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INTERACTIVE VIDEO WITHIN THE MUSEUM SETTING: THE ATTRACTING POWER, USE, AND EFFECT ON VISITORS' INTERACTION WITH AN EXHIBIT

by

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ABSTRACT

INTERACTIVE VIDEO WITHIN THE MUSEUM SETTING: THE ATTRACTING POWER, USE, AND EFFECT ON VISITORS' INTERACTION WITH AN EXHIBIT

By

Kristine Ann Morrissey

Research suggests that without some type of intervention, it is unlikely that the casual museum visitor will learn. Visitors may be overwhelmed by the vast amounts of diverse stimuli present. Visitors' interaction with exhibits can be increased by using adjuct devices to attract and direct their attention. A variety of devices have been used effectively but most media are not able to address the varied needs and interests of a heterogeneous audience because of their linear format.

This study investigated the use of an interactive videodisc program (authored with Hypercard) as a form of media with potentially greater capability to support effective instructional strategies. A non-obtrusive video camera was installed outside the exhibit hall to record visitor behavior on both experimental days (with the program present) and control days (without the program present). The computer program recorded the number of users, their self-assessed interest in birds and comfort level with computers and the level of options utilized.

An analysis of variance showed the elapsed time within the exhibit was significantly higher on experimental days than on control days ($p=.001$). Visitors who did not use the program, but were present on the experimental days also spent significantly longer periods of time within the exhibit than the control group ($p=.004$). Viewing time for one specific

mount shown on the videodisc was significantly higher on experimental days than control days (p=.001) but that of a second mount was not.

Groups who used the program were compared to the general population of visitors using chi-square test of association to assess whether gender, group composition, computer comfort level or interest in birds were related to use of the program. Group composition (p=.004), gender (p=.0001), computer comfort level (p=.03) and interest in birds (p=.0003) were all found to be related to usage.

Program users were coded as using either the Level One options (from the main menu) or Level Two options (from sub-menus). ANOVA procedure suggests that bird interest was related to the level used (p=.03) but computer comfort level was not (p=.37).

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CHAPTER ONE. INTRODUCTION

Introduction

Research on museum education consistently suggests that most museum visitors do not attend to the exhibits even though attention has been shown to be a critical factor in learning. This has been supported by both experimental research on cognitive and affective outcomes, as well as visitor behavior studies (Screven, 74, 75; Gennaro, 1981; Koran, Lehman, Shafer and Koran, 1982; Koran and Koran, 1983; Koran, Longino and Shafer, 1983; Ambach, 1986; Falk, Koran and Dierking, 1986; Koran, Koran and Foster, 1988). Museum educators and exhibit designers face the instructional problem of attracting the visitor's attention and of focusing that attention on the critical elements of the exhibits.

Attracting and directing visitors' attention is a difficult and complex instructional task in an informal setting such as museum for several reasons. The characteristics of the stimuli within the museum are often novel and complex and can overwhelm the visitor (Falk, Martin and Balling, 1978; Falk and Balling, 1982; Koran et al., 1983). Because of the nature of its informal learning setting, "attention is not enforced or reinforced by extraneous rewards " (Du Terroil, 1975, p. 4). Museum visitors are a heterogeneous group with varying degrees of prior knowledge, experience, interest areas and motivation as well as many other learner characteristics (Falk, Koran, Dierking and Dreblow, 1986).

Various types of media have been used to increase the attention and participation of visitors. Instructional devices such as audio tapes, wall panels, video tapes and slide presentations have all shown success in increasing attention when they are specifically designed to direct the visitor's attention to the critical attributes of the exhibit.

Different media appear to attract different types and numbers of visitors (Washburn and Wagar, 1972; Screven, 1974; Beer, 1987), suggesting that potentially effective devices may not be used by visitors. As new technologies become available, questions arise as to both their ability to influence visitors' behaviors as well as visitors' motivation to utilize them. This research focused on a relatively new technology, the interactive videodisc, and its potential to attract and to influence the way the casual museum visitor interacts with a particular exhibit on birds.

This study investigated three general questions: 1) What is the effect of the interactive videodisc on visitors' elapsed time in the exhibit hall; 2) What types of groups are attracted to the interactive videodisc program; and 3) Are there any differences between groups who utilize the Level One user control options within the interactive video program and groups who use the Level Two options?

Museums and Scientific Literacy

The museum's ability to influence visitor learning has become increasingly important as public museums have proliferated and as educators have increasingly turned to them as a source of scientific literacy for the population at large (Ucko, 1985; Koran et al., 1983; Ambach, 1986; Alexander, 1988). By the 1980's, there were over 6000 museums in the United States with millions of visitors annually (Koran and Dierking-Shafer, 1982; Falk et al., 1986).

Suggesting the potentially important role museums play in science literacy, Ucko (1985) points to recent reports from the National Science Foundation and the United States Department of Education which report that "the current trend toward virtual scientific and technological illiteracy-unless reversed-means that important national decisions

involving science and technology will be made increasingly on the basis of ignorance and misunderstanding" (p. 288). These comments are underscored by reports from groups such as the Roundtable Group on Science and Engineering Talent (1987) warning that "The advance of science and technology is essential to the health of the nation-essential to quality of life, to economic stability and national security" (p. iii).

Although the definition of scientific literacy has fluctuated over the four decades of its use, Mitman et al. (1987) suggest that the term currently includes at least the following features: 1) preparing all students and citizens to function within an increasingly technologically oriented society, 2) a general body of science content, and 3) appreciation for the meaningfulness of science in the context of other frameworks such as "science and technology" or "science and society." Their research suggests that there is a gap between current practices in science classrooms and the commonly accepted goals of increasing scientific literacy for all individuals. If this gap continues to exist, the problem of scientific illiteracy will continue into the future.

Museums may be uniquely prepared to address scientific literacy for the general public for at least three reasons. First, museum audiences are not limited to the age bracket served by formal education, but include families and individuals of all ages. Second, as an informal educational institution, they are free of the affective and emotional overtones of the formal classroom (Feher and Rice, 1985; Falk et al., 1986). As Ucko explains, "Unlike school, the museum setting is voluntary, open-ended, nonlinear, hands-on and entertaining. There are no requirements, no prerequisites, no exams, and no grades" (p. 291). Third, because museums collect and exhibit tangible objects, they have the potential to actively involve

the public in processes integral to scientific literacy such as observing, discriminating, classifying, generalizing and creating hypotheses.

Learning in the Museum Setting

This section reviews two questions considering the role of attention in the museum setting: 1) What evidence exists that the visitor is not attending to the stimuli within the museum exhibits, and 2) Does this lack of attention affect learning? Naturalistic studies on visitor behavior and experimental research on both cognitive and affective outcomes are reviewed.

Visitor observation studies have identified common patterns of behavior that suggest that visitors are not attending to the stimuli within the museum environment. First, visitors seldom read exhibit labels (Screven, 1969, 1974; Cone and Kendall, 1978; Wolf, 1980; Beer, 1987) and rarely allocate more than fifty to sixty-five percent of their attention to the exhibits (Falk, Koran, Dierking and Dreblow, 1985). Second, the amount of time spent with each exhibit is minimal, with the typical visitor spending an average of less than forty seconds at each exhibit (Screven, 1974; Linn, 1976; Cone and Kendall, 1978; Falk, 1983), and perhaps even less than twenty seconds (Robinson, 1928; Nielsen, 1946; Shettel, 1973; Shettel, 1976). Third, most visitors skip more than half the displays (Brooks and Vernon, 1956; Cone and Kendall, 1978; Beer, 1987) and disregard the designated layout of exhibits (Nielsen, 1946; Shettel, 1976; Cone and Kendall, 1978; Alexander, 1979), often paying exaggerated attention to exhibits on the right even to the exclusion of those on the left (Shettel, 1976).

These general trends of behavior suggest that the typical casual museum visitor generally does not attend to the exhibits. If this is true, what are the consequences? Is attention necessarily related to learning? In discussing the relationship between attention and learning, Kulhavey

(1986) states, "both common sense and research data suggest that even if the relationship between attention and learning is not absolute, attending behavior itself still represents one of the more powerful determinants of what people will gain from study" (p. 116). Koran and Koran (1984) state, "Museum educators have long recognized that attention is a critical factor in visitor learning from museum exhibits" (p. 14).

Research by Falk and colleagues has identified a high correlation between attention and positive affective and cognitive outcomes. Falk's research found that time spent within the exhibit and the locus of attention of the visitor were strong predictors of learning. This correlation between nonverbal behaviors (elapsed time and locus of attention) and both positive affect and cognitive learning has been substantiated by several studies by Falk and others (Falk et al., 1978; Martin, Falk and Balling, 1981; Balling and Falk, 1981; Falk and Balling, 1982; Falk, 1983; Falk et al., 1985).

These studies suggest that attending to the exhibits is an important determinant of learning in the museum setting. Experimental studies have looked more specifically at the amount of learning taking place within the museum and have consistently reported that without some type of intervention, there is a lack of learning (Shettel, 1973; DeWaard, Jagmin, Maistro and McNamara, 1974; Screven, 74, 75; Gennaro, 1981; Koran, et al., 1982; Koran, Longino and Shafer, 1983; Ambach, 1986; Falk et al., 1986; Koran et al., 1988). In one of the earliest and most often cited studies of museum learning, Screven (1974) tested visitors after viewing an exhibit on primitive human skulls and compared their scores to a control group who had not seen the exhibit. There were no significant differences between the scores of the experimental and control groups. Screven states that,

"Evidence that is available suggests that exhibits as normally presented are not very effective in communicating the information contained in them."

Screven's findings are consistent with other early research conducted by Shettel (1973) to evaluate the effectiveness of scientific and technical exhibits. Data collected within the exhibit "The Vision of Man" in the National Museum of History and Technology led Shettel to this conclusion:

> However, not so expected was the fact that the casual viewer group (i.e., the actual museum visitor) pre-test scores were not significantly different from the casual viewer post-test scores, and actually lower than the control group scores ...Thus one is forced to say that the casual viewer group as a whole learned very little from the exhibit as measured by the tests used. (p. 37)

In a review of educational research within science and natural history museums, Koran, Longino and Shafer (1983) conclude that "Unless the visitor has prerequisite knowledge, is directed to specific learning outcomes, or has very specific learning intents, it is unlikely that learning will result."

One possible explanation for the lack of attending behavior within the museum setting is offered by research that suggests that visitors are overwhelmed and inhibited in their learning by the amount of novel stimuli within the museum (Falk et al., 1978; Martinet al., 1981; Koran et al.1983; Falk et al., 1986; Koran et al., 1988). Koran et al., (1983) state:

> A critical problem in science museums is the tremendous number of stimuli, many quite novel, competing for attention. . . visitors have difficulty focusing their attention and remaining in the area of the stimulus for a sufficient amount of time for information processing to occur. (p. 334)

Research on attention suggests that in a novel situation, the learner must deal with the incoming stimuli by first ascertaining the dimensions of

stimuli (Grabe, 1986). Kulhavy discusses the importance of three types of instructional accessories: schema activators, questioning, and mnemonics. Schema activators and questioning are of particular interest to this study. Kulhavy defines schema activators as "any semantic stimuli which work to provide people with a way of organizing or interpreting the information" (p. 127). Kulhavy suggests that these schema activators influence attention by "providing the learner with an appropriate knowledge schema for interpreting and integrating new information" (p. 127).

Various efforts have been initiated to influence the way the visitor interacts with the exhibits and to help the visitor process the information within the exhibits. Attention directing devices which serve as schema activators in helping visitors orient themselves to the relevant attributes of an exhibit, have been successful in promoting visitor learning. The next section reviews efforts that involve the use of adjunct devices as instructional accessories to help the visitor focus attention. The section concludes with a look at the device used in this study, the interactive videodisc.

Using Adjunct Devices to Focus Visitor Attention

Koran et al. (1989) describe two approaches to improving visitor learning.

> While behavioral approaches emphasize changing the environment in order to influence visitor behavior in hopes that greater interest and learning will occur, the cognitive approach emphasizes influencing how the learner perceives, thinks and acts in relation to exhibits. (p. 1)

This study followed the cognitive approach and investigated the use of an adjunct guidance device, the interactive videodisc program, to influence the ways the visitor interacts with the exhibit. Adjunct devices are those that

are used to supplement or enhance an exhibit. They may be any type of media but their function is to help the visitor interpret the exhibit. The use of adjunct devices are a practical alternative to creating new exhibits or changing permanent exhibits (Koran et al., 1989), or to docents or other intermediaries which are not readily available or even desired by many casual visitors.

A variety of guidance devices have shown success in helping the visitor process information and encouraging more interaction with the exhibits. A few examples are wall panels highlighting critical information (Koran, Longino, Shafer and Koran, 1983), punchboards with related questions and feedback (Screven, 1975); study guides (Gennaro, 1981; Nielsen, 1946), slide-tape presentations and study cards (DeWaard, 1974). These devices have been consistently effective when used to focus attention, cue visitors to intended learning and to elicit participation. The role of viewer interaction and participation in increasing attention has been supported by studies by Screven and others utilizing devices that elicit visitor responses such as mechanical question and answer devices, audio tapes or written materials (Screven, 1969, 1974, 1975; Shettel, 1973; DeWaard et al., 1974) or computers (Hilke, 1988).

While these media devices have shown promise in supporting visitor learning, they are limited in their ability to address the varied needs and interests of a heterogeneous audience because of the linear format of most media. Museums visitors are a diverse population entering the museum with a wide range of individual and group characteristics. Individual differences include age, gender, prior knowledge, interest level and purpose for visit (Falk et al., 1985). Group differences include size, distribution, relationships, and purpose. Computers offer a unique option

by providing the capacity to branch according to the user's input. But computers are limited to text and still graphics whereas motion is not only more attractive to visitors (Washburn and Wager, 1972; Beer, 1987; Patterson and Bitgood, 1988), but it is often necessary to adequately illustrate concepts and principles in the natural sciences. The new technology of interactive videodisc combines the branching capacity of computers, the audio and motion capabilities of video, and the durability of videodiscs.

This study investigated the use of an interactive videodisc program as a new form of media with perhaps greater capabilities than linear media to support the instructional strategies found effective in influencing visitor learning. Specifically, the device is capable of supporting interactivity, providing information to orient the visitor in either text, audio or video format, asking questions, receiving and reacting to responses and providing feedback.

The use of computers or interactive video in museums is quite limited at this time, but there is increasing pressure for museums to integrate computer technology into exhibits (Hilke, 1988). It is likely that its presence will follow the pattern established by other educational devices moving into informal setting as their popularity increases in formal settings. As there is a lack of research on this new device, this study focused on the effects of interactive video on visitors interaction within an exhibit in an attempt to follow up on previous research done on more traditional devices.

One concern with the use computers or computer mediated programs in the museum setting is the limitation on the number of users. While only a small number of visitors can use the computer at one time,

other media can address a large audience. However, if even a small number of users are influenced by their use of the computers, other visitors may imitate their behavior. Research suggests that museum visitors often imitate or model behaviors observed in other visitors (Koran, Koran, Foster, Dierking, 1988). Koran (1988) states that "modeling is an effective method of directing and controlling attention and introducing behaviors not already in the observer's repertoire." To investigate the role of modeling, visitors who did not use the program but who visited the exhibit when the interactive videodisc was present, were compared to the control group of visitors who visited the exhibit when the program was not present.

Given the informal nature of the museum, it is possible that even the most effective device may not attract visitors. Shettel's (1968) comments about exhibits may be relevant to the use of devices. He states, ". . . regardless of the type of exhibit, in order to be educationally effective it must attract and maintain their attention" (p. 331). The term "attracting power" has been used to refer to the ability of an exhibit or device to attract the viewer as measured by the percentage of visitors who stop. Studies that have investigated attracting power indicate that visitors' choices are influenced by the type of medium used (Screven, 1974; Washburne and Wagar, 1972; Beer, 1987) and that the attracting power of a device is not necessarily related to its instructional impact (Screven, 1974). This suggests that the potential effect of a guidance device in an informal free-choice setting such as a museum may be mitigated by its attracting power. Therefore, this study investigates not only the effect of an interactive videodisc program, but also its attracting power.

This study investigates the characteristics of the groups that are attracted to the device. Specific variables investigated include the

composition of the group, gender of both the adults and children, and background related to the content of the exhibit (birds) and comfort level with the medium employed (computer). Group composition investigates any differences in groups composed of different ratios of adults to children. Research in the museum setting has found that children often react differently than adults. Children are more likely to touch objects but less likely to read labels or spend time in the exhibit area and are more influenced by motion (Bitgood, Nichols, Pierce and Patterson, 1986; Koran, Koran, and Longino, 1986).

There is limited research on gender differences in the use of technology within the museum setting but one study found no gender differences in the use of computers within an exhibit area (Hilke, 1988). Gender is studied as little research has looked at gender differences in the museum setting and this research offers an opportunity to study the behavior of families in a free-choice informal setting and to investigate any gender related differences in use of the device.

This study also investigates whether visitors are attracted to the device because of their interest in the content area (birds) or because of their interest in the medium utilized (computer and laserdisc player) and if there is any interaction between interest in the content area and interest in the medium. If visitors are attracted because of an interest in birds, and there is no relationship to the medium, then it may be that any device would be effective in attracting viewers. If the medium is significantly related to the choice, then a popular medium may be able to attract visitors to less popular or more difficult content areas. For example, visitors with a high interest in birds may avoid the program if they have a low interest in computers or visitors with a low interest in birds may be drawn because of

the device. If visitors' interest in the media and the content are interrelated in their influence on choice of using the device, then both content and attracting power of the medium need to be considered when designing guidance devices and strategies.

User Control Options

Many of the claims for the desirability of computer based/aided instruction rest on its ability to branch according to the user's input, thereby allowing greater user control and individualization (Laurillard, 1984; Hannafin and Colamaio, 1986). In a museum setting, user control over content, sequence, practice, and amount and type of information could help meet the needs of the heterogeneous audience with varied interests, prior knowledge, motivation, distractibility, and available time (Hilke, 1988). However, one of the more prominent and complex instructional design issues in designing interactive videodisc programs involves different instructional control strategies (Hannafin and Colamaio, 1986). There are no clear directives regarding user control (vs. program control) of the pacing, sequencing and amount of information presented. Research on varying levels and types of user control has shown contradictory and inconclusive evidence in both computer aided instruction (Steinberg, 1977; Ross and Rackow, 1981; Tennyson, 1985; Goetzfried and Hannafin, 1985) and interactive video instruction (Hannafin and Colamaio, 1986).

The problems of these contradictions are compounded for museum applications as most computer and interactive video research has been conducted in formal settings such as industrial and military training settings (Hofmeister, 1982). Therefore, their generalizability to the audience within the informal free-choice setting of a museum is uncertain. Because most of the interactive video research has been conducted within a fairly

specific and prescribed setting, little is known about the conditions where interactive video is most effective (Ebner et al., 1984). Ebner states:

> If videodisc technology's potential is to be realized and fully exploited, it will have to be used appropriately in the correct educational settings, and consistent with its unique capabilities and strength.
> (p. 26)

This study did not attempt to resolve the complex issue of user control that has remained clouded after several decades of research. Instead, it attempted to assess patterns of usage and investigated whether the level of options used by the viewer is related to the viewers' computer skill or interest in birds. While this may not determine the effectiveness of user control options, it does address the issue of whether the museum is an appropriate setting for offering the user control over the way information is presented. This may lay groundwork for later research on individual differences and appropriate user control options.

Summary of the Problem

Studies suggest that without some type of intervention, it is unlikely that the museum visitor will learn from interacting with the exhibits. However, visitor behaviors can be influenced with a resulting increase in participation and learning. Specific instructional design variables proven to be successful within the museum setting include: cueing, attention focusing, eliciting responses (i.e. through questions) and providing feedback. While various strategies and devices have been effective within the museum setting, research shows that visitors may not use the instructional devices that are most effective.

The interactive videodisc has become increasingly popular in educational settings and may offer unique educational capabilities to the museum setting. However, little research has been done on appropriate settings for its usage or its attracting power within informal settings. Research on interactive video often neglects identifying or manipulating instructional design variables. One instructional design variable of considerable interest to the museum setting, that of user control, has yielded inconclusive and contradictory research.

This research investigated the effectiveness and the attracting power of the interactive videodisc program. It also investigated visitors' use of the control options and looked for a relationship between the level of use and prior interest in birds or computers.

Central Research Questions and Hypotheses

This study focused on three related questions. The first question pertains to whether the interactive videodisc program influenced the way visitors interacted with the bird exhibit. The dependent variable, interaction with the exhibit, was measured by assessing time spent within the exhibit. The independent variable was the presence or absence of the interactive videodisc program. To investigate the effect of the program, three comparisons were conducted. First all subjects on the experimental day were compared to all subjects on the control day. Second, those visitors who did not use the computer on the experimental day were compared to the control group to test for modeling effects'. Third, the experimental group was compared to the control group in terms of viewing time of two specific mounts in the exhibit area that were part of the interactive videodisc presentation.

The second question relates to the power of the interactive videodisc program to attract the casual visitor and the relationship between the independent variables of group composition, gender, and prior interest in the device or the content area and the dependent variable of using the device. The third question focused on visitors' responses to the options of control over the amount of information and the presentation of practice questions. Two levels of control options were offered by the program and use of these two levels was compared to the users' interest in birds and comfort level with computers. The dependent variable was the level of options used and the independent variables were the users' interest in birds and computer comfort level.

The hypotheses related to the research questions are listed below.

1) What is the effect of the interactive videodisc program on visitor' elapsed time in the exhibit hall?

Null Hypothesis 1.1: There is no significant difference in the elapsed time spent within the exhibit hall between the experimental group exposed to the interactive videodisc program and a control group not exposed to the interactive videodisc program.

Null Hypothesis 1.2: There is no significant difference in the elapsed time spent within the exhibit hall between the control group and the group who did not use the computer on the experimental days.

Null Hypothesis 1.3: There is no significant difference in the elapsed time spent in front of a hawk mount in the exhibit hall between the control group and the experimental group.

Null Hypothesis 1.4: There is no significant difference in the elapsed time spent in front of an eagle mount in the exhibit hall between the control group and the experimental group.

2) Are groups who use the program different from groups who don't use the program?

Null Hypothesis 2.1: There is no significant relationship between group composition and use of the interactive videodisc program.

Null Hypothesis 2.2: There is no significant relationship between gender and use of the interactive videodisc program.

Null Hypothesis 2.3: There is no significant difference in the computer skill level of the groups who used the computer and that of a random sample of the general public.

Null Hypothesis 2.4: There is no significant difference in the level of interest in birds of the groups who used the computer and a random sample of the general public.

3) Are there any differences between groups who use the Level One control options and groups who use the Level Two ccontrol options?

Null Hypothesis 3.1: There is no significant difference between those groups who use the level One control options and those who use the Level Two control options regarding their level of interest in birds.

Null Hypothesis 3.2: There is no significant difference between those groups who use the Level One ccontrol options and those who use the Level Two control options regarding their skill level with computers.

Null Hypothesis 3.3: There is no significant interaction between the computer skill and the level of interest in birds on use of control options.

Purpose of the Study

This study examined the effect of the interactive videodisc program on the visitors' interaction with the exhibit. The dependent variable was the visitors' amount of time spent within the exhibit hall. Visitors in the experimental group exposed to the interactive videodisc program were compared to visitors in a control group who were not exposed to the program.

Research has shown that the effectiveness of a device is not necessarily related to it usage. Therefore, this study examined the attracting power of interactive videodisc program. The dependent variable was the initiation of the program and the independent variables were group composition, gender and prior interest in birds or computers.

If interactive videodisc proves to be a practical and pedagogical alternative to other types of media, then further information is needed about instructional design strategies to design levels of interactivity to meet the needs of the users. This study examined user control over the amount of information and number of practice questions presented and investigated whether the level of control the viewer uses is related to either interest in the content (birds) or skill level with the medium (interactive videodisc).

Delimitations

This study did not attempt to compare interactive video to other technologies or to make any conclusions about the effectiveness or desirabilities of other devices. Therefore, results of this study cannot be used to make generalizations about, or comparisons with the effectiveness or desirability of other types of media.

This study included only casual visitors within a specific bird exhibit that is located within a university museum. Observations were made

during the winter months. The audience within this museum at these times may not be representative of those at other types of museums or other times of the week or year. The visitor who comes as part of an intact group may react differently than the subjects of this study.

While this study investigated user control, it does not make any claims about the instructional effects of offering user control. Rather it was limited to the question of whether visitors utilized the option and whether use was related to interest in birds or skill with the computer.

To investigate the effectiveness of the interactive videodisc as an exhibit adjunct device, the only outcome variable used was elapsed time. The results of this study cannot be used to make inferences about other potential outcomes.

Significance of the Study

Interactive video is a relatively new technology that has been proposed as overcoming many of the drawbacks inherent in computer aided instruction and video-based instruction (DeBloois, 1982). However, the numerous claims and assumptions for interactive video have not been substantiated. As Hannafin states, "Since little research has been conducted with interactive video to either refute or support the claims of uniqueness, the instructional potential and applications of interactive video remain a concern" (Hannafin, 1985, p. 237).

This study extends the work done within educational and training settings which tend to be highly structured and more formal settings, to the informal educational setting of a museum, studying not only the effectiveness, but also the attracting power of the interactive videodisc program. It incorporated much of the work done by Screven, Koran and others on the effectiveness of guidance devices used with exhibits, but went

on to study whether the casual visitor used the device, and what factors influenced the use of the device. The results of this study may have implications for museums educators attempting to influence visitor behaviors and interactions with museum exhibits as well as the curators and exhibit designers responsible for the exhibits. It may also have implications for those in other informal settings.

This study also extends the user control research by looking at the issue under the different conditions of an informal setting and focusing on whether visitors used the option rather than focusing on its effectiveness or efficiency. Identifying the characteristics of users who utilize the optional control may have implications on the feasibility and desirability of offering user control in a free choice learning setting, thereby preparing the groundwork for further research on the effect of different levels of control in an informal setting.

Assumptions

This study assumed that increased participation and learning from the exhibits is desirable and consistent with the mission of museum education and that learning is accurately measured by measuring elapsed time spent within the exhibit area. It also assumed that without some type of intervention, learning is not likely, but that interventions can affect learning. Adjunct devices were assumed to be appropriate within the museum setting.

In this study, the role of the interactive videodisc program was seen as introducing rather than presenting the subject matter of the exhibit, serving to focus attention on the specimens within the exhibit. This assumes that the exhibit should be the focus of the visitor's learning experience, not the interactive video program. Finally, there is an

assumption that the program used in this study was of interest to the visitor and relevant to the goals of this exhibit.

Chapter Summary

Research on museum visitor behavior has shown consistent evidence that the visitor is generally passive, rarely reading labels or interacting with the exhibits in a manner conducive to learning. This is of considerable interest and concern to museum and science educators who are beginning to turn to museums as a source of science literacy for learners of all ages.

Both museum and science educators are attempting to identify methods to enhance the effectiveness of museums. One method showing promise is the use of guidance devices such as audio and video tapes, questioning machines, and computers. However, there has been little research on the attracting power of these devices or on instructional design issues such as that of user control options. As the museum is a free-choice setting, the attracting power as well as the effectiveness of a device or an instructional strategy needs to be considered.

While many devices have been successful in the museum setting, there are both practical and pedagogical drawbacks that interactive videodisc may overcome. More research is necessary to better understand the appropriate uses of interactive videodisc and the instructional design strategies supported by the interactive videodisc device.

CHAPTER TWO. REVIEW OF LITERATURE

Introduction

This chapter draws from research on museum education, research on attention, and research on media, particularly that involving interactive video. In this paper, the use of the term "interactive video" is consistent with the general definition proposed by Floyd (1982) as "any video program in which the sequence and selection of messages is determined by the user's response to the material" (p. 2). Using this definition, both interactive videodisc and interactive video tape are referred to as interactive video and the chapter looks at research utilizing both formats though this study utilized an interactive videodisc.

Efforts to understand and influence museum visitors' experiences can be viewed as following either a behavioral or a cognitive approach. Behavioral approaches investigate ways to influence visitor behavior through changing the environment (i.e. exhibits) while cognitive approaches attempt to influence how visitors process the information within the exhibit (Koran et al., 1989). This study followed the latter approach and drew from the body of research that deals with visitors' cognitive behaviors within the museum setting. The chapter focuses on instructional variables that influence visitors cognitive behaviors and reviews research on the interactive videodisc as a device that may be particularly suited to handle those variables.

This chapter begins with the role of museums as a source of informal science education for the general public and investigates the amount of learning that actually takes place within museums. Various strategies are reviewed that utilize diverse media devices to enhance the learning potential of exhibits with particular emphasis on interactive video as a

device that may perform well under the unique learning conditions of the museum setting. Particular attention is paid to the issue of user control options in the design of interactive video programs.

Role of Museums in Science Education

The growing role of museums in science education is evident from the increased attention from both the general public and science educators. Over the last decade, the field of science education has begun to explore the potential role of museums in promoting science literacy (Falk, 1983; Ucko, 1986). A review of the last twenty years of the Journal of Research in Science Teaching illustrates this trend. While the decade from 1967 through 1977 shows no articles addressing science education within the museum setting, the next decade included at least ten articles dealing with topics such as the museum field trip (Wright, 1980; Gennaro, 1981; Falk et al., 1978), attention and curiosity in museums (Koran et al., 1984), attention directing devices and techniques used with exhibits (Koran et al., 1982; Lehman and Lehman, 1984), and research within the museum (Koran et al., 1983).

This increased attention from science educators has been complemented by an enthusiastic response from the general public. Science related museums comprise only eighteen percent of all museums, yet almost forty-three per cent of the total museum attendance is to science related museums including natural history museums, nature centers and science technology centers (Price et al., 1981): Fifty million individuals visit science technology centers alone (Ucko 1985). With over 6000 museums in the United States (Koran et al., 1983) and a new one opening every 3.3 day (Alexander, 1979), almost every community "of any size in the United States, has its museum" (Burcaw, 1975, p. 16). A large percentage of the

visitors come in groups. A review of the family museum experience reported that most visitors come as part of a group with one study finding that over two thirds of the visitors who were not part of a school group came as part of a social group and 60% of these groups were family groups (Dierking, 1989)

As the number of visitors and attention from science educators has increased, so have efforts to measure learning within the museum setting. While some research on museum education took place over fifty years ago, only in the last two decades has the study of museum learning become an active field (Washburne, 1975; Hayward and Larkin, 1983). One of the most often cited experimental studies investigating visitor learning was conducted by Screven in 1974. The study, conducted at the Milwaukee Public Museum, involved the recognition and ordering of five primitive skulls by appearance and name. The experimental group was allowed to spend as much time as desired in the exhibit and then asked to take a post-test. A control group was given the post-test without the benefit of visiting the exhibit. There were no significant differences between the scores of the experimental and control groups. Screven states that, "Evidence that is available suggests that exhibits as normally presented are not very effective in communicating the information contained in them" (p. 70).

Screven's findings are consistent with extensive research conducted by Shettel to evaluate the effectiveness of scientific and technical exhibits (Shettel, 1973). Data collected within the exhibit "The Vision of Man" in the National Museum of History and Technology found no differences in post-test scores between individuals exposed to the exhibit and a control group that did not view the exhibit. Shettel concludes that the casual museum

visitor group "as a whole learned very little from the exhibit as measured by the tests used" (p. 37).

Research on Attention

The term "attention" has collected many connotations. The behavior referred to in this paper as "attending to" something is first examined. Grabe (1986) suggests a model of attention resembling an expanded use of the term "selective attention". Grabe's model of attention is built on several interrelated propositions: 1) mental resources are limited, 2) both external (environmental) and internal sources of stimuli (long term memory) compete for the learner's attention, and therefore, 3) the learner must make decisions in allocating the limited resources among competing stimuli.

A similar and consistent view of attention is described by Kulhavy et al. (1986). Kulhavy suggests that there are two types of attention as related to learning- primary and processing attention. Primary attention involves simply filtering the stimuli through the sensory system, while processing attention is described as the "effective agent for directing encoding activities, and for fixing the limits on what will and will not be learned and remembered" (p. 117). Both of these views suggest that attention is a limited resource and involves the learner in actively selecting which stimuli to attend to and in directing strategies for processing the stimuli.

But what determines the stimuli the learner attends to and the strategies selected? Kulhavy et al. (1986) suggest there are several variables that affect the way the learner attends to and encodes incoming stimuli. These variables are graphically illustrated in Figure 1. Kulhavy states that the linear relationship between the components is shown for discussion purposes and not a suggestion of the way the learner operates. Kulhavy

proposes that the learner's prior knowledge and instructional expectations call up a related task schema while the message content and structure call up a related knowledge schema. The task schema influences the mathemagenic behaviors while the knowledge schema influences the way the information is interpreted. Finally, the instructional accessories such as cues, directions, and adjunct devices influence how the new information is encoded and learning takes place. Therefore, in an educational setting, influencing learning could take the form of altering the content or of introducing instructional accessories appropriate to both the learner and the stimulus characteristics.

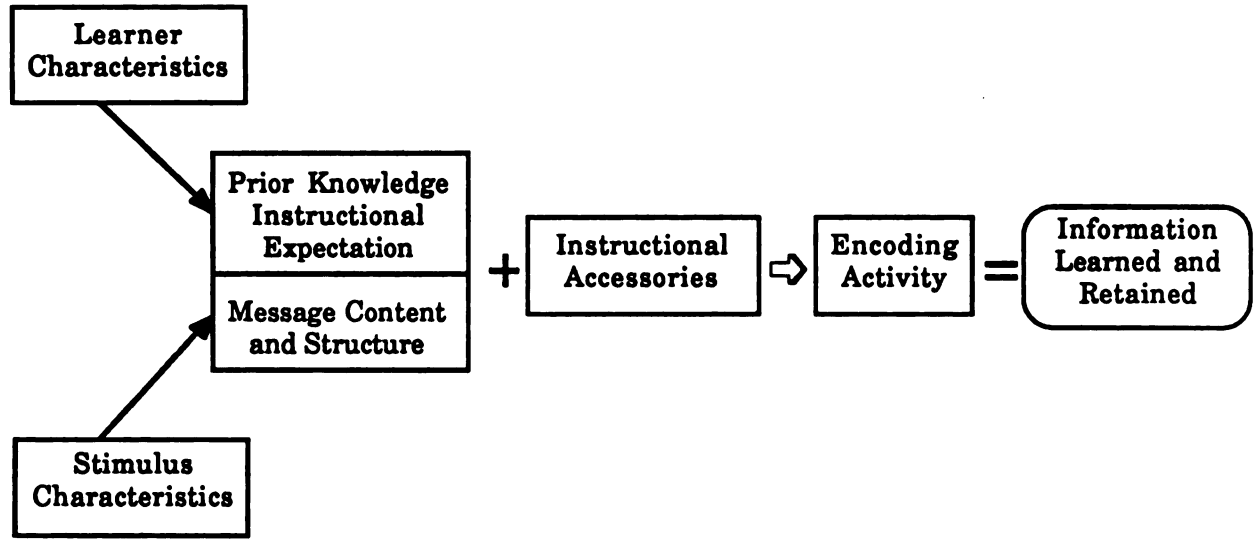


Figure 1. Kulhavy's model of components affecting instructional encoding

Attention in the Museum Setting

Attention has been used as an indicator of museum learning for over 50 years. One of the most commonly used measures of attention has been observations of elapsed time within an exhibit. Robinson coined the term "holding power" in 1928 to refer to the average time visitors devoted to an

exhibit in an art museum (Falk, 1984). The use of time as a dependent variable within museum research was supported very early in the history of the field by the work of Melton, Feldman and Mason in the 30's and 40's. More recent research by Falk and others (described below) has supported the use of time as an indicator of learning and has extended this line of research.

In a search for unobtrusive methods for measuring cognitive and affective changes, Falk (1983) studied the possibility of using observable behaviors such as visitors' locus of attention and amount of time spent viewing an exhibit as valid measures of learning. Earlier research had established a high correlation between nonverbal behavior and both positive affect and cognitive learning (Falk, 1976; Falk et al., 1978; Martin et al., 1981; Balling and Falk, 1981; Falk and Balling, 1982). Falk (1983) then initiated a study to test a model of museum learning hypothesizing that learning was a function of time and behavior. His model states that "The change in knowledge brought about by a museum visit, as typically measured by change of score in pre-test/post-test designs, is postulated to be predicted from some interaction of the visitor's time spent and behaviors exhibited" (p. 268).

To test the model, Falk conducted a study within the Hall of Human Biology of the British Museum of Natural History. The subjects were given a pre-test before visiting the museum and a post-test after the visit. The subjects were school children ranging from eleven to sixteen years of age and were not aware of the relationship between the tests and the museum visit. The subjects were encouraged but not required to visit the exhibit. While visiting the exhibit, the subjects were monitored by closed-circuit television. Behaviors were then measured by amount of time spent at the

exhibit and locus of attention at the exhibit. Learning was measured by a fourteen item multiple choice and true/false test. Results indicated that Falk's model including time spent viewing exhibits and observable behavior together, was successful in predicting learning in 83% of the visitors studied (Falk, 1983). Further research has continued to corroborate this correlation between nonverbal behaviors and both cognitive and affective learning (Falk et al., 1985).

These studies support the hypothesis that attention is an accurate predictor of learning in the museum setting. Both naturalistic and experimental studies have shown that most visitors do not attend to the exhibits and their contents. Recent research by Falk and others on the impact of novel environments suggest a possible explanation for the lack of learning. This research is consistent with this discussion of attention and applies to the setting of a museum with vast amounts of novel stimuli.

A series of studies conducted by the Center for Environmental Studies of the Smithsonian Institution has led to the proposition that the abundance of novel stimuli in a setting may inhibit rather than encourage learning. An initial study of the effects of the environment found that children who were familiar with the outdoor setting of the field trip (i.e. children living in rural wooded areas) showed higher conceptual learning than children who were unfamiliar with the setting (Falk et al., 1978). Falk suggests that the children in the unfamiliar group were unable to assimilate incoming stimuli into an existing cognitive structure, resulting in disequilibrium and instigating an adjustment or adaptive process which directed the students toward exploring elements of the environment, rather than learning the task at hand. Further research has corroborated the novel field trip phenomenon (Martin et al., 1981) and identified a

continuum with maximum learning occurring with a moderate amount of novelty; too little novelty or too much may interfere with learning (Balling and Falk, 1981).

Additional research suggests that adults as well as children are overwhelmed and inhibited in their learning by the amount of novel stimuli within the museum (Koran, Jr. et al.1983; Falk et al., 1986). In a synthesis of museum research, Koran, Longino, and Shafer (1983) observe:

> A critical problem in science museums is the tremendous number of stimuli, many quite novel, competing for attention. . . . visitors have difficulty focusing their attention and remaining in the area of the stimulus for a sufficient amount of time for information processing to occur. (p. 334)

In Grabe's model, discussed in the section above, attention is a limited resource within an information processing system with goals or priorities determining where the resource is expended. When the cognitive system must coordinate and execute many processes that all require attention, the system is overwhelmed and the learner is unable to complete the task. This view is consistent with museum research that suggests that the visitor may become disoriented and fail to process the stimuli at the initial stage of learning if the stimuli is too difficult or complex (Wilson and Koran, 1976; Koran et al.1983; Falk et al., 1986).

A model of learning in museum settings developed by Koran, Longino, and Shafer (1983) and revised in 1987 by Koran and Koran can be used to explore the reaction to stimuli within the museum. (See Figure 2.) This model is similar to those advocated by proponents of an information processing view of learning. The key concepts of information processing concern the components of the memory system, the organization of the knowledge within the memory, and the active processes of perceiving,

storing, retrieving and using knowledge. This model of learning places the visitor in an active role. Koran and Koran (1989) describe this view of the visitor as not passive consumers of information, "rather visitors must use their information-processing skills, search and scanning abilities, memory and intrinsic motivation to organize and understand the exhibit."

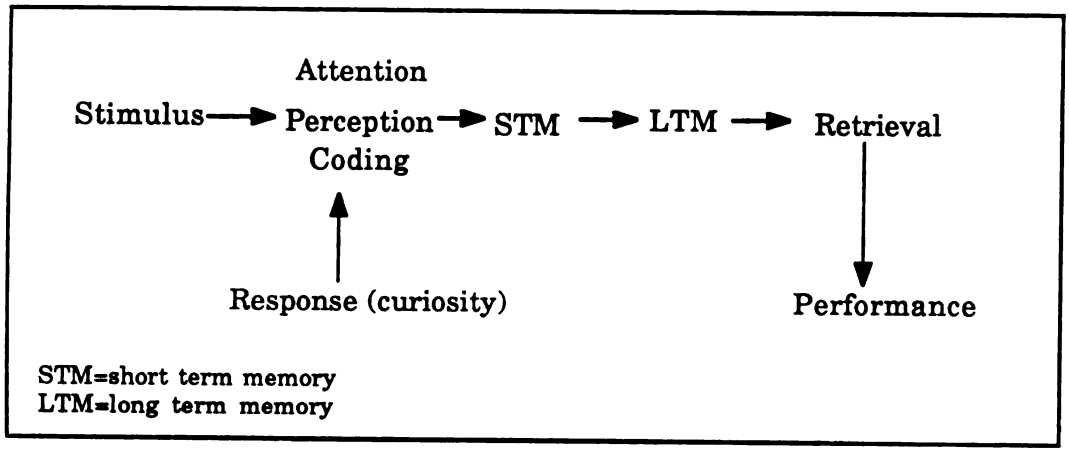


Figure 2. Model of Museum Learning

In the museum setting, stimuli include text labels, physical characteristics of the artifacts and specimens within an exhibit, audio cues either planned as in audio tapes or unplanned such as the conversation of another group, or perhaps even smells. The visitor selectively attends to specific stimuli, perceives and codes it in short term memory (STM). Attention, perception, and coding are influenced by the level of curiosity aroused by the stimuli. From the STM, the information then moves into long term memory (LTM) which is generally described as the point when learning takes place (Gagne, 1985). Information can later be retrieved.

Koran's learning model proposes that the stimuli should elicit attention, perception, and coding which are all affected by the response of curiosity. Koran and colleagues suggest that the visitor can be guided to

selectively attend to and process the abundant information within the museum setting through strategies that influence mathemagenic behaviors at the initial stage of learning, that of attention, perception and coding (Koran, Jr. et al.1983; Koran et al., 1989). The term "mathemagenic" was coined by Rothkopf to describe the activities learners perform at this initial stage of addressing stimuli. The learner's mathemagenic behaviors can be directed through strategies that focus the visitors' attention, elicit active participation, provide feedback, prompts and cues. This is consistent with Grabe's model which suggests that processing attention, rather than the superficial primary attention, can be encouraged through instructional accessories that influence how the new information is encoded and learning takes place. Falk suggests:

> Novelty, and the very powerful needs for exploration it generates, is an extremely important educational variable. The challenge for educators is to harness this variable to enhance rather than hinder our educational objectives. (p. 133)

Research on museum education and research on attention agree that learners can be encouraged to develop and select appropriate mathemagenic behaviors. Grabe (1986) suggests that in a novel situation, "learning to attend is a two-stage process. First, the students must gain some appreciation for the dimensions of the stimuli they have been asked to work with. Then the students must attend to the dimensions that are relevant to a particular task and ignore the dimensions that are irrelevant" (p.75). Kulhavy discusses the importance of three types of instructional accessories: schema activators, questioning, and mnemonics. Schema activators and questioning are of particular interest to this study. Kulhavy defines these activators as "any semantic stimuli which work to provide people with a way of organizing or interpreting the information" (p. 127).

Kulhavy suggests that these schema activators influence attention by "providing the learner with an appropriate knowledge schema for interpreting and integrating new information" (p. 127).

Efforts to help the visitor focus attention on critical information, cueing, prompts and other instructional strategies have been shown to help the visitor employ appropriate mathemagenic behaviors and consequently led to increased learning. The next section reviews the use of adjunct devices as instructional accessories.

Adjunct Devices as Instructional Accessories

Screven's study (1974) with the Milwaukee Public Museum's display on primitive skulls was discussed earlier. After ascertaining that the exhibit was ineffective in communicating information, Screven attempted to increase the effectiveness through the utilization of an adjunct guidance device. The device consisted of an audio tape that contained information and questions coupled with a punchboard which allowed the visitor to select answers on the punchboard and then receive feedback from the audio tape. The questions on the audio tape were designed to orient the visitor to names and relationships, to make comparisons and to give the visitor "a sense of progress, active participation and contingent feedback" (p. 71).

Visitors to the exhibit were asked to use the audio/punchboard system as they walked through the hall and were then given the same criterion test used in the earlier study conducted within the hall. Subjects using the guidance device showed significant improvement over both the pre and post-test groups who didn't use the device. By orienting the visitor to key information and providing an opportunity for responses and feedback the visitor appeared to learn more. This suggests that orienting, questions and providing feedback may influence visitors' attention and interaction

within the exhibit.

A similar, but more complex experimental study involved the Frederick Carder Glass Exhibit in the Renwick Gallery of the Smithsonian Institution (Screven, 1975). Screven designed ten experimental conditions, created through the manipulation of exhibit label design (three groups), adjunct devices such as audio tapes (five groups), and two control groups who didn't see the exhibit (although one group used an adjunct device). Screven's devices function in a similar capacity as the instructional accessories that Kulhavy recommends for helping the learner attend to the stimuli. Each of the experimental conditions was administered on different days for eleven months. After completing the visit to the exhibit, the 736 casual visitors participating in the study were given a criterion test and asked to react to their experiences. Reactions were recorded in one of five categories ranging from intense dislike of the device or material to very enthusiastic.

Results of Screven's research are examined in relationship to the variables suggested as important in influencing mathemagenic behavior. All the conditions employing adjunct guidance devices that guided the viewer to attend to specified characteristics of the exhibit showed a significant improvement over all of the control groups. The four groups using adjunct devices that included questions scored significantly higher than the two conditions of labels without questions and the control groups. Of the three conditions employing audio, only one condition did not include questions and this group was significantly lower than the other two audio groups. As the questions were the only design difference for the audio groups, this would suggest that eliciting a response was an important design element. Screven concluded that the exhibit was not very effective

without use of some kind of adjunct device, but the use of an adjunct device did improve the effectiveness of the exhibit.

Attributing the success of Screven's devices to the "interactive nature of visitor responding, feedback, and positive reinforcement" (p. 457), DeWaard et al. (1974) attempted to identify non-electronic and therefore less expensive adjunct devices that would serve the same purpose. The subjects viewed the Age of Man exhibit with or without a set of programmed cards that varied by the presence or absence of feedback, and the amount of information. The subjects received the same post-test used in Screven's study. Scores for all four experimental groups were significantly higher than both the control group that viewed the exhibit without any aids and the control group that did not view the exhibit, reinforcing Screven's conclusion that visitors learn little without some intervention, but that learning can be increased through the use of adjunct devices.

Similar research has attempted to influence the visitor through intervention strategies before the visitor experiences the exhibit by providing what Kulhavy might call a "schema activator". One study investigating both pre and post-viewing intervention, used wall panels designed to focus the attention of visitors entering a walk-through exhibit of a cave that was considered "so rich in stimuli that some means of directing and controlling attention" was necessary to encourage learning (Koran et al., 1983, p. 342). Subjects were directed to read wall panels presented either prior to entering the exhibit or at the end of the walk through exhibit. Both groups exposed to the wall panel learned more than a control group that did not have access to the panel.

Another example is a study by Gennaro (1981) conducted with a group of eighth grade earth science students prior to visiting the Science

Museum of Minnesota. The experimental group was exposed to a unit designed to serve as an advance organizer preparing them for new material on the "Big Bang" and plate tectonics theories, while the other students received the same amount of instruction but through a traditional unit on geology. When visiting the museum, the students viewed a program on the "Big Bang" and plate tectonics theories. Students were given both a pre and post-test measuring their knowledge of information presented in the museum program. Students exposed to the advance organizer scored significantly higher, with no interaction effect noted for different ability groups.

Research investigating participatory exhibits suggests that eliciting the visitor's participation seems to lead to increased learning. While this study is not directly related to research on participatory exhibits, claims for the advantages of user participation with interactive video suggest that the field has implications for this study which utilizes an interactive video system. Discussing exhibit design, Shettel (1973) writes:

> One of the most powerful principles to emerge from the general field of behavioral psychology and its application to instruction has been the idea that active participation heightens the acquisition and retention of information. (p. 40)

Eason and Linn call for more active involvement of the museum visitor by reviewing the philosophy of educational theorists such as Bruner who espoused the importance of involving the learner in the act of discovery, and Dewey, Shulman and Tamir, who have promoted active participation as integral to learning. Further research on participatory exhibits suggests that actively involving the visitor can increase visitors' attention and subsequent learning (Sneider, Eason, and Friedman, 1979; Feher and Rice, 1985).

Summary of Research Involving Adjunct Devices

These studies suggest that visitors' attention can be attracted and focused through the use of instructional accessories used as an adjunct to the exhibit. Visitors' attention seems to be influenced by strategies such as orienting or focusing attention, cueing, eliciting the visitor's response through questions and providing feedback, and promoting participation. These instructional design strategies were used as the basis for the design of the interactive videodisc program employed in this study.

This study builds on this research and investigated whether an interactive videodisc program, which included the instructional strategies identified above, could influence visitors' attention within an exhibit hall. The research hypothesis was that the interactive videodisc program, when designed with appropriate instructional strategies, could act as an effective instructional accessory within the museum setting.

Attracting Power of Adjunct Devices

While research cited above suggests that a variety of devices can be used to influence mathemagenic behaviors, other research shows that the potential effectiveness of a device can be mitigated by its lack of attracting or holding power. Attracting power is defined as the percentage of visitors who stop to use the device and holding power as the length of time the visitor stays with the device or exhibit. Screven's study within the Renwick Gallery of the Smithsonian (1975) attempted to measure visitor acceptance of the ten different experimental conditions discussed earlier. A comparison of the effectiveness as measured by a post-test and the visitor responses suggests that the strategy most effective is not necessarily the most popular. Of the four strategies discussed, the audio with no questions and tape-paced rather than self-paced, was significantly less effective than

the other three strategies, yet it received the most positive reaction and had the strongest holding power with only 14.6% quitting before completion. Individuals using the self-paced audio with questions scored higher than any of the other ten conditions, yet this condition had the highest quitting percentage (39.7%) and a lower acceptance score than the tape-paced with no questions. This research suggests that the effectiveness of a device is not necessarily related to its attracting or holding power.

Research on the attracting power of various devices, shows visitors do display specific preferences. One study evaluated visitors' reactions to the content and medium components of exhibits (Washburne and Wagar, 1972). Visitors expressed highest interest for motion pictures, followed by audio, models and objects. Text ranked in the bottom quarter of the ranking followed only by two dimensional mediums such as slides or flatwork. More recent research has supported the high attracting and holding power of motion (Bitgood, Patterson, Benefield, 1986; Patterson and Bitgood, 1988).

In an observational study of visitor behavior in ten museums in the Los Angeles area, Beer (1987) studied the attracting and holding power of exhibits based on the combinations of materials. Beer found visitors were significantly influenced by the combination of materials in the exhibits with the attracting and holding power roughly related. Exhibits with "text only" had the lowest attracting power and the second (out of eleven) lowest holding power. When audio, audiovisual, models or manipulables were added, both the attracting and holding power increased with the combination of text, audio and model showing the strongest attracting and holding power. The study also investigated the attracting and holding power of exhibits with varying lengths of audiovisual presentations. The longer the presentation, the lower the percentage of visitors viewing the

whole presentation. Beer's study suggests that the visitor's attention is often limited and the attracting and holding power of exhibits can be increased through the addition of audio, audiovisual, models or manipulables.

These studies suggest that visitors seem to use a consistent criteria in selecting the exhibits they will attend to, with the medium employed influencing the attracting and the holding power of exhibits. Visitors seem to be attracted by motion and sound and their attention may not hold if the presentation is too long (over three minutes) or if the medium involves text only. Screven's study also suggests that the attracting and holding power of a device is not necessarily related to its effectiveness. Both the effectiveness and the attracting power of a device need to be explored when attempting to select or design strategies to influence visitors.

Research on museum learning and on the use of adjunct devices can be synthesized and their implications viewed together. Consistent research suggests that without some type of intervention, the museum visitor does not learn. Intervention devices include participatory exhibits, wall panels, audio tapes, movies and printed materials. Instructional strategies that have proven successful include eliciting viewer participation, orienting and focusing attention on critical attributes of the exhibit, questions and feedback. Screven suggests that "the deliberate programming of pre-exhibit experience may be one of the more feasible, economic, and unobtrusive ways of facilitating learning in museums" (Screven, 1975). This study used these findings as a guide in development of the interactive videodisc program. Included in the program were motion, audio, and text screens that introduce information within the exhibit, questions and appropriate feedback, and opportunities for visitor interaction with the program.

While these studies show promise in using a variety of techniques, there is a lack of research on visitors' reactions to the different types, and of the attracting and holding power of each. This is relevant to the museum setting as there is no extrinsic reason for the visitor to use the devices. In selecting effective adjunct devices, design decisions should consider information on both the comparative attracting power as well as the effectiveness of various strategies and devices. Therefore, this study investigated the attracting power of the interactive videodisc and attempted to identify characteristics of the types of visitors that were attracted to the device.

Media Research

Gagne (1985) defines media as the"combination of things or systems of things used to deliver communications or other instructional stimuli to the learner." Research discussed earlier indicates that the combination of objects (specimens and artifacts) and accompanying labels are not adequate to promote learning in the instructional situation of the museum, and that other combinations may be more effective in encouraging cognitive outcomes. This section looks at other types of media and their potential to attract and direct visitors' attention. The interactive video is reviewed as a medium that may have the capabilities appropriate to reach the casual visitor within the informal setting of the museum.

Research on instructional media has warned against confusing the medium with the instructional message when researching learning from media (Clark, 1983, 1988; Hofmeister, 1985; Clark and Soloman, 1986; Grabowski, 1989). Clark compares mediated instruction to a grocery delivery truck. While the truck delivers the food, the nutritional value of the food cannot be attributed to the truck. In the same way, media delivers

instruction, but it is the instructional strategies that influence learning and not the media. Studies that report causal connections between media and achievement or other outcomes are commonly confounded by other variables including novelty effect and different instructional methods used within the treatments that are compared. Clark (1986) advises that, "Five decades of research suggest that there are no learning benefits to be gained from employing different media in instruction regardless of their obviously attractive features or advertised superiority" (p. 450).

Clark suggests that research on media should instead emphasize the instructional design variables and the effectiveness and/or efficiency of a device in implementing the stipulated instruction design strategies. Despite the warning of Clark and others, most research on interactive video has shown the same tendency to compare this new medium to other mediums and to draw conclusions about the device rather than the instructional strategies. Reeves (1986) evaluation of current research regarding interactive video states:

> Despite at least 25 years of unfavorable criticism and few useful results (Hoban, 1958; Phillips, 1980; Sander, 1981), research and evaluation studies which use experimental and quasi-experimental designs to compare one instructional technology with another (or with the mythical "traditional instruction") continue to predominate research with instructional innovations. (p. 102)

In a current review of research on interactive video, Slee (1989) states "We MUST re-orient ourselves toward conducting research on instructional strategies of effective variables that lead to formulating generalizable theory. In addition, an increased focus on the evaluation of interactive videodiscs and their uses would enable us to optimize the medium for particular situations, types of content, and types of learners" (p. 159).

Therefore, this section follows the advice of Clark and others and avoids reviewing media comparison studies. Instead the characteristics of interactive video are compared to other media and research is reviewed that focuses on instructional design variables related to the design of instructional interactive video programs. Over two decades ago, Gagne (1965) warned that no single medium is likely to have properties that make it best for all purposes. Gagne suggests selecting media based on the characteristics of the media and those of the instructional situation. This section will first review the characteristics of the museum as an instructional setting and then review various media and their instructional characteristics. Reviewing the characteristics of the museum setting is related to identifying what Reigeluth and Merrill define as the instructional conditions which are "the factors that influence the effects of methods and are therefore important for prescribing methods" (Reigeluth, 1983, p. 14). The characteristics of the museum as a learning setting are largely determined by the fact it is an informal learning setting and the learners are often very different in their backgrounds, expectations and other individual characteristics. In a comparison of formal and informal learning, Bitgood (1988) points out some of the differences. In formal education, classrooms generally provide little distracting stimulation, the learner stays in the same or similar environment for extended periods and learners are exposed to small amounts of stimuli repeatedly and for extended lengths of time. In comparison, the museum setting offers extensive amounts of novel stimuli and the learner is generally exposed for brief periods. There is no instructor present for the casual visitor and no extrinsic reward system. The type of learning that is taking place ranges from verbal knowledge to higher level problem solving, depending on the

contents of the exhibit and the characteristics of the learner. Because museums receive many visitors yet often operate on limited budgets, media selection is often influenced by cost effectiveness.

The learning setting within the museum suggests the media should possess at least some of the following characteristics: flexibility, ease of maintenance, ability to direct attention, ability to elicit response and provide feedback or reinforcement, and ability to individualize. The next section will review characteristics of various media that have been used within the museum setting. The media reviewed include printed materials (labels, brochures, exhibit guides), video and motion pictures, computers and interactive video.

Printed materials are relatively inexpensive to generate, require little maintenance, and can be designed to direct attention, and elicit responses. The user has complete control over what is read, the sequence of reading and responses to any questions embedded in the text, thereby individualizing the way the material is received. However, this potential is neutralized by the reaction of most visitors to ignore printed material as evidenced by the lack of attention to labels (Screven, 1968, 1974; Cone and Kendall, 1978; Wolf, 1980; Beer, 1987) as well as research by Screven (1975) suggesting that exhibit guides were not well received by the visitors and when used, often detracted attention from the exhibits themselves. Video and motion pictures appear to be more enticing to visitors than printed text. As one museum educator states, "visitors come to museums primarily for visual experiences, not to read" (Vanausdall, 1986). There are pedagogical as well as practical liabilities with video and motion pictures. The costs and maintenance requirements are higher than that of printed material and visitors seldom watch for more than three minutes (Beer, 1987).

Motion pictures can be designed to focus attention and elicit responses, but the continuation of the program is not contingent on viewer participation, and the individual viewer does not have any control over the content or sequence of presentation. Some research suggests that these constraints may create passivity in viewers (Laurillard, 1984).

The branching capabilities of computer programs allow them to react to each user's input, offering control over sequence, content and presentation styles which can be responsive to individual interests, prior knowledge or other individual characteristics. However, computers and appropriate software, are often expensive and can be more difficult to maintain than other mediums discussed. Presentation modes include only text or computer generated graphics. With museum exhibits often offering only a static view of the phenomenon or items on display, there may be a unique instructional value in the ability of motion picture to show a bird in flight, a fossil being excavated or a habitat through changing seasons.

The merger of the computer's technology with the video, joins the computer's ability to branch (allowing greater individualization and user control) with the video's varied presentation capabilities. This ability of interactive video to involve the user through requesting and reacting to user responses is one of the characteristics receiving the most attention in educational applications. Floyd (1982) states that "viewer participation in an interactive video program is a critical factor; this is not so for traditional linear video programs, in which the viewer remains passive" (p. 2). In a chapter addressing educational technology in the future, Bork writes "most learning theories agree on the importance of addressing individual differences, but most mediums are unresponsive to this " (DeBloois, 1982, p. 7). Proponents of interactive video suggest that the extensive and varied

display facilities are likely to stimulate and maintain students' attention more effectively than computer graphics or straight video (Deshler and Gay, 1986; VanHorn, 1987). Dalton and Hannafin (1986) suggest that current research "indicates that the variety of visual and auditory learning stimuli present in interactive video can dramatically improve learning ." Other advantageous characteristics include use of motion which may increase interest, motivation and emotional impact (Ebner, 1984), the use and high fidelity of audio (DeBloois, 1982; Ebner, 1984), large data storage capability and rapid random access (DeBloois, 1982; Parsloe, 1985), ability to integrate information from many sources (Parsloe, 1985), and low maintenance (DeBloois, 1982; Parsloe, 1985; VanHorn, 1987).

Summary of Media

A review of the characteristics of the museum as an informal learning setting, and the characteristics of various instructional media, suggests that the interactive video format may have the capabilities to address the instructional conditions within a museum. Over ten years ago Screven (1974) offered this advice for the design of effective exhibits:

> One way of securing cooperation, attention and control within the framework of the exhibit is to provide for *interaction* between the exhibit's instructional components and the visitor. . . . To achieve this interaction, one must find ways 1) to direct and sequence viewer attention to names, distinctions, relationships, etc.; 2) to provide for selective responding by the viewer; and 3) to provide for immediate feedback (preferably differential feedback) following viewer responses. (p. 70)

While this advice was meant for the devices available at that time, the prescription seems to speak to the potential of the characteristics of the interactive video.

Interactive Video Research

Research on interactive videodisc programs show a lack of emphasis on the instructional design strategies used within the programs studied. Researchers and instructional designers have called for more aggressive research on the instructional design principles related to the design of interactive video programs (DeBloois, 1982; Schaffer and Hannafin, 1985; Hannafin, Phillips, and Tripp, 1986; Hannafin and Colamaio, 1986; Hannafin, Phillips, Riebner, and Garhart, 1986). DeBloois (1982) suggests that because of the unique capabilities of interactive video, "instructional models once useful for linear single audience, instructional development may no longer be useful for non-linear, interactive applications with varied audiences" (p. 32). Efforts have turned to identifying instructional variables that may be most advantageous in the design of interactive video programs and measuring the effects of variables under varying conditions (Hannafin and Colamaio, 1986; Hannafin and Phillips, 1986; Hannafin, Garhart, Rieber and Phillips, 1985).

Many of the specific variables of interest in computer aided instruction (CAI) research have continued to be points of investigation in this new technology. For example, interactive video research has looked at the role of control strategies (Ebner et al. 1984; Laurillard, 1984; Goetzfried et al., 1985; Hannafin, 1987) , feedback, orienting instructions (Hannafin, Phillips and Tripp, 1986), practice (Hannafin, Phillips and Tripp, 1986; Hannafin, 1987), levels of interactivity (Schaffer et al., 1985), and processing time (Hannafin et al., 1986) and visual display formats.

Control strategies received considerable attention in earlier computer based instruction and continues to be of interest in interactive video programming research. Different levels or amounts of user control

have been investigated including: 1) adaptive control, 2) learner or user control with varying levels, and 3) combinations of adaptive and learner control for different functions. The learner (or user) control method allows the individual learner to determine the learning strategy including such areas as number of examples given, sequence and rate of presentation, and type of feedback. With the adaptive control method, the instructional presentation is directed by the program and is continuously adjusted to the individual user's needs based on achievement, interest level and characteristics of the learning task (Tennyson, 1980). Still other research has investigated the effects of mixing control options over sequence of content, amount of practice, type and amount of feedback. Research on control options has measured a variety of outcomes including achievement, error rates and completion rates, anxiety states and attitudes (Steinberg, 1977).

The results from user control research related to both CAI and interactive video have been contradictory. Learner control in CAI had been assumed to benefit the learner through "anxiety reduction, greater task engagement, faster learning, improved attitudes, and better performance" (Steinberg, 1977). Steinberg's (1977) review of student control in CAI disputes these assumptions and reviews a large body of contradictory research on learner control. Regarding control over practice, Steinberg cites studies that show improved achievement (for example, Judd et al. 1970) while another study showed learners opted for excessive practice (Lahey et al., 1975), problems that were too difficult (Whitlock, 1976) or under some circumstances, inadequate amounts of practice (Montanelli and Steinberg, 1976). Learner control over sequence has shown reduced achievement (Judd et al. 1970; Oliver, 1975) particularly for low achievers

and increased the drop out rate for college students in one study (Curtin et al., 1976). Steinberg concludes that "Because the data base is inadequate and the experimental results are highly variant, it is not possible to make generalizations regarding the locus of control in CAI " (p. 88).

Reacting to the contradictory research on control, Tennyson (1980) tested a strategy of allowing learner control but providing advisement that includes diagnosis and prescriptions related to the criterion performance. He tested this approach, termed "learner-adaptive control" against adaptive control and learner control with university students in an introductory physics course. The advisement was based on a management system, the Minnesota Adaptive Instructional System (MAIS) that was developed by Tennyson and associates. His findings in this study suggest that the learners in the learner-adaptive strategy performed significantly higher than the learner control group and as well as the adaptive control group, but needed 24% less time than the adaptive control group. Tennyson states that the reduction in on-task time is particularly important because students in a learner control situation consistently leave before mastery. This research suggests that learner control can be more effective if integrated with instructionally sound advisement.

Goetzfried and Hannafin (1985) investigated the effects of three levels of control over CAI strategies on the accuracy and efficiency of mathematics rule and application learning for low achieving 7th grade students. The three experimental treatments were an externally controlled adaptive strategy, an individually based learner control with advisement strategy, and a no control linear design strategy. Results suggested no significant differences in the effectiveness of each treatment, but significant differences in efficiency with the no control group requiring less time with

no loss in achievement, suggesting that the linear model was more appropriate for the subjects and content addressed in this study. There were also no differences for gender.

Almost a decade after Steinberg's synthesis, Goetzfried and Hannafin (1985) state that the problem of how to optimally apply control is not yet resolved regarding CAI:

> The locus of control in CAI design, learner, computer, or combined control, has been a recurring, but as yet unresolved, issue. The amount of control that learners can effectively manage, and the factors likely to affect control strategies, are not generally known. (p. 3)

With no definitive answers regarding the use of control, it has become clear that it is a complex issue with various factors influencing the effect of the locus of control. Some of the factors include nature of the learning task (Hannafin, 1984), the ability level or prior achievement of the learner (Tennyson, 1980) and age of the learner (Hannafin, 1984).

Research on locus of control has been extended into research on interactive video with some suggesting that the issue may be even more important when designing instruction using interactive video for at least two reasons: 1) the videodisc can provide vast amount of information, so there is increased potential for varied ways to present it (Laurillard, 1984), and 2) many believe that the interactivity possible with interactive video can enhance discovery or inquiry approaches to learning that require user control over "their own learning sequence, content, forms of representation, speed or presentation (slow, fast motion, or still frames), and overall pace" (Deshler and Gay, 1986).

Hannafin and Colamaio (1986) investigated the effects of practice and three types of control- designer imposed, learner selected, and linear on

three learning outcomes- factual information, procedures and problem solving related to CPR. Their findings suggest that both the designer imposed and the learner selected control groups performed significantly better than the linear group for all three learning outcomes, but found no significant differences between the designer imposed and learner selected conditions.

The studies discussed above were conducted in formal learning settings with many of them dealing with the relatively homogeneous audience of college students. There is a lack of research on the effects of user control options for the learner in a free choice setting such as a museum and with the adult learner or the mixed family group. In a review of empirical issues in interactive video research, Hannafin (1985) recommended the following proposition as one requiring more research, "interactive video is not appropriate for the full range of learners, to-be-learned content and types of learning tasks. . .What is lacking is a clear understanding of when, why, how, and for whom interactive video is effective" (p. 25). Because the museum audience is a heterogeneous group with varied interests and knowledge bases, the user control options offer an instructional strategy that could help meet diverse needs. Further research on locus of control is relevant to instructional design within the museum setting.

Summary of Interactive Video Research

Research on interactive video has turned to many of the same instructional design variables as CAI had earlier investigated. Research on locus of control has been contradictory and complicated in both computer aided and interactive video research. Learner control with advisement has shown some promise in producing consistent results.

Little research has investigated the conditions most appropriate for employing interactive video. Most research has focused on formal settings, while neglecting informal setting such as the museum. This suggests that the small body of research that does exist on interactive video may not be generalizable to the museum setting.

To further study the role of user control strategies, this study focused on visitors' use of two levels of control options. The two levels were differentiated by the amount of examples and the presence of practice questions. Visitors who used the second level of options (Level Two) were compared to visitors who used only the first level of options (Level One). Characteristics of the visitors were investigated to determine if interest in birds or comfort level with computers were related to the level of options used.

Chapter Summary

Research from the field of museum education suggests that museum visitors often do not attend to the exhibits and consequently do not learn from their visit. This has been substantiated by both experimental research and observational studies. Some research suggests that this is because visitors are overwhelmed by the vast amounts of stimuli present within the museum. Efforts have turned to preparing visitors for the exhibit using adjuct devices such as slide shows, videos, or printed materials. These devices are meant to operate as schema activators, preparing visitors conceptually for the information within the exhibit. These efforts to use adjunct devices have been consistently successful in increasing visitor participation and visitor attention within the exhibit area. Visitor attention can be measured by identifying the amount of time spent within the exhibit or in front of an exhibit. Elapsed time has been shown to be highly

correlated to both cognitive and affective outcome measures. It can also be measured using non-intrusive methods, thereby not disturbing the spontaneous behaviors of visitors.

This research focused on the use of a relatively new instructional medium, the interactive videodisc, as an adjunct device. Research on the use of interactive videos has been primarily conducted in formal settings such as higher education institutions or within industry. Research within informal learning settings such as the museum is rare. One research issue regarding instructional development of interactive video programs is that of control options. User control refers to giving the user, or the learner, control over such options as sequence and type of presentation, practice, and speed. Program control refers to designing the program to control the sequence, speed, etc. Research on the effects of different types and amounts of user control options has been contradictory and confusing. This study utilized a program with two level of user control options and investigated which level would be used and whether any individual characteristics of the users were related to the level of options used.

CHAPTER THREE. METHODS.

This chapter describes the sample of visitors used for this study, the setting for the study and the materials used for the interactive videodisc program. The measurement instruments used to collect data about visitors' use of the videodisc program and their behaviors within the exhibit area are presented and the validity and reliability of each instrument is discussed. The procedures used for the data analysis are also described and the validity and reliability of the procedures are reviewed.

Setting

The study took place within the Michigan State University Museum, a natural and cultural science museum. The area of observation was a special exhibit on endangered birds of Michigan titled "Birds in Trouble in Michigan". This exhibit was selected as the setting for two reasons: 1) The hall has only one door used as both entrance and exit, simplifying the task of measuring the amount of time spent within the hall and ensuring that visitors were exposed to the interactive program before encountering the hall, and 2) The number of videodiscs currently available are limited and there was an appropriate videodisc available on the topic of birds.

On experimental days, the interactive videodisc system was set up on a rolling cart outside the entrance to the exhibit area. (See Appendix A for diagram.) A sign was placed over the station that read "Video Introduction to Birds in Trouble in Michigan Exhibit". The video deck used to record visitor behavior, was placed inside a black wooden box and placed on top of an exhibit case on the opposite side of the hallway. The video camera was mounted on top of the box. The video camera was part of the security system and consistent with other cameras mounted around the museum. The wide angle of the camera offered a view of the computer users, the

entrance to the exhibit hall and one wall of the exhibit area.

Population and Sample

Each group of visitors that entered the exhibit hall, or who used the interactive videodisc program during the days of the study were part of the study. Groups were defined as any number of individuals who entered and/or exited the hall together or were seen either conversing, in physical contact or sharing in any child care responsibilities. The study focused on the group rather than the individual because most visitors enter the museum as part of a social group, and the majority as part of a family (Dierking, 1989; Kropf, 1989) and the group or family influences the behavior of each member (Cone and Kendall, 1978; Hilke and Balling, 1985; Kropf, 1989; Dierking, 1989)

The groups of casual visitors were investigated rather than intact formalized groups for three reasons. First, the needs of intact groups visiting the museum can be addressed through guided tours, pre/post visit information and special orientation sessions or materials. However, the casual visitors are primarily responsible for addressing their instructional needs without the support of a formalized presentation. Second, as the number of casual museum visitors continues to grow at phenomenal rates (Alexander, 1979), and as the science education community expends more energies on increasing science literacy of the population as a whole, museums become one of the most likely vehicles to reach those individuals no longer part of formal education (Ucko, 1983; Feher and Rice, 1985; Finkelstein, Stearns and Hatcher, 1985). Third, it has been suggested that much of the existing experimental research done within the museum setting has been done with intact groups specifically brought into the museum for the study with results that are not useable or generalizable to

the real museum audience (Wolf, 1979, 1980; Falk, 1976, 1983).

Materials

The hardware components included the videodisc player (Pioneer 2000), a computer to drive the videodisc and to present the instructional program (Macintosh Plus), an interface between the computer and the videodisc player, and a video monitor. Software included Hypercard, which was used as the authoring program to create the program and a videodisc from the Audubon Society. A complete diagram of the set up is included in Appendix A. To make the system less intimidating to the non-computer literate, the keyboard was disconnected from the computer and a Kensington "turbo mouse" replaced the traditional Macintosh mouse.

The videodisc, "Audubon Society's VideoGuide to the Birds of North America: I" is marketed by MasterVision and covers 116 species of birds that breed in North America including loons, grebes, pelicans, swans, geese and ducks, hawks, vultures, and falcons, and chicken-like birds. Video segments show close-ups of distinguishing characteristics and motion pictures illustrating behaviors such as diving into water for food. The sound track includes bird sounds and a narrative with information on identification, threats to the survival of the species, range, and other significant information. Seven segments were selected from the videodisc that were consistent with the content and conceptual approach of the exhibit on endangered birds. The birds illustrated in these segments were the Bald Eagle, Northern Harrier, Cooper's Hawk, Red-shouldered Hawk, Merlin, Peregrine Falcon, Greater Prairie-Chicken.

Samples of text from the exhibit label and an audio segment from the videodisc illustrate the consistency between the information within the exhibit and that on the videodisc.

> Once common in parts of Michigan, the decline of the Red-shouldered Hawk has followed the loss of the larger tracts of bottom land forest to human encroachment. Research is needed to determine the sensitivity of this species to pesticides and other forms of environmental contamination, both here and in its wintering areas.
> (from the label for the Red-shouldered Hawk)

> This vocal raptor [Red-shouldered Hawk] is declining throughout its eastern range due to the accumulation of pesticides in its prey. It is also a victim of the disastrous, ongoing destruction of its bottomland forest habitat from the building of recreational lakes on the rivers of the eastern U.S.
> (from the audio segment on the videodisc)

When the program was not being used, the video ran continuously with no audio and the introductory screen on the computer invited visitors to "press the red dot" on the turbo mouse to begin the program and to turn on the audio. Once either of the buttons was pressed, the video stopped and the computer program presented the introductory screen.

The design of the Hypercard program was influenced by previous research on museum guidance devices and included the following instructional design strategies: providing information that would orient the visitor to key concepts within the exhibit, use of questions, eliciting responses and providing feedback, offering user control over content, sequence and pacing. (See Appendix B for a printout of the presentation screens.) Throughout the program, options are presented on the screen and the visitor turns the ball to move a corresponding arrow on the screen and then clicks on their choice. The main body of the program begins with a menu that allows the user to select the content and sequence. The options on the main menu are:

1) Introductory segment
2) Video on hawks
3) Video on eagles

4) Video on falcons
5) Video on prairie-chickens
6) Challenge questions

Before each video segment, the viewer is presented with a screen on the computer that includes general information about the video segment and relates the segment to the mounts within the hall. Each video segment lasts between thirty and sixty seconds. After each video segment, the viewer is shown a sub-menu related to the species just viewed. The viewer may return to the main menu or ask for further examples or questions related to that species.

At all times the user has control over the content (i.e. moving from one type of birds to another) and the mode of presentation (i.e. shifting from examples to questions). Each selection that the viewer makes is recorded by the program. The program consists of one main menu, seven sub-menus, seven video introduction screens, seven screens with practice questions and feedback and fifteen instructional screens.

The interactive videodisc program was designed to introduce the visitors to important information within the exhibit and to supplement the exhibit with video and audio support for concepts involving motion or sound. No tests were done to assess the content validity of the program but the face validity was assessed by three content specialists. The program was reviewed by the Curator of Ornithology who designed the Birds in Trouble in Michigan exhibit, the museum naturalist who wrote the labels for the exhibit, and the Curator of Education who is also a biologist. These three individuals felt the program was consistent with the exhibit.

Data Collection Instruments

As the focus of this research was on visitor behavior, it was important to have accurate and reliable observations of all visitors during

both the experimental and control days. A video camera was used to record the behavior and characteristics of the subjects. The video camera, mounted on the wall outside the special exhibit hall, was part of the museum's security system, identical to others throughout the building, thereby reducing potential intrusiveness of the instrument. The wide angle lens on the camera allowed a view of the computer outside the door of the exhibit, the entrance to the exhibit and one wall of the exhibit. (See Appendix A for diagram.) The tape deck coded the dates and times providing an accurate measure of time spent within the exhibit hall and also supported the ability to match the computer records with observations from the video tapes.

While the video observations provided the descriptive data necessary for analyzing visitor interaction with the exhibit hall, this study was also interested in the specific ways the user interacted with the computer program. The user's choice of options or "path" through the program was of interest as previous research on user control options has primarily emphasized formalized learning settings and this study was based in a free-choice informal learning setting. Therefore, the computer program was designed to collect data about each choice the user selected, specifically the level and type of choice. Level One options were defined as those selected from the main menu. Level Two options were defined as those selected from one of the sub-menus. For each group viewing the program the following data was recorded by the computer program: elapsed time on program, number of choices from the main menu (Level One), number of choices from the sub-menus (Level Two), and types of options (questions or examples).

Previous research on the use of adjunct devices in museums has

suggested that both individual differences and characteristics of the media may influence visitors' usage of adjunct devices. To analyze whether users were drawn to the program because of the medium or the content, the interactive video program asked each user the following two questions:

1) Do you feel comfortable with computers?

___ yes ___ somewhat ___ no

2) How would you rate your interest level in birds?

___ high __ medium __ low

The answers to these questions were not available for the subjects who did not use the computer. Therefore, it was necessary to conduct a survey of the museum population to provide sample responses that were representative of the general population and could then be compared to the responses from the groups who used the interactive video program. On three week-end days outside of the observation days, a random sample of 65 visitors exiting the bird exhibit were asked to fill out a short survey included in Appendix D with two questions identical to those presented by the computer: 1) How would you rate your interest in birds, and 2) Are you comfortable with computers? Sixty-five groups were interviewed to provide a sample size comparable to the number of groups that used the interactive video program.

Validity and Reliability of Instruments

To investigate whether the program influenced visitors interaction with the exhibit, elapsed time within the hall was used as the dependent variable. Elapsed time was measured from the moment the group walked through the entrance to the exhibit until exiting. Time spent on the videodisc program outside the hall was not considered part of the elapsed

time within the exhibit. Elapsed time has been used as a dependent variable to measure learning within the museum setting since the 1920's when Robinson first coined the term "holding power" to investigate the effectiveness of art exhibits (Falk, 1984). Time has been show to be highly correlated to both cognitive and affective measures and has been validated by Falk and others over several studies (Falk, 1976; Falk et al., 1978, 1981; Balling and Falk, 1981; Falk and Balling, 1982; Falk, 1983). More recent research on the role of attention in museum learning has supported the relationship between elapsed time and learning (Koran, Koran and Foster, 1989; Haeseler, 1989). In a review of the use of time as a dependent variable, Falk states (1983),

> Time is, perhaps not coincidentally, the single measure most frequently used for evaluating exhibit(s) quality/effectiveness and assessing visitor behavior-the time spent in an exhibit, the time spent in an exhibit hall, the time spent in a museum. Time, as a research variable, is easy to measure, essentially objective, and theoretically non-trivial." (p. 183)

Elapsed time was measured by observing the videotapes and recording the time that the first member of the party entered the exhibit hall and the time that the last member exited the hall. The videodeck recorded the time by the hour, minute and second. Therefore, it was possible to stop the video tapes at the point of interest and record the time shown on the videotape.

The characteristics of the groups were also identified from observing the video tapes. All video tapes were viewed by the researcher and the following data coded for each group entering the hall or using the program: entrance and exit time, number of adults and children in party, gender of each member and, if the computer was used- starting and ending time with the computer. All coding was done by the researcher to avoid reliability

problems of multiple observers. No reliability tests were conducted to test the internal consistency or stability of the coding over time. However, the independent variables were selected for this study because they were observable and discrete objective variables resistant to subjective variances in observations.

The Hypercard computer program that drove the interactive videodisc program was designed to collect data about the users' choices throughout the program. The Hypercard program was designed so that if no input was received after one minute, the computer recorded all data on the past user and returned to the introductory screen. This protected the data collection from being confounded by the possibility of two users being recorded as one, which could happen if a second user took over in the middle of the program. Also, anytime a viewer asked to see a choice from the main menu that had already been recorded, the program asked if the viewer was a new user and if so, the program again recorded all choices and began a new file for the current users. These precautions were meant to insure the validity of each users' records.

Procedures and Design

Data was collected in two hour segments over five consecutive week-ends, with one day of each week-end randomly assigned the experimental condition and the other as the control condition. Week-ends were selected rather than week-days because the audience of interest was the casual visitor and week-days typically include a larger number of intact groups such as school classrooms, or other organized and more formalized educational groups.

Under both the experimental and control conditions, the video deck was pre-set to record for the same two hour period each day making it

possible to insert a new tape before the museum opened and insuring a consistent time schedule of taping. During the control days, the only data collected was by the video tape. Under the experimental conditions, the interactive videodisc program was set up at the entrance to the hall with a label describing it as a "Video Introduction to the Birds in Trouble in Michigan Exhibit." (See illustration of the set up in Appendix A.) At the end of each experimental day, the data collected by the computer was recorded and a new file established for the next session. This data was later analyzed to address the question related to user control.

Data Analysis

The first research question of this study pertains to whether the interactive videodisc program influenced the amount of interaction between visitors and the exhibit hall of interest. Elapsed time was used as a measure of visitor interaction with the exhibit. For each group, elapsed time was computed for time within the exhibit and time in front of two specific bird mounts (Bald Eagle and Red-shouldered Hawk) that were part of the videodisc presentation.

A posttest-only control group experimental design was utilized with treatments randomly assigned to each day. According to Campbell and Stanley (1968), this design offers strong protection against threats to internal and external validity. Specific factors controlled by this design include history, maturation, testing, instrumentation, regression, selection, interaction of testing and treatment, and mortality. Interaction of selection and other factors is not controlled. One way analysis of variance (ANOVA) was used to determine whether the differences between the group means were greater than would be expected from sampling error alone (Glass and Hopkins, 1984). Four comparisons were tested: 1) the

elapsed time within the exhibit between all visitors on the experimental day and all visitors on the control day, 2) the mean elapsed time within the exhibit between visitors on the experimental day who did not use the interactive videodisc program and all visitors on the control day, 3) the elapsed time spent in front of the Bald Eagle between all visitors on the experimental day and all visitors on the control day, and 4) the elapsed time spent in front of the Red-shouldered Hawk between all visitors on the experimental day and all visitors on the control day.

As the museum setting is an informal learning environment with minimal or no external pressures on the learner, some types of visitors are likely to be attracted to certain devices more than other devices. Therefore, this research also looked at the attracting power of the interactive video system and attempted to identify the variables that might be related to the visitors use. Potentially related variables included gender (of both the children in the party), group composition (ratio of adults to children and gender of each member), self-assessed level of interest in birds and level of comfort with computers.

Both the dependent variable (use of the program) and the independent variables (group composition, gender, bird interest and computer comfort) were categorical variables. Therefore, non-parametric statistical methods were required. The chi-square test of association was selected as it is commonly used to test the relationship between two factors or variables with unknown expected proportions (Kirk, 1982; Glass and Hopkins, 1984). This procedure compared the groups that used the interactive videodisc program to the general population of exhibit visitors during the time of the study (i.e. the total sample within this study). If the groups of computer users were a representative sample of the general

population on all independent variables, then chi-square would show the observations to be independent of each other suggesting no relationship between the independent variables and the use of the program.

The third research area of this study addressed the use of the two levels of control options. Users were identified as either Level One if all their selections were from the main menu, or Level Two if they went beyond the main menu and selected from the sub-menus that offered a more indepth look at the species of bird. The research assumption was that the Level Two users would have a higher level of interest in birds and a higher comfort level with computers than Level One users. Because these variables were also categorical, a chi-square procedure was used to assess whether there were any significant differences between the group who used the program and the control group that was randomly selected on days when the program was not available.

Chapter Summary

This research was conducted within the Michigan State University Museum, a natural science and cultural history museum. The observations were conducted within an exhibit titled "Birds in Trouble in Michigan", a special exhibit on endangered birds of Michigan. An interactive videodisc program was used to introduce visitors to conceptual information and terminology used within the exhibit. The program was set up outside the exhibit hall on randomly selected experimental days. An experimental posttest-only control group design was used to assess whether the experimental group with access to the program, spent greater amounts of time within that exhibit than a control group that visited the exhibit when the program was not present. The characteristics of the visitors who used the program were also investigated as this study was interested in

identifying relationships between individual or group characteristics and characteristics of media programs. Specific visitor characteristics studied included group composition, gender of the adults and children in the group, and the level of interest and level of comfort with the computer. Visitors who used the program were tracked in their use of the program to investigate any relationship between the levels of options used (Level One or Level Two) and either self-assessed interest in birds or comfort level with computers.

All data for this study was collected through non-intrusive methods in an attempt to keep the study an observation of natural behaviors. A security camera identical to other cameras throughout the building, was used to collect data on visitor characteristics (group composition and gender) and elapsed times. The video recorder was contained in a wooden box that was painted black and placed on top of an exhibit case. The video tapes were later viewed and data recorded by the researcher. The Macintosh computer program driven by Hypercard collected data on the users' choices throughout the program, the users' self-assessed level of interest in birds and level of computer comfort, and the time of use.

Mean elapsed times for the experimental group and the control group were compared using analysis of variance (ANOVA) procedures. The characteristics of those using the computer were compared to the characteristics of the general population visiting the exhibit using a chi-square procedure. The chi-square procedure tested for any relationship between each of the independent variables (group composition, gender, interest in birds, computer comfort level) and the dependent variable of using the interactive video program. Groups that used the program were also investigated to assess whether self-assessed interest in birds or comfort

level with the computer was related to the level of options used. A chi-square procedure was used to compare the characteristics (i.e. bird interest and computer comfort) of the Level One users to the characteristics of the Level Two users.

CHAPTER FOUR. RESULTS.

Setting and Subjects

This study took place within Michigan State University Museum, a natural and cultural science museum. The specific area of observation was a special exhibit on endangered birds of Michigan. The study took place over five week-ends with each day randomly assigned to either control or experimental conditions. Under the experimental conditions, an interactive videodisc system was set up outside the entrance to the hall. (See Appendix A.) The system consisted of a computer, a videodisc player and a video monitor and contained a program related to the exhibit. On control days, the system was not present.

All groups of visitors who entered the exhibit, "Birds in Trouble in Michigan" during the five week-ends of data collection were included in this study. Visitors who used the interactive videodisc program but did not enter the hall were also included in the study. The total number of groups included in the study was 366 with 181 in the experimental group and 185 in the control group. Groups ranged in size from one individual to eight. Groups were defined as individuals who entered and exited together or were observed either conversing or in physical contact. Under the experimental condition, 65 groups used the interactive videodisc program.

Description of Data Collected

Three sets of data were collected during this study:

1) Observations from the video tapes provided the following information for each group: number of adults and children, gender of each individual, elapsed time in hall, use of interactive videodisc program and elapsed time on program.

2) The computer program that was part of the interactive videodisc

system collected the following information for each group: starting and ending time on the computer, number and type of Level One and Level Two options used, and self-assessed level of comfort with the computer and interest in birds. Level One options were defined as those selected from the main menu and Level Two options were those selected from sub-menus.

3) On three week-end days outside the original five week-ends of observations, a random sampling of 65 visitors exiting the bird exhibit were asked to fill out a short survey with six general questions such as number of adults in party and two research questions identical to those presented on the computer: 1) How would you rate your interest in birds (high, medium or low), and 2) Are you comfortable with computers (yes, somewhat, no).

Results and Discussion

This study focused on three general research questions discussed below: 1) What is the effect of the interactive videodisc program on visitors elapsed time in the exhibit hall, 2) Are groups who use the interactive videodisc program different from groups who don't use the program, and 3) Are there any differences between the groups who use the Level One options and the groups who use the Level Two options?

Research Question One: What is the effect of the interactive videodisc program on visitors' elapsed time in the exhibit hall?

Null Hypothesis 1.1: There is no significant difference in the elapsed time spent within the exhibit hall between the experimental group exposed to the interactive videodisc program and a control group not exposed to the interactive videodisc program present. *Null hypothesis 1.1 was rejected (p=.001)*

The average length of time spent within the endangered birds exhibit hall for all subjects (control and experimental groups) was 145 seconds (see Table 1). The mean length of elapsed time within the exhibit hall for the control group was 126 seconds and for the experimental group (with interactive videodisc present), the mean elapsed time was 167 seconds. During the experimental days, the mean of the groups who used the interactive videodisc program was 180 seconds and the mean for groups who didn't use the program was 160 seconds.

TABLE 1. Elapsed time spent within exhibit area for each group

Group		Subjects	Mean
Control group		181	126 seconds
Experimental group		185	167 seconds
non-computer users	120*		160* seconds
computer users	65*		180* seconds
before **			219 seconds
after **			122 seconds
All subjects in both groups		366	145 seconds

* experimental group broken into the users and non-users
** computer users broken into groups that used the computer before entering the hall and groups that used it after exiting

The ANOVA procedure used to analyze the difference between elapsed times of the control and the experimental group yielded a statistically significant difference ($p < .001$). (See Table 2.) Two post-hoc comparisons were also conducted. Elapsed time for program users (180 seconds) was significantly higher than non-users (160 seconds) on the experimental days ($p<.05$), and the elapsed time for groups who used the computer before entering the exhibit (219 seconds) was significantly higher ($p<.05$) than those who used the computer after exiting (122 seconds).

TABLE 2. ANOVA results for elapsed time of experimental vs. control group

Source	SS	DF	MS	F	Sign of F
Between groups	125792.85	1	125792.85	10.59	.0012*
Within groups	4300137.592	365	11878.833		
Total	4425930.44	366			

* $p<.001$

Null Hypothesis 1.2: There is no significant difference in the elapsed time spent within the exhibit hall between the control group and the group who did not use the interactive videodisc program on the experimental days.

Null hypothesis 1.2 was rejected (p=.004)

Research on behavior modeling within museums (Koran, Koran, Foster and Dierking, 1988) suggests that if groups who used the program behaved differently within the exhibit hall, then that behavior may have been observed and modeled by other visitors. A second comparison was done between the control group (not exposed to the program) and individuals who did not use the computer on the experimental day to test for any effect of modeling on non-users. A significant difference was also found between these two groups (p=.004) with the mean of the non-users on the experimental days (160 seconds) higher than the mean of the control group (126 seconds). (See Table 3.)

TABLE 3. ANOVA results for non-users on experimental group vs. control group

Source	SS	DF	MS	F	Sign of F
Between groups	93286.438	1	93286.438	8.16	.0044*
Within groups	3771062.41	365	11427.46		
Total	3864348.85	366			

* p<.01

Null Hypothesis 1.3: There is no significant difference in the elapsed time spent in front of a hawk mount in the exhibit hall between the control group and the experimental group.

Null hypothesis 1.3 was rejected (p=.001)

Null Hypothesis 1.4: There is no significant difference in the elapsed time spent in front of an eagle mount in the exhibit hall between the control group and the experimental group.

Null hypothesis 1.4 was not rejected (p=.91)

To further investigate whether visitors' cognitive processes were influenced, data were collected on viewing time of two specific bird mounts within the exhibit that were part of the interactive videodisc program presentation- the Red-tailed Hawk and the Bald Eagle. It was hypothesized that groups viewing the video segments on these two mounts would be prepared conceptually for the exhibit and more likely to attend to these mounts than the control group. A comparison of the control group and the experimental group showed significant increase in the experimental groups' viewing time for the mounted hawk but not for the eagle. (See Table 4.)

TABLE 4. ANOVA results of viewing times of bird mounts

Source:	SS	DF	MS	Sign of F
Test involving viewing time of eagle mount.				
Between groups	1.22	1	119.5	.9195
Within groups	42564	365	1.22	
Test involving viewing time of hawk mount.				
Between groups	320.167	1	320.167	.000*
Within groups	6419.53	365	18.032	

* $p<.001$

This research found that the presence of an instructional interactive videodisc program influenced the way visitors interacted with an exhibit hall as measured by elapsed time spent within the hall. The presence of the program appears to have influenced groups who used the program and also those groups who did not use it. Visitor attention was higher on experimental days for one specific mount (hawk) but not for the second mount (eagle) observed.

Research Question Two: Are groups who use the program different from groups that don't use the program ?

Museum research has suggested that different media devices and instructional strategies attract different proportions and types of visitors (Washburne et al., 1972; Screven, 1975; Beer, 1987). In a free-choice learning setting such as a museum, with a heterogeneous audience, museum educators are interested in matching visitor characteristics with the capabilities of differing mediums. This study attempted to identify characteristics of groups and individuals that might be likely to use the

interactive videodisc device. All groups who had one or more members sit at the interactive videodisc system and initiate the program were coded as computer users. Specific variables investigated include group composition, gender, computer comfort level, and interest in birds. Each variable is discussed below.

Null Hypothesis 2.1: There is no significant relationship between group composition and use of the interactive video program.

Visitors come to the museum in heterogeneous groups varying in age, number, gender, prior expectations and many other factors. This study was interested in whether the interactive videodisc program would appeal to any particular types of group of visitors. To investigate whether the composition of the group was related to usage, all groups were first coded in the following categories: single adult (1), male and female (2), mixed group of adults (3), single adult with children (4), male and female with children (5), mixed adult group with children (6) and only children (7). This breakdown was designed to investigate the effects of different combinations of adults and/or children in each group.

To test whether the composition of the group was a good predictor of usage, a regression equation was tested with six predictor variables representing the different types of groups with the outcome variable being use of the program. While this yielded a statistically significant F ($p < .001$), the corresponding R^2 was only .13. (See Table 5). The coefficient of determination (R^2) assesses "...how powerful an explanation (or prediction) our regression model provides" (Lewis-Beck, 1980, p.20) When $R^2 = 1$, then the independent variable (s) accounts for all variation in the dependent variable. The R^2 of .13 suggested that knowing the group composition was helpful in explaining (or predicting) approximately 13

percent of the variance in visitors' choice to use the device. Understanding the behavior of thirteen percent of the audience is probably not of practical value.

The regression model is based on an assumption that there is no measurement error in either the independent or dependent variables. In this study, it appears that measurement of the dependent variable (groups' use of the device) was hampered by the heavy usage of the computer program. An assumption of this study was that the attracting power of the device could be measured by observing if groups used it. However, it seems likely that many of the groups may have been attracted to the device but unable to access it because it was already in use by another group. For many, if not most of the groups, use of the program may have been dictated by availability more than any other variable. Therefore, this study did not meet the assumptions of the regression model making it impossible to test the predicting power of the independent variables.

TABLE 5. Use of Program Regressed on Group Composition

DF:	R:	R-squared:	Std. Error:
189	.365	.133	.441

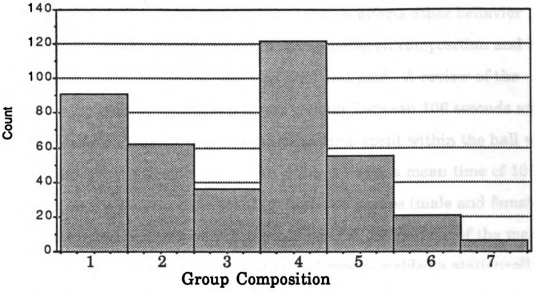
Source	DF:	Sum Squares	Mean	F	Sign of F
Regression	6	5.468	.911	4.687	.0004
Residual	184	35.584	.194		
Total	190	41.053			

An alternative way to explore the relationship between group composition and computer use was possible by changing the comparison groups. Instead of comparing users to non-users, it was possible to compare the group of computer users to the general population (all subjects

of this study) and assessing whether the computer using group was a representative sample of the general population. Figure 3 compares the composition of the groups who used the program (n=65) to the composition of all the groups who entered the exhibit during this study (n=366). The types of groups that were most frequently observed throughout the study were composed of a single adult with children (group 4). The second most frequently observed type of groups were those composed of single adults (group 1) and then groups composed of a male and female adult (group 2). If the groups that used the computer were a representative sample, the frequency of these types of groups would show the same trends. Instead, there appeared to be a drop out of the adult groups (groups 1 and 2) and the highest proportion of users were the groups composed of a single adult with children (group 4) followed by groups with a male, female and children (group 5). Groups of only children (group 7) are also over represented in the computer sample primarily because children were unlikely to visit the exhibit without parents but it was not unusual for children to use the computer while parents visited other exhibits.

To assess the relationship between the composition of the group and use of the program, a chi-square procedure compared the proportions of each type of group composition in the general population to the proportions in the group of computer users. The test yielded statistically significant results ($p<.001$) suggesting differences in the group composition for those groups who used the program and those who didn't use the program (see Table 6).

a. Breakdown of all groups visiting the exhibit



1=single adult 2=male & female adult 3=mixed adults
4=single adult with children 5= male & female with children
6=mixed adults with children 7=children

b. Breakdown of groups using the IV program:

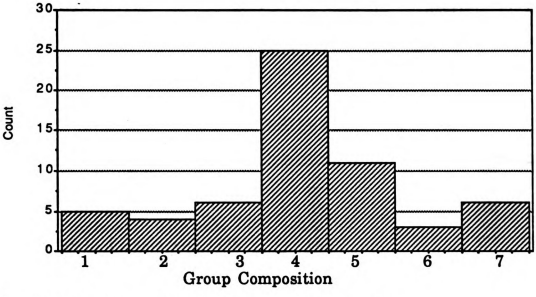


Figure 3. Breakdown of Groups by type of Composition

To investigate whether group composition affects other behavior within the museum setting, the relationship between composition and elapsed time spent within the hall was next analyzed. A review of the mean time for each type of group shows a range between 106 seconds and 186 seconds (see Table 7). The lowest mean time spent within the hall was for type four groups (single adult with children) with a mean time of 106 seconds with the longest time spent by type two groups (male and female with no children) with a mean of 186 seconds. A comparison of the mean elapsed time of each of the different types of groups yielded a statistically significant difference (p=.005) between the groups (see Table 8).

TABLE 6. Relationship between group composition and use of computer

Total Chi-Square	DF	Coefficient	P
47.327	6	.329	.0001*

* p<.001

TABLE 7. Mean time spent within hall by group composition

Group	number	mean time in seconds
1. Single Adults	91	136
2. Male & Female adults	62	186
3. More than 2 adults	36	166
4. Single adult with kids	122	106
5. Male, Female with kids	55	127
6. More than 2 adults and kids	21	136

Note: Group seven is not represented as only two groups of children without adults were observed in the exhibit hall.

TABLE 8. ANOVA results of group composition and elapsed time in hall

Source	SS	DF	MS	F	Sign of F
Between groups	200935.653	5	40187.131	3.405	.0051*
Within groups	4224994.791	365	11801.661		
Total	4425930.44	366			

* p<.01

Summary of Hypothesis 2.1

It was not possible to assess the predicting power of group composition on use of the program because access to the program was limited. However, it was found that the groups that used the computer program were not a representative sample of the general population. Groups with children were over-represented and groups with adults only were under-represented in the computer users. Groups with children spent less time within the exhibit hall, were also more likely to use the interactive videodisc program. Adult only parties spent longer periods of time in the exhibit hall and they were less likely to use the program.

Null Hypothesis 2.2: There is no significant relationship between gender and use of the interactive videodisc program.

Null hypothesis 2.2 was rejected (p=.0001)

To investigate the effect of gender, each group was coded by gender for both the adult(s) and children in the party. As with group composition, the groups who used the interactive videodisc program were compared to the general population (all subjects of this study) to assess whether the it was a representative sample of the general population. A chi-square procedure was used to test for a relationship between gender and use of the

program. The test was statistically significant (p=.0001). (See Table 9a.)

The percentages of users to non-users for each type of group is shown in table 9b. The percentages of users for each group (i.e. the top row of figures) is re-arranged in table 9c to show the gender of both the adult (s) and children in each type of party. A three by four matrix shows the gender of the adults in the party (either male, female, male and female) crossed by the gender of the children (girl, boy, boy and girl, no children). Each cell represents one of the categories of group composition and identifies the percentage of that group that used the computer. For example a party that had a female adult and one or more girls was coded as a "7". On Table 9c, this is under adult column of "Female" and the children's row marked "Girl". The number in the cell, 5.26, indicates that just over five percent of all groups with a female adult and girl(s) used the program.

TABLE 9. Chi-Square test of relationship between gender and use of program

a. Statistical results

Total Chi-Square	DF	Coefficient	p
70.559	16	.391	.0001
			* p<.001

b. Percentages of users to non-users in each group*

	Group Number					
	1	2	3	4	5	6
computer users	7.55	2.63	6.45	22.73	9.09	10
non users	92.45	97.33	93.55	77.27	90.91	90

Table 9 (cont.)

	Group Number					
	7	8	9	10	11	12
computer users	5.26	14.29	14.29	24	50	5.88
non users	94.7	85.71	85.71	76	50	94.12

*Percentages of computer users are re-arranged on the following table.

c. Percentages of users from Table 7b rearranged by gender of adults and children in party

	ADULTS IN PARTY		
KIDS IN PARTY	Female	Male	M & F
Girl	5.26 (19)	14.29 (14)	5.88 (17)
Boy	14.29 (28)	24.00 (25)	41.18 (17)
Girl & Boy	10. (10)	50.00 (20)	16.00 (25)
None	2.63 (38)	7.55 (53)	6.45 (62)

Table 9c suggests that the gender of both the children and the adults appears to influence whether the group used the computer. Groups with an adult male were more likely to use the computer than groups with an adult female. This is true whether there were children in the group or not. Similarly, groups with a boy were more likely to use the program than groups with a girl. Of the parties with a single adult female, 5 percent of the groups with girls used the computer compared with over 14 percent of the groups with boys. Fourteen percent of adult males with girls used the computer compared with 24 percent of males with boys. Of parties with a male and female, almost 6 percent of the parties with girls used the computer compared with over 41 percent with males.

When the party included both genders for either the children or the adults, the effect of gender is not as clear. When the adult is either a female, or a when there is both a female and male, the presence of a girl and boy increases the chances of using the program over groups with only a girl, but not as much as when only a boy was present. However, if the only adult is a male, the presence of a girl and a boy almost doubles the chances of using the program over parties with a boy and triple that of parties with a girl. Consistent with the earlier look at group composition, this table illustrates the low participation of groups composed of adults without children. Less than three percent of single female parties, seven percent of adult male parties and six percent of parties with a male and female used the program.

Summary of Hypothesis 2.1

Group composition was analyzed in terms of the gender of each member of the party and different combinations of gender may have influenced whether a group uses the computer program. Groups with adult males were more likely to use the computer than were groups with adult females. Likewise, groups with male children were more likely to use the program than were groups with female children. Groups with an adult male and female were most likely to use the computer when the child was a boy than they were with either a girl, or a girl and boy. The highest percentage of users (50%) was within parties composed of a male adult and a girl and boy.

Null Hypothesis 2.3: There is no significant difference in the computer skill level of the groups who used the interactive videodisc program and that of a random sample of the general public. *Null hypothesis 2.3 <u>was</u> rejected (p=.03)*

Null Hypothesis 2.4: There is no significant difference in the level of interest in birds of the groups who used the interactive videodisc program and a random sample of the general public. *Null hypothesis 2.4 was rejected (p=.0003)*

It was hypothesized that some individuals might be attracted to the program because of an interest in the medium (interactive video) whereas other individuals might be drawn because of an interest in the content of the program (birds in danger). There was also concern that the medium might inhibit groups with a low skill with computers. Groups that used the program were compared to a random sample of the general public to compare the way they ranked their interest in birds and computer comfort level. A chi-square test to assess any differences in the two groups found significant differences between the two groups in both bird interest (p=.003) and computer comfort (p=.037). (See Table 10.)

TABLE 10. Computer Skill and Bird Interest

Total Chi-Square	DF	Coefficient	p
Computer skill 6.584	2	.20	.0372*
Level of bird interest 16.544	2	.32	.0003**

* p<.05
** p<.001

A comparison of the random sample to the program users is illustrated in Table 11. A higher percentage of the program users identified themselves as being comfortable with computers (58%) than the general

public (50%). Of the general public, 20 percent identified themselves as not being comfortable with computers but only 6 percent of computer users identified a low skill level. It was expected that groups with a high interest in birds would be more likely to use the program than were those with a low interest. However, the percentage of users identifying a high interest in birds (31%) was just slightly higher than the proportion with a low interest (26%). The percentage of the general public professing a low level of interest in birds was only 3% compared to the 26% of the program users who identified a low level of interest. However, it also seems likely that the medium itself may have kept away other groups with a low level of skill in computers.

TABLE 11. Comparison of program users to random sample of exhibit visitors

a. Answer to Question: "Are you comfortable with computers?"

	yes	somewhat	no	Totals
random sample	50%	29.69%	20.31%	100%
computer users	58.02%	35.8%	6.17%	100%
Totals	54.48%	33.1%	12.41%	

b. Answer to Question: "How would you rate your interest level in birds?"

	high	medium	low	Totals
random sample	28.12%	68.75%	3.12%	100%
computer users	31.25%	42.5%	26.25%	100%
Totals	54.48%	33.1	12.41	

Summary of Research Question Two

Groups who chose to use the interactive videodisc program were not a representative cross section of the museum population, but rather a more specific sub-group. The most frequent users were parties composed of a

single adult with children. Groups with adult males were more likely to use the program than groups with females, and groups with boys more likely to use the program than groups with girls. Groups who identified themselves as comfortable with computers (answering either "yes" or "somewhat") were slightly over-represented while groups with a low comfort level were under-represented in the group of program users. The groups using the program showed a higher ratio of groups with a low level of interest in birds in comparison to the random sample of museum visitors.

Research Question Three: Are there any differences between the groups who use the Level One options and the groups who use the Level Two options?

Null Hypothesis 3.1: There is no significant difference between those groups who use the Level One options and those who use the Level Two options regarding their self-assessed interest in birds.

Null hypothesis 3.1 was rejected (p=.05)

Null Hypothesis 3.2: There is no significant difference between those groups who use the Level One options and those who use the Level Two options regarding their skill level with computers.

Null hypothesis 3.2 was not rejected (p=.37)

Null Hypothesis 3.3: There is no significant interaction between bird interest and computer comfort level on use of options.

Null hypothesis 3.3 was not rejected (p=.21)

Because of the heterogeneous nature of the museum audience, this study was interested in identifying ways to adapt presentations to individual differences. While the branching capabilities of computers suggest an ability to individualize program presentations, research on the

use of different levels and types of user control options has been inconclusive and sometimes contradictory. Rather than investigating the effectiveness or efficiency of different control options, this study was interested in whether there were any differences between visitors in the types of options utilized.

The interactive video program was designed to include two levels of viewer control. Level One involved choices from the main menu which included viewing video segments, an introductory segment and a comprehensive challenge question segment. Level Two involved choices from the sub-menus and suggests a more indepth interaction with the subject. Of the groups using the program, six did not go beyond the main menu, thirty used the Level One options and forty-three used the Level Two options. To test whether the groups who used the Level One control options were different than the Level Two users, an ANOVA procedure compared the two groups with the independent variables of bird interest and computer skill. Bird interest was found to be significantly related to level of options used (p=.03) but computer skill was not (p=.37). There was no interaction between computer skill and bird interest regarding use of level one or two (see Table 12).

TABLE 12. Level One users compared to Level Two users

Source:	SS	DF	MS	F	Sign of F
Computer skill (A)	.421	2	.211	.996	.3716
Bird Interest (B)	1.398	2	.699	3.305	.0393*
AB	1.231	4	.308	1.455	.2186
Error	32.35	153	.211		

* $p<.05$

Figure 4 compares the interest level and computer skill levels of the groups that used the Level One options and the groups that used the Level Two options. Of the Level One users, the highest proportion reported that they were comfortable with computers ("yes"), with the second largest proportion "somewhat" and only a small proportion answering "no". In the Level Two group, none of the "no" respondents went beyond the first level of usage.

Level One users were more evenly divided in their level of bird interest than the Level Two users. The Level Two users were primarily "high" with a substantial proportion of "mediums" but a very low proportion of "low". While there were no significant differences in relationship to computer skill, none of the few groups with low skill used Level Two.

A. Two groups broken down by computer comfort.

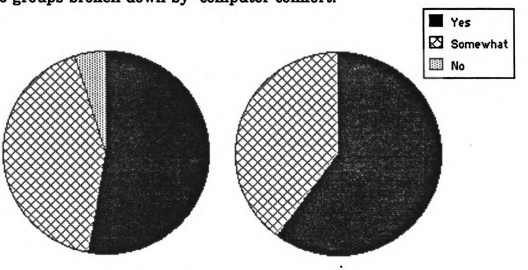
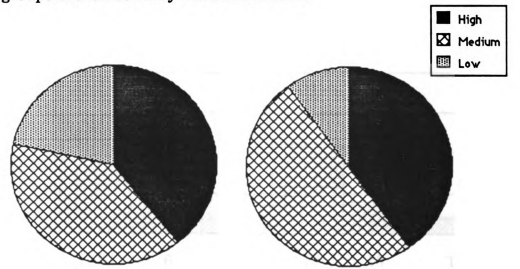


FIGURE 4. Level One users compared to Level Two users.

B. Two groups broken down by interest in birds



LEVEL ONE USERS LEVEL TWO USERS

Figure 4 (cont.)

User Reactions to the Program

This study found that the program was very popular with groups and that the groups who used it, spent comparably long periods of time with the computer. Some groups spent up to eighteen minutes with the program with an average time of almost six minutes (353 seconds). This differs from previous research on media in museums which has suggested that most visitors spend less than three minutes with media presentations (Beer, 1987).

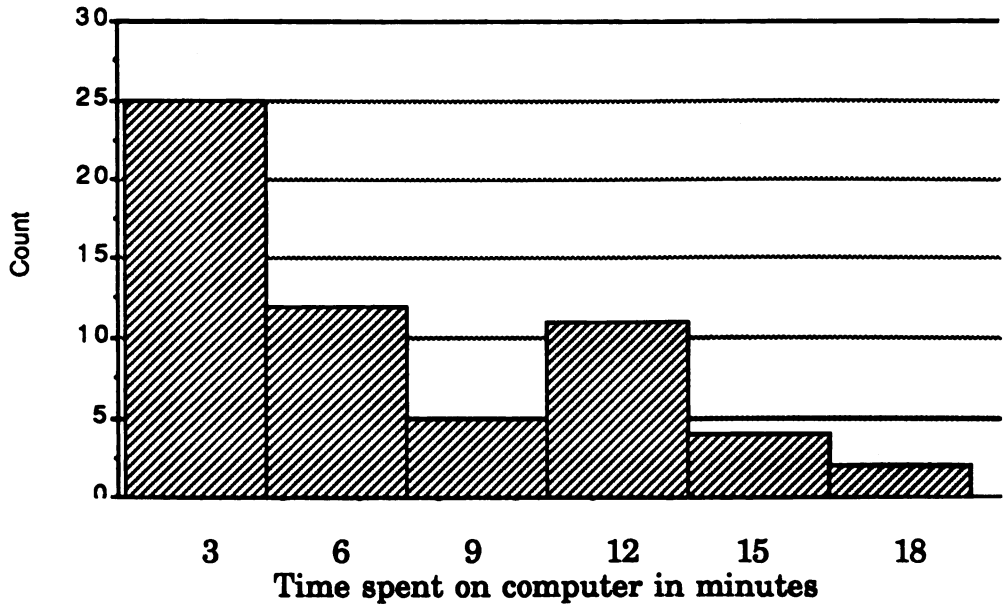


FIGURE 5. Users' time with the interactive video presentation

Chapter Summary

Three research areas related to the use of an interactive videodisc program within a museum setting were investigated by this study including the attracting power of the program, visitors' use of control options, and the effects of the device on visitor interaction with an exhibit.

The presence of the interactive videodisc program seems to have had an effect on both the users and the non-users. The average elapsed time spent within the exhibit was higher among program users than non-users, and the average time of the non-users was higher when the program was up than on control days.

It was not possible to accurately assess the attracting power of the program because of the unavailability of the computer to many of the groups due to extensive usage. However, a comparison of users to the total population suggests that groups with children were more likely to use the program than groups without children. The gender of both adults and

children seems to have influenced usage with groups more likely to use the program when a male adult or child was present. Prior interest in birds and comfort level with computers were both significantly related to use of the program with a significant proportion of the population with a low level of interest in birds drawn to the device. Groups with a low level of comfort with computers were under represented and may have avoided use of the program regardless of interest level in birds.

Two levels of user options were offered by the computer program. Use of these levels of options was related to the groups' level of interest in birds but not to their computer comfort level. Groups with a low level of interest in birds primarily used the Level One options, while groups with a medium or high level were more likely to use the Level Two options. While there was not a statistically significant relationship between computer comfort level and level of options, none of the groups with a low level of comfort used the second level of options. The variety of control options may have encouraged a greater period of interaction with the media than is common with linear media formats.

CHAPTER FIVE. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Museums are playing an increasingly important role in science education as the rate of scientific illiteracy continues to increase both among the school aged population and the adult population (Ucko, 1986). As an informal learning setting, museums may be uniquely prepared to address scientific literacy for the general public. Museums are free of the affective and emotional overtones of the formal classroom with no requirements, prerequisites, exams or grades (DuTerroil, 1975; Feher and Rice, 1985; Falk, Koran, Jr. and Dierking, 1986). They appeal to a large cross section of the population and increasing numbers of families and individuals are visiting museums annually (Price, 1981; Ucko, 1986; Koran, et al., 1983).

While museums may be an appealing setting, learning is also more difficult in this setting for many reasons and a large and consistent body of research has shown a lack of learning for most museum visitors (Shettel, 1973; Screven, 1974; Koran and Koran, 1986; Falk, Koran, Jr. and Dierking, 1986). Within the museum setting, the visitor is exposed to vast amounts of stimuli for very brief amounts of time and generally with little or no individualized intervention between the visitor and the exhibit (Bitgood, 1988). This is contrasted to formal education where the learner is generally exposed to controlled amounts of stimuli for a greater length of time and with the support of an instructor or some type of mediator.

It has been hypothesized that visitors are often overwhelmed by the vast amount of diverse and complex stimuli and that they fail to attend to the stimuli (Falk et al., 1978; Koran, Jr. et al.1983; Falk, Koran, and Dierking, 1986). Research has found that the way visitors process the

information within an exhibit can be influenced through the use of a variety of strategies (DeWaard, 1974; Screven, 1974; Gennaro, 1981; Koran et al., 1983; Falk et al, 1986; Koran et al., 1988). Instructional strategies that have been consistently successful in attracting, directing and influencing the attention of museum visitors include orienting the visitor to critical attributes of the exhibit, eliciting visitors' responses through questions, providing opportunities for participation through hands-on items, providing feedback, and cueing. A variety of media devices have been successfully used to develop presentations based on these strategies including filmstrips, study guides (Nielsen, 1946; Gennaro, 1981) wall panels (Koran et al., 1983), audio cassettes (Screven, 1974), punchboards (Screven, 1974; DeWaard, 1974), flip cards.

While these media devices have shown promise in supporting visitor learning, they are limited in their ability to address the varied needs and interests of a heterogeneous audience because of the linear format of most media programs. Museum visitors are a diverse population entering the museum with a wide range of individual and group characteristics. Individual differences include age, gender, prior knowledge, interest level and purpose for visit. Group differences include size, distribution, relationships, and purpose. Computers have offered a new option by providing the capacity to branch according to the users input. But computers are limited to text and still graphics whereas motion is not only more attractive to visitors (Washburn and Wager, 1972; Beer, 1987. Patterson and Bitgood, 1988), but it is often necessary to adequately illustrate concepts and principles that involve the natural sciences. The new technology of interactive videodisc combines the branching capacity of computers, the audio and motion capabilities of video, and the durability of

videodiscs.

This study investigated the interactive videodisc program as a new form of media with perhaps greater capabilities than linear media to support the instructional strategies found effective in influencing visitor learning. Specifically, the device is capable of supporting interactivity, providing information to orient the visitor in either text or video format, asking questions, receiving and reacting to responses, and providing feedback. An instructional presentation program was developed that used an interactive videodisc about birds, a Macintosh computer and a Hypercard program to author the program and drive the disc player. The program was used within an exhibit on endangered birds in a university museum setting.

Of specific interest to this study were three research questions:

1) What is the effect of the interactive videodisc program on visitors' elapsed time in the exhibit hall?

2) Are groups who use the interactive videodisc program different from groups who don't use the program?

3) Are there any differences between the groups who use the Level One options and the groups who use the Level Two options?

Elapsed time was selected as the outcome variable to measure the effect of the interactive videodisc. Elapsed time has been shown to be highly correlated to both cognitive and affective measures (Falk, 1976; Falk et al., 1978; Martin Falk and Balling, 1981; Falk and Balling, 1982; Falk, 1984; Koran, 1989). Measuring elapsed time was done by using a non-obtrusive video camera that was part of the building security system. Naturalistic research that does not tamper with the informal museum setting yields results that are more likely to be useful and generalizable (Wolf, 1979, 1980).

Research on the use of media within museums has shown that different types of media (i.e. models, video, flat art work, text labels, etc.) attract differing numbers and types of visitors (Washburn et al., 1972; Screven, 1974; Beer, 1987). Also, visitors are sometimes attracted to the devices that are least likely to be effective (Screven, 1974). Therefore, this research on the potential effectiveness of the interactive videodisc program included an investigation of which types of visitors were most likely to use the device.

The third area of research in this study involved the instructional design issue of user control. User control, or learner control, is traditionally defined as giving the user control over the pacing, sequence, amount and type of information and practice (Hannafin, 1984; Milheim, 1989). In a museum setting with a heterogeneous audience, it was hypothesized that visitors would take advantage of control options to create a personalized presentation appropriate for their particular interests. This study was interested in whether the users' perceived computer comfort level or level of interest in birds would be related to the level of the control options used.

Discussion of Question One

A concern among museum educators is that the computers might compete with the exhibits (Vanausdall, 1986; Hilke, 1988). By its definition as a museum, a primary focus of a museum is its collection and important functions of the museum are to increase, preserve, interpret and share that collection (Shannon, 1974; Burcaw, 1983; Eisner and Dobbs, 1986; Loomis, 1987). The International Council of Museums defines a museum in part as "any permanent institution which conserves and displays for purposes of

study, education, and enjoyment, collections of objects of cultural or scientific significance" (Burcaw, 1983). To justify interactive video programs in a museum setting, research must ask not only if the program helps the visitor learn, but does the program attract and focus attention on the exhibits? This question is related to the first three hypotheses.

The first hypothesis of this study investigated the effect of the presence of the program on visitors' elapsed time within the exhibit. Visitors on control days spent an average of 126 seconds within the hall. On the experimental days, when the interactive videodisc program was outside the exhibit area, the mean time within the hall was 167 seconds, statistically higher than the control group ($p=.001$) which spent an average of 126 seconds in the hall. This suggests that the exhibit was more productive in visitor learning when the interactive videodisc program was part of the exhibit. On the experimental days, one third of the visitors observed or 65 groups, used the interactive video program. The mean elapsed time for these groups was 180 seconds, which was higher than the mean of 160 seconds for groups who didn't use the program on the experimental days (statistically significant at $p= .05$), or the control group. It is possible that the results of this last comparison were influenced by other confounding variables as groups self-selected whether they would use the program. Therefore, the statistical test for the first research hypothesis rests on the comparison between all groups under the experimental conditions and all groups under the control conditions because the conditions were randomly assigned. Similarly, some of the groups used the program before entering the hall and others used it after exiting. The groups that used the computer before they entered the hall had a mean time of 219 seconds which was significantly higher ($p< .05$) than the mean time

mean time of 122 seconds for groups that used the computer after exiting. The higher mean for the groups that used the program before entering the exhibit suggests that the program effectively prepared visitors to process the information within the exhibit. It was hypothesized that the program would influence the ways visitors attended to the exhibits and processed the information within the exhibit as measured by elapsed time. This research hypothesis appears to be supported by these data.

During the experimental days, the majority of the visitors (two thirds) did not use the interactive videodisc program. This study hypothesized that these non-users might also be affected by the presence of the program. Visitors who did not use the program, spent more time in the exhibit area on the experimental days (160 seconds) than did visitors on the control days (126 seconds). This difference was statistically significant ($p=.004$). This suggests that visitors did not need to directly interact with the program to be influenced by it.

There are at least three possible explanations for this finding. First, many visitors were "peripheral viewers"- watching over the shoulders of other groups but not actually using the program. They may have seen a brief segment or text screen that consequently influenced their behavior. A second possibility is that the presence of a computer sent a subliminal message to the visitors that "this exhibit is important". A third explanation may be the effect of non-users modeling behaviors of those who used the program. Research suggests that modeling is a strong factor in the behavior of museum visitors (Koran et al., 1988). Visitors who used the program may have consequently behaved differently and their behaviors may have been imitated by non-users. This may be because there is not a prescribed way to behave within museums and visitors are susceptible to

what they perceive others doing. As Koran (1988) explains "a visitor can watch another visitor with an unfamiliar object or event and acquire the behaviors or strategies of the observed visitor." This suggests that individuals who do not use the program, may be influenced by the behaviors of other individuals who were in turn influenced by the program. Beyond modeling specific behaviors, visitors may have been imitating a more general attitude toward the exhibit. A certain tone or atmosphere may have been created by the groups using the computer and this enthusiasm and level of activity picked up by other visitors and translated into a more active involvement with the exhibit. In a study of the effect of computers within an exhibit area, Hilke (1988), found a similar effect on non-users, and hypothesizes that "the higher level of energy, personal investment, and interaction routinely evidenced by visitors at the computer affected the atmosphere in the exhibition as a whole" (p.14). Most likely, some interaction of these three variables explains why even the non-users behaved differently than the control group.

The third hypothesis of this study looked at visitors elapsed time with two specific bird mounts within the exhibit. It was hypothesized that if the program influences the way visitors processed information within the exhibit area, then groups viewing video segments on two specific mounts (Red-tailed Hawk and Bald Eagle) would be more likely to attend to these mounts than the control group. The average viewing time for the hawk was 1.2 seconds on control days and 3.2 seconds when the computer was present, which was statistically higher ($p=.001$). The average viewing time for the eagle was 8.4 seconds on the control days and 8.5 seconds on the experimental days which was not significant different. A possible explanation for the differential effect on the two mounts may be that the

eagle was already of high interest and familiarity to most visitors while the hawk is not as familiar and perhaps more susceptible to being influenced by exposure. The significant difference in viewing time for the hawk supports the hypothesis that viewers' cognitive processes were influenced by the program. This effect was tested for the total experimental group and not just the computer users, indicating that modeling may have influenced non-users viewing time of the hawk.

The findings from these first three hypotheses indicate that the computers did not compete with the exhibit hall, but instead served to focus and increase attention within the exhibit area. This finding is supported by research conducted by the Smithsonian to investigate the impact of a computer program within an exhibit on lasers (Hilke, 1988). Hilke's research found that the computer did attract more visitors than other parts of the exhibit but when the computer was present, there was a 15 percent increase in the average number of visitors and visitors spent significantly more time in the exhibition when the computer was on. Hilke's study concludes that the computer did not seem to reduce visitation to the other parts of the exhibit.

A second concern with computers in a museum setting was that only one person can operate the device at a time, whereas other media can address larger audiences. This research did find that the use of one computer may have limited the role of the program as an introduction to the exhibit but the positive effects of the program went beyond those groups who actually interacted with the program. The interactive videodisc program used in this study was designed as an introduction to the exhibit, "Birds in Danger in Michigan". The theoretical assumption was that introducing visitors to critical concepts and facts would prepare them for

the exhibit and lead to greater attention and more effective information processing within the exhibit. Previous research has suggested that media presentations that include text and audio visual components attract as much as 49% of visitors (Beer, 1987). However, this study found that only approximately one third of the experimental group (35%) used the program and many of the groups used the computer on exiting rather than before entering. Hilke's research (1988) on the impact of computers with exhibits found that the computers were used by approximately 29% of the visitors. Therefore, when the program was used as an introduction, it was effective in influencing visitor time within the exhibit; however, the use of only one program may have limited visitor access.

While the computer was limited in the number of visitors that could use it at one time, it was often used by groups rather than individuals. A high rate of interaction was observed among individuals using the program and different members of the groups were often observed pointing to the computer screen or images on the video screen. More information is needed about effective computer/visitor ratios and practical concerns such as cost-effectiveness of this type of device as compared to other media.

A concern of this study was the relatively low amount of time spent within the exhibit hall. A high amount of information and visual stimuli was present within this exhibit. Yet, the highest mean length of elapsed time, exhibited by the visitors who used the computer, was 180 seconds. While this is almost a full minute longer than the control group (126 seconds), it still suggests that only a small amount of information was processed by visitors. Can this amount be increased further and how? Or is there a ceiling set by visitors and their reasons for visiting? If so, then it is critical to find ways to help visitors process the information within the

exhibit efficiently and effectively.

Summary of Question One

This study found that the interactive videodisc program was effective in focusing attention on the exhibit, and that the time spent with the program did not compete with the exhibit. Groups that used the program before entering the exhibit spent a longer period within the exhibit than other groups. This suggests that the interactive videodisc format supports instructional strategies that have been identified as effective in influencing the ways visitors attend to and process information within a museum setting. The use of only one computer did limit the ability of the program to function as an introduction to the exhibit because most visitors did not have access to the program. However, when the interactive videodisc program was part of the exhibit, even groups who did not use the program spent statistically longer periods within the hall than control groups. This suggests that more learning took place within the exhibit area when the program was part of the exhibit than on days when it was not part of the exhibit.

Discussion of Question Two

Attracting power of a device is defined as the percentage of visitors who use it. Previous research has shown that different types of media attract different proportions of visitors (Washburn and Wager, 1972; Beer, 1987), and that the attracting power of a device is not necessarily related to its effectiveness (Screven, 1975). One device may be effective but never used, while another device may be highly used but without the desired outcomes. Therefore, this study attempted to study both the effectiveness of the interactive videodisc (as measured by its ability to influence time spent

within the hall) and also its attracting power.

To measure the attracting power of the interactive videodisc system, this study assumed it would be possible to compare those visitors who stopped to use the device to those visitors who did not stop. Because of the popularity of the program and the limiting factor of only one computer, most groups did not have the option to use the program. The program was in use during the majority of the time, therefore it was not possible to ascertain whether groups would have stopped if the program had been available. Observations suggested that the greatest predictor of usage was availability. As soon as the program became available, it was almost immediately taken over by a group.

The predicting value of group composition was tested with a regression procedure and found to be statistically significant ($p<.001$). However, the corresponding low R^2 value of .13 suggested that group composition predicted usage for only thirteen percent of the population in this study. To create a valid test of attracting power, each group would need to have access to the program and then whether they used it or not would be an accurate measure of the attracting power for that type of group. To conduct this type of research, either the sample size needs to be controlled or number of devices increased.

While it was not possible to draw conclusions about variables that might predict usage, it was possible to compare the groups who did use the computer to the general population of exhibit visitors and then look for any differences between the two groups. No conclusions are made about those visitors who didn't use the computer but conclusions could be drawn about whether the users were a representative sample of the general population. The study compared program users to the total population of the study on

the following characteristics: group composition, gender of children and adults, self-assessed interest level in birds and self-assessed computer comfort level. A chi-square procedure was used to compare the group of users to non-users on each variable. The groups of users were found to be different that the groups of non-users on each variable: group composition ($p<.0002$), gender ($p<.0001$), computer skill ($p< .0003$) and interest in birds ($p< .03$).

1) Group Composition and Attracting Power

The type of group most frequently observed in the exhibit were composed of a single adult with one or more children. This type of group was also the most likely to use the interactive videodisc program. Groups composed of single adults were the second most frequently observed group, followed by groups composed of a male and female. However, adult groups were under-represented in the groups that used the computer. Almost fifty percent of the total population of exhibit visitors were groups of adults only, but of the groups using the computer, less than twenty percent were adult groups.

Previous research has suggested that visitors may prefer devices that are least effective in promoting learning (Screven, 1975). This study was therefore interested in whether the groups that were most likely to use the program, were the groups that were in need of the intervention. A comparison of the elapsed time of each different type of group found a significant difference ($p=.005$). Groups with a single adult and one or more children spent the least amount of time within the exhibit area (106 seconds) and groups with an adult male and female spent the longest time (186 seconds). This suggests that the group that seems most in need of some type of intervention, the group composed of a single adult and one or

more children, is also the group most likely to use the interactive videodisc program. The interactive videodisc program appears to attract a group that can benefit from exposure to the program. The program may serve as an alternate form of presentation for these groups as well as an effective method for influencing the amount of time this group spends within the hall.

2) Gender and Attracting Power

This study afforded a rare opportunity to observe families in a free-choice learning setting and to investigate any differences between males and females in their use of the computer program. Disappointingly, this study found that males and females were not equally represented among those groups who used the interactive videodisc program.

This study found that the gender of both the children and the adults influenced whether the group used the computer. Groups with an adult male were more likely to use the computer than groups with an adult female. This was true whether there were children in the group or not. Similarly, groups with a boy were more likely to use the program than groups with a girl.

When the party included both genders for either the children or the adults, the effect of gender was not as clear. When the adult was either a female or a combination of a female and male, the presence of a girl and boy made the chances of using the program greater than when only a girl was present, but not as great as when only a boy was present. However, if the adult was a male, the presence of a girl and a boy almost doubled the chances of using the program over parties with a boy and tripled that of parties with a girl. On experimental days, almost 100% of groups with an adult male, boy and girl and 80 % of groups with an adult male and female

and boy used the program. Given the common lack of access to the program, this suggests a highly motivated group that most likely had to wait or return several times to gain access. Further research should look at these groups to determine why they were so likely to use the program.

This look at gender raises many questions. Did families encourage boys more than girls to use computer related devices? Were boys more interested in either the program itself or the device? Were boys more assertive in gaining access than girls? Were female adults intimidated by the machine and was this passed on to their girls? Was the content of the program (birds) more appealing to males than females?

As computers have not been used extensively in museums, there is not yet a large body of research that investigates these questions. One study, conducted by the Smithsonian's traveling exhibits program (SITES) explored the effect of a computer within an exhibit and looked for gender difference in usage (Hilke, 1988). Contrary to this study, the SITES study found no gender differences in the usage of the computer. However, a preliminary SITES study conducted during the summer months had found that 8-12 year old boys were the most frequent users. During the fall and winter of the actual study and when visitor populations were lower, the numbers were more representative. The SITES researcher suggests that boys may have been more aggressive in competing for the machine during the busier summer months. This suggests that in this study, interest in computers may have been confounded by assertiveness in accessing the machine. However, it is also possible that the population for the SITES exhibit is a different population than that found within the university museum. The SITES exhibit, "The Laser at 25" was a traveling exhibit on the history and application of laser technology and was hosted by the

Maryland Science Center and the Discovery Center in Fort Lauderdale. It is possible that the exhibit drew a population that was highly interested in science and that within this specialized audience, there may not have been the gender differences. The audience within a natural and cultural history museum may or may not be a more representative sample of the general public.

Future research is needed to look at the use of technology within museums. The findings from SITES research suggests that a study for gender differences should insure adequate access to the machine so that aggressive behavior is not confounded with computer interest.

3) Computer Skill, Bird Interest and Attracting Power

Significant differences were found between computer users and a random sample of the population regarding perceived level of computer comfort and interest in birds. Both the content and the medium used to present the message, appeared to influence visitors' attraction to the program. Even though this study attempted to simplify the technology by replacing the computer keyboard with a turbo mouse and running the video at all times, it still appears that non-computer literate individuals were not likely to use the program. Of the general population, 20% identified themselves as not being comfortable with computers but only 6% of the program users identified themselves similarly. Conversely, the data suggests that the medium may have attracted individuals who were not specifically interested in birds. A survey of the general public identified the greatest proportion of visitors identifying their level of interest in birds to be primarily medium (69%), with high second (28%), and only 3% of the population identifying a low interest in birds. However, of the computer users, a much larger proportion of users, (26%) identified their level of

interest as low, with 43% identifying a medium level of interest and 31% a high level.

Summary of Question Two

The population who used the interactive videodisc program was different from the general population of visitors in several ways. Groups with children were more likely to be attracted than were groups with only adults. Groups with males (adult or children) were more likely to use the program than groups with females. Non-computer literate groups may have avoided using the program even though no computer skill was necessary to use the program. However, the medium may have attracted individuals who were not particularly interested in the content of the program.

Museums interested in using computers or multi-media formats that include computers, should be aware of the potential differential reactions based on both individual and group characteristics. This study suggests that interactive videodisc is an appropriate medium for attracting target populations which include children. Further research is needed to look at both individual and group characteristics and the types of mediums that might be most effective at attracting each.

Discussion of User Control Options

The program used in this study offered the user control over options including pacing, sequence, content, questions and number of examples presented. Letting the user control these options has been defined as user or learner control as compared to program controlled when the selections are made within the program, or adaptive control which is a merger of user and program control. Research user control options has often been contradictory or inconclusive. While a substantial body of research has

investigated the impact of various types of options, (learner controlled, adaptive, and program controlled) in relationship to achievement, there is a lack of research on the use of control options in an informal learning setting such as a museum.

The program used in this study offered two levels of options and two types of selection- extra video presentation or practice questions on the video segments. The first level of user control (Level One) was defined as only selecting options from the main menu, which included choices of video segments, an introductory segment and challenge questions. The second level of control (Level Two) was defined as selecting options from the sub-menus that branched from these primary main menu selections. The second level options further explored the species of birds presented in the video segment by either showing a second example of a bird of the same species or asking a question related to the video segment.

Of the groups using the program, six did not go beyond the main menu, thirty stayed at the first level and forty three used the second level of user control options. A statistically significant difference was found between Level One users and Level Two users regarding their interest in birds but not in their computer comfort level. These data should be interpreted in light of the findings from the previous two hypotheses of this study which found that the groups using the computer were not a representation of the general public and specifically, that groups with a low computer skill were not likely to use the program. It is possible that no significant differences were found regarding computer skill because the groups likely to respond differently (i.e. those not comfortable with computers), were under-represented in the sample who used the computer.

Groups who were not interested in birds did not seem to use the Level

Two options. Those groups who used the Level One options were fairly evenly divided in their level of bird interest between low (36%), medium (39%) and high (36%). However, Level Two users were primarily of high (40%) or medium interest (51%) with only a small proportion indicating a low interest (9%).

A similar difference was found between the groups using the two levels regarding their computer skill. The largest proportion of Level One users identified their comfort level with computers as high (62%) with a lower proportion identifying it as medium (33%) and a small proportion as low (5%). Of the groups who used the second level, there were no groups with low computer skills, and the proportion of high (65%) to medium (34%) was about the same as Level one. While it was not statistically significant, it is noteworthy that the small sample of users that were not comfortable with computers, did not use the Level Two options.

Given control over content and level of presentation, users appeared to take advantage of the options. To further investigate how personalized each presentation was, an analysis of thirty of the groups was conducted by looking at each option selected and the number of times each option was selected. A listing of users' paths is included in Appendix C. Of the thirty groups analyzed, there were twenty seven different patterns. In a museum setting with a heterogeneous population, it is virtually impossible to design a presentation appropriate for every visitor. However, the type of interactive program used in this study offers users the opportunity to personally design their own presentation.

Offering the user control over the presentation also may encourage a more active participation and involvement. While the average amount of time spent with linear forms of media in museums is commonly under

three minutes (Clowes and Wolff, 1980; Beer, 1987), the average time spent with this interactive program was almost six minutes. Hilke's study on the visitors' use of a computer within an exhibit on lasers (discussed above) similarly reported that visitors often spent as much as four to six minutes with the computer (Hilke, 1988). Beer (1987) found that 27% of museum visitors spent less than 30 seconds viewing media presentations and that presentations of six minutes or more, held 0% of the viewers for the full presentation. In this study, only 11% of those using the interactive video program spent three minutes or less with the program and over 33% of the users spent more than six minutes. These observations suggest that interactive computer presentations may involve users differently than other traditional linear media formats within the museum setting.

While the branching capabilities of computers allow a more personalized approach, the number of individuals interacting with the device at one time is limited. In comparison, the audience for a linear format video or film is limited only by the size of the presentation area. Interactive videodisc programs are generally utilized by only one group or even one individual at a time. While it was not unusual for groups to gather around the device, there was still a limiting factor of the size of the screen. But even more critical that the screen size is the personal interaction. If user control is related to longer periods of use, then the effect of the program may be limited to the individual controlling the branching choices. Further research might look at other variables that could be responsible for the greater amount of time spent with this device.

Summary of Question Three

Users were unlikely to use the second level of options if they were not interested in the content or if they were not comfortable with the medium.

This is not unexpected and suggests that users let their interests dictate how they interacted with the program. Viewers appeared to use the options to create a presentation that was appropriate for their interests. Those with a low interest were able to control the amount of information and number of examples they were presented with, while high interest users were able to pursue their interest through additional video examples and questions. The user control options may have encouraged more participation than linear forms of media.

Visitors' Reactions

Visitors' behaviors suggested a general level of comfort with the device. Observations of visitors on the video tapes showed that users seemed to move through screens and find the right buttons on the screen to make choices. There were no observations of visitors trying to move the mouse and then giving up. This study concludes that the Hypercard program was very supportive in the design of a "user friendly" program and the hardware set up with a turbo mouse seemed to be supportive of the user.

Conclusions

The following conclusions are drawn from this research study:

1) This study found that the presence of an interactive videodisc program (designed to introduce visitors to information within the exhibit) positively influenced the amount of time visitors spent within the hall. The program also seems to have influenced visitors who did not use it. When the computer was present, even non-users showed increased time over the control group.
2) The interactive videodisc was not used by a representative sample of the general population of museum visitors. Groups with children were

more likely to use it than adult only groups. Males were more likely to use it than females.

3) The medium may have attracted some individuals with a low interest in the content area (birds) but it may also have kept away groups that were not comfortable with computers.
4) The branching capabilities offered by the computer seems to be an advantage in the museum setting. Visitors spent greater lengths of time with the program than is common with museum media presentations investigated in other museum studies.
5) The user control options allowed visitors to create their own individualized presentations. An examination of thirty different users found twenty seven different paths taken by these users.
6) Users' level of interest in birds was related to the level of control options used but computer comfort level was not. Users were not likely to go beyond the first level of options if they had a low level of interest in birds.
7) Access to the videodisc program was limited because users spent a longer time with the program than anticipated and the exhibit drew more visitors than a pilot study had predicted. As an introduction to the exhibit, the program was limited in the proportion of the visitors who used the program before entering the exhibit area.

Limitations of this Study

The study was conducted within a natural and cultural museum on a university campus. It is possible that the type of audience may not be representative of other museum populations. The study was conducted on week-ends only as the focus was on casual museum visitors. These results may not generalize to intact groups visiting the museum as part of a formal educational effort, or to museums of other types or locations.

This study found that visitors were often limited in their access to the interactive videodisc program, possibly because the exhibit had more visitors than anticipated and because groups spent longer with the program than expected. Trends in pattern use may have been different if more stations were available. All findings on the gender and group composition differences should be interpreted in light of the possibility that the variable of attracting power may have been confounded with other variables related to gaining access such as aggressiveness or patience.

This study did not attempt to compare interactive videodisc as a medium to other types of mediums. In fact, efforts were made to avoid this type of study. The intent was to study whether this type of media could support the instructional design strategies important in influencing museum visitor learning. The results of this study do not support the use of interactive video over other types of media. Rather, they show that an interactive videodisc is capable of supporting various instructional design strategies.

Elapsed time within the exhibit hall was used as the outcome variable to measure effectiveness of the interactive videodisc program. Research indicates that while time is an effective predictor of learning, observations of time and behavior offers a more significant predictor of learning (Falk, 1983; Falk et al., 1985). This study had originally planned to used both elapsed time and behavior as outcome variables. However, the viewing angle of the video camera did not allow a close enough view of visitors to accurately assess behavior. Therefore, the study relied on only elapsed time as the outcome variable.

This study investigated the use of an adjunct device (interactive video) as a method for influencing viewers' attention within an exhibit. No efforts

were made to study ways to change or design exhibits. These data should not be used to draw conclusions about exhibit design.

Visitors' level of computer skill and bird interest were identified through one question each that the visitors answered. No efforts were made to validate the answers. Instead the interest of the study was the difference between computer users and the general public regarding their self-assessed levels. Conclusions about these two variables should only refer to "self-assessed" or "perceived" levels. No conclusions can be made about actual computer skills or bird interest. Also, computer users answered the questions on the computer and the random sample of the population answered the questions on paper. This may have influenced the answers.

The definition of "Level One" and "Level Two" usage was created by the researcher. The distinction is somewhat arbitrary.

All video observations and coding was conducted by the researcher. There were no efforts to check the reliability of the coding procedures. Although most of the coding involved recording objective information from the video tape (i.e. time of entrance, time of exit), judgements were made about group composition and gender of members. Individuals may have been coded as part of the wrong group if they happened to have entered and exited together.

Conclusions about the relationship between computer skill and level of usage was hampered by the small number of computer users with a low skill level. Therefore, conclusions about users with a low computer skill level may not be valid.

Recommendations for Further Study

1) The use of time as the measure of visitor interaction with the exhibit was selected because of its high correlation with both affective and

cognitive measures, and because it could be measured with non-intrusive data collection devices. Other measures of visitor interaction or reactions to the exhibits could be identified through surveys or by interviewing visitors. While such techniques might influence the spontaneous behaviors of visitors, they would provide a different type of data that might further understanding of visitors' reactions to the media and to their behaviors within the exhibit areas.

2) The relationship between the characteristics of the user and the capabilities of the media device needs to be explored further. In museum settings with heterogeneous audiences and a free choice learning setting, such information would help museum educators and exhibit designers select the media that is appropriate both for the message and the audience it is meant to attract. In this study, a lack of devices hampered the ability to compare users to non-users. Future research on the relationship between characteristics of the device and the characteristics of the visitors who use the device should insure an adequate visitor/device ratio.
3) This research suggests that non-computer users may have been influenced by the behavior of users. Modeling has been shown to be a factor in museum visitor behavior. Future research should investigate whether any individual characteristics are related to modeling. Are some types of visitors more likely role models and are some types of visitors more susceptible to the influence of others' behaviors?
4) The relationship between gender and computer usage was consistent between adults and children. However, there seemed to be some type of interaction when both genders were present either among the children or the adults. Groups composed of an adult male, female and boy and

groups composed of an adult male and a girl and boy, both were highly over represented in computer users. Research should investigate the behavior of these two groups.

5) One interactive videodisc arrangement was not enough to meet the visitor demand. Future research might investigate an optimal ratio of computers of computer driven devices to visitors. Such research should consider cost effectiveness of this presentation mode compared to other options.

6) This study found that the primary users of the interactive videodisc program were groups composed of one adult and children. This group also seems to show the least amount of time within the exhibit area. Future research could focus on this group and explore reactions of this specific group to interventions such as that provided by the interactive videodisc program.

7) Adult groups were highly unlikely to use the interactive videodisc program as were groups with a low level of computer skills. Adults may have believed that it was inappropriate for them to use the program. This is supported by anecdotal observations of adult behavior. The few single adults who used the program were commonly observed standing in front of the machine rather than sitting and were likely to move on when others approached the machine. This could be interpreted as an attitude of not really being involved with the machine, even though the mean time spent on the computer by adult groups was 358 seconds, slightly higher than the mean for all users of 353 seconds. Research using a greater number of computers may produce a more representative sample of adults. Research should investigate why adults were under-represented and investigate ways to encourage those

who may be intimidated by the technology.

8) Visitors spent greater lengths of time with this medium than is common with more traditional linear media within museum settings. Research should attempt to identify the variables related to this trend. Possible variables to explore include: the presence of user controlled options, the variety of choices between text screens and video, questions, feedback, short presentation segments, video and audio components.

9) User control options were well utilized by the users in this study. This study defined Level One options as those on the main menu and Level Two as those that branched from a sub-menu. Some individual characteristics were identified that were related to how users reacted to these two levels of options. Further research should explore ways to define different patterns of program branching and to try to match individual characteristics to branching patterns. This would provide instructional designers with information to design programs with optimal user control options for the target audience.

10) This research found that the interactive videodisc device was effective in supporting instruction design strategies that influenced the ways visitors interacted with the exhibit area. Instructional design strategies used within the program include: use of questions, eliciting responses, providing feedback, presenting information about the critical concepts within the exhibit hall, offering options between video and text segments and control over content, sequence, and pacing. Future research could manipulate these variables to determine which seem to be most appropriate within this setting and whether any of these variables are more appropriate for different learners.

11) This research viewed the interactive video program as an adjunct to the

exhibit and not as a part of the exhibit. The relationship between media and the exhibits needs to be explored. The attitudes of museum educators, exhibit designers and the public toward this relationship could be explored through surveys, interviews and observational studies.

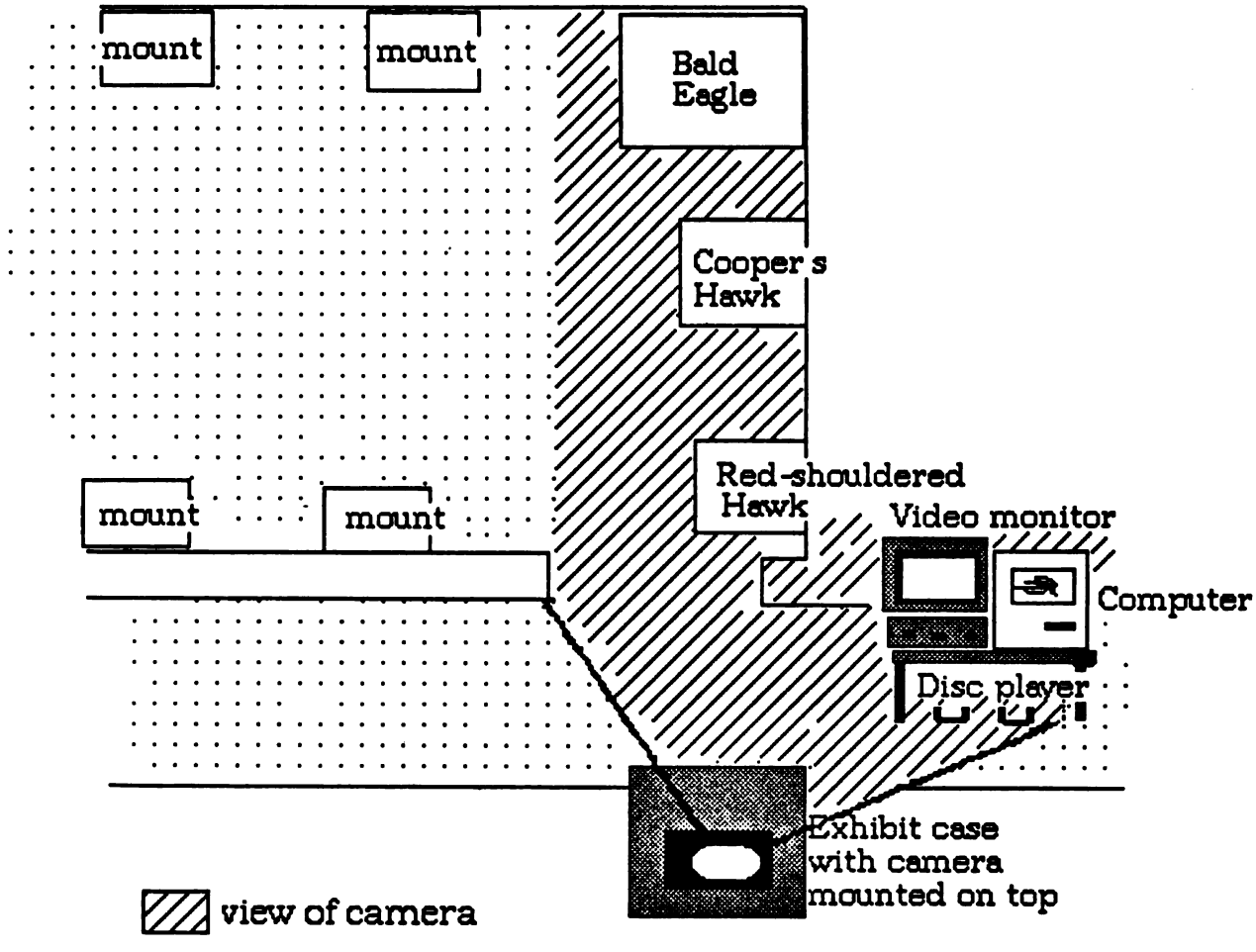
12) This research has identified and corroborated previously identified design variables related to the attracting power and holding power of exhibits. These variables include at least modeling, focusing attention, and providing schema activators. Research could attempt to create and empirically test a model that identifies and relates these variables. Such a model could guide the design of adjunct devices and the evaluation of existing ones.

APPENDICES

APPENDIX A

APPENDIX A

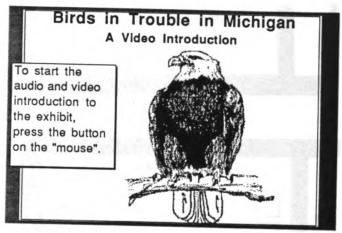
Diagram of Videodisc Location

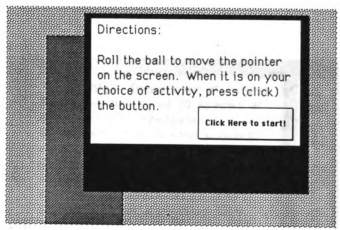


APPENDIX B

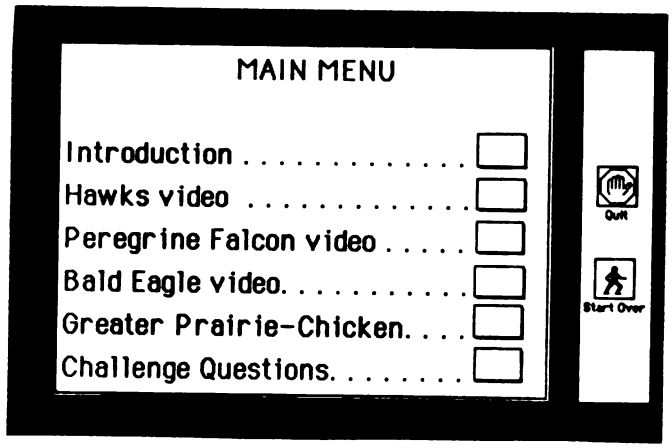
APPENDIX B

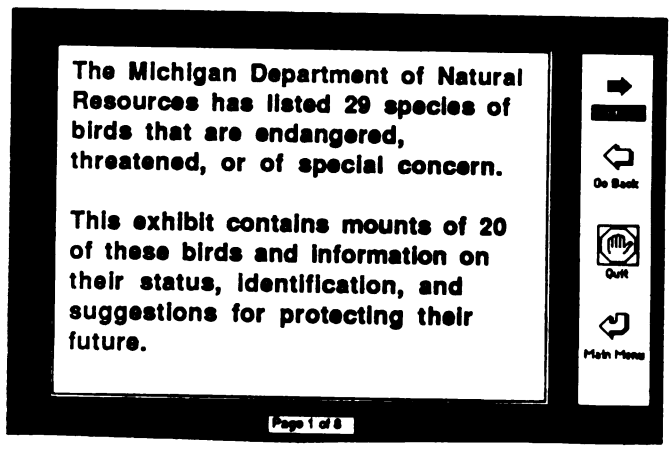
Hypercard Presentation Screens

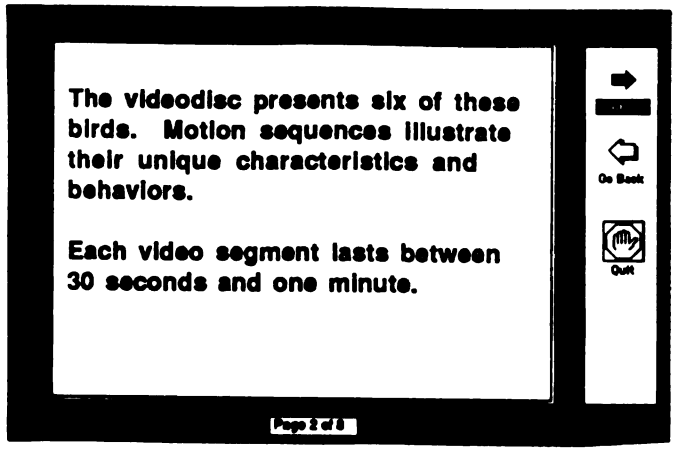


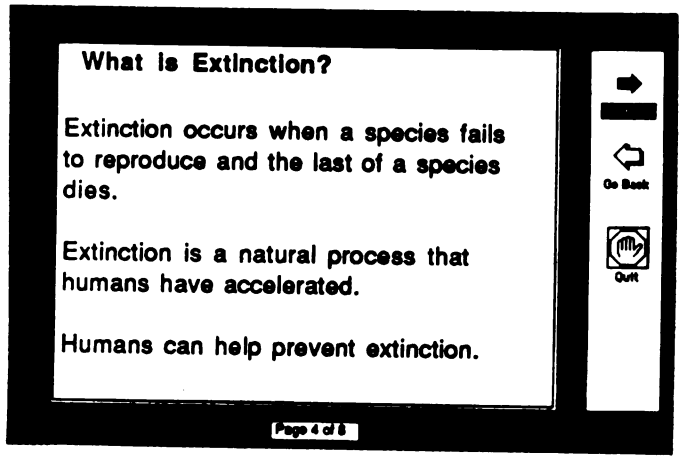


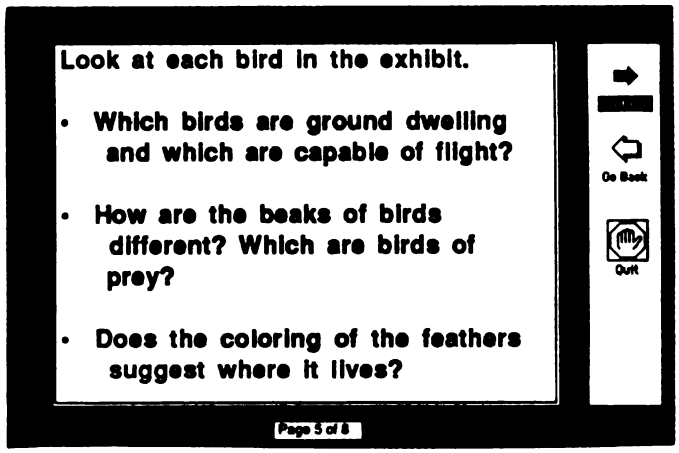

This video presentation will introduce you to some of the birds in the special exhibit to your left.
We hope you enjoy the exhibit.
Quit

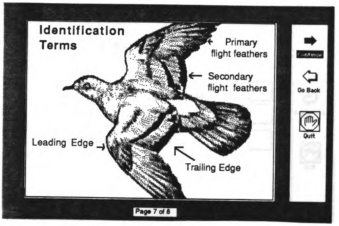

MAIN MENU
Introduction . . . . . .
Hawks video . . . . . .
Peregrine Falcon video . . . . .
Bald Eagle video. . . . . .
Greater Prairie-Chicken. . . .
Challenge Questions. . . . . .
Quit
Start Over

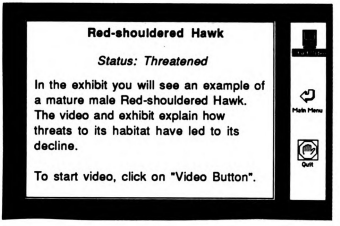

The Michigan Department of Natural Resources has listed 29 species of birds that are endangered, threatened, or of special concern.
This exhibit contains mounts of 20 of these birds and information on their status, identification, and suggestions for protecting their future.
Go Back
Quit
Main Menu

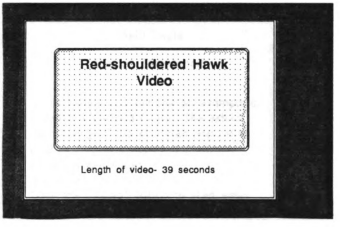

The videodisc presents six of these birds. Motion sequences illustrate their unique characteristics and behaviors.
Each video segment lasts between 30 seconds and one minute.
Go Back
Quit
Page 2 of 8

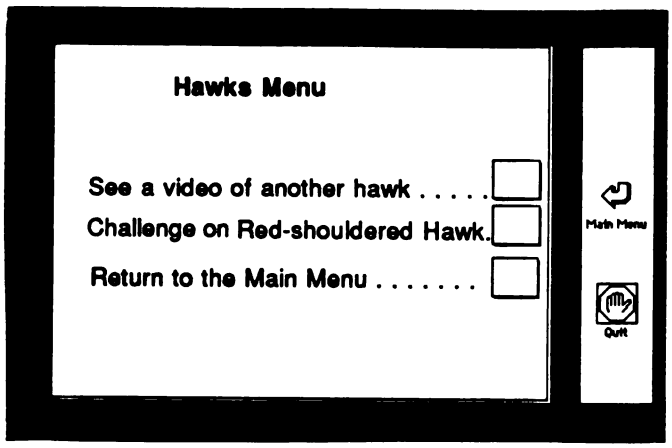

What is Extinction?
Extinction occurs when a species fails to reproduce and the last of a species dies.
Extinction is a natural process that humans have accelerated.
Humans can help prevent extinction.
Go Back
Quit
Page 4 of 8

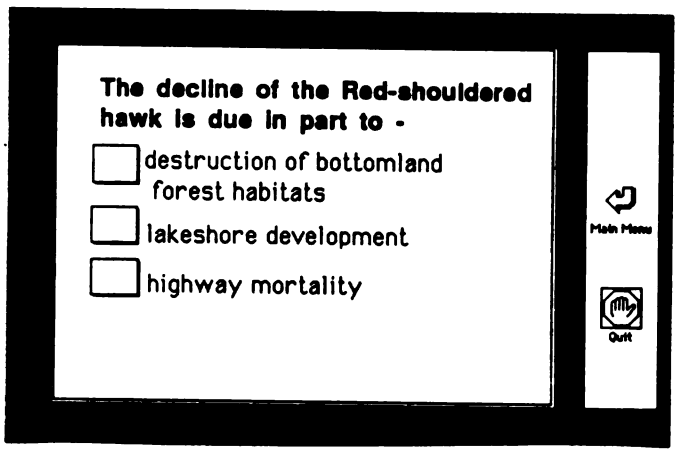

Look at each bird in the exhibit.
• Which birds are ground dwelling and which are capable of flight?
• How are the beaks of birds different? Which are birds of prey?
• Does the coloring of the feathers suggest where it lives?
Go Back
Quit
Page 5 of 8

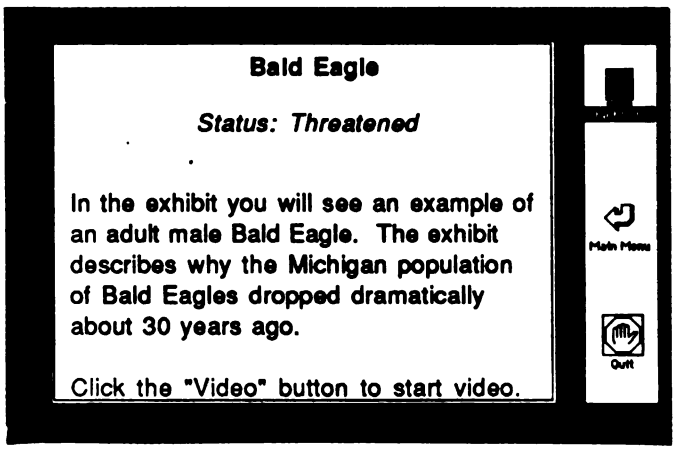

Identification Terms
Primary flight feathers
Secondary flight feathers
Leading Edge
Trailing Edge
Go Back
Quit
Page 7 of 8

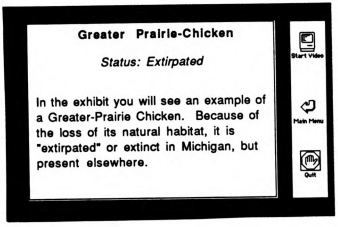

Red-shouldered Hawk
Status: Threatened
In the exhibit you will see an example of a mature male Red-shouldered Hawk. The video and exhibit explain how threats to its habitat have led to its decline.
To start video, click on "Video Button".
Main Menu
Quit

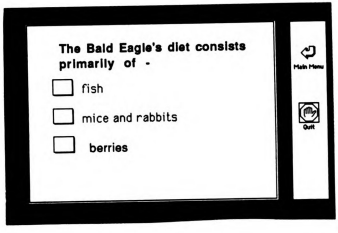

Red-shouldered Hawk Video
Length of video- 39 seconds


Hawks Menu
See a video of another hawk . . . . .
Challenge on Red-shouldered Hawk.
Return to the Main Menu . . . . . .
Main Menu
Quit


The decline of the Red-shouldered hawk is due in part to -
destruction of bottomland forest habitats
lakeshore development
highway mortality
Main Menu
Quit

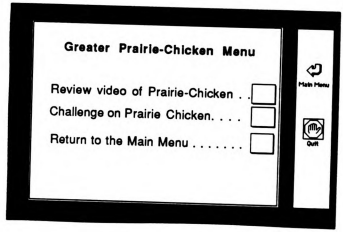

Bald Eagle
Status: Threatened
In the exhibit you will see an example of an adult male Bald Eagle. The exhibit describes why the Michigan population of Bald Eagles dropped dramatically about 30 years ago.
Click the "Video" button to start video.
Main Menu
Quit

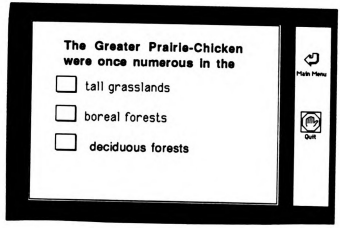

Greater Prairie-Chicken
Status: Extirpated
In the exhibit you will see an example of a Greater-Prairie Chicken. Because of the loss of its natural habitat, it is "extirpated" or extinct in Michigan, but present elsewhere.
Start Video
Main Menu
Quit


The Bald Eagle's diet consists primarily of -
fish
mice and rabbits
berries
Main Menu
Quit


Bald Eagle
Video
Length of Video- 31 seconds


Greater Prairie-
Chicken


Greater Prairie-Chicken Menu
Review video of Prairie-Chicken . .
Challenge on Prairie Chicken. . . .
Return to the Main Menu . . . . . .
Main Menu
Quit


The Greater Prairie-Chicken
were once numerous in the
tall grasslands
boreal forests
deciduous forests
Main Menu
Quit

APPENDIX C

APPENDIX C

Printout of Computer Records

start Time	end time	date	computerSkill	birdInterest
1:37 PM	1:37 PM	3/4/89	somewhat	medium
1:41 PM	1:51 PM	3/4/89	somewhat	medium
1:51 PM	1:53 PM	3/4/89	yes	medium
1:54 PM	2:10 PM	3/4/89	yes	high
2:23 PM	2:33 PM	3/4/89	somewhat	low
2:38 PM	2:40 PM	3/4/89	somewhat	medium
2:41 PM	2:44 PM	3/4/89	yes	medium
2:49 PM	2:52 PM	3/4/89	somewhat	medium
2:56 PM	2:58 PM	3/4/89	yes	high
3:13 PM	3:30 PM	3/4/89	somewhat	medium
3:31 PM	3:32 PM	3/4/89	yes	medium
3:33 PM	3:36 PM	3/4/89	yes	high
3:45 PM	3:49 PM	3/4/89	yes	high
3:49 PM	3:53 PM	3/4/89	somewhat	medium
3:53 PM	3:54 PM	3/4/89	yes	high
	6:29 PM	3/13/89		

hawk questions	hawk examples	Eagle questions	eagle examples	Falcon questions	falcon examples
0	0	0	0	0	0
0	3	0	0	0	0
0	0	0	2	0	0
0	0	0	2	0	0
0	0	0	1	0	0
0	0	0	0	0	0
0	0	0	1	0	0
0	2	0	0	0	0
0	0	0	0	0	1
1	1	1	1	1	1
0	1	0	0	0	0
1	3	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

APPENDIX D

APPENDIX D

Museum Visitor Survey

1. Number of adults in party _____
2. Number of children (over 2 years) in party _____
2. Number of infants (under2 years) in party _____
4. How would you rate your interest in birds?

   ___ high ___ medium ___ low

5. Are you comfortable with computers?

   ___ yes ___ somewhat ___ no

6. How would you rate your interest in animals?

   ___ high ___ medium ___ low

7. How long do you think you will spend on this visit?

8. Have you visited in the last year?

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