousal plays a significant role in many motivational models, like the ARCS model developed by John Keller (1983). The 'A' in this acronym stands for gaining the learner's *attention,* which is handled through arousing or curiosity-seeking cognitive engagement.

The interactions between arousal, motivation, and attention and their affect on learning have gained considerable focus in educational research in recent years. Posner

(1982) described four basic ideas about attention. Each is listed below with parenthetical comments regarding relevance to the current study:

1. Mental operations related to attention take time to perform and the amount of time required will correspond to fixed qualities of the stimuli (such as presentation speed) and the discretionary strategies of individuals (such as cognitive style).

2. Mental events occurring closely in time are processed successively. (Montage video attempts to replicate these closely related mental events.)

3. Internal events can be studied by observing the amount of facilitation or inhibition they cause and this process is hierarchical. (Immediate memory feeds longer term recollection.)

4. Attentional processing favors stimulus change. An orienting reflex biases people toward fresh or novel sources of stimulation. (Presentation speed can act like an orienting reflex.)

The works of Reeves et al. (1986), Reeves and Geiger (1994), and Reeves and Nass (1996) have centered on the individuality of the attentional reflex. They clearly defined attention as "a psychological cognitive process that varies within individuals over time" (Reeves et al., p. 254). These more modern theories look at attention as more of a filtering device that is not exactly an *all or nothing* gateway. Further, there might be different types of attention requiring different types of responses. For example, *vigilance tasks* require people to wait for an event and then respond quickly. They decrease over time and require individuals to attend to only one at a time. These are primitive orienting cues that stem from primal man. *Attentional preparation tasks* give people cues or primes before stimulus occurs. *Perceptual intrusion tasks* are those so arranged that people cannot avoid attending to them. Finally, *attention switching tasks* are those in which subjects must switch their attention from one task to another. Reeves et al. elaborated further. They posited an Orienting Response Theory (OR) that suggests, in part, that

attention is subject to habituation that explains, for example, how people become accustomed to living in cities and with noises and after a time becomes accustomed to them to the point of eventually being able to block them out without loss of focus on other tasks at hand. OR Theory might explain how youths of today might have become accustomed to fast-paced media so that they can able to learn from it more efficiently than their elders who are generally less exposed to these new media techniques.

These new ideas about arousal also encompass the concept that attention (and subsequent arousal) in humans involves mechanisms that are used differently depending on the task to be performed. Lang et al. (1999) differentiated between cortical and emotional arousal in which the former can cause the body to bring more attention to a situation rather than less. However, even cortical arousal may have its limits. In reviewing Zillman's *limited capacity* model, Lang proffered four related principles:

1. A viewer will allocate an overall level of processing resources to the complete viewing task based on goals, interests, etc.

2. A viewer's goals influence the proportion of resources allocated to the various sub-processes (such as storage & retrieval).

3. The structural and content features of the message elicit orienting behavior and the automatic allocation of resources to encoding.

4 The content and structural attributes of a message can also elicit arousal, which results in the automatic allocation of resources to encoding and to storage.

Zillman (1991) admitted that when there are insufficient resources available (i.e., cognitive overload) to carry out all the sub-processes, some aspects of cognitive processing will be performed less well. This idea of finding optimum levels of arousal to enhance motivation and performance was further developed by Winifred Hill (1985) who developed a series of laws and theories that included several about stimulating students'

interest through arousing content. Among her assumptions were that optimal arousal involves three factors: novelty, complexity, and intensity. The level of arousal (i.e., attentional demands) is function of an inter-reaction among these three factors. Highly intensive and novel stimuli are more arousing than those that are weaker or more familiar. Moderate intensity levels of arousal are more reinforcing than either high or low levels of either the newness or novelty of content. According to Lang et al. (1999), it is important to find a consistency and/or balance between the level of external arousal applied by the presentation vehicle and any arousal that might be inherent in the content. If task or conceptual complexity outweighs its novelty, a more moderate stimulus would be more reinforcing for cognition. If, on the other hand, intensity and complexity are relatively equivalent in strength, a change in content (or novel form of content) is what will regain a viewer's attention. Hill summarized by stating that "a highly novel stimulus will [sic] be more reinforcing if it is mild and simple, whereas among very familiar stimuli the more intense and complex ones [sic] tend to be preferred" (p.176).

Lang et al. (1999) and Lang et al. (2000) elaborated further on the correlation between *intensity* and *complexity of content*, relating the former to presentation speed and the number of structural features occurring in a message. Again, referring to the *limited capacity model* she suggested that, as the pacing in a message increases, the number of orienting responses (ORs) elicited by that message (and the amount of information available to be encoded) will also increase. Because of these increased ORs, a viewer will automatically allocate more resources to encoding fast paced messages. She also proposed that viewers control some aspects of the resource allocation process by making decisions such as whether to watch, how carefully to watch, how hard to try based on

how interesting the subject is, how relevant the information is, or simply whether the they want to remember it at all. Furthermore, Lang proposed that the medium itself can control some aspect of the automatic allocation of processing resources by also eliciting it own orienting responses (ORs) from the viewer. The prime example Lang used in her research was an increase in presentation speed. Lang found that these ORs are automatic, reflexive, and attentional responses to changes in the environment or to stimuli, and people have learned that they signal important information. She also found that this automatic allocation of resources is a relatively short-tem response, occurring over seconds. She concluded limited, elicited arousal results in the automatic allocation of resources to both encoding and storage.

Kahneman (1973) proposed a *variable capacity model* that predicts that arousal elicited by a message will increase one's overall pool of available cognitive resources. While he failed to specify some type of upper limit, he did suggest that secondary reaction time might slow down as presentation speed increases, especially if content is also arousing. Conversely, as speed increases for messages with calm content, rapidity alone might be sufficient to increase the size of the cognitive pool allocated to respond to the message. Basil (1994) proposed a *fixed capacity model* that predicts that higher resources may be committed to the message but the overall size of the cognitive pool remains constant. Overall, arousing messages might cause slower reaction times than calm messages if the presentation speed also increases because resources are automatically allocated to the encoding sub-processes as the result of orienting response. Conversely, if more resources are committed to creating a faster response, resources available for encoding will be reduced.

Sheingold's (1973) work further complicates the ability to unwind these contrasting views of resource allocation by showing that the age and sex of the viewers tend to confound things. Lang et al. (2000) later tried to unravel these variables by eliminating content as one of them. Using a measuring device that calculated skin conductance and heart rate, she gauged secondary task reaction times during several different studies and came to the conclusion that the *limited capacity model* most accurately reflects what occurs (at least in a casual viewing environment) with the following two hypotheses:

1. Arousing content is likely to elicit feelings of arousal and measurable sympathetic nervous system activation. As pacing increases, viewers encode more and, therefore, recognize more of specific content.

2. Arousal results in the automatic allocation of processing resources to encoding and storage.

Lang's conclusions suggest that media producers who want their messages to be remembered should create arousing messages that are presented slowly or at medium speed, or calm messages that are presented at medium or fast speed. These producers should not create messages that are at the same time calm and slow or arousing and fast. While Lang's work has been a watershed for casual television viewing, questions remain as to how much of their work relates to student viewers and in an educational environment where content might simply be considered boring. In spite of these reservations, the limited capacity model was used to develop a portion of the hypotheses for the current study.

The Hueristics of Pictures

To the extent that processing of viewed information is controlled by highly varying individual past experiences, extracting information also varies greatly. While

there have been a few well-elaborated schema theories that "demonstrate specific influences of the effect of showing pictures episodically in the absence of personal or semantic interpretations, a number of independent investigations of perceptions formed on the basis of televised news reports demonstrate convincingly that there exists a "high degree of correspondence between subject interpretation and recall" (Zillman & Brosius, 2000, p. 38). Value judgments also play a role information processing. Several studies into news viewing (Burns, 1992; Hayes-Roth & Hayes-Roth, 1977) also have shown that pictorial representations have a positive effect on attention and processing. Likewise, the value of increasing the number of occurrences of pictorial displays (as opposed to simply reiterating a fact verbally) has been demonstrated in a number of studies. Zillman and Brosius showed that an increased number of occurrences of a pictorial message can also influence perception in the news. For example, in their studies, viewers' concept of how much significance or importance they should appropriate to a story seemed to rest in direct proportion to the number of times it was shown on television, to the point that where subjects applied more significance to the story than it actually warranted. Zillman and Brosius pointed the fact that repeated visual representations tended to slant the news, suggesting that there was "strong evidence that the sheer number of concrete, visible sources relating their experiences and concerns does exert an influence on issue perception" (p. 110). They further suggested that photographs used in print media and on televised newscasts, regardless of how innocuous the content, are remembered longer and the image that was more likely to be retained was of the visualization, rather than the textual message that accompanied it.

In conveying any mediated information, it has long been deemed important to separate the flow into manageable chunks and to isolate and focus on some events at the expense of attention to occurrences in between (Kozma, 1986). According to Zillman and Brosius (2000), a mediated narrative (even an instructional message) broken down into exemplifying chunks may jump from event to event, irrespective of the event's proximity in location or time, so long as it shares enough similarity that makes it sufficient to provide reliable information about other events in the group (or the group itself). A picture or series of pictures, then, may become a form of an *exemplar* to be used to aid recall and recognition as long as they formulate a schema for their viewers. While it is has been shown that learners remember more when they attach personal meaning to an idea or concept (Brown & Kulick, 1977; Tulving, 1972), research into casual television viewing has also demonstrated that viewer recognition and recall for content of news shows (Zillman & Brosius), music videos (Hitchon et al., 1994), and/or advertisements (Hill & Lang, 1993) can be modified, either through a form of *exemplification* of the information by means of lashing loosely related content or structure in associated pictorial representations. All three of these studies, taken together, show that by using a combination of stratifying content into meaningful and related chunks and employing certain cueing strategies can overcome some of the memory-related limitations imposed by presenting unfamiliar content. Mayer et al. (1996) suggest that attention and memory for pictures (especially moving pictures) can be controlled by the use of formal exemplifying features such as zooms, presentation speed, sound effects, and music. Likewise, the format of the instrument used in the current study employs many of these visual exemplification techniques (such as similar coloration, zooming, and differing the

length of time images are displayed) to stratify presented information into manageable chunks to aid in the recognition and recall of its viewers.

Pacing versus Presentation Speed

When referring to the speed of presentation, non-education researchers often use the terms, *rhythmicity, tempo* and *pacing*, interchangeably. However, their definitions do not always equate. Educational multimedia developers often refer to *pacing* as the rate that a learner proceeds from one place to the next, as in *self-paced instruction* (Canelos, 1986; Kozma, 1986). In this connotation, pacing is more associated with interactive video, where interaction also implies some degree of learner control of the rate and sequence of the events that take place. On the other hand, in broadcast or instructional video, where the events are presented to viewers at a pre-defined rate, pacing may be better defined as "the rate of information presentation" (Kozma, p. 14). With this latter definition, pacing is more associated with *rhythmicity* or *tempo*. It is within the latter context that the term *pacing* is referred to in the current study. In recognition of the fact that, in educational circles, the term *pacing* has long been associated with Canelos' connotation, the term *presentation speed* is being used exclusively in the current study, even though pacing was the operative term used most often in the literature, especially in studies conducted in non-educational settings.

There is one point in the research where both casual viewing and educational researchers appear to agree: that changing the speed in, and/or adding musicality or rhythmicity to a pictorial presentation adds to memory for its content (Flowers, 1995; Hitchon et al., 1994; Luckett, 1996; Patel, Peretz, Tramo, & Labreque, 1998; Shaffer, Greenspan, Tuchman, Cassily, Jacokes, & Stemmer, 2000; Wagely, 1978). There are

also indications (Corcoran, 1981) that rhythmic control can be learned and translated as a coding structure in its own right to enhance learning and can be made to act as a cueing system. Zillman (1991) found that rapidly presented visual programs foster superior attention, and potentially superior learning. While he admitted that much of the successes of faster speeds may be attributable to arousal, he also quoted studies that showed that the creation of "transient alertness, even by primitive means such as the frequent instigation of the orienting reflex, tends to facilitate information acquisition in audiences for which high levels of attentiveness cannot be (otherwise) expected" (p. 126). Apparently, alternating the speed of an instructional message tends to increasingly arouse the cortex, which, in turn, as many researchers have suggested, tends to make a viewer more alert (Lang et al., 1999; Pearl, 1982; Reeves et al., 1986; Zillman, 1991). Nelson (1990) quoted studies that seem to indicate that rhythm serves both organizational and expressive functions that can also be shown to significantly help to organize thinking and cognition. While investigating the effects of training using tachistoscopes Peck (1987) found that by increasing the speed of a lesson slightly, it may be possible to increase attention and, by doing so, also increase learning. Peck also found that the effects of altering the speed are more pronounced for slow than for fast readers, something later confirmed by Walters (1983). In fact, a review of the literature into the use of tachistoscopes in remedial and rapid reading training programs (Dick, 1973; Long, 1982; Schale, 1971; Sheingold, 1973; Woodley, 1984) appears to confirm the positive effect a more rapid presentation speed can have on increasing attention and cognition, especially when the content includes redundant clues and it represents conceptual information. These rapid reading training techniques have been shown to also increase visual

awareness of larger spans of information, and processing rates can be accelerated without loss of comprehension.

Zillman (1991) showed that the tempo of a message can be influenced by more than its structural or production process. Message content, for example, may have a carry-over effect. He showed that the interspersion of fast-paced humor is often mediated by cortical arousal. Semi-attentive children in the audience may be made alert "by the inserted humorous tidbits, and this alertness may have carried over into exposure to the immediately subsequent educational material" (Zillman, p. 126). These content studies were not limited to humor. Other studies looked at attentional reflexes caused by fireworks (Reeves & Nass, 1996; Zillman, 1991), and negative or violent content (Pearl, 1982; Reeves et al., 1986; Reeves & Nass, 1996). Hill and Lang (1993) used a combination of image complexity and the number of structural or formal features in a message to manipulate effects of pacing. Other studies looked into the interaction between pacing and content. In his studies into the levels of arousal found in fast cuts in music videos, Hitchon et al. (1994) found that fast-paced video montage did not contribute negatively to the complexity or ambiguity issues as long as the story line was not confusing or ambiguous. Theoretically speaking, if increasing the speed of message delivery does not necessarily cause attentional overload, one might be able to make a stronger case by looking at a corollary question (i.e., does the slowing of the pace that an image is presented necessarily increase its retention?). In video productions, presentation speed has a direct relationship to the number of frames an image appears, with 30 frames per second being the standard (Stephens, 1996). Potter and Levy (Keller, 1976) and others (Goodglass, 1971) found a significant correlation between retention and duration

of images displayed for 200 to 300 and milliseconds, which equates to approximately 1/3 of a second, and those displayed for more than a second. Optimal retention occurred between 200-300 milliseconds and one to two seconds. Conversely, in other studies, it was found that images displayed for more than one to two seconds actually caused a decrease in cognition due to loss of attention (Thorson & Lang, 1992). It might be that duration becomes a "variable of lesser import as the size of the learning set increases and the number of categories decreases" (Keller, p.82). In short, this research appears to indicate that longer displays do not necessarily signify a relative increase in recall, and can actually cause degeneration. In the current study, images appear on screen for as little as 1/3 of a second to a maximum of one second, with the majority appearing for less than 1/2 of a second, well within the range indicated by Potter and Levy (Keller) and Goodglass.

How Learner Attributes Affect What is Learned

Cognitive style

The concept of cognitive style has endured for more than fifty years. It came out of the New Look movement in perception that was born during a symposium sponsored by the American Psychologist Association held in New York in 1949 (Witkin & Goodenough, 1981). Participants in the New Look movement were a loose confederation of psychologists who became critical of the dominant approaches to perception then in vogue. Their main criticism was that most current approaches tended to ignore the person doing the perceiving. Out of that symposium came a flood of new studies aimed at looking at the personality traits of individuals (i.e., individual differences) during the

process of learning. Out of this broad context of research emerged the concept of *cognitive styles* (Witkin & Goodenough).

Guilford defined *cognitive style* as that "which conceptualizes intelligence as having a process dimension" (Green, 1985, p. 2). According to this view, learning is not merely an automatic reaction to a stimulus but a set of operational steps that varies, depending on individual proclivities. Brumby (1982) asserted the following assumptions regarding cognitive style:

- One's cognitive style is singular (i.e., an individual has only one) and can be measured on a bi-polar scale.
- While an individual possesses one style, others may be present in varying degrees.
- Individuals can select an appropriate style appropriate to the task at hand.

Earl Messick (1970), a charter member of the 1949 New Look movement, catalogued nine dimensions of cognitive style, covering research that he and his colleagues performed, and that of others who came along in the years that followed. His list included scanning, breadth of categorization, conceptualizing style, levelers versus sharpeners, distractibility, tolerance for unrealistic experiences, cognitively complex versus simple, field-dependent versus independent, and impulsive versus reflective. Of the nine mentioned, meta-research (Green, 1985) has shown the latter two to be the most commonly accepted as credible sources for investigating how individuals perceive and process visual patterns. Of these two, impulsive-reflective was determined to be the most relevant to the current study.

Impulsive - Reflective Style

The impulsive-reflective scale was borne out of Jerome Kagan's research work

(1965) with cognitive tempo (i.e., rate of cognition) in younger aged children in which their speed and attention to detail was indexed. Children deemed to be *impulsive* tend to react very quickly and make quick decisions (i.e., they select the first answer that occurs even though it may be wrong), while *reflectives* tend to take more time to consider various options but are also generally more accurate with their interpretations. Contrary to many stereotypes about bright children thinking quickly, Kagan (1966) found that neither tendencies for fast or slow decision times were significantly related to verbal ability or innate intelligence. According to Block, Block, and Harrington, (1974) some have criticized Kagan's findings, noting that although response times were positively correlated with performance, overall, the correlations were often quite low (ranging from close to zero to around .45). However, according to others (Ayabe, 1973; Bridgeman, 1980) theirs and others' research appeared to ignore the converse of the measurement scale that compares slow-accurate to fast-accurate, which states that accuracy and not speed counts the most in complex problem-solving situations. Bridgeman points out that, even with timed tests, the negative correlation between speed and accuracy can also be a plus, suggesting that there are many children who "are fast and accurate" (p .212). The problem, then, appears to be taking an extremely bi-polar classification and make subjective determinations in overall *psychological* and/or *personality* evaluations that may require less polarization and more sub-categorization. These classifications (or close derivations thereof) have been used quite successfully and deemed to be valid classifications in specific educational evaluations. Campbell and Davis (1982) found that the "reflection-impulsivity style construct emerges as an ecologically valid and parsimonious descriptor of a component of student behavior" (p. 8) where it is

determined, for example, to hinder learning performance. Conversely, Boyden and Gilpin (1978) found latency and error rates to be independent of measures of distractibility. The relationship between impulsivity and academic achievement is not necessarily tied to aptitude or intelligence but to one's ability to attenuate and/or process specific types of inputs (Kogan, 1971; Leino, 1981; Messer, 1970). Cooper (1982) suggested that differences in processing speeds may well be accurate indicators of one's ability to process mostly visual information. Ridberg et al. (1970) found that cognitive style is predictive of performance in a variety of measurement tools, including those for reading recognition, secondary learning, and reasoning. Hedberg and McNamara (1985) found that when using visual information the tendency to reflection or impulsivity might be an important predictor of performance, particularly in relation to time and error under conditions of response uncertainly and time pressure. Merriënboer (1990) was able to use the classification as a predictor of academic performance and use it to pre-arrange feedback strategies to increase effective computer usage, especially in younger students.

It appears as though impulsivity is a characteristic that mitigates with age. Wright (1979) found that impulsivity lessens over time as one grows into adulthood. Okun et al. (1979) found that adults have significantly higher latencies than middle-aged and younger adults. In other words, as one grows older an individual tends to become more logical in his or her outlook, incorporating familiarization and planning into perceptual processes. However, an increased ability to exert a reflective response to stimuli can also work in reverse. O'Brien (1968) discussed effects of becoming stimulus bound, especially when exposed to substandard information. This phenomenon, which occurs mostly in adults, causes individuals to so over-structure their internal response that they

were unable to subsequently correctly perceive a very clear and undistorted image. Although adults tend to be more reflective in response to stimuli, these same reflective tendencies could work against them when comparing the correctness of their responses to younger individuals, especially if the younger person participates more often in visually oriented past times. There appears to be a crossover of the effectiveness of one's increased developmental reflective abilities and one's ability to effectively develop a corresponding facility to realize perceptual closure from visual data that is either less than highest in fidelity and/or is displayed at a very rapid rate.

Anderson and Revelle (1994) looked at the effect changes in daily arousal rhythm patterns play in causing similar alterations in impulsivity-reflectivity. In this context, arousal is meant to portray the processes that mediate non-specific alertness, or liveliness. Impulsives tend to demonstrate high alertness and sense of arousal, a key element in learning preparedness. Highly impulsive children have also been linked to certain attention deficit syndromes, as portrayed by their lacking in the ability to sustain longer periods of attention (Anderson & Revelle). Anderson and Revelle's research indicates that the impulsivity rates vary (i.e., are more prominent) by the time of day, with impulsivity in those individuals with impulsive tendencies being more pronounced in the morning hours.

Using impulsivity-reflection to categorize individual differences has not been without a certain amount of controversy. While the impulsive-reflective scale can be very beneficial in predicting certain academic outcomes and has significance in timed tests, there are shortcomings in making a completely accurate independent identification with regards to whether a student fits this classification in all contexts and under which

conditions (Bridgeman, 1980). For sure, the impulsivity label was considered powerful by some (Kagan, 1965; Kagan, 1966) and appealing by others (Hedberg & McNamara, 1985). However, some researchers (Ayabe, 1973; Bridgeman, 1980; Campbell & Davis, 1982) found that some weakness exists in the outcome of using classification as it relates to discriminant validity and generalizability. In other words, there appears that some evidence of loss of power, due to a corresponding loss of independence of traits in the subjects tested in certain studies. The criterion used to justify discriminate validity in the identification of a classification method or methods, which measure a discrete trait to the exclusion of others (Campbell & Fiske, 1959). An additional problem in using this classification is that it appears to be more heavily weighed down by the errors subjects made than latency itself (Ayabe; Block et al., 1974). Further, there is an indication that many studies failed to yield consistent findings in an ecological (i.e., classroom) setting due to inconsistencies with the exact definition of impulsivity (Campbell & Davis).

Lastly, previous studies systematically excluded females. Some researchers went so far as to suggest that gender differences were so extreme that they would skew the results (Cairnes & Cammock, 1984). The current study looked at gender differences to see if the same rationale is still justified.

Factors From Film and Television That May Affect Learning

Preconceived Mental Demands

Salomon's (1984) with mental effort appears to confirm the idea that learning that is or is not realized by a medium can be influenced by one's previous experiences with that medium by coloring student preconceptions about the mental demands being placed on them by that medium. In his studies, students reported that they exerted more effort

towards reading than with television, but they rated the latter as more realistic and more efficient. Greater mental effort requirements attributed to reading seemed to result in greater perceived demand (PDC) towards that medium. Conversely, as these same students perceived less mental effort was required towards television, they exerted a correspondingly less effort and paid less attention. The amount of effort exerted was also in direct proportion to preconceived notions about one's perceived self-efficacy about either medium. The more comfortable they were with the medium, they less effort was exerted. While Salomon's studies showed some overall weakness due to some discrepancies between self-reports and actual performance, his studies were backed up by several others'. For example, Ksobiech (1976) reported that pre-conceived task demands affected the proportion of time students requested to see the visual portion of a video presentation or only the audio portion, based on whether they were told that they were going to be examined on the material, or were only asked to observe it for evaluation. Students sought the video or audio source that maximized the purpose for which they were to receive the material. Krendl and Watkins (1983) found that students viewing television for entertainment value differed in the number of items they were able to recall from it from those who were asked to view a presentation to learn from it.

Accordingly, some researchers (Langer, Blank, & Chanowitz, 1978; Langer & Imber, 1979; Schank & Abelson, 1977) hold the view that most encounters with television cause viewers to generally approach it with a sort of mindlessness that can undermine its role in an educational setting. It was very important for the success of the current study that the subjects do not consider the activity of viewing the video and subsequently answering the questions that followed as an entertainment activity,

especially because researchers have shown that currently most of younger viewers' day-today encounters with both computers and videos (in particular music videos) are for amusement purposes (Seward-Barry, 1997).

These ideas about preconceived demands relate directly to the procedures used in the current study. Care was taken while administering the test to 1) demonstrate the purpose of the viewing activity using a sample portion of the video and 2) instruct the subjects to treat the activity just as if they were to be graded on it, even though no intention to do so was introduced to them beforehand.

Exemplars and Other Formal Features

Although many studies seem to establish television's reputation as a medium that promotes mindless non-engagement of its viewers, research has been far from definitive. As of a recent count (Abelman, 1995), over 4,000 scientific research articles and government reports have been published examining media effects with special emphasis on the impact of television on children, and still the literature continues to be imprecise as to how children learn from media interactions. On the other hand, some studies appear to be more conclusive. Anderson and Bryant (1983) produced results of studies of specific formal features of television and showed that the research can be fairly robust in that subjects were able to define and understand the internal mental processes involved with interpreting mediated messages. For example, they found that valence in children can be influenced by specific interpretations of what they see and hear. Particular (i.e., a woman's and/or child's) and/or peculiar voices, sound effects, auditory changes, and visual movements all had a positive effect on recall and comprehension, whereas men's

voices, long zooms, and long periods of inactivity were found to be less comprehensible and less interesting.

Other studies used foreign (Salomon, 1994) or indigenous (Worth & Adair, 1997) subjects unfamiliar with certain features and/or function common to film and television production in the United States confirmed these findings. Salomon found that Israeli children unfamiliar with the format or content were able to recognize and recall information from various episodes of *Sesame Street* just as well as American children who were well exposed to the shows. In teaching film-making young Navajo Indians who had never seen movies before, Worth and Adair were able to demonstrate in qualitative and longitudinal studies that certain film communication contains *universals* that do not appear to vary, even in light of cultural biases. The Navajo films showed, as a group, similar functional patterns in their visualizations to those of other cultures. Worth and Adair found that how we interact and become social through our manipulations of a variety of symbols and symbol forms (such as those associated with film) enables people to communicate more fully and fruitfully with each other. For example, while observing general movement patterns in a film, a viewer can also know exactly what the producer is trying to communicate. Worth and Adair (p. 8) wrote, "you can actually see what is being done -how it moves. If you write an entire book about it, then it is still. You give it to someone and he reads it and he does not get the same picture in his mind. What I want to see is how something can move in front of my eyes." Worth and Adair were suggesting that a movie is a movie, regardless of the language and culture in which the maker lives. There are subtle differences in the use of specific techniques, content, and so forth, but overall, most features and patterns were the same (i.e., the linear nature of episodic

sequences). While the study with the Navajo tribe dealt with making films, Worth and Adair found that much of their findings would carry over to video. In later experiments several years later, their results with video followed a parallel course. For example, they found an aversion on the part of their subjects to the use of zooming and close-ups while teaching them to use the medium. These same proclivities carried over, even with advanced technologies and easier access found on the video cameras.

Salomon (1979; 1994) suggested that a proper review of media effects of television involves the examination of the subtle interactions among components of the medium, individual characteristics of its viewers, and the proposed outcomes for which the medium is being used. Zillman and Brosius (2000) make a further differentiation. To them, many of the effects attained by mass media are due to the redundant, stereotypical, and cyclical attributes by which viewers learn by extracting personally relevant material (i.e., episodic memory per Tulving (1972)). According to Zillman and Brosius, rather than creating a sense of mindlessness, this redundancy is actually what creates the power of the medium. They pointed out that all media (especially mass media) create learning through the use of specialized media effects (i.e., exemplars) that may be best realized when used over and over again. For example, most successful mass media producers understand that, in conveying information, it is important to cut the flow into manageable chunks and to isolate and focus on some events at the expense of attention to occurrences in between. In other words, a story line may jump from event to event irrespective of the events' proximity in location or time. It is an effective strategy so long as the succeeding events share enough similarity and are sufficient to imply that every individual event is capable of representing the group of events at large (Zillman & Brosius). In other words,

a scriptwriter shows a man getting into his car and driving out of the driveway. Then in the next scene he is on the highway on the outskirts of a big city. Finally, he pulls up into his parking space at work. Enough information has been presented to allow viewers to imagine that time has passed and the man has driven all the way to work and are able to fill in the information in between. Bryant and Rockwell (1991) found that viewers well-versed in television and/or film techniques can fill in gaps of omitted information, even after missing as much as five or more minutes of a television show simply because they are familiar with the repetitive formats used by screenwriters. Abelman (1995) showed that viewers can learn how to build an internal concept map for the most often-used devices in films and teleplays (including time leaps, fall backs, dream sequences, scenes showing characters recalling past events, etc.) even without comparable real-world experiences. This appears to further reinforce the theory that television viewing is a learned activity and highlights the inter-relatedness of children's linguistic, cognitive, and perceptual skills for accurate comprehension of television's most basic narrative device: temporal sequencing. Corcoran (1981) suggested that intelligence may be defined as a skill in a particular medium and that symbolic codes that serve communication purposes can be internalized by a receiver to serve in a cognitive capacity. In other words, filmed/televised techniques such as zooming, slow motion, or rapid montage may actually be thought of as tools of thought. Viewers appear to learn how to use these tools naturally without being trained, because these types of story-building and post-production editing devices are used redundantly in one show after another (Abelman; Arnheim, 1974; Corcoran; Jankowski & Fuchs, 1995; Zillman & Brosius).

Pearl (1982) discussed the relationship between form and content and admitted that her research showed that it is the *form* (that is, the way it uses verbal and linguistic codes), *not the content* of television that is unique. However, she also cautioned that form and content cannot always be distinguished --"no more than grammar and meaning in any verbal language can" (p. 24). Like grammar, some forms are unique to the medium and apply syntactical meaning only in the context of that medium. For example, slow motion is not real and its meaning must be learned. But once learned, these formats are generally used by people in their own thinking. Pearl outlined a taxonomy for this coding structure of formal features. For example, *entropy* or *form complexity* is a combination of the number of different scenes in a show, the number of characters, and the number of times the scene and characters appear. *Dynamism* is the rate of change in scenes and characters. In this view, content variation is merely determining which features appear together, their tempo or rate, and/or their variability within scenes.

Unfortunately, the link back to attribution or lack of perceived mental demand has been caused by television producers who tend to use these same technical features over and over again as a means of convenience in an entertainment industry that tends to value volume over quality (Jankowski & Fuchs, 1995). However, redundancy of format and content can also play a role in causing viewers to make value judgments about what they see. Zillman and Brosius (2000) cite studies showing that an increased number of occurrences sometimes influences viewers' perception of the news story. For example, if the number of occurrences of a particular story in a newscast is increased, viewers tend to be influenced by the story in that the event was probably more significant than it actually was. (i.e., it tends to slant the news). There is strong evidence that "the sheer number of

concrete, visible sources relating their experiences and concerns does exert an influence on issue perception" (Zillman & Brosius, p. 110). They go on further by stating that the incidental use of image exemplars that add non-redundant, specific information to the text of a news report does influence issue perception. Specifically, the incidental nature of a pictorial supplement to a story goes unrecognized and, as a result, is integrated with the narrative information in fostering perceptions and judgment. Over time, if presented enough times, the photographs are actually remembered longer and the retained image of the incident was of the photograph, not of the text. Furthermore, if the image that supplements a news story presents a negative or positive aspect, that image can actually influence one's value judgments. This is especially so if the presentation speed of that image is varied (Barnett, 2000; Corcoran, 1981; O'Brien, 1968; Pearl, 1982).

However, presentation speed has not always been consistently viewed as a positive media effect. Pearl (1982), for example, talked of television being a magnet on viewers that "shapes their behavior" (p. 1). In an attempt to investigate the ties to violence and television viewing she found herself in conflict with her own research. First she claimed that "the rapid form of presentation characterizing American television in which novelty piles upon novelty in short sequences may well be counterproductive for organized and effective learning sequences" (Pearl, p.20). But she then goes on to state that this may be more of a problem with younger children. Kozma (1986) appears to support this view. He points out that a fast tempo does not necessarily sustain visual attention, and that an increased tempo is not likely to provide enough time for the viewer, especially one inexperienced with television formats, to extract that which is needed bring it into working memory. In addition, others have indicated that as the amount of

information increases with the increase speed, short-term memory limitations are soon reached and information is lost (Lang et al., 2000). The fact that broadcast medium presents information linearly and does not permit a child to return and review content puts the onus on the producer to utilize commonly recognized techniques such as maintain scenes for longer periods, to limit the objectives of the program, slow its speed, and/or to use slow motion. Kozma points out that shows like Sesame Street accommodate these limitations by constraining the objectives of each episode and representing information in different formats. However, simply slowing the speed down may not be the total solution either. Cronbach and Snow (1977) point out that viewers who are familiar with the content might actually need a faster speed to maintain their attention.

Salcedo (1985) looked at such features as focal length and found that close-ups were regarded as more intimate emotionally by viewers. Other features elicited similar varied impressions (Barnett, 2000; O'Brien, 1968): time on screen (the longer characters appeared on screen, the better impression they left on viewers), types of transitions (fades are considered to be more positive or emotional than cuts), and slow motion among them. In addition to its presentation speed, the video used in the current study utilizes several of the above features to increase comprehensibility and emotional involvement of its viewers.

Symbol Systems

Symbol systems differ along several dimensions, which Salomon (1979; 1994) believed are to be primarily those of notationality, repleteness (density) and resemblance. A notational symbol system is one in which there is a strong, clear, and consistent correlation between a set of symbols and a set of objects or concepts, such as a written

language, musical notes, or mathematical symbols. Repleteness or density refers to the relative richness or number of dimensions that the information conveys, like a sketch as compared to a full-color painting, a textual passage as compared to a picture (even more so if that picture is moving). Salomon distinguished among symbol systems with respect to the degree that they resemble the object or concept being represented. Symbol systems tend to vary in terms of their depictive and/or descriptive reference, from a one-to-one to a totally abstract representation. Salomon also distinguished between psychological and real resemblance. Depicting an object with a high degree of realism may or may not be required for understanding, depending on an individual's pre-conceived ideas as to that something should look like. As all cognition and learning are based on internal symbolic representations that are central to all systems of mediated communication and thinking, actual resemblance (i.e., fidelity) may or may not be required in individual cases. Gardner, Howard, and Perkins (1974) agreed with this thinking and proposed that concepts like *fidelity* should be viewed in its broadest context. That is, the symbolic process should be compared to how one imagines or conceives something, not necessarily how true to form it is (i.e., colors, lines etc). In other words, a medium might be said to be faithful to the real world if it presents information in a way that is true to the way one thinks (i.e., in a streaming sense).

Salomon (1979) explains that it is not the medium itself that makes the difference in message processing. Rather, he held that film and television are generally not symbol systems themselves, but rather are a place where multiple symbol systems are used. Because they manifest no one system, television and film adopt the symbol system of the content they depict. For example, television and film may use photography, print, speech,

dance, music, etc. and can be replete, resemble reality, and approximate notions of notational ability, borrowing their power from other media. This same power to employ a wide range of symbol systems may also define film and television's potential shortcomings, reflecting a fallacy in the belief that they always deliver to their potential (Wetzel et al., 1994). For example, if a video screen is simply placed in front of the class that displays nothing more than a talking head lecture covering an irrelevant content, there will be little hope for realizing a valuable instructional delivery. All media carry with them a systematized methodology for symbolic processing, but that varies in how they are used, in what context, and by which individuals.

Symbol systems theory plays a significant role in formulating some of the hypotheses for the current study. First, the pictures found in the depiction of historical events are iconic in nature and, as such may be considered primary symbols. Second, although the speed of delivery is considered rapid or fast (at about 200-300 millisecond per image), the speed within this context is varied, which manipulates the amount of mental effort required to comprehend the conceptual context. As the images are presented in combination in a montage format, they represent reality to viewers in a way similar to the way they think (i.e., in a streaming sense). Lastly, as outlined by Salomon (1979), fidelity not withstanding, the images in the videos used in the current study are indeed symbols in that they represent the sole source of reality about the historical events to the viewers who were not live witnesses to those events. In addition, as per the conceptualizations of Snow et al. (1965), the amount of information the subjects are able to extract from the videos may well depend on the amount of previous experience they have with this medium (television).

Evaluating the Educational Impact of New Media

The technologies which are helping video and computing converge, and with which it is now possible to more easily create visual productions full of rapidly presented montages, are often referred to as *new media.* In spite of its inference, the term *new media* is not new. Researchers have been alluding to television in this way for almost fifty years. In writing his introduction to the Seventy-Third Yearbook of the National Society for the Study of Education, David Olson (1974) noted that new technologies/media are not the panacea to all possible educational reform needs that researchers were looking for:

> It would be of much greater promise to discover the areas in which media diverge and hence serve different purposes. Perhaps, the function of the new media is not primarily that of providing more effective means for conveying the kinds of information evolved in the last five hundred years of a book or literate culture but, rather, it is that of using new media as a means of exploring and representing our experience in ways that parallel those involved in that literate culture. (p. 8)

Olson's ideas have been backed up by other researchers. Gross (1974) suggested that new media does not reduce the vital importance of competence in the basic modes of intelligence and communication. Chu and Schramm (1968) found in earlier studies that screen size, using animation, changing the aspect ratio or size of the screen made few, if any, significant difference in learning, even though these changes all were seen to be preferred by students in follow-up questionnaires. While the current study also takes advantage of many of the features of new media, it is not new media by itself that can take credit for any positive (or negative) outcomes with regards to memory. The basic premises for how to evaluate the use of media in educational settings remain. Olson reaffirmed the need to base research of new media using a symbol systems approach. He

resolved that previous research showed the lack of a strong theoretical base, and that new media would not reach their potential until some scheme is shown through empirical evidence that they can re-specify information, how that this re-structuring would be influenced by the media that presents it, and what the psychological consequences of relying on that re-structuring might be. Media are similar in the knowledge they communicate, but they differ as to the skills needed and developed by using them. Evidence appears to show that educational media cannot be chosen simply because of their ability to convey certain kinds of content. Rather, they must be chosen based on their ability to develop the intellectual processing skills that they help to develop.

Olson (1974) outlined several criteria for analyzing the theoretical potential of various media for use in educational settings which became a basis some of the goals of the study and several of the recommendations in Chapter 5. To evaluate the instructional impact of media one must:

- Identify the specific symbol system it uses.
- Identify the specific basic skills that are required and how much of literacy is required for use of this medium.
- Identify the intellectual consequences of exposure to that medium (i.e., is the ability to imagine an action in slow motion dependent upon having seen slow-motion film?).
- Identify the scholastic goals for which the medium is most appropriate.
- Determine how knowledge and skill (intelligence) in the medium can be evaluated.

New Media and Memory

New media make it very much easier to create new an interesting pictorial storylines using rapidly presented montages, as evidenced by the exponential use in

commercial television. Market and psychological research (Reeves & Nass, 1996; Stephens, 1996) has demonstrated its effectiveness on memory in commercials and marketing campaigns. Further, researchers (Reeves et al., 1986; Reeves & Nass) appear to concur with Olson's assertions in light of a rapidly changing technological arena. Rapid changes are also in process for the way in which researchers view media assessment. Several things gave rise to an increased interest in looking at the psychological and sociological aspects of television viewing during the late 1980s. An evaluation of the then-current research by Reeves et al. found that there was an increased understanding about attention. First, was the fact that recognition was not always present, and second, and most important, that continued attention was not always a necessary prerequisite for learning and understanding. Until that time, most evaluation of attention was limited to measuring direct eye contact. However, Reeves et al. discovered that due to increased changes in visual displays, with their rapid scene changes, quick movements, and zooming, that viewers appeared to have developed a sense of being able to filter stimuli and, in essence multi-process. At the same time, much attention was paid to the potential harm this newer, faster paced television was having on its younger viewers (increased proclivity for violence, poor attitudes and moral judgment, etc.). The question Reeves et al. began to look into was why these same effects could not be implemented into instructional programs in order to accomplish increased educational goals. The answer may or may not be obvious and requires that one take a deeper look at the aspects of the new characteristics of message delivery brought on by newer technological developments. In other words, attention is only one of the variables. Reeves et al. also found that earlier studies to determine which program attributes caused children to attend

to television during shows like Sesame Street or the Electric Company served to also point out that attention might be better defined as "visual selection" (p. 253). Attention was measured by a hidden observer who pushed a button when a child's eyes were directed towards the television screen. This type of *eyes on screen* method dominated research for years. However, more recent literature has clearly defined attention as "a psychological cognitive process that varies within individuals over time" (Reeves et al, p. 254).

Reeves et al. (1986) later began to find that perhaps, attention, as it relates to new media, is a many-fold process and that it is not necessary an *all-or-nothing* effect. Perhaps, different types of attention required different types of responses. *Vigilance tasks* are an automatic process that requires people to wait for an event and to respond quickly. This process decreases over time and only allows a subject to be able to attend them one at a time. Reeves et al. correlated this to primitive cues that are born out of human's animal instincts. *Attentional preparation tasks* involve giving people cues or primes before a stimulus occurs. Television can be thought of as a continuous priming or cueing process. This strategy could be used to study the sequencing of various visual devices, such as pans, zooms, audio silence, screen luminance, or presentation speed and their ability to prime attention for subsequent program content. Other questions could be asked about the effects of un-cued or abrupt scene changes on attention and the circumstances under which cueing increases processing efficiency. Just as Olson viewed symbol systems, attention appears to require internal devices that are also used differently, depending on the task that is to be performed. Measuring attention can be added to

Olson's list of criteria for analyzing the theoretical potential of various media for use in educational settings.

Effect of Fast Cuts on Memory

Reeves et al. (1986) re-defined the result of attentional changes in humans, referring to them Orienting Responses (OR's). These types of responses help to explain, for example, how humans become habituated to living in large cities with lots of loud noises, or how one becomes so used to the common sounds found in his or her home (like a cuckoo clock) and begins to tune them out. Reeves et al. identified several characteristics of OR's that have implications for evaluating the effectiveness of fast cuts in an educational setting. Reeves et al. also related these changes to cortical arousal, in which an individual may have some type of control over and learn how to manipulate for his or her own purposes. They noted that there is some evidence to suggest that those who habituate slower perform better on audio and visual tasks than those who habituate quickly. They also documented studies that showed that high cortical arousal in adults is related to an increased ability to remember information --both of which are premises of the current study. These ideas about OR's also formed the basis of some of the recommendations found in Chapter 5.

Presentation Speed versus Content

Lang et al. (1999) more recently discussed adding interesting and arousing content as having a positive effect on cortical arousal and, therefore, recall and recognition. She also noted that too much arousal can be harmful. In describing a limited capacity model, she outlined a sequence where viewers allocate an overall level of mental processing resources to the complete viewing task based on their goals, interests, etc. In

turn, these goals influence the proportion of resources allocated to the various mental sub-processes (such as storage and retrieval). The structural and content features of the message elicit orienting behavior (OR) and an automatic allocation of resources. When there are insufficient resources available to carry out all the sub-processes, some aspects of processing are performed less well, indicating that too many inputs are overloading the system. Fast-cuts can be this overloading stimulus, unless the content is delivered in a structured and continuous way (i.e., it builds its story through a series of related schema).

Lang et al. (1999) further noted that it is the medium itself, by calling upon certain processing requirements (i.e., its symbol system) that can elicit an Orienting Response. The Limited Capacity Theory suggests that stimuli that elicit arousal result in the automatic allocation of resources to encoding and to storage. Thus, an increase in presentation speed by itself can increase a viewer's arousal levels and result in the need to allocate additional resources to encoding and storage. Lang and Basil (1998) and Lang et al. (1999) and Lang et al. (2000) found that content alone can also elicit arousal. Arousal will create the cognitive process to reach its top limit much more quickly if content is also arousing. On the other hand, as the presentation speed increased for messages containing only calm content, subjects were able to take on additional cognitive tasks. Lang's studies provided evidence that one should blend the types of content with the speed of the pace it is presented. Lang et al. (2000) found that memory capacity problems can be ameliorated if the content is structured so that the amount of new information provided is limited, irrespective of the presentation speed of the video presentation. Further, they found that, if the pieces of information are related to some larger overall schema, the presentation speed also did not matter as much. These concepts

were supported by earlier research (Arnheim, 1974; d'Ydewalle & Vanderbeeken, 1990) into recalling visual sequences where individual frames of information were best remembered when they related to an overall schema of events. An important factor in memory enhancement in all these experiments was the cohesiveness of the contextual content of the messages being presented.

Montage

Mitchell Stephens (1996) elaborated on the potential for an increase in memory capacity for related schemes of events in his chronicles of the development of montage in cinema and television. He delineated the beginnings of the use of montage from its use in the early films of Sergei Einstein (1949), to Chuck Braverman's (1969) use of kinestasis editing, and its later extensive use in MTV music videos. Stephens demonstrated how rapid presentation rates have not only enhanced montage videos. He also provided several examples how producers have been able to replace textual messages as a primary form of communications. His work appears to support the same type of "technological determinism" (p. 21) found in McLuhan's (1964) *the medium is the message* principle: that the means we use to express our thoughts also change our thoughts. Stephens suggests that, conceptually, most of thinking with regards to mankind's current system of logic is based on the literacy of the written word. He even predicts that new media, with its ability to empower individuals to regularly use vast communicative strategies like montage, will create a new, unique form of abstract logical thought, similar to what Alan Kay (1999) had in mind.

In order to provide full understanding of the concept of montage, Stephens (1996) traces the etymology of the term. Montage was first introduced by Russian filmmakers,

who referred to a concept of permitting producers to "record movement in the most complex combinations and [sic] to place points wherever they wanted" (p.102). The Russians began to produce short films that placed short cuts of still photography and pasted them together to form a surreal *photomontage* in which "the meaning of a shot is dependant upon the shots that surround it" (Stephens, p. 102). It is this view of montage as a collection of highly related thoughts expressed visually that provided the catalyst for its use in the current study as a way to provide gist memories in videos without the need for textual supplements.

Montage, in combination with fast cuts, has become a whole new form of intellectual discourse that Stephens (1996) called "complex seeing" (p. 178), a technique that was not available to early television producers. Much of early television lingered much longer over scenes, allowing the narrative to play a significant role in telling the story. According to Stephens, new media technologies are changing the paradigm. "Now that the cuts and montage have increased the speed of the instances we see, we are no longer dwelling on the individual instance but, rather, are being persuaded by the onslaught and the continuity of the entire series. Not only are we affected by each individual image but their composite total" (p. 180). In essence, the ability of an individual to become accustomed to the fast-cut montage may be a newer, higher level form of persistence of vision --the gestalt-like concept that forms the basis of being able to watch films. The mind closes the gaps in between pictures in a stop-action series of movements to form one continuous motion. The current study attempts to see if montage has the potential to follow a similar track in an educational setting.

Summary

In researching the current trends of the so-called media effects, one thing has become evident. It is the newer structures and the form (of which rapid presentation is a part) of the montage video segments that continue to play an ever-increasing role in how messages are delivered. This view is not a new one. McLuhan (1964) and Salomon (1979) predicted *media effects* long before technology caught up with television's promise.

Flowers (1995) cited research as early as the 1970s that contended that educational environments might be "too visuo-centric" (p. 570), indicating that looking into visual processing may have been overdone in many previous studies and that its role in learning might have been exaggerated. In some respects, Flowers might be correct. Singer (1980) admitted that many previous assertions regarding textual versus visual image processing had yet to be supported directly by research evidence, and suggested the need for further experiments on length of video sequences and its effect on retention of content (or at least intelligent comprehension of content). Intraub's (1999) experiments appear to answer that need. She found that humans possess a "remarkable capability" (p. 67) to understand scenes that are presented at a pace far more rapidly than normal scanning, so long as the scene changes overlap with at least somewhat related content.

Over the past decade, media researchers have started to look at the impact new media have on cognition in a casual viewing environment (Basil, 1994; Hawkins et al., 1997; Hill & Lang, 1993; Hitchon et al., 1994; Walma van der Molen & Van der Voort, 2000; Watt & Krull, 1977; Zillman, 1991). Some are also beginning to conduct more extensive research on the effects on memory of editing techniques and the content found

in rapidly presented montage in commercial programs (Lang, 1994; Lang & Basil, 1998; Lang et al., 1999; Lang et al., 2000). It is perhaps Lang's work in commercial television that provides the best backdrop for studies that investigate a corresponding effect of these new media techniques might have in the educational domain. If one accepts the contentions of Reeves et al. (1986) and Stephens (1996), it should be easy to understand how today's youth, brought up on MTV, with its fast cuts, rapid movements, and iconoclastic acoustics, could get used to, prefer, and possibly learn from similar techniques in an educational setting.

There are those who contend that the rapid format of television segments takes away from attention and understanding (Anderson et al., 1979; Anderson & Bryant, 1983; Anderson & Collins, 1988). Reeves et al. (1986) demonstrated information in several research studies that contradict that belief. Stephens (1996) and Meyrowitz (1985) appear to agree. They concluded that, once its capabilities are fully implemented using techniques like fast cuts and video montage, television will provide an opportunity to transcend the time and place continuum by cutting rapidly between images taken from different contexts. In other words, viewers can find additional meaning in the relationship between numerous different scenes. Taken in this way, the video image provides opportunities for creative seeing, making the case that interpreting images requires more imagination of their viewers, not less.

This does not mean that educators or their students have no obligation with regards to content. Lang and Basil (1998) and Lang et al. (1999) and Lang et al. (2000) have suggested that producers who want their messages to be remembered should create arousing messages that are presented slowly or at medium speed or calm messages that

are presented medium or fast. Producers should not create messages that are, at the same time, calm and presented slowly or arousing and presented too fast. Carrying this thought into an educational setting, Verhagen (1992) found that increasing the presentation speed of video images can be fully interpreted and remembered if learners start their viewing task with a realistic expectancy of its demand characteristics and are motivated to tune their mental effort accordingly. Further, research in tachistoscope training (Schale, 1971) showed that rapid reading training increases visual awareness of larger spans of print, and that the processing rates can be accelerated without significant loss of comprehension. As a minimum, even if comprehension is the same, or even if it suffers only slightly, fast cut montage may not be a negative influence.

Media choices may be as much about cost and efficiency as about cognition and learning (Cobb, 1997). If it is accepted that one type of efficiency is cognitive efficiency, it follows that media choices can profit from an understanding of cognitive processes much in the same way as the latter can be positively leveraged by the type of media that is ultimately selected.

In this chapter, a theoretical basis was laid out for the methodologies, procedures and analyses used in the current study. An analogy may be made to describe the way that video montage derives its ability to convey meaning through the use of closely-related pictures and rapid presentation. One should view montage similarly to the concept of *chunking* in speed reading of text-based passages. In montage, the individual pictures take the place of words and sentences. Several related pictures become the paragraphs. Presentation speeds may vary, just as one might vary reading rates, causing variations in the ability of individuals to remember specifics and derive contextual meaning from the

passages. What remains is trace memory for remembering the gist of the storyline, even if the specific words or phrases (i.e., verbatim memory for the specific pictures) cannot be recalled exactly.

The next chapter outlines the specific methodologies used in this study to investigate some of the affects that variation of presentation speed, personal cognitive style, and gender may have on memories for information presented in the passages. These methods follow closely the ideas of looking at combined memories, and then breaking these down into verbatim and gist recollections to see if there are any differences. After analyzing the results, implications are reviewed and recommendations are made for this initial look into memories for pictorial representations.

CHAPTER 3
METHODOLOGY

Introduction

In this study the researcher attempted to elicit information about how differing the presentation speed might affect immediate memory for the pictorial representations found on the video montage. For this portion of the study, scores for verbatim and gist memories were pooled together. The researcher then investigated whether the same pooled scores differed between males and females taking the test. Next, the scores for verbatim and gist memories were segregated and reviewed in light of the differing presentation speeds. It is recognized that gist memory is a less exact indication of immediate memory about individual pictures than is verbatim memory. However, it was anticipated that a review of gist memory might provide additional overall insights to memory in that it requires viewers to draw certain conclusions about the contextual meanings much like a typical reading comprehension test of text-based materials. Lastly, the researcher investigated the effect cognitive style might have on the verbatim scores and gist scores taken together, as well as for each of them individually.

A computerized instrument was specifically prepared for this study that displayed the video at one of three different presentation speeds and then immediately tested subjects to determine what they remembered from the video. The program was encoded to score verbatim and gist memory scores separately and also combined into a single

score (referred to henceforth as the *total score* or *total combined score*) in order that comparisons may be made for speed, gender, and style.

Verbatim memory was tested in two ways. First, subjects were asked in a series of questions to pick out from groups of four the one picture that appeared in the video. They were then asked to identify the picture in each of a series of four still images that did not appear on the video. In order to test whether the subjects were able to comprehend (i.e., get the gist of) contextual meaning conveyed by the video, subjects were asked to place pictures in chronological sequence, to identify by way of multiple choice questions some of the major techniques used in the video to project moods and attitudes, and to answer some questions about the circumstances (i.e., storyline) presented in the video.

Population

The subjects for this study came from a population of ninth grade students in a high school in North Central Florida. Ninth graders were selected due to their closeness in age to the norms developed for the instrument selected to categorize cognitive style so that some historical comparisons may be made. That instrument provided normative data, which was very useful in helping to categorize and compare the current group of students as to their impulsive-reflective tendencies and current trends.

Sample

The overall sample set consisted of 204 subjects. The entire sample was used in the analyses to determine the effect of presentation speed on combined test scores as well as verbatim and gist scores taken separately. The entire sample was also used to investigate differences between males and females. However, the nature of the instrument used to categorize this sample set into one of two cognitive styles dictated the creation of

a subset of subjects (n=129) from the original sample set of subjects (n=204) for the second portion of the study, as demonstrated in Figure 1. In the identification of subjects as to being either impulsive or reflective, a resulted in a certain portion of participants

Impulsive N = 65	Slow –Inaccurate N = 37
Fast-Accurate N = 38	Reflective N = 64

Figure 1
Subjects Included in the MFFT-20 Cognitive Style Test

did not qualify as being in either category. As per the instructions provided with the test instrument, these outliers (i.e., the fast-accurates and slow-inaccurates) were excluded from this portion of analysis to determine the effects of cognitive style on immediate memory. Subjects were categorized by cognitive style as determined by a computerized program specifically designed for this study. The program scored the subjects on each test question according to latency to first choice and the total number of errors. The overall sample and the subset were both randomly placed into one of three groups and shown the video at one of the three different presentation speeds.

Instrumentation

To categorize the subjects by cognitive style, a 20-item version (MFFT-20) of the Multiple Familiar Figures Test (MFFT) developed by Cairns and Cammock (1984) at the University of Northern Ireland was administered. The original MFFT is an instrument developed by Jerome Kagan (1965; 1966) that was subsequently evaluated for validity and reliability and adapted over the years by several individuals (Arizmendi, Paulsen, &

Domino, 1981; Block et al., 1974; Watkins, Lee, and Erlich, 1978) to determine impulsive-reflective tendencies. The original format of the MFFT-20 was developed as a paper version in which participants made their choice of selecting the matching figure from a set of six distracters by pointing to their choice. The investigator was responsible for keeping track manually of the number of choices made and timing latency to first response using a stopwatch. For the current study, the paper copies of the figures and alternative choices that were to be matched were scanned into a computer and imported into a program written in Macromedia 8.5 that was specifically developed for this study. The program presented the pictures and their alternatives on one screen and allowed subjects to click on their selected picture to indicate their response. The computer program automatically kept track of the total number of choices made by each participant and the amount of time to first choice for each of the item sets.

As with the paper versions of the MFFT, subjects in this study were presented with 12 sample pictures of familiar items and are then asked to identify which one of six alternatives is identical to the sample. If an error was made the subjects were subsequently asked by the computer to retry until a correct response was found. Subjects were also automatically timed as to how quickly or slowly they made their initial choices (latency) and how many total errors they made. The dividing line between impulsive and reflective was determined by calculating a median split score for both latency and total number of errors. The scores were placed into quadrants made up of two intersecting axes. Those who made very quick but inaccurate decisions ended up in a quadrant labeled 'impulsive'. Those who were more deliberate (i.e., showed an increased latency to first response) and made fewer errors than the calculated median were to be determined

'reflective'. Subjects found to be fast-accurate (i.e., faster and more accurate than the calculated medians) or slow-inaccurate are placed in two other cells. As per the instructions provided, subjects who landed in either one of these latter two categories were excluded from the study.

According to the literature, (Berry, 1991; Green, 1985) the impulsive-reflective test, in addition to leveling-sharpening and dependence-independence, has been one of the most commonly used and more accurate means to test for cognitive style and to show how individuals perceive and process visual patterns. Because the treatment in the current study was to show accuracy of visual processing as well as processing speed, it was determined that impulsive-reflectivity would be the most closely related of the three cognitive style classifications to use.

Another goal of this study was to determine if there might be an interaction between a subject's reaction to rapidly-presented content and his or her cognitive styles. Rapid visual presentation has been found in several studies to increase cortical arousal. Further, impulsivity has been reported by some as a stable mediator of the rate of change in arousal states. Anderson and Revelle (1994) have demonstrated that impulsives are susceptible to attentional lapses that are, in turn, "mediated by impulsivity-related phase differences in diurnal arousal patterns" (p. 334). There is no one 'correct' style. There could well be a proper time and a place for being impulsive or being reflective. It was determined that a test for the interaction between cognitive style and how well subjects receive and process rapid visual presentations could result in some very interesting findings that could be quite useful in helping to determine the proper use of rapid visual presentations in the educational environment.

The MFFT has been subject to several attempts to refute it as a valid categorization test (Salkind & Wright, 1977; Watkins et al., 1978). Further, Ikegulu and Ikegulu (1999) found that the notion of a generalized visual processing rate may be questionable, based on the fact that there have been few repeated measurement studies to test the generalizability of the dimension. Other research has indicated that impulsive-reflective designation might be best depicted on a continuous (i.e., from low to high), rather than a bi-polar scale, as reported in the impulsive-reflective array (Salkind & Wright). On the other hand, Salkind and Wright demonstrated in other studies that continuous scaling seems to contradict a basic definitional premise of a cognitive style (that is style by its very nature is bi-polar). This apparent anomaly appears to some to create a potential lack of power for the impulsive-reflective scale to be useful in accurately classifying a cognitive style. Ault, Mitchell, and Hartmann, (1967) contributed a loss of power due to Kagan's possible over-reliance on latency rather than number of errors to determine reflective versus impulsivity. The findings of Ault et al. seem to contradict Kagan's original hypothesis, that stated categorization is the result of both speed and error-rate considered together (Kagan, 1965).

In spite of these and other attempts to dispute it, Kagan's MFFT instrument has been supported in several research studies that more than reinforced its validity (Arizmendi et al., 1981; Green, May, 1985), making a strong enough case to justify its use it in the current study. To further strengthen power of the MFFT as a categorization technique, a 20-item variation of the original instrument was chosen for the current study because it had been validated by its authors in five separate reliability tests, and who

strongly assert that their instrument overcame most of the objections that arose in the previous studies.

Cairns and Cammock (1984) developed the 20-item MFFT (henceforth referred to as the MFFT-20) and presented five case studies that asserted an increased reliability and accuracy in that subjects were more accurately categorized into one of the four quadrants (impulsive, reflective, fast-accurate, or slow-inaccurate). Their instrument used 20 sets of pictures (instead of the 12 in Kagan's original test) that were reduced down from an original list of 32 items that was, in turn, concatenated and prioritized by several earlier studies. The authors then ran a test on 90 subjects chosen at random. The 32 items (2 samples and 30 test items) were then paired down to a final list of 20, and chosen on the basis of their being the most commonly missed. The authors then performed four separate reliability tests of over 300 total additional subjects that developed sets of norms, and established strong correlations between order position (i.e., the order in which the picture sets are presented), error rates, and interactions between age and sex. They then reviewed the selected items for highest item-total error correlation. Subjects were classified as reflective or impulsive using the double median split criterion. The median error and latency scores were total 34 errors and 11.7 seconds respectively. The coefficient alpha for their 30-item test was .98 for latency and .81 for errors, both at ($p < .01$). The authors then developed their 20-item instrument, and re-tested it in three additional reliability studies. The first study aimed at obtaining reliability coefficients using corrected correlation between split-halves given two weeks apart. This study also yielded product-moment correlations for errors and latency of .80 and .83 respectively. Using Spearman-Brown, the authors then determined that the complete 20-item test would have

reliabilities of .89 for errors and .91 for latency. A third study was then conducted to investigate test-retest reliability of the MFFT-20. The results were favorably compared to the most reliable form (form F) of original MFFT for error and latency when administered to a similar age group (Egeland & Weinberg, 1976). Based on the information discovered in their studies, the authors determined that the MFFT-20 was a superior instrument with regards to reliability and validity to earlier tests.

A computerized instrument was developed by the current investigator to test subjects' memories immediately following the presentation of a video. The video was a copy of a kinestasis film depicting a snapshot history of the United States first produced by Charles Braverman (1969). The current holder of the copyright to this video has provided permission to the current investigator to utilize a copy for use in this study (R. Wright, personal communication, March 21, 2001).

Test Descriptions

Initial Development

Two sets of question banks for verbatim memory were developed from which the final multiple choice test items were derived. The first bank consisted of 15 sets of four multiple choice questions from which participants would be asked to first pick out the one picture in each group that actually appeared in the video. The second bank, also consisting of 15 questions, was made up of similar groupings of still images, but the participants would be asked to select the one picture in each group of four that did not appear on the video. Care was taken to insure that all pictures were presented in identical size, shape and fidelity. To develop a final set of questions concerning gist memory, several questions were written that asked viewers about the overall content and major

themes presented in the video. Some of these were pictorial questions and some were text-based. These three question banks (consisting of a total of 45 questions) were then presented to three social studies teachers and one English teacher who evaluated them for appropriate content, duplication of pictures, and to check for potential fidelity problems that might distinguish correct responses from distracters. The overall set of 45 questions was pared down to 25, based on the feedback from the teachers. The questions were then presented to a several student test viewers who provided additional feedback. As a result of this phase, the program was changed to randomly place the responses on the screen so as to randomize the placement of correct answers on the screen and to eliminate the opportunity for participants sitting next to another to share answers. In addition, the color schemes for the screen background and text were changed to reflect those combinations deemed more pleasing to the younger age group of participants for whom this test was designed.

Pilot Test

A pilot test was conducted with a group of students from a different high school in the area consisting of subjects of identical age and similar demographic make-up as the final test group. The pilot group consisted of 97 subjects. They were given the test in a group setting that was arranged in such a way that no one could see any on else's screens. So as to supplement the viewers' understanding of the instructions, an audio instructional track of a female reader was added to the computerized program so that the participants could both see and hear the directions on how to take the test. Headphones were used to reduce background noises and distractions. To determine reliability, two alpha reliability scale tests were run. The 15 items dealing with verbatim recall and the 10 items asking

gist (i.e., comprehension) questions were analyzed both together and separately. Adjustments were made to overcome any potential reliability shortcomings prior to administering the actual test to the selected subjects. A reliability co-efficient on the combined question set yielded an alpha level of .9028. The co-relational alpha tests to determine reliability of the test instrument to assess verbatim and gist memory individually resulted in co-efficient ratios of .7548 and .8662 respectively. These results indicate that the reliability of the test instrument fell within reasonable ranges of acceptability for its intended use in this study.

Test Administration

To test for cognitive style, a computerized version of the MFFT-20 test was developed for use in the current study. The same pictures from the original MFFT-20 were scanned into digital form and placed on an 800 x 600 computer screen format using Director 8.5, an interactive software program developed by Macromedia. Multiple copies of an executable form of the program were made so that each subject was able to view his or her own individual screen in a lab containing 25 Dell Pentium IV and 5 Apple G-4 Computers. Controls were put in place so that no subjects were able to see another's screens. Subjects also wore headphones in order to hear the indirections that were also displayed on the screens. As with the pilot study, the headphones also add the convenience of providing a more focused environment by eliminating surrounding stray noises and disruptions. The program presented two sets of sample items and 20 sets of actual pictures in the exact order as the paper version of the MFFT-20.

The computer program for both the MFFT-20 and the verbatim and gist questions automatically kept track of the responses by the participants and outputted that

information to text files. These files were then imported into Microsoft Excel and concatenated to consolidate the results for each test instrument. These results were then exported into an SPSS version 10.0 data file for analysis.

Stimuli

Subjects were shown a video entitled *American Time Capsule*, a kinsestatic visual portrayal of a chronological history of the United States which is presented very rapidly through a montage of approximately 1,300 still photographs, portraits, and paintings. The original video was imported into a Macromedia Director 8.5 program written specifically for this study in which it could be played back at one of three different speeds (fast, medium, and slow), based on a specific password that was randomly provided to each subject. A spreadsheet was developed to track which password was assigned to each subject and to ensure an equal distribution of assignments over the sample base, for each gender, and for each cognitive group. At the 'fast' rate, subjects saw the video at its original speed (averaging 300 milliseconds per picture) that lasted approximately four minutes. The 'medium' speed presented the video in about six minutes. The slowest speed presented the 1,300 pictures in about eight minutes, or one every 500-600 milliseconds. The subjects were first shown a sample portion of the video presented at the same rate of speed for the purposes of gaining their attention, accustoming them to the presentation style and speed, and providing an overview of the subject matter. The subjects were able to begin viewing the entire video when they felt they were ready by clicking a button on the screen. In order to facilitate correct interpretation of the directions supplied, the subjects were provided the same set of instructions in a small

help box on every screen and heard an audio reading of the instructions whenever they changed.

Methodology

Testing began immediately after the video was viewed. Subjects were asked to click a start button when they were ready to begin. The process of clicking the button initiated the internal system clock that tracked latency to first response. By providing instructions in this way, the program avoided counting time reading and understanding the questions as part of the latency calculations during the administration of the MFFT-20.

The study utilized a combination of pictorial and textual methods to assess memory. For the verbatim portion of the test, subjects were shown several groups of pictures and asked to pick out via a mouse click the one picture among three distracters that did or did not appear in the video. For the gist memory questions subjects were asked contextual questions in the program. Subjects were also asked to place sets of pictures into contextual-chronological order based on their presentation in the video.

These methods of testing visual clues appear to be in accordance with long-established procedures and findings the literature. Archer (1965) proposed that, if one is testing for visual processing, evaluative vehicles should also be designed that are closely aligned with the visual process because something may be lost in the translation to verbal. Corcoran (1981) noted in his studies into visual perception that testing should utilize the same mode as the original presentation (i.e., textual to textual, pictorial to pictorial) because textual and pictorial forms of information are processed at different rates and in different ways. He also found that reading has the tendency to interfere with

the retrieval of some internal visual representations. Mayer et al. (1996) indicated that words may not serve as proper feedback format to visual motion cues. For these reasons, verbal questions were kept to a minimum in the current study.

In spite of the initial intent to eliminate text-based questions, it was eventually determined that the gist portion would require some of these types. The gist questions were intended to simulate reading comprehension-like assessments where subjects are not asked to memorize every word they read from a book. Rather, they are asked about their overall impressions and understandings about its content. Therefore, it was determined that it was not important that the subjects remember every picture in the gist portion of this the test used in this study, but, like the reading comprehension test, they would be asked to recall contextual information from of the video. So as to further ameliorate the potential confound imposed by the additional reading requirements imposed by the text-based questions, all instructions and questions for the textual portion of the test were presented in both visual and auditory form.

Research Design

Three separate analyses of variance were utilized in this study. First, it was determined that to accurately obtain overall test results for the effects of presentation speed and to detect possible genders differences, the entire sample set had to be analyzed. To analyze the effect of gender and presentation speed on the overall sample, a two-way 2 x 3 factorial design ANOVA (2 gender categories and three presentation speeds) was administered to the entire sample of 204 subjects, as shown in Table 1. Next, it was determined that testing for two separate score results required a separate multivariate

ANOVA (verbatim and gist) x (fast, medium, and slow). The design for this analysis is shown in Table 2.

Table 1
2 x 3 Two-way ANOVA (204 Subjects)

	PRESENTATION SPEED		
GENDER	Fast	Medium	Slow
Male (N = 107)	34	38	35
Female (N = 97)	41	31	25

Table 2
Multivariate Analysis of Variance (204 Subjects)

	PRESENTATION SPEED		
QUESTION TYPE	Fast	Medium	Slow
VERBATIM vs GIST	75	69	60

Last, the procedures for administering the MFFT-20 specified that a certain number of the subjects, by definition, would be systematically excluded from analysis. The administration of the cognitive style test yielded a subset of the sample of 129 subjects who were categorized as either impulsive (n=64) or reflective (n=66) and to

Table 3
2 x 3 Two-way ANOVA (129 Subjects)

	PRESENTATION SPEED		
STYLE	Fast	Medium	Slow
Impulsive (N = 64)	22	25	17
Reflective (N = 66)	24	21	20

whom this portion of the test would be administered. As the main and interaction effects for presentation speeds were also to be analyzed, a second 2 x 3 factorial design ANOVA was designed, as shown in Table 3.

Hypotheses

The hypotheses for this study are stated in the null form. The following hypotheses were determined for the research design using analyses of variance:

Hypothesis 1. There are no significant differences in overall test scores (both verbatim and gist scores are pooled together), for the overall sample set based on presentation speed of the video.

Hypothesis 2. There are no significant differences in overall test scores between male and female subjects in the overall sample set.

Hypothesis 3. There is no significant interaction between presentation speed and gender for overall test scores.

Hypothesis 4. There are no significant differences in verbatim test scores, for the overall sample set, based on presentation speed of the video.

Hypothesis 5. There are no significant differences in gist test scores for the overall sample set, based on presentation speed of the video.

Hypothesis 6. There are no significant differences in overall test scores for those subjects from the overall sample set who are determined to possess impulsive or reflective tendencies.

Hypothesis 7. There are no significant differences in verbatim test scores for those subjects who are determined to possess impulsive or reflective tendencies.

Hypothesis 8. There are no significant differences in gist test scores for those subjects who are determined to possess impulsive or reflective tendencies.

Hypothesis 9. There is no significant interaction between cognitive style and presentation speed of the video.

Summary

Most of the universally recognized instructional design and development theories have accurately established that audience/pupil analysis is an important part of the design process. Cognitive style is one of many different attributes that might need to be considered when technology that is used in instructional settings. The MFFT-20 used in this study to categorize subjects as to their reflectivity-impulsivity has been determined by independent reliability studies to be valid and more powerful than the original MFFT, producing what is believed to be a more effective measurement tool for analyzing this form of cognitive style.

The testing instrument developed for this study was tested for reliability and construct validity through a series of feedback sessions with teachers, peer groups and pilot testing. The reliability test results during the pilot fell within an acceptable range. Because the whole test implementation was automated, the statistical outputs were consistently reported ands made for an ease of analyses along several axes. In addition, the automated cognitive style instrument and treatment tests allowed them to be administered in same day, thereby significantly reducing the potential for mortality among and contamination between the participants. This chapter describes in detail the implementation and methodology of the test instruments.

The next chapter will report the results of these tests. The statistics will be presented in both narrative and table form, leading to the subsequent chapters where the results will be analyzed and discussed with regards to the kinds of inferences that may be made.

CHAPTER 4
ANALYSIS OF THE DATA

Introduction

This study had four overall purposes. The first was to determine whether differences in presentation speed of a video montage would have an effect on a memory. Second, this study attempted to determine whether the presentation speed affect males and females differently. A two-way analysis of variance was used in these two portions of the study. Third, the study attempted to determine whether there would be differences between immediate verbatim and gist memory for the content of the video caused by changes in presentation speed. The design of this portion of the study was a multivariate analysis of variance. Last, an investigation was made to determine whether the immediate memories for subjects classified as either impulsive or reflective would be influenced by changes in presentation speed. The design of this portion of the study was a 2 x 3 factorial design ANOVA.

Results

The data were analyzed with analyses of variance and a multivariate ANOVA. The relevant statistics are presented in ANOVA summary tables. In addition, descriptive statistics are included for means and standard deviations.

Hypothesis 1. There are no significant differences in overall test scores (in which verbatim and gist scores are pooled together), for the overall sample set based on presentation speed of the video.

The analysis resulted in an F (2, 201) of .317 (see Table 4). An F ratio of .317 is not significant at ($p < .05$), therefore, this null hypothesis was not rejected.

Table 4
Source Table of Analysis of Score Variance by Presentation Speed

Source	SS (Type III)	df	MS	F	Sig.
Between Groups					
SPEED	6.377	2	3.189	.317	.729
Error	2022.329	201	10.061		
Total	2028.706	203			

The means and standard deviations for presentation speed are presented in Table 5. In Table 5, 'Fast' represents the results for those who watched the video presented at its original speed (averaging 300-400 milliseconds per picture), 'Medium' at 1/3 of the original (approximately 500-700 milliseconds), and 'Slow' (at approximately 1/2 the original speed (each picture was presented at approximately 1 second each).

Table 5
Score Means and Standard Deviation for Presentation Speed

SPEED	Mean	SD	N
Fast	12.99	3.18	75
Medium	12.70	3.05	69
Slow	12.57	3.30	60
Total	12.76	3.16	204

Hypothesis 2. There are no significant differences in overall test scores between male and female subjects in the overall sample set.

The analysis resulted in a between subjects effect F (1, 202) of 1.542 (see Table 6). Because an F ratio of 1.566 for this main effect is not significant at ($p < .05$), this null hypothesis could not be rejected. The means and standard deviations are presented in

Table 6
Source Table of Analysis of Variance for Gender

Source	SS (Type III)	df	MS	F	Sig.
Between Groups					
GENDER	15.604	1	15.604	1.566	.212
Error	2013.101	202	9.966		
Total	2028.706	203			

Table 7
Score Means and Standard Deviation for Gender

GENDER	Mean	N	SD
Male	13.03	107	3.34
Female	12.47	97	2.94
Total	12.76	204	3.16

Table 7. The mean scores and standard deviations are shown by gender (i.e., males and females). The table shows a difference in scores and standard deviations between males and females, with males obtaining a higher average score. However, as the differences are not significant, they are considered statistically as random variations.

Hypothesis 3. There is no significant interaction between presentation speed and gender for overall test scores.

Table 8 shows the interaction effect for between subjects of SPEED * GENDER resulted in an F ratio of .435. This F ratio is not significant at ($p<.05$). Therefore, this null hypothesis was not rejected.

Table 9 shows the means and standard deviations comparing presentation speed with gender. Males had higher memory scores than females but, these differences are shown to be not significant. As such, they are considered random fluctuations.

Table 8
Source Table of Analysis of Variance of Speed versus Gender

Source	SS (Type III)	df	MS	F	Sig.
Between Groups					
SPEED	8.437	2	4.219	.419	.659
GENDER	15.540	1	15.540	1.542	.216
SPEED * GENDER	8.766	2	4.383	.435	.648
Error	1995.428	198	10.078		
Total	35268.000	204			

Table 9
Score Means and Standard Deviation for Speed versus Gender

SPEED	GENDER	Mean	SD	N
Fast	Male	13.56	3.10	34
	Female	12.51	3.20	41
	Total	12.99	3.18	75
Medium	Male	12.97	3.46	38
	Female	12.35	2.48	31
	Total	12.70	3.05	69
Slow	Male	12.57	3.46	35
	Female	12.56	3.12	25
	Total	12.57	3.30	60
Total	Male	13.03	3.34	107
	Female	12.47	2.94	97
	Total	12.76	3.16	204

Hypothesis 4. There are no significant differences in verbatim test scores, for the overall sample set, based on presentation speed of the video.

The analysis of verbatim scores resulted in an F (2, 201) of 1.082 (see Table 10).

Table 10
Source Table of Analysis of Variance for Verbatim Scores for Speed

	SS (Type III)	df	MS	F	Sig.
Between Groups	12.035	2	6.018	1.082	.341
Error	1117.592	201	5.560		
Total	1129.627	203			

Because the F ratio for verbatim recall was not significant at ($p<.05$), this null hypothesis could not be rejected. The means and standard deviation are presented in Table 14.

Hypothesis 5. There are no significant differences in gist test scores for the overall sample set, based on presentation speed of the video.

The analysis of gist scores resulted in an F (2,201) of 5.491 (see Table 11). Because the F ratio for verbatim recall was significant at ($p<.05$), this null hypothesis was rejected.

Table 11
Source Table of Analysis of Variance for Gist Scores for Speed

Source	SS (Type III)	df	MS	F	Sig.
Between Groups	32.462	2	16.231	5.491	.005*
Error	594.127	201	2.956		
Total	626.588	203			

* Significant at ($p<.05$)

Because the results were found to be significant, and because there were more than two groups to be compared, a Bonferroni test was run to compare individual pairings of gist scores to each of the individual presentation speeds. Table 12 shows that the pair-wise comparisons are significant for gist scores when comparing 'Slow' and 'Fast' speeds, but not significant between 'Medium' and 'Slow' or 'Medium' and 'Fast'.

In order to further compare verbatim and gist scores, a means and standard deviation table (Table 13) is presented. Table 13 shows a mean score for fast speeds of 6.01 out of 10 possible gist responses for those viewing the video at the fast speed and 5.05 (out of 10) mean score for those viewing it at the slow speed. Table 13 shows that,

as a percentage, those subjects who watched the video at the two faster speeds also tended to get more gist questions correct than those watching at the slow speed. For the verbatim questions, there were no significant differences based on changes in speed.

Table 12
Multiple Comparisons Between Speed and Gist Scores

SPEED	SPEED	Mean Difference	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Fast	Medium	.25	.287	1.000	-.45	.94
	Slow	.96*	.298	.004	.24	1.68
Medium	Fast	-.25	.287	1.000	-.94	.45
	Slow	.72	.303	.057	-.01	1.45
Slow	Fast	-.96*	.298	.004	-1.68	-.24
	Medium	-.72	.303	.057	-1.45	.01

* Significant at ($p<.05$)

Table 13
Score Means and Standard Deviation for Gist versus Verbatim Test Items

	SPEED	Mean	Std. Deviation	N
VERBATIM	Fast	6.93	2.47	75
(15 questions)	Medium	6.97	2.26	69
	Slow	7.48	2.33	60
	Total	7.11	2.36	204
GIST	Fast	6.01	1.79	75
(10 questions)	Medium	5.77	1.64	69
	Slow	5.05	1.72	60
	Total	5.65	1.76	204

Hypothesis 6. There are no significant differences in overall test scores for those subjects from the overall sample set who are determined to possess impulsive or reflective tendencies.

As seen in Tables 14 and 15, the sample size is smaller (n=129 versus n=204) due to the procedures involved in determining impulsive and reflective tendencies. A portion

of the sample was systematically excluded due to these subjects being cast as either fast-accurate or slow-inaccurate, which placed them outside the parameters set forth by the administrative instructions that accompanied the MFFT-20. An analysis of variance was performed and obtained an F (2,123) of 6.560 for the main effect for cognitive style. The F ratio for between subjects was significant at ($p<.05$), therefore, the null hypothesis was rejected. The means and standard deviations are presented in Table 15. This table shows

Table 14
Source Table of Analysis of Score Variance by Presentation Speed and Cognitive Style

Source	SS (Type III)	df	MS	F	Sig.
SPEED	2.968	2	1.484	.160	.852
STYLE	60.870	1	60.870	6.560	.012*
SPEED * STYLE	7.380	2	3.690	.398	.673
Error	1141.340	123	9.279		
Total	21733.000	129			

* Significant at ($p<.05$)

Table 15
Means and Standard Deviation for Overall Scores for Style

SPEED	STYLE	Mean	Std. Deviation	N
Fast	Impulsive	11.50	2.09	22
	Reflective	13.50	3.31	24
	Total	12.54	2.94	46
Medium	Impulsive	12.36	3.86	25
	Reflective	13.24	2.14	21
	Total	12.76	3.19	46
Slow	Impulsive	11.82	3.30	17
	Reflective	13.10	3.02	20
	Total	12.51	3.18	37
Total	Impulsive	11.92	3.17	64
	Reflective	13.29	2.85	65
	Total	12.61	3.08	129

that impulsive subjects had significantly lower correct scores than reflective subjects, regardless of presentation speed.

Hypothesis 7. There are no significant differences in verbatim test scores for those subjects who are determined to possess impulsive or reflective tendencies.

In order to further investigate the differences in scores obtained for impulsive or reflective styles, a one-way analysis variance was developed (Table 16). An analysis of

Table 16
Source Table of Analysis of Score Variance for Verbatim and Gist and Cognitive Style

		SS (Type III)	df	MS	F	Sig.
GIST	Between Groups	12.089	1	12.089	4.410	.038*
	Within Groups	348.144	127	2.741		
	Total	360.233	128			
VERBATIM	Between Groups	14.267	1	14.267	2.925	.090
	Within Groups	619.423	127	4.877		
	Total	633.690	128			

* Significant at ($p<.05$)

was performed and obtained an F (1, 127)of 2.925 for verbatim scores. The F ratio for between subjects was not significant at ($p<.05$), therefore, the null hypothesis was not rejected.

Hypothesis 8. There are no significant differences in gist test scores for those subjects who are determined to possess impulsive or reflective tendencies.

The same analysis of variance used for Hypothesis 7 was used to show both verbatim and gist scores (Table 16). The analysis obtained an F (1, 127) of 4.410 for verbatim scores. The F ratio for between subjects was significant at ($p<.05$), therefore, the null hypothesis was rejected.

A means and standard deviation table (Table 17) was developed to further

investigate these differences. Table 17 shows that the significant differences in test scores found in Hypothesis 6 were derived from the gist portion of the memory test, which is consistent with previous findings regarding the significance of gist versus verbatim memory from the overall combined test scores.

Table 17
Means and Standard Deviation for Gist and Verbatim Scores for Style

	STYLE	Mean	Std. Deviation	N
GIST	Impulsive	5.20	1.77	64
	Reflective	5.82	1.54	65
	Total	5.51	1.68	129
VERBATIM	Impulsive	6.77	2.14	64
	Reflective	7.43	2.27	65
	Total	7.10	2.23	129

Hypothesis 9. There is no significant interaction between cognitive style and presentation speed of the video.

The interaction effect for between subjects of cognitive style (STYLE) and presentation speed (SPEED) resulted in an F (2, 123) of .398 (see Table 14). This F ratio is not significant at ($p<.05$). Therefore, this null hypothesis was not rejected.

Summary

The results of the study indicate that combined memory scores (verbatim and gist added together) tended to improve as the speed of the presentation slowed down. However, these differences were not statistically significant and are considered random fluctuations. The analysis of variance for gender also shows small differences in scores between males and females. These differences, too, were not significant at the .05 level.

In order to more fully review the differences that presentation speed imposes on memory, the scores for verbatim and gist portion of the test were recorded and analyzed

separately. An analysis of variance shows an interesting result when verbatim and gist memories are separated and compared. Gist memories were affected more by presentation speed than verbatim memories. The analysis of variance tables also reveal that gist memory was more affected by cognitive style than is verbatim memory. The means and analysis of variance tables reveal that those viewing the video at the fastest rate scored significantly did better on the gist portion of the memory test, whereas the differences in mean scores on the verbatim portion of the test were not significant. While the scores appeared to improve for verbatim questions as the presentation rate was slowed, the differences were not statistically significant at the .05 level and, therefore, have to be considered random variations.

Because the analysis of variance for presentation speed involved three different rate comparisons, a Bonferroni follow-up test was used to pin-point the exact location of the differences. The results confirm that a significant difference lies between the fast and slow presentation speeds for gist memory, whereas the differences in scores between the medium and fast and the medium and slow speeds for either gist of verbatim questions are not significant.

The pertinent source and means table shows that combined total scores (i.e., totals in which verbatim and gist scores were added together) improved for those in the sample who were categorized as being reflective over the impulsive subjects, regardless of presentation speed. The analysis of variance indicates that these mean variances were significant at the .05 level. However, the interaction differences between speed and cognitive style were not found to be significant at the same .05 level. A review of the means table (Table 17) for impulsive versus reflective for verbatim and gist questions

identified the source of the significant variations. Of the two types of memory tested, the gist comparison proved to be significant, whereas the differences between reflective subjects on the verbatim portion of the memory test were found to be random variations at the .05 level.

The role of this chapter was to report on the specific statistics as they related to the current study. The results of the tests show that many of the variances that were uncovered were not significant at the .05 level. However, two of the comparison tests (the one contrasting gist memories and presentation speed and the one that evaluated cognitive style and presentation speed) revealed significant differences. The impact of these variations and considerations as to how they relate to the current and potential future studies will be discussed in the next chapter.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

Introduction

This study had several purposes. First it attempted to determine if a change in presentation speed of a video montage might alter subjects' combined memory scores (i.e., a single total score of the entire memory test was evaluated as a whole in which verbatim questions and gist questions were pooled together). Second, the study attempted to see if a change in presentation speed would create any significant differences in the combined memory scores between males and females. Next, the verbatim and gist scores were considered separately to determine if presentation speed has a significant affect on either group. The entire sample set was used in the analyses of variance to investigate these first two conditions. Lastly, the study attempted to find out if there are significant differences in combined memory scores for the video presented at three different speeds, based on subjects' cognitive style. Categorizing subjects as to impulsive or reflective tendencies, by definition, resulted in using only that portion of the overall sample set who were identified as impulsive or reflective in this portion of the study. To further investigate any differences, verbatim and gist memories were also considered separately for this portion of the study.

Analyses of variance were used to investigate the effects of presentation speed, gender, and cognitive style. Findings are reported below.

Findings

All hypotheses are stated in the operational null form and were tested at the .05 level.

Hypothesis 1. There are no significant differences in overall test scores (both verbatim and gist scores are pooled together), for the overall sample set based on presentation speed of the video.

The null hypothesis was not rejected.

Hypothesis 2. There are no significant differences in overall test scores between male and female subjects in the overall sample set.

The null hypothesis was not rejected.

Hypothesis 3. There is no significant interaction between presentation speed and gender for overall test scores.

The null hypothesis was not rejected.

Hypothesis 4. There are no significant differences in verbatim test scores, for the overall sample set, based on presentation speed of the video.

This hypothesis was not rejected.

Hypothesis 5. There are no significant differences in gist test scores for the overall sample set, based on presentation speed of the video.

The null hypothesis was rejected. Further, a Bonferroni post-hoc test indicates that those watching the video at the fastest speed scored significantly better on the gist portion of the test than did those watching the video at the slow speed.

Hypothesis 6. There are no significant differences in overall test scores for those subjects from the sample who are determined to possess impulsive or reflective tendencies.

The null hypothesis was rejected.

Hypothesis 7. There are no significant differences in verbatim test scores for those subjects who are determined to possess impulsive or reflective tendencies.

This hypothesis was not rejected.

Hypothesis 8. There are no significant differences in gist test scores for those subjects who are determined to possess impulsive or reflective tendencies.

This hypothesis was rejected.

Hypothesis 9. There is no significant interaction between cognitive style and presentation speed of the video.

The null hypothesis was not rejected.

Discussion

Presentation Speed

There were no significant differences in overall combined test scores when the presentation speed of the video was varied. While there were differences in the total number of correct responses, those differences were not significant, meaning that any difference between the scores in this portion of the study must be considered random variations. The lack of significance between the groups due to changes in presentation speed appear to run counter to many commonly understood ideas about memory processing and speed of message delivery --that immediate memory could be conversely affected by the presentation speed of the video. Part of the reason that subjects in the

slower groups did not score better might have been because they became disinterested (the videos lasted six and eight minutes versus four for the fastest group) as the duration of the video grew longer –a phenomenon observed by the principle investigator while conducting this study. The poorer scores may have been due to a lack of attention that could have counter-balanced any positive gain in memory that the subjects might have enjoyed by being able to look at the pictures for longer periods of time.

Gender

The total mean score for males (13.03) was larger than that for females (12.47). However, the analysis of variance did not indicate that this difference was significant at the .05 level, indicating that any differences in scores that did exist between males and females were random variations. Therefore, it was determined that gender, as a variable, was not a factor and need not be considered separately in the remainder of this study.

Verbatim versus Gist Memory

The mean scores for both verbatim (7.11 out of 15 possible correct responses) and gist (5.65 out of 10) both represent an accuracy level of about 50% of the total number of questions for each type. For verbatim memory questions, subjects who watched the video at the slowest rate performed better than did those who watched the video at the medium or fastest rates. The scores appeared as if they would improve as the presentation rate slowed down, but the differences between the fast and medium speeds were virtually identical (6.93 and 6.97 respectively). Further, these differences were not significant at the .05 level at any speed, therefore were considered to be random fluctuations. In summary, verbatim memory was not affected by presentation speed.

When considering gist memory, the means table indicates that the scores improved as the presentation speed got faster. The analysis of variance reveals that these differences were significant at the .05 level. Because there were three presentation groups being compared, a follow-up test was run to pin-point where the significant differences existed. The Bonferroni test shows that the significant difference between test scores exists between the fasted and the slowest presentation speeds, while the differences between the other two groups (fast-medium and medium-slow) were not significant. The difference only mattered when one compares the two extremes of the presentation speeds.

Cognitive Style

By definition, reflective individuals were expected to score better on tests than impulsives. The means and standard deviation table used confirms that this assumption held true in this study as well. Reflective subjects did score significantly better in the overall test scores in which the verbatim and gist questions were combined. However, in a separate analysis in which the verbatim and gist scores were viewed separately, the differences for verbatim memory were found to be not significant at the ($p>.05$) level. On the other hand, there was a significant difference in gist memory when considering cognitive style.

The mean number of overall correct responses for impulsive subjects was 11.92 out of a possible 25 (approximately 48%). For reflective subjects, the overall mean was 13.29 correct responses out of 25 questions (approximately 53%). The descriptive statistics are more revealing when verbatim and gist scores are separated. When looking at the verbatim scores alone, impulsive subjects scored an average of 6.77 out of 15 possible verbatim responses (approximately 45%). Reflective subjects correctly answered

an average of 7.43 (approximately 49%). These differences were not found to be statistically significant and, therefore, were considered random fluctuations. In the gist portion, however, impulsive subjects scored an average of 5.20 out of a possible 10 (52%). The reflective subjects scored an average of 5.82, or a little more that 58% correct answers, which was shown by the analysis of variance to be statistically significant. These results show that while cognitive style did affect memories for the video, the gist memory was affected most.

Interaction Between Speed and Style

No significant differences were found to be caused by an interaction between presentation speed and cognitive style. This means that, at least for the subjects in this study, cognitive style mediated immediate memory but it was not further affected by a change in presentation speed. That portion of the subject group that was found to be impulsive or reflective was affected by the speed in the same way as the remainder of the sample group.

Implications

The results of this study indicate that students tend to remember gist information from rapidly presented videos better than those presented at slower speeds. These results appear to contradict earlier research that seemed to indicate that the viewers would be able to remember more information from pictures if they are presented at slower speeds. One of the reasons might have been because the earlier studies measured memory on a combined basis, concentrating solely on measuring immediate verbatim memory. The parsing of gist and verbatim scores in the current study has uncovered a potential new approach to investigate differences in pictorial cognition. The fact that the significant

differences in gist memory was masked when the verbatim and gist memory scores were considered together reveals that researchers may need to identify new paradigms that take into consideration the goals and intended outcomes of the instructional activities they are investigating. Not all classroom experiences need to have rote memory as a sole learning outcome. Stimulating gist memories, like teaching reading comprehension, may have its own place in overall instructional schemes.

To a degree, the results of the cognitive style instrument used in this study to categorize subjects indicate that some things about learning styles have changed since the original instrument was analyzed and developed. When one compares the results of MFFT-20 cognitive style in the current study to the norms provided by Cairns and Cammock (1984), not only has the median total number of errors decreased (from 28-30 in the Cairns and Commock studies to eight in the current study), but also so has the median latency to first response (from 18 to 9.12). These reductions seem to indicate that latencies to first response for visual activities are growing shorter, but the quicker responses do not always translate to higher error ratios. Students appear to be developing a propensity for remembering things from rapid visual presentations.

Another change that took place is the shrinking of the differences in visual cognition between males and females. With Cairns and Cammock, female responses were considered to lie so dramatically outside of the norms that they were systematically eliminated from their studies. In the current study, any differences between males and females that did exist were found to be non significant. While females still may be found to be more reflective than their male counter-parts, these differences may be growing smaller.

The results of this study also indicate that using the impulsive-reflective cognitive style instrumentation may be still a valid measuring tool. While both verbatim and gist memories were both negatively affected by cognitive style, it was only gist memory for the rapidly presented videos that was affected significantly. When considering the entire sample without regard to style, the analysis of variance did not yield any significant differences. The cognitive style portion of this study uncovered some discrepancies (i.e. learning difficulties) that might have otherwise gone unnoticed.

Whether the changes found here are the result of differences in casual television viewing habits or computer usage (or both in combination) was outside the purview of the current study. However, many of the results indicate that something is different about the way today's youthful learners perceive visual inputs, creating several interesting scenarios for future studies.

It is noteworthy that the total correct number of responses for all groups was quite low (around 50%). The relatively low numbers of correct to total possible responses serves to reinforce that the purpose for integrating video presentations into teaching and learning situations has not changed. While a change in presentation style may provide an essential pre-condition for increasing knowledge, it still needs to be coupled with sound instructional strategies for any learning to take place.

Recommendations

The results of this study have raised some interesting questions about the nature of visual perception and it discovered a potential for investigating several new paradigms for instruction. The following recommendations are made for future studies in this area:

1. When one compares the median latencies and errors and the percentages of

fast-accurates between the Cairns and Cammock studies and the current study, there appears to be a general lowering of the latencies and errors and a general increase in the number of fast-accurates as a percentage of the total sample. Further investigations could be developed to determine what, if any, the increased usage of rapidly presented digital media that was found in the review of the literature may have on cognitive style.

2. Other trends between the Cairns and Cammock study and the current one appear to have developed. For one, females were excluded from the Cairns and Cammock study due a determination that the differences between males and females were significant enough at that time that including them would confound the results. In the current study, the differences between males and females were not significant. An investigation could be made to determine whether the differences in cognitive styles between males and females have lessened with the latter's increased usage of digital media.
3. One could investigate the optimal duration of rapidly presented frames before verbatim and gist memories deteriorate to the point where presentation speed has a significant affect.
4. One could look into the effect of other variations of presentation speeds on memory. The current study only looked into rapid presentation. There have been several studies that have looked with limited success into the effects of slow motion on long-term memory (Corcoran, 1981; Kozma, 1986; O'Brien, 1968; Olson, 1974; Pearl, 1982). Some of these studies are quite old and modern digital creation techniques make it much easier to design

and evaluate these types of studies than it was previously.

5. Another dimension of learning is long-term memory and forgetting. The current study only dealt with short-term memory, an essential but insufficient condition for learning. A study could be developed to investigate the effects of repetition and rehearsal, and whether presentation speed has any interaction effect. Future studies could look into using short, rapidly presented videos as an orientation/learning set, and expand the subject base to make the results more generalizable to a larger population.
6. It is possible that the impulsive-reflective comparisons for gist memory indicated a significant result was due to a relatively low number of test questions devoted to that portion of the test (10 questions devoted to gist versus 15 for verbatim). For the current study, a determination had to be made to balance the need for statistical power with that for limiting the total number of questions to a reasonable number. While the reliability analysis performed in the pilot study on the gist questions proved successful, it is recognized that the low number of questions may have had a bearing on the results. A future study could be designed to study only the effect of gist memories where more questions could be asked.
7. Joseph Hill (1981), prior to his untimely death, had begun to look into the effects of contextualism on recognition and recall. These studies could be expanded and investigated to determine how contextual memory correlates with presentation speed.
8. One of the premises of the current study was that the ability of today's

media-centric youth to more quickly perceive and assimilate rapidly presented visual images was due to casual television viewing habits and video game usage. Studies could be developed into determining whether increasing perceptual skills can be a trainable activity, especially using older subjects who might not have had the same viewing and gaming opportunities previously.

9. The results of this study align to a certain degree with Stephens' (1996) assertions that video montage can convey composite thoughts in as much as a paragraph does in text-based communications. Based on the results of the current study, a further investigation could be developed to look further into the effects of continued used of video montage to develop gist memory.
10. Studies could be developed to determine the relationship between numbers of incorrect choices students make prior making correct selections, latencies, and learning progress. New interactive technologies provide novel opportunities for educators to easily build test instruments that track both these test-taking characteristics. While the results were not included, the computer software used in the current study to track verbatim and gist memory was also programmed to track latency as well as correct responses in the exact manner that was used in the automated MFFT-20 cognitive style test. Tracking latencies as well as number of responses made prior to correct selection could be incorporated into more formal studies to more thoroughly track the progress of student learning.

Finally, it should be noted that the technology employed allowed the investigator to conduct this study with a small number of large groups (30+ at the same time). This was a bane as well as a blessing. There were times when the interactions between subjects became somewhat difficult to control. Luckily, there were three proctors in the room to ensure that subjects remained on task and were correctly following directions. Future studies might fare better if the number of sessions were increased to allow for smaller group sizes. Large group interactions did cause a certain number of distractions and may have had some bearing on the results. While these types of large groups might indeed be more *authentic* (i.e., they represent more closely an actual classroom setting), crowd control is an issue and a potential confound to the results of the research.

Summary

In some regard, readers of this study would be correct if they note that it appears to have raised more questions than it has answered. This was a part of the original motivation to do the study. The catalyst to do this study was an inclination on the part of this investigator to apply a research base to the myriad of recent unsubstantiated reports found in the literature and personal anecdotal observations about the changing nature of cognition and communications in today's technology rich society.

As a minimum, it appears that ideas concerning the nature of cognitive style are in need of updating. The review of the literature revealed that little has been done in this area for almost twenty years and the median latency and errors have been shown to decrease significantly since original studies took place.

It should be noted that it was never the intent of this study to discover some new paradigm for learning. Rather, it simply intended to re-open some discussions and

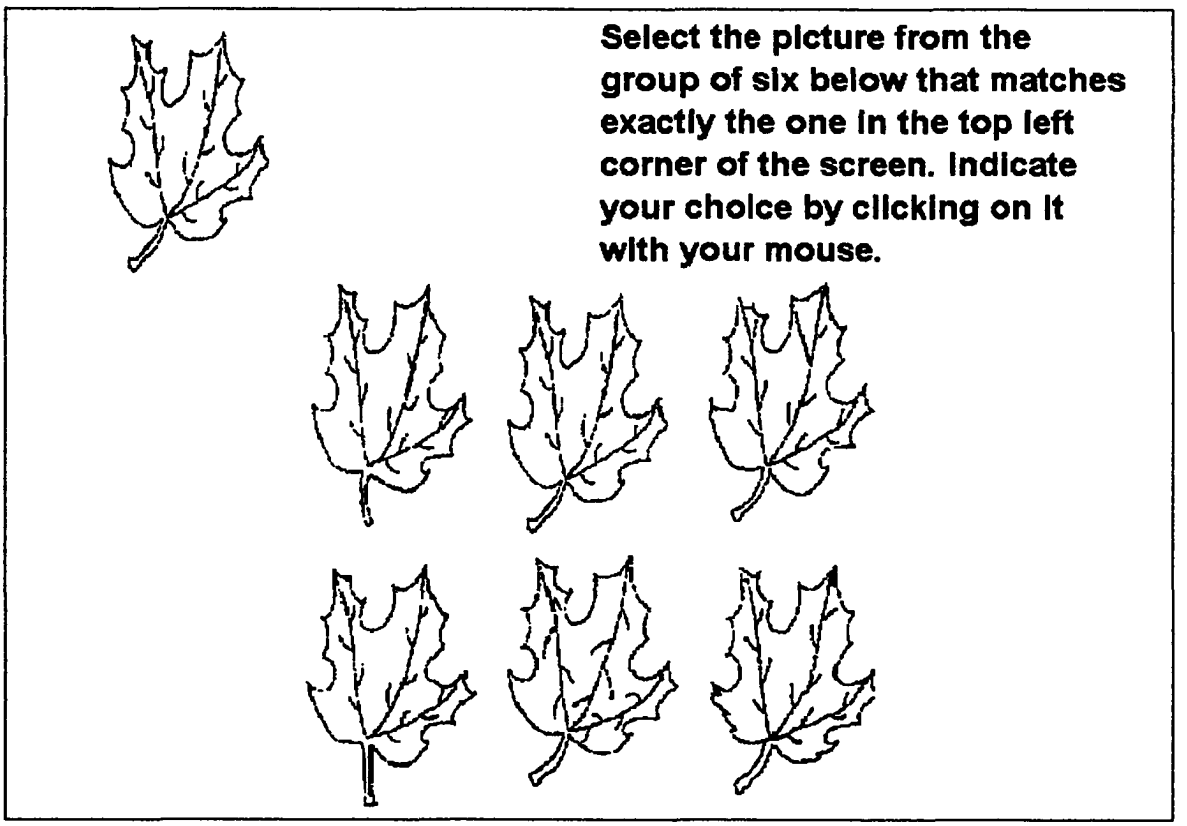
reinforce existing theories about learners and knowledge gained from viewing pictures. The results of this study simply show that today's youths have changed their propensity for and skills in mediated pictorial cognition. Technological improvements have both significantly increased the occurrence of rapidly presented montage passages found in television programs, in movies and movie trailers, and in commercials in particular. They have also made it possible to more effectively test the effect of the rapid presentation speeds and cognitive style that was not practicable previously.

The analyses of variance in this study revealed both some significant and non significant results. They showed that one's cognitive style does mediate memories for pictorial representations, but, overall, presentation speed does not. In addition, there are no significant differences between the way males and females remember them.

The lack of significance in certain portions of this study may be significant. First, the fact that there were no more than random differences between slow medium and fast presentation speeds is noteworthy in itself, as these results may not be what one might have expected in light of previous research into the interactions between presentation speeds and object memory. Further, once the non-significant, combined test scores were separated into their verbatim and gist portions and were subsequently analyzed, the gist score variations were found to be significantly affected by presentation speed. Co-mingling the scores for memory together into one combined result had the effect of masking a significant interaction that was occurring –one that might have otherwise gone unnoticed. These results further reinforce long-standing, generally accepted instructional principles that promote audience analysis and the matching of competency assessment with very specific the instructional goals.

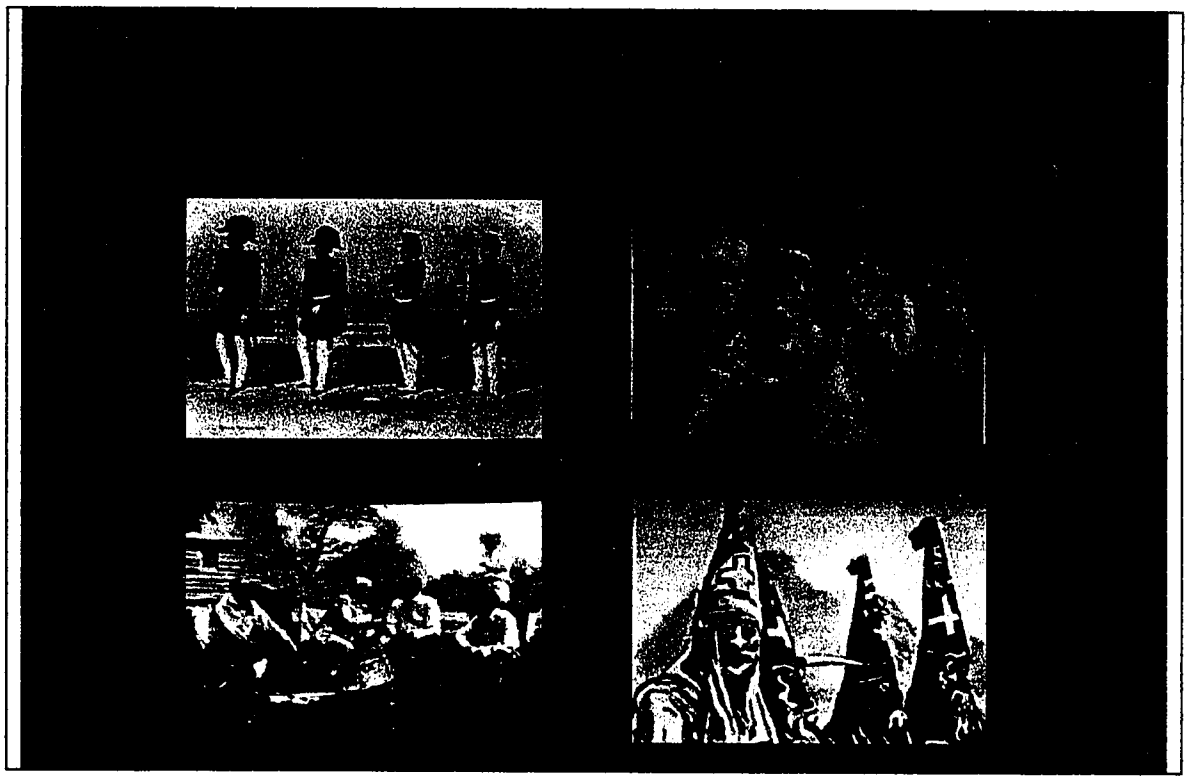
APPENDIX A

SCREEN SHOT FROM MFFT-20 COGNITIVE STYLE TEST



APPENDIX B

SCREEN SHOT FROM TEST INSTRUMENT SHOWING SAMPLE VERBATIM QUESTION



REFERENCES

Abelman, R. (1995). Gifted, LD, and gifted/LD children's understanding of temporal sequencing on television. *Journal of Broadcasting and Electronic Media, 39*, 297-312.

Allison, T., Ginter, H., MacCarthy, G., Nobre, A.C. , Puce, A., Luby, M., et al. (1994). Face recognition in human extrastriate cortex. *Journal of Neurophysiology, 71*, 821-825.

Alwitt, L. F., Anderson, D. R., Lorch, E.P., & Levin, S. R. (1980). Preschool children's visual attention to attributes of television. *Human Communication Research, 7*, 52-67.

Anderson, D., Alwit, L., Lorch, E., & Levin, S. (1979). Watching children watch television. In G. M. L. Hale (Ed.), *Children's understanding of television* (pp. 331-353). New York: Academic Press.

Anderson, D. B., & Bryant, J. (1983). Research of children's television viewing: The state of the art. In J. A. Bryant, D. (Ed.), *Children's understanding of television: Research on comprehension and attention.* (pp. 331-354). New York: Academic Press.

Anderson, D. R., & Collins, P. A. (1988). *The impact of children's education: Television's influence on cognitive development.* Washington, DC: Office of Educational Research and Improvement.

Anderson, K. K., & Revelle, W. (1994). Impulsivity and time of day: Is rate of change in arousal a function of impulsivity? *Journal of Personality and Social Psychology, 67*(2), 334-344.

Anderson, L. A. (1986). *Attention and visual perception: The availability of features.* Paper presented at The Human Factors Society-30th Annual Meeting, Houston, Texas.

Archer, E. J. (1965). Concept identification as a function of obviousness of relevant and irrelevant information. In D. P. R. C. Anderson & Ausubel (Ed.), *Readings in the Psychology of Cognition* . New York: Holt, Rhinehart & Winston.

Arizmendi, T., Paulsen, K., & Domino, G. (1981, Spring). The Matching Familiar Figures Test: A primary, secondary, and tertiary evaluation. *Journal of Psychology*, 812-818.

Arnheim, R. (1974). Virtues and vices of the visual media. In D. R. Olson (Ed.), *Media and Symbols: The forms, expression, communication, and education* (pp. 180-210). Chicago: University of Chicago Press. The Seventy-Third Yearbook of the National Society for the Study of Education.

Arnold, R. S. (1996). *Instructional effectiveness of compressed motion video signals.* (Doctoral Dissertation, University of Central Florida, 1996). Dissertation Abstracts International, 51 (03), 1103A.

Ault, R. L., Mitchell, C., & Hartmann, D. P. (1967). Some methodological problems in reflective-impulsivity. *Child Development, 47*, 227-231.

Ayabe, H. I. (1973). *Measuring reflection-impulsivity accurately.* Paper presented at the Annual Meeting of the American Educational Research Association, February 25 - March 1, New Orleans, LA, (ERIC Document Reproduction Service No. ED 079 333).

Bargh, J. A. (1988). Automatic information processing: Implications for communications and effect. In L. Donohew, Syphder, H. & Higgins, E. T. (Ed.), *Communication, social cognition, and affect* (pp. 9-32). Hillsdale, NJ: Lawrence Erlbaum Associates.

Barnett, B. (2000). The impact of slow motion video on viewer evaluations of television news stories. *News Photographer, 55*(7), 4-11.

Bartlett, F. C. (1932). *Remembering.* Cambridge: Cambridge University Press.

Basil, M. (1994). Multiple resource theory I: Application to television viewing. *Communication Research, 21*, 177-207.

Berlo, D. K. (1960). *The process of communication: An introduction to theory and practice.* Toronto, CA: Holt, Rinehart & Winston.

Berry, L. H. (1991). *Visual complexity and pictorial memory: A fifteen-year research perspective.* Paper presented at the Annual Convention of the Association for Educational Communications and Technology. (ERIC Documentation Reproduction Service No. 334 975).

Biederman, I., Rabinowitz, J. C., Glass, A. L., & Stacy, E. W. (1974). On the information extracted from a glance at a scene. *Journal of Experimental Psychology, 103*, 597-600.

Block, J., Block, J. H., & Harrington, D. M. (1974). Some misgivings about the Matching Familiar Figures Test as a measure of reflection-impulsivity. *Journal of Developmental Psychology, 10*, 611-632.

Boyden, J. G., & Gilpin, A. R. (1978). Matching familiar figures test and Stroop test performance in adults. *Perceptual and Motor Skills, 46*, 854.

Brainerd, C. J., & Reyna, V. F. (1990). Grist of the gist: Fuzzy-trace theory as the new intuitionism. *Developmental Review, 10*, 3-47.

Brainerd, C. J., & Gordon, L. L. (1994). Development of verbatim and gist memory for numbers. *Developmental Psychology, 30*(2), 163-177.

Braverman, C. (1969). The world of kinestasis. *Media & Methods, 6*(3), 61-62.

Bridgeman, B. (1980). Generality of a "Fast" or "Slow" test-taking style across a variety of cognitive tasks. *Journal of Educational Measurement*, 17, 211-217.

Brown, R. & Kulick, J. (1977). Flashbulb memories. *Cognition, 5*, 73-99.

Brumby, M. N. (1982). Consistent differences in cognitive styles shown for qualitative biological problem-solving. *British Journal of Educational Psychology, 52*, 244-257.

Bruning, R. H., Shraw, G. J., & Ronning, R. R. (1999). *Cognitive psychology and instruction*. Upper Saddle River, NJ: Prentice-Hall.

Bryant, J., & Rockwell, S. C. (1991). Evolving cognitive models in mass communication reception processes. In J. Bryant, Zillman, D. (Ed.), *Responding to the screen: Reception and reaction processes*. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Burns, B. (1992). *Percepts, concepts, and categories: The representation and processing of information.* Amsterdam: Elsevier Science Publishers.

Cairns, J., & Cammock, T. (1984). The 20-Item Matching Familiar Figures Test. (ERIC Document Reproduction Service: No. 015681-4).

Calvert, S. L. & Scott, C. (1989). Sound effects for children's temporal integration of fast-paced television content. *Journal of Broadcasting and Electronic Media, 33*(233-246).

Campbell, D., & Fiske, D. (1959). Convergent and discriminate validation by the multi-trait/multi-method matrix. *Psychological Bulletin*, 56, 81-105.

Campbell, D. S., & Davis, R. B. (1982). *On the validity of reflection-impulsivity as a construct in classroom research.* Paper presented at the Annual Meeting of the American Educational Research Association, New York, March, 1982, (ERIC Document Reproduction Service No. ED 222 502).

Canelos, J. (1986, January). *External pacing as an instructional strategy for the design of micro-computer based instructional program to improve performance on higher level instructional objectives.* Paper presented at the Annual convention of the Association for Educational Communications and Technology, Las Vegas, N.V.

Carr, T. H. (1982). Words, pictures, and priming: On semantic activation, conscious identification, and the automaticity of information processing. *Journal of Experimental Psychology - Human Perception and Performance, 8*, 757-777.

Chu, G. C. & Schramm, W. (1968). *Learning from television: What the research says.* Washington, D. C.: National Association of Educational Broadcasters, Stanford, CA. Institute for Communication Research.

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research, 53*, 445-459.

Cobb, T. (1997). Cognitive Efficiency: Toward a revised theory of media. *Educational Technology Research and Development, 45*(4), 21-35.

Coltheart, V. (1999). Introduction. In V. Coltheart (Ed.), *Fleeting Memories: Cognition of brief visual stimuli* (pp. 1-12). Cambridge, MA: The MIT Press.

Comstock, G. A., Chafee, S., Katzman, N., McCombs, & M., & Roberts, D. (1978). *Television and human behavior.* New York: Columbia University Press.

Cooper, L. A. (1982). Strategies for visual comparison and representation: Individual differences. In R. J. Sternberg (Ed.), *Advances in the Psychology of Human Performance* . Hillsdale, NJ: Lawrence Erlbaum Associates.

Cooper, R. (2000). *Visual dominance and the control of action*, [Online]. Available: http://www.psyc.bbk.ac.uk/staff/rc/publications/cogsci98/visual_dominance/ [2001, March 11].

Corcoran, F. (1981). Processing information from screen media: A psycholinguistic approach. *Educational Communications and Technology Journal, 29*, 117-128.

Cowan, N. (1998). Children's memories according to fuzzy-trace theory: An endorsement of the theories purpose and some suggestions to improve its application. *Journal of Experimental Child Psychology, 71*(2), 144-54.

Cronbach, L. J. & Snow, R. E. (1977). *Aptitudes and instructional methods: A handbook of research on interactions.* New York: Irvington.

Crowder, R. G. (1976). *Principles of learning and memory.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Dale, E. (1969). *Audiovisual methods in teaching.* New York: Holt, Rinehart & Winston.

Davis, E. T., Scott, K., Pair, J., Hodges, L.F., & Oliverio, J. (1999). *Can audio enhance visual perception and performance in a virtual environment?* Paper presented at the Human Factors and Ergonomics Society-43rd Annual Meeting, Los Angeles, CA.

Dick, A. O. (1973). *Utilization of visually presented information: Final Report .* Washington, DC: National Center for Educational Research and Development. (ERIC Document Reproduction Service No. ED 078 365).

Dixon, N. F. (1981). *Pre-conscious processing.* New York: John Wiley & Sons.

Downs, E. (1989). *The effects of cueing strategy, level of information, and motion condition on children's interpretation of implied motion in pictures.* (Doctoral Dissertation, University of Florida, 1989). *Dissertation Abstracts International,* 51 (03), 0792A.

Durso, F. T. & Johnson, M. K. (1979). Facilitation in naming and categorizing repeated pictures and words. *Journal of Experimental Psychology: Human Learning and Memory, 5*(5), 449-459.

d'Ydewalle, G., & Vanderbeeken, M. (1990). Perceptual and cognitive processing of editing rules in film. In R. Groner, d'Ydewalle, G., Parham, R. (Ed.), *From Eye to Mind: Information Acquisition in Perception, Search, and Reading* (pp. 129-139). Amsterdam: Elsevier Science Publishers, B.V.

Ederlyi, M. H. (1985). *Psychoanalysis: Freud's cognitive psychology.* New York: W. H. Freeman.

Edgar, G. K. (1997). Visual accommodation and virtual images: Do attentional factors mediate interacting effects of perceived distance, mental workload, and stimulus presentation modality? *Human Factors, 39*(3), 374-382.

Egeland, B., & Weinberg, R. A. (1976). The matching familiar figures test: A look at its psychometric credibility. *Child Development, 47*, 483-491.

Ellis, W. D. (1938). *A source book of gestalt psychology.* New York: Harcourt, Brace & World.

Estes, W. K. (1994). *Classification and cognition.* New York: Oxford University Press.

Flannagan, P. (1998). Aurally and visually guided search in a virtual environment. *Human Factors, 40 (3),* 461-469.

Flowers, J. H. (1995). Musical versus visual graphs: Cross-modal equivalence in perception of time-series data. *Human Factors, 37*(3), 553-570.

Gardner, H., Howard, V., & Perkins, D. (1974). Symbol systems: A philosophical and educational investigation. In D. R. Olson (Ed.), *Media and Symbols: The forms of expression, communication, and education* (pp. 27-55). Chicago: University of Chicago Press. The Seventy-Third Yearbook of the National Society for the Study of Education.

Gentry, C. G. (1998). *Introduction to instructional development.* Belmont, CA: Wadsworth Publishing.

Gibson, E. J. (1969). *Principles of perceptual learning and development.* New York: Appleton-Century-Crofts.

Gibson, J. J. (1979). *The ecological approach to visual perception.* Boston: Houghton Mifflin.

Goldstein, E. B. (1989). *Sensation and perception,* (3rd Edition). Pacific Grove, CA: Wadsworth.

Goodglass, H. (1971). Stimulus duration and visual processing time. *Perceptual and Motor Skills, 33,* 179-182.

Green, K. E. (1985). *Cognitive style: A review of the literature* . Chicago, IL: Johnson O'Connor Research Foundation, Human Engineering Lab. (ERIC Document Reproduction Service No. ED 289 902).

Gross, L. (1974). Modes of communication and the acquisition of symbolic competence. In D. R. Olson (Ed.), *Media and symbols: The forms, expression, communication, and education* (pp. 56-80). Chicago: University of Chicago Press. The Seventy-Third Yearbook of the National Society for the Study of Education.

Gummerman, K., & Gray, C. R. (1972). Age, iconic storage, and visual information processing. *Journal of Experimental Psychology, 13,* 165-170.

Haber, R. N. (1970, May). How we remember what we see. *Scientific American,* 221, 104-112.

Hawkins, R. P., Pingree, S., Bruce, L., & Tapper, J. (1997). Strategy and style in attention to television. *Journal of Broadcasting & Electronic Media, 41,* 245-264.

Hayes-Roth, B., & Hayes-Roth, F. (1977). Concept learning and the recognition and classification of exemplars. *Journal of verbal learning and verbal behavior, 18 (5)*, 321-338.

Hedberg, J. G., & McNamara, S. E. (1985). *Matching feedback and cognitive style in visual CAI tasks.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL, March 31 - April 4, 1985. (ERIC Document Reproduction Service No. ED 260 105).

Hill, J. E. (1981). *The educational sciences: A conceptual framework.* West Bloomfield, MI: Hill Educational Sciences Research Foundation.

Hill, S., & Lang, A. (1993). *The effects of redundancy, pacing, and visual complexity on memory and recognition of in-stadium advertisements.* Paper presented at the International Communication Association, Miami, FL.

Hill, W. F. (1985). *Learning: A survey of psychological interpretations* (4th ed.). New York: Harper & Row.

Hitchon, J., Druckler, P., & Thorson, E. (1994). Effects of ambiguity and complexity on consumer response to music video commercials. *Journal of Broadcasting and Electronic Media, 38*, 294-306.

Hokanson, B. (2000). *Accelerated thought: Electronic cognition, digital image creation and analysis as a means to examine learning and cognition. Dissertation Abstracts International,* 61 (03), 953A. (UMI No. 9963005).

Huba, M. E., & Vellutino, F. R. (1980, August). The development of visual encoding and retention skills. *Journal of Experimental Child Psychology, 30*, 88-97.

Ide, T. R. (1974). The potentials and limitations of television as an educational medium. In D. R. Olson (Ed.), *Media and Symbols: The forms of expression, communication, and education* (pp. 330-356). Chicago: University of Chicago Press. The Seventy-Third Yearbook of the National Society for the Study of Education.

Ikegulu, P. R., & Ikegulu, T. N. (1999). The effectiveness of window presentation strategy and cognitive style of field dependence status on learning from mediated instructions. (ERIC Document Reproduction Service ED 428 758).

Intraub, H. (1999). Understanding and remembering briefly glimpsed pictures: Implications for visual scanning and memory. In V. Coltheart (Ed.), *Fleeting memories: Cognition of brief visual stimuli* (pp. 47-94). Cambridge, MA: The MIT Press.

Jankowski, G., & Fuchs, D. (1995). *Television today and tomorrow: It won't be what you think.* New York: Oxford University Press.

Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking.* Englewood Cliffs, NJ: Prentice-Hall.

Joyce, B., Weil, M., & Calhoun, E. (2000). *Models of teaching* (6th ed.). Boston: Allyn and Bacon.

Kagan, J. (1965). Impulsive and reflective children: Significance of cognitive tempo. In J. D. Krumboltz (Ed.), *Learning and the Educational Process*. Chicago: Rand McNally.

Kagan, J. (1966). Reflection-impulsivity: The generality and dynamics of conceptual tempo. *Journal of Abnormal Psychology, 71*, 17-24.

Kahneman, D. (1973). *Attention and effort.* Englewood Cliffs, NJ: Prentice Hall, Inc.

Kay, A. (1999). User interface: A personal view. In B. Laurel (Ed.), *The Art of Human-Computer Interface Design* (13th ed., pp. 191-207). Reading, MA: Addison-Wesley.

Keller, J. M. (1983). Motivational design of instruction. In C. M. Reigeluth (Ed.), *Instructional Theories and Models: A Overview of Their Current Status* . New York: Lawrence Erlbaum Associates.

Keller, P. F. G. (1976). *Pictorial memory processes under conditions of the kinestasis film.* (Doctoral Dissertation, Southern Illinois University, 1976). *Dissertation Abstracts International*, 38 (05), 2498.

Kini, A. S. (1994). *Effects of cognitive style and verbal and visual presentation modes on concept learning in CBI.* Paper presented at the Annual Meeting of the American Educational Research Association. (ERIC Document Reproduction Service No. ED 371 032), New Orleans.

Koffka, K. (1935). *Principles of gestalt psychology.* Reprint 1963. New York: Harcourt, Brace & World.

Kogan, N. (1971). Educational implication of cognitive styles. In G. S. Lesser (Ed.), *Psychology and Educational Practice* . Glenview, IL: Scott Foresman.

Kozma, R. B. (1986, Spring). Implications of instructional psychology for the design of educational television. *Educational Communications and Technology Journal, 34*, 11-19.

Krendl, K. A., & Watkins, B. (1983). Understanding television: An exploratory inquiry into the reconstruction of narrative content. *Educational Communication and Technology Journal, 31*, 201-212.

Ksobiech, K. J. (1976). The importance of perceived task and type of presentation in student response to instructional television. *AV Communication Review, 24*, 401-412.

Lang, A. (Ed.). (1994). *Measuring psychological responses to television.* Hillsdale, N. J.: Lawrence Erlbaum Associates.

Lang, A. (1996). Negative video as structure: Emotion, attention, capacity, and memory. *Journal of Broadcasting and Electronic Media, 40*(4), 460-477.

Lang, A., & Basil, M. (1998). Attention, resource allocation, and communication research: What do secondary task reaction times measure anyway? In M. Roloff (Ed.), *Mass Communication Yearbook* (Vol. 21, pp. 443-474). Beverly Hills, CA: Sage.

Lang, A., Bolls, P., Potter, R., & Kawahara, K. (1999, Fall). The effects of production pacing and arousing content on the information processing of television messages. *Journal of Broadcasting & Electronic Media, 43*(4), 451-468.

Lang, A., Zhou, S., Schwartz, N. Bolis, P., & Potter, R. (2000). The effects of edits on arousal, attention, and memory for television messages: When and edit is an edit, can an edit be too much. *Journal of Broadcasting & Electronic Media, 44(1)*, 94-109.

Langer, E. J., Blank, A., & Chanowitz, B. (1978). The mindlessness of ostensibly thoughtful action: The role of "placebic" information in interpersonal interaction. *Journal of Personality and Social Psychology, 36*, 635-642.

Langer, E. J., & Imber, L. G. (1979). When practice makes imperfect: Debilitating effects of over-learning. *Journal of Personality and Social Psychology, 37*, 2014-2024.

LeDoux, J. (1991). Emotion and the limbic system concept. *Concepts in Neuroscience, 2*(2), 169-199.

Leino, J. (1981). Psychometric test theory and cognitive processes: A theoretical scrutiny and empirical research. *Research Bulletin No. 57, Helsinki University, Institute of Education, Finland.* (ERIC Document Reproduction Service. No. ED 223 672).

Loftus, G. R., & Kallman, H. J. (1979). Encoding and use of detail information in picture recognition. *Journal of Experimental Psychology: Human Learning and Memory, 5*(3), 197-211.

Long, G. M. (1982). Interaction of arousal and task difficulty upon perceptual restriction. *Perceptual and Motor Skills, 32*(1), 259-264.

Luckett, J. D. (1996). *Music preparation and the good language learner.* (Doctoral Dissertation, University of Central Florida, 1996). *Dissertation Abstracts International*, 57 (10), 4296A.

Marr, D. (1982). *Vision.* New York: Freeman Press.

Mayer, R. E., Bove, W., Bryman, A., Mars, R., & Tapangco, L. (1996). When less is more: Meāningful learning from visual and verbal summaries of science textbook lessons. *Journal of Educational Psychology, 88*(1), 64-73.

McCollum, J. F., & Bryant, J. (1999). Pacing in children's television programming. *Mass Communication & Society*(March), 2-40.

McLuhan, M. (1964). *Understanding media: The extensions of man.* New York.

Merriënboer, J. J. G. (1990). Instructional strategies for teaching computer programming: Interactions with the cognitive style reflection-impulsivity. *Journal of Research on Computing in Education, 23*(1), 45-53.

Messer, S. B. (1970). Reflection-impulsivity: Stability and school failure. *Journal of Educational Psychology, 61*, 467-490.

Messick, S. (1970). The criterion problem in the evaluation of instruction: Assessing possible, not just intended outcomes. In D. E. W. M. C. Wittrock (Ed.), *The evaluation of instruction: Issues and problems* . New York: Holt Rinehart.

Meyrowitz, J. (1985). *No sense of place: The impact of electronic media on social behavior.* New York: Oxford University Press.

Miller, P. H., & Bjorkland, D. F. (1998). Contemplating fuzzy-trace theory: The gist of it. *Journal of Experimental Child Psychology, 71*, 184-193.

Moreno, R., & Mayer, R. E. (2000). Coherence effect in multimedia learning: The case for minimizing irrelevant sounds in the design of multimedia instructional messages. *Journal of Educational Psychology, 92 (1)*, 117-125.

Murch, G. M. (1973). *Visual and Auditory Perception.* Indianapolis, IN: Bobbs-Merrill Company.

Murdock, B. B. (1982). Recognition memory. In C. R. Puff (Ed.), *Handbook of Research Methods in Human Memory and Cognition.* (pp. 2-27). New York: Academic Press.

Nazarro, J. R., & Nazarro, J. N. (1970). Auditory versus visual learning of temporal patterns. *Journal of Experimental Psychology, 84 (3)*, 472-478.

Nelson, D. D. (1990). *Personal tempo as a consideration in the rhythmic training of first grade students.* (Doctoral Dissertation, University of Florida, 1990). *Dissertation Abstracts International*, 51 (10), 3356A.

Neuman, O., & Prinz, W. (1990). *Relationships between perception and action.* New York: Springer-Verlag.

Neuman, W. R. (1976). Patterns of recall among television news viewers. *Public Opinion Quarterly, 40*, 115-123.

Nugent, G. C. (1982). Pictures, audio, and print: Symbolic representation and effect on learning. *Education Communications and Technology Journal, 30*, 163-174.

O'Brien, C. R. (1968). *Variables of perception in selected individuals viewing progressively accurate visual stimuli.* (Doctoral Dissertation, University of Florida, 1990). *Dissertation Abstracts International*, 30 (01), 0173A.

Okun, M. A., Callistus, W. M., & Knoblock, L. B. (1979). *Adult age differences in cognitive tempo.* Paper presented at the Annual Meeting of the American Educational Association, San Francisco.

Olson, D. R. (1974). Introduction. In D. R. Olson (Ed.), *Media and symbols: The forms of expression, communication, and education. The Seventy-Third Yearbook of the National Society for the Study of Education.* Chicago: University of Chicago Press.

Ong, W. J. (1982). *Orality and literacy: The technology of the word.* London: Routledge.

Paivio, A. (1986). *Mental representation: A dual coding approach.* Oxford, England: Oxford University Press.

Patel, A. D., Peretz, I, Tramo, M., & Labreque, R. (1998, January). Processing prosodic and musical patterns: A neuro-psychological investigation. *Brain and language, 61*(1), 123-144.

Pearl, D. (1982). *Television and behavior: Ten Years of scientific progress and implications for the eighties. Volume 1: Summary Report.* Rockville, MD: U.S. Department of Health and Human Services.

Peck, K. L. (1987). *Adaptive external pacing as an alternative to self-pacing in computerized instruction.* (Doctoral Dissertation, University of Colorado, 1987). *Dissertation Abstracts International*, 48 (05), 1105A.

Pezdek, K. (1977). The cross-modality semantic integration of sentence and picture memory. *Experimental Psychology: Human Learning and Memory, 3*, 515-524.

Plass, J. L., Chun, D. M., & Mayer, R. E. (1998). Supporting visual and verbal learning preferences in a second-language multimedia learning environment. *Journal of Educational Psychology, 90*(1), 25-36.

Posner, M. I. (1982). Cummulative development of attentional theory. *American Psychologist, 37*, 168-179.

Postman, N. (1986). *Amusing ourselves to death: Public discourse in the age of show business*. London: Heineman.

Ramachandran, V. S. (1994). 2-D or not 2-D: That is the question. In H. R.I. Gregory, J. (Ed.), *The Artful Eye* (pp. 249-267). Oxford, England: Oxford University Press.

Reeves, B., Thorson, E. & Schleuder, J. (1986). Attention to television: Psychological theories and chronometric measures. In J. Bryant, & D. Zillman (Ed.), *Perspectives on media effects* (pp. 251-279). Hillsdale, NJ: Lawrence Erlbaum Associates.

Reeves, B., & Geiger, S. (1994). Designing experiments that assess psychological responses to media messages. In A. Lang (Ed.), *Measuring Psychological Responses to Media* (pp. 243). Hillsdale, NJ: Lawrence Erlbaum Associates.

Reeves, B., & Nass, C. (1996). *The media equation: How people treat computers, television, and new media like real people and places*. New York: CSLI Publications.

Rettenbach, R. (1999). Do deaf people see better? Texture augmentation and visual search compensate in adult but not in juvenile subjects. *Journal of Cognitive Neuroscience, 11*(5), 560-580.

Reyna, V. F., & Kiernan, B. (1994). Development of gist versus verbatim memory in sentence recognition: Effects of lexical familiarity, semantic content, encoding instructions, and retention interval. *Developmental Psychology, 20*(2), 178-191.

Ridberg, E. H., Parke, R. D., & Hetherington, E. M. (1970). Modification of impulsive and reflective cognitive styles through observation of film-mediated models. *Journal of Experimental Psychology, 5*(3), 369-377.

Salcedo, A. M. (1985). *A rhetorical and structural analysis of instructional television* . Anaheim, CA: Association for Educational Communications and Technology. (ERIC Document Reproduction Service No. 256 332).

Salkind, N. J., & Wright, J. C. (1977). The development of reflection-impulsivity and cognitive efficiency. *Human Development, 20*, 377-387.

Salomon, G. (1979). *Interaction of media, cognition, and learning.* San Francisco: Josey-Boss.

Salomon, G. (1984). Television is "easy" and print is "tough": The differential investment of mental effort in learning as a function of perceptions and attributions. *Journal of Educational Psychology, 76*, 647-658.

Salomon, G. (1994). *Interaction of media, cognition, and learning.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Salomon, G., & Cohen, A. (1977). Television formats: Mastery of mental skills and the acquisition of knowledge. *Journal of Educational Psychology, 69*, 612-619.

Schale, F. (1971, December). *Measuring degree and rate of visual awareness in rapid reading on television.* Paper presented at the National Reading Conference, Tampa, FL.

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals, and understanding.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Seidman, S. A. (1981, Spring). On the contributions of music to media productions. *Educational Communications and Technology Journal, 29.*

Seward-Barry, A. M. (1997). *Visual intelligence.* Albany: State University of New York Press.

Shaffer, R. J., Greenspan, S. I., Tuchman, R. F., Cassily, J. F., Jacokes, L. E. & Stemmer, P. J. (2000, August 19). *Interactive metronome: Effects on motor control, concentration, control of aggression, and learning in children with attention-deficit/hyperactivity disorder.* Paper presented at the Progress in Motor Control II Congress, Penn State University, State College.

Shalev, L., & Algom, D. (2000). Stroop and Garner effects in and out of Posner's beam: Reconciling two concepts in selective attention. *Journal of Experimental Psychology, 26*(1), 997-1017.

Sheingold, K. (1973, August). Developmental differences in intake and storage of visual information. *Journal of Experimental Child Psychology, 16*, 1-11.

Sheppard, R. N. (1967). Recognition memory for words, sentences and pictures. *Journal of Verbal Learning & Verbal Behavior, 6*, 156-163.

Singer, J. L. (1980). The power and limitations of television: A cognitive-affective analysis. In P. L. Tannenbaum (Ed.), *The entertainment functions of television* . Hillsdale, NJ: Lawrence Erlbaum Associates.

Smith, E. E., & Haviland, S. E. (1972). Why words are perceived more accurately than non-words: Inference versus unitization. *Journal of Experimental Psychology, 92*, 59-64.

Sperling, G. (1963). A model for visual memory. *Human Factors, 5*, 5-31.

Stephens, M. (1996). *The rise of the image the fall of the word.* New York: Oxford University Press.

Sterrit, G. M., Camp, B., & Lipman, B. S. (1996). Effects of early auditory deprivation upon auditory and visual information processing. *Perceptual and Motor Skills, 23,* 123-130.

Thompson, A. D., Simonson, M. R., & Hargrave, C. P. (1996). *Educational technology: A review of the research.* Washington, DC: Association for Educational Communications and Technology.

Thorson, E., & Lang, A. (1992). The effects of television videographics and lecture familiarity on adult cardiac orienting responses and memory. *Communication Research, 19*(3), 346-349.

Tovee, M. J. (1998). The speed of thought: How fast can you see? In M. J. Tovee (Ed.), *The speed of thought: Information processing in the cerebral cortex* (pp. 143-152). New York: Springer-Verlag.

Tse, T., Vegh, S., Marchionini, S., & Shneiderman, B. (1999). *An exploratory study of video browsing user interface designs and research methodologies: Effectiveness in information seeking tasks.* Paper presented at the 62nd ASIS Annual Meeting, Washington, DC.

Tulving, E. (1972). Episodic and semantic memory. In W. E. Tulving & Donaldson (Ed.), *Organization of Memory* (pp. 381-403). New York: Academic Press.

Tyner, K. (1998). *Literacy in a digital world: Teaching and learning in the age of information.* Mahwah, NJ: Lawrence Erlbaum Associates.

Verhagen, P. W. (1992). *Preferred length of video segments in interactive video programs.* Proceedings of Selected Research and Development Presentations at the Convention of the Association for Educational Communications and Technology. (ERIC Document Reproduction Service No. ED 348 036).

Voss, J. F., Tyler, S. W., & Bisanz, G. L. (1982). Prose comprehension and memory. In C. R. Puff (Ed.), *Handbook of research methods in human memory and cognition* (pp. 349-392). New York: Academic Press.

Wagely, M. (1978). *The effect of music on affective and cognitive development of sound-symbol recognition among preschool children.* Unpublished Doctoral Dissertation, Texas Woman's University, Denton.

Walma van der Molen, J. H., & Van der Voort, T. H. A. (2000). The impact of television, print, and audio on children's recall of the news: A study of three alternative explanations of the dual coding hypothesis. *Human Communication Research, 26,* 3-26.

Walters, D. L. (1983). *The relationship between personal tempo in primary-aged children and their ability to synchronize movement with music. Dissertation Abstracts International,* 44 (02), 423A.

Watkins, J. M., Lee, H. B., & Erlich, O. (1978). *The generalizability of the matching familiar figures test.* Paper presented at the Annual Meeting of the American Educational Research Association (ERIC Document Reproduction Service No. ED 175 882), Toronto, CA.

Watt, J. H., & Krull, R. (1977). An examination of three models of television viewing and aggression. *Human Communication Research, 3,* 99-112.

Wertheimer, M. (1959). *Productive Thinking* (Enlarged Ed.). New York: Harper & Rowe.

Wetzel, C. D., Radtke, P. H., & Stern, H. W. (1994). *Instructional effectiveness of video media.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Winn, W. (1982). Visualization in learning and instruction: A cognitive approach. *Educational Communications and Technology Journal, 30,* 3-25.

Witkin, H. A., & Goodenough, D. R. (1981). *Cognitive styles: Essence and origins. Field dependence and field independence.* New York: International Universities Press.

Wittrock, M. (1979). The cognitive movement in instruction. *Educational Researcher, 8,* 5-11.

Woodley, J. W. (1984). *The role of non-visual information in visual perception: An integration of research perspectives* . Austin, TX: (ERIC Document Reproduction Service No. ED 283 134).

Worth, S., & Adair, J. (1997). *Through Navajo eyes: An exploration in film communication and anthropology* (2nd Edition). Albuquerque: University of New Mexico Press.

Wright, J. C. (1979). *Changes in conceptual tempo over time: Developmental versus logical familiarization.* Paper presented at the Bicentennial Meeting of the Society for Research in Child Development. March 15-18, San Francisco.

Yerkes, R. M., & Dodson, J. D. (1908). The relationship of strength of stimulus to rapidity of habit formation. *Journal of Neurological Psychology, 18*, 459-482.

Zillman, D. (1991). Television viewing and physiological arousal. In J. Z. Bryant, D. (Ed.), *Responding to the screen: Reception and reaction processes* (pp. 103-133). Hillsdale, NJ: Lawrence Erlbaum Associates.

Zillman, D. & Brosius, H. (2000). *Exemplification in communication.* Mahwah, NJ: Lawrence Erlbaum Associates.

BIOGRAPHICAL SKETCH

Mr. Kenny holds a bachelor's degree in Education from Niagara University in New York and a master's degree in instructional technology/media: educational technology from the University of Central Florida. Prior to entering into the doctoral program at the University of Florida, he spent more than 20 years in the computer services industry and in private business. He has spent the last six years teaching media studies and technology on the secondary level in Orlando, Florida.

Mr. Kenny is an active member in the Florida Association of Media Educators (FAME), and the Association of Educational Communications and Technology (AECT) and has presented several papers at conferences sponsored by both of these organizations.

Mr. Kenny also published a textbook in 2001, entitled *Teaching Television Production in the Digital Age,* a book dedicated to showing new teachers how to establish television and media studies programs in their schools.

Mr. Kenny has been married to his wife, Sandra, for thirty years. He has two married children.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy

Lee J. Mullally, Chair
Associate Professor of Teaching and Learning

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy

Jeffry A. Hurt
Associate Professor of Teaching and Learning

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy

M. David Miller,
Professor of Educational Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy

David Ostroff
Professor of Journalism and Communications

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

May, 2002

Dean, College of Education

Dean, Graduate School