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COGNITIVE MODEL FOR LEARNING IN EDUCATIONALLY ORIENTED RECREATION FACILITIES

By

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ABSTRACT

COGNITIVE MODEL FOR LEARNING IN EDUCATIONALLY ORIENTED RECREATION FACILITIES

By

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Professionals who work at educationally oriented recreation facilities, such as nature centers, museums and zoos, spend time and money designing messages and exhibits for their audiences. Yet a number of studies show that visitors do not attend to this information. To help make visitor information more effective in recreational/educational settings, cognitive theories can be applied. Cognitive psychology supports the premise that people are active information processors but often function in a scripted or automatic cognitive state. People also function in a fully conscious state where advanced cognition and learning can take place but only under limited conditions.

This dissertation explores theories of cognition. In doing so it suggests a shift in the visitor information and interpretation paradigm from visitors as active processors of information to visitors as passive information processors. A theoretical model is developed to better explain the way visitors learn in the recreation setting.

Langer's theory of mindlessness/mindfulness is applied

in the recreation setting to the conscious state of the visitor. A learning model is proposed that represents the following path diagram of predicted causal relationships: antecedents to the learning environment (social, psychological, situational), the stimuli (exhibit or message that is designed to attract the attention of the visitor), visitor attention to the message, visitor perception which influences participation in the media, visitor involvement through touching of the interactive device, the interactive device which offers a high level of perceived control, the visitor becomes mentally engaged in the message and visitor perceptions are modified. The path diagram also suggests that if the interactive device offers a low level of perceived control, then the visitor may continue to participate in the interactive device without learning the intended message. A method is proposed for testing this learning model.

DEDICATION

This dissertation is dedicated to:

Colin Edward Downer-Carlson and

Hanna Katherine Downer-Carlson,

two very special people in my life.

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INTRODUCTION

Environmental issues have advanced to the forefront of our modern day culture making the care of our natural resources everyone's problem (Planet of the Year, Time Magazine Jan. 2, 1989). At the same time, science literacy is at an all time low in our nation's schools (American Association for the Advancement of Science, 1989). Project 2061, "Science for All Americans," (AAAS, 1989) has identified several studies which confirm that scientific knowledge for U.S. children and young adults is far below the desired national and world norms. To reverse the trend and help ensure the future quality of our natural resources, effective educational and management strategies must be implemented.

Educationally oriented recreation facilities such as parks, nature centers, museums, zoos, theme parks, aquariums, science museums and wildlife sanctuaries actively communicate natural and cultural history information to their visitors (McDonough, 1986). The number of visitors affected is staggering, given that there are over 6,000 museums in the U.S. and over 160 million visitors to science centers each year (Koran et al, 1983). Children's museums, alone, are found in over 150 major cities in the U.S. and Canada (Scholfield-Bodt, 1987). In 1983, more people in the U.S. visited informal science education centers (zoos, nature centers aquariums and science museums) than attended all professional sporting events (Nichols, 1987). The two Disney parks in the United States draw more than 40 million visitors annually (King, 1991a). Heritage parks (also called theme parks) have been developed around the world in Thailand, Indonesia, the Philippines, the Netherlands and Japan (King, 1991a). In these facilities, visitors learn everything from applied science, art awareness, and natural and cultural history, to self "enlightenment" (King, 1991b; USA Weekend, 1991).

Since the 1980s, zoos worldwide have joined in an effort to promote preservation and conservation of endangered animals through education, research and breeding programs. But in many cases, their educational efforts have failed (Polakowski, 1987), partly because individuals in many countries do not feel connected to their natural heritage, nor do they feel obliged to preserve it (Herreman, 1986). To change these views, it has long been felt that interpretive programs, properly applied, are an ideal setting to influence the general public on natural resource issues, but there are few studies to support this theory.

Interpretation

Recreation environments are often considered an ideal place to educate the visiting public about natural resources and related issues (Cantu, 1973; Sharpe, 1982; McDonough, 1986). These informal settings are sensory stimulating and therefore encourage the visitor to be in a leisure mind-set. Visitors come motivated to explore the information they want to see or read at their own pace (Koran et al., 1983; Screven, 1986). To understand, serve and educate the visitor, it is vital to have an understanding of the leisure mind-set (Mullins, 1991). It is important to distinguish the leisure setting of museums, zoos, parks, and visitor centers from formal education institutions. The visitor in the leisure setting is under no obligation to learn.

Creating learning environments in a leisure setting is called the art and science of interpretation (Cherem, 1979). Interpretation is further defined as "a communication process designed to reveal meaning and relationships of our culture and natural heritage, to visitors, through firsthand involvement with an object, artifact, landscape, or site" (Tilden, 1957). Tilden (1957) suggest that information presented in the recreation setting must provoke curiosity and relate to the audience while revealing factual information.

Environmental interpretation is critical in promoting public awareness and understanding of environmental issues (McDonough, 1986). It has been shown that environmental knowledge correlates with a positive change in attitudes towards management (Olson et al., 1984) and the environment (Atkinson, 1990). Tilden (1967) wrote that "through interpretation, understanding; through understanding, appreciation; through appreciation, protection of our resources."

Goals of educationally oriented recreational facilities are to inform and enrich the visitor about the natural and cultural world around them (Sharpe, 1982; Propst and Roggenbuck, 1981). This information is presented in a variety of interpretive ways, such as signs, brochures, exhibits, bulletin boards, displays, dioramas, films, videos, slide shows and touch screen computers (Propst and Roggenbuck, 1981; Sharpe, 1982; Screven, 1986). In addition to the non-personal approach, most of these facilities also have interpreters, lecturers, guides, volunteers and educators who lead tours, hikes and programs.

Visitor Motivations

Understanding why people visit recreational facilities is vital to meet educational goals and objectives (Propst and Roggenbuck, 1981). The social environment and a place to have fun may be just as important as being in a learning environment (Screven, 1986). Most people make visits in groups, either friends or family, and stay together throughout the experience (Serrell, 1988). Much pleasure is derived from the group interaction and shared learning through both written and visual information (McManus, 1989).

Visitors also like to be involved with real problems or manipulating real objects. It can be enjoyable and, at the same time, encourage learning (Washburne and Wagar, 1972). It is generally believed that such a "hands-on" recreational environment makes science and cultural history more exciting because people become motivated to learn (Tilden, 1957; Sharpe, 1982). This belief is also supported by a number of museum studies (Shettel et al., 1968; DeWaard et al., 1974; Screven, 1969, 1973, 1974; Koran et al., 1983).

These hands-on educational experiences convey both cognitive and affective information to the visitor (Koran et al., 1983; Falk et al., 1986). Learning in the cognitive domain about natural history and resource inter-relationships is important, but the visitor also gains an emotional appreciation for the resource in the affective domain (Martin, J. and O'Reilly,J. 1988). For example, a visitor can gain a sense of going back in time by experiencing a restored fort from the fur trading era or a 19th century fishing village. Science museum visitors may see their hair stand on end, or experience various optical illusions. Aquarium or zoo visitors may be allowed to compare their body sizes to that of a blue whale.

Unfortunately, visitors may not be learning much. Many studies show that visitors in recreation environments spend little time reading text, looking at exhibits, or processing the information presented to them (Shettel et al., 1968; Screven, 1969, 1973, 1974, 1975; DeWaard et al., 1974; Koran et al., 1983; Miles, 1987; Koran et al., 1988; Bitgood et al., 1988; Moscardo, 1988). Zoo visitors may leave with animal stereotypes that are not only incorrect but work against the interest of wildlife preservation (Sommer, 1979). Studies at the Children's Museum of Indianapolis found that children view their experience as entertainment (Ault, 1987). Many visitors at Walt Disney World's EPCOT Center are overwhelmed by the number of exhibits and suffer "art shock" from the "over-choice" (King, 1991b). Visitors at interactive science museums appear to be "window shopping" with minimal mental processing taking place (Miles, 1987).

Communication Challenge

Opening the door that encourages learning may be the greatest challenge for educationally-oriented recreation facilities. Although visitors in a leisure/recreation setting are being asked to think, process information, and to make sense of what is being presented, they do not appear to be looking for hard facts. Instead, they are looking for an experience based on leisure components (Mullins, 1991). These include freedom of choice and self-direction, control of one's own time, opportunities for curiosity and exploring, and an environment that lacks evaluation and allows interaction with others (Koran et al., 1983; Falk et al., 1986; McManus, 1989; Mullins, 1991).

The majority of the visitors do not come into contact with professional staff and get most of their information through exhibits and displays (Jones, 1986). Exhibits are the most commonly used form of communication in educationally oriented recreation facilities. Exhibits act as the interpreter or teacher, and the visitor becomes the learner or student.

EXHIBITS

Exhibits can be defined as a three-dimensional expression of an idea (LaFlame, 1977) that tells a story, displays objects, uses more than one stimulus or sense, and ties everything into one theme (Ackert and McDonough, 1986). Exhibits can include both moving and non-moving components and encourage either active or passive viewing (Cherem, 1977).

Exhibits and displays fall into five broad categories: flatwork, object exhibits, dioramas, models and natural exhibits (Ackert and McDonough, 1986). For a review of exhibit types and design, see "Help for the small museum," (Neal, 1969) and "Ideas for Exhibits," (LaFlame, 1977). Whatever the type, the purpose of all exhibits should be to encourage or act as a catalyst to learning (Jones, 1986).

A number of studies have critiqued exhibits to make them more effective in a educationally oriented recreation settings. Serrell (1983) lists eight "deadly sins" of unsuccessful labels: too wordy or long, too technical for the intended reader, boring and inappropriate information, poorly edited, type that is too small, too hard to read, poor choice of colors, and poorly placed information. Bitgood (1989) adds three more sins: the failure of the exhibit to grab the attention of the visitor, messages that are lost among the "visual noise" of too many objects or labels, and information that doesn't address the visitor's knowledge, interest and misconceptions.

Interactive exhibits, on the other hand, are found to increase learning in museums and zoos (DeWaard et al., 1974; Gillie and Wilson, 1982; Birney, 1988; Derwin and Piper, 1988). Applied in all types of interpretive environments, these participatory experiences increase motivation, learning, retention of information and satisfaction (Cohen, 1987).

Cherem (1977) argues that exhibits which include both motion and action through physical manipulation allow visitors to use a number of their senses. These exhibits have a higher appeal because people are active, allowing even low-motivated visitors to learn (Washburne and Wagar, 1972; Cherem, 1977).

However, the research on the effectiveness of interactive exhibits is split, with major studies showing that visitors learn very little from interactive exhibits (Borun and Miller, 1980; Beer, 1987; Borun, 1989). These studies show that people are highly attracted to interactive exhibits, but seldom read or follow the instructions (Beer, 1987).

Interactive exhibits attract visitors' attention by encouraging them to press buttons, listen to stories, make choices and answer questions (Screven, 1974, 1986). By going through motions or actions, the visitor in an interactive environment physically participates in the activity. But, physical involvement does not always equate with mental involvement (Ackermann, 1987). Attraction to lights, colors, shapes, lines, sounds, action, and motion does not necessarily lead to learning (Matlin, 1983). Often, visitors do not connect the activity with the intended learning. This is especially true in a recreation setting where a variety of stimuli vie for the attention of visitors (Falk et al., 1986; Ackermann, 1987).

A closer look at instructional psychology provides a framework to better understand how learning takes place in the educationally oriented recreational setting.

A COGNITIVE APPROACH

Learning is made up of both internal (cognition) and external (stimuli) events. It is the mental linking of two ideas or events together (Gagne, 1985). In the learning experience there are four components: the learner, stimulus, content recovery from learner's memory, and response/performance (Gagne, 1985).

The way people learn has been explored throughout the last 100 years in the fields of psychology and education (for review see Bower and Hilgard, 1981; or Gagne, 1985). Traditional views of behavioral psychology suggest that learning is the result of trial-and-error (Thorndike, 1898), conditioned response, (Pavlov, 1927), reinforcement or stimulus-response (Skinner, 1966), and insight (Kohler, 1927). These theories are used to explain behavior or abilities to solve problems. However, they do not explain how people learn other non-problem information such as reading or learning a foreign language and give small credence to the processes inside the individual's mind (Gagne, 1985)

The emergence of cognitive psychology in the latter half of the twentieth century addresses not only the outcome, but the process leading to the outcome (for review of the history, see Knapp, 1986). The cognitive approach emphasizes learning as a change in mental activity and memory. It provides a framework that reflects the type of learning found in many settings, including the educationally oriented recreation setting (Gagne, 1985; Knapp, 1986; Koran et al., 1983).

Cognitive psychology suggests that cognition mediates the effect that the stimuli has on the response (Iso-Ahola, 1989). Learning takes place within the mind of the visitor and not as a result of certain stimuli.

The cognitive approach is process-oriented, and many recreation researchers suggest it is a viable approach to understanding learning (Hammit, 1984; Ham, 1986; Iso-Ahola, 1989; McDonough and Lee, 1990; Roggenbuck et al., 1991). Looking through the visitors' mind-set is paramount because learning can only take place when visitors choose to engage in the mental process.

A cognitive view suggests that if learning is the desired outcome merely presenting information is not enough. What must be considered is information the visitor already knows. This is important in determining subsequent learning because new knowledge is based on existing knowledge or prior structures (Lee, 1990), what psychologists call schema (Bartlett, 1932). These meaningful materials (signs, symbols, concepts) are incorporated as information into the learner's pre-existing structure of knowledge (Prince, 1982).

Information is processed through a series of memory stages, metaphorically similar to a computer: sensory memory, short-term memory, and long-term memory (Atkinson and Shiffrin, 1968). New information needs to relate to previous information in one's long-term-memory (hard drive). When applied to an educationally oriented recreation setting, visitor evaluation must address more than behavioral change when measuring success; changes in the visitor's cognitive structures (schema) must also be measured (Lee, 1990).

This change in cognitive structure is what Langer et al. (1978) calls "mindfulness" or a process of accessing and modifying schemata. Visitor behavior, then, is based on previous learning, retrieved from scripts that are modified and stored in one's schemata. Visitors who stop at an exhibit, observe and interact with the objects, read the script and follow its message are engaged in modifying schemata in their short- and long-term memory.

Langer has also examined the "mindlessness" state of consciousness where the individual functions in an automatic mind-set, using little mental energy. Langer (1989) argues that people function most of their waking hours in this automatic or mindless state. Research from the museum, zoo and interpretation fields (cited earlier) shows that little learning takes place in these settings. Applying the "mindlessness" theory to the recreation/education setting suggests that the visitor functions much of the time in a mindless state.

Information processing theory suggests that in the mindless state, information is processed through more than one channel (Ashcraft, 1989). Multiple-channel processing refers to doing or listening to more than one thing at the same time. It is like listening to the radio and talking on the phone, or attending to what is going on while driving a car. People function well in these automatic or mindless states but have poor levels of recall. In this state, information is retained between 15 and 20 seconds (Phye & Andre, 1986).

Most of one's day is spent functioning in a multiple-channel state. From an evolutionary point of view, being alert to a variety of stimuli at the same time would be to attend to a wide range of functions and potential dangers. The visitor, in this multiple-channel state, is attracted to a wide range of learning opportunities at the same time, applies minimum mental energy and retains little information.

Equally important is the fact that in this mind-set people have limited mental capacity and tire easily. Mental capacity for new information is about seven items or "chunks" of information (Miller, 1956). Museum research also supports the idea of limited mental capacities and the need to present written information in small amounts or chunks (Bitgood et al., 1986a). When visitors experience too many exhibits at once, they suffer from burnout or "museum fatigue," which affects learning negatively (Robinson, 1928; King, 1991b).

The cognitive approach suggests that visitors must be engaged in the exhibit or information if learning is the desired outcome. This mindful state is the reordering of cognitive structures in one's long-term memory. Cognitive processes take place in a single-channel format and new information is processed in serial order (Craik & Lockhart, 1972). In this mentally-involving state, the individual attends more to content cues and the brain appears to stretch, adding to greater storage capacity (Kahneman, 1973). The individual processes the information, adding or modifying schemata, in ones memory. During information processing the individual is mentally aware of the learning going on, time seems to disappear, and pleasure is an outcome of learning (Langer, 1989).

The purpose of an exhibit or display is to encourage mental engagement. Learning takes place only when the visitor is engaged, cognitive structures are modified, and then processed in a single channel (Ashcraft, 1989).

Paradigm Shift

Visitors are not always active information processors. This suggests a shift from the active learner paradigm to a passive learner (Moscardo, 1988). Under most conditions, visitors in recreation settings are likely to be in an automatic mind-set which Langer calls mindlessness.

To encourage learning (mindfulness) in the educationally oriented recreation setting, the literature supports three motivational constructs that influence cognition: visitor perception, visitor involvement and perceived control.

Visitor perception influences early stages of participation, attention, and the willingness of a visitor to even enter a facility, i.e., "museums are boring" (Bitgood and Thompson, 1987). In addition, visitors perception directly influences the amount of mental effort that he/she puts forth (Salomon, 1983). For example, studies find that print media is perceived to require more mental energy than television. But when printed media is attended to, the information presented is retained longer than television (Salomon, 1983).

Involvement is a motivator that can encourage cognitive processing. Through interactive devices or hands-on exhibits, involvement opens the door to learning by acting as a "foot-in-the-door" to the mental engagement needed to understand information or exhibits. Involvement can provide the perception that the visitor is in control of what they choose to learn. Feeling in control of one's environment leads to mindfulness (Langer, 1989).

While "hands-on" exhibits are essential for learning, they may not lead to "heads-in" experiences (Ackermann, 1987). "Action" by the visitor and evaluation of the "effect-of-an-action" are vital for learning (Ackermann, 1987). Research by Screven (1974, 1975) on interactive devices supports the need for feedback in the museum setting.

The more that the individual perceives they are in control of the learning environment, the greater the likelihood that they are in a mindful state (Langer and Imber, 1979). The recreation and leisure literature is filled with the notion that true leisure is based on one's perception of control over one's environment (perceived control), or the ability to choose activities freely (Iso-Ahola, 1989; Propst and Kurtz, 1989). Perceived control also encourages intrinsic motivation and is identified as one of the basic motivators to the recreation and leisure experience (Iso-Ahola, 1989; Propst and Kurtz, 1989).

PROBLEM STATEMENT

Informal, self-motivating, leisure environments should be hypothetically an ideal place to learn. However, numerous studies in both museum and outdoor recreation fields indicate that the opposite is true. The research found that people spend little time (8-40 seconds) attending to exhibits or signs (Robinson,1928; Shettel et al., 1968; Screven, 1969, 1973, 1974, 1975; DeWaard et al., 1974; Shiner and Shafer, 1975; Lime, 1979; Clowes and Wolff, 1980; Koran et al., 1983; Korn, 1987; Miles, 1987; McDermott, 1987; Koran et al., 1988; Bitgood et al., 1988; Moscardo, 1988). Though more visitors are attracted to exhibits that include audiovisuals, seldom do they stay for even half the program (Landay and Bridge, 1981; Beer, 1987; Korenic and Young, 1991). Slide-tape programs in exhibits hold the visitor an average of 35 seconds (Alt, 1979). Zoo visitors stay at animal exhibits a mean time of 17 seconds. The length of stay at a zoo is influenced by animal size, animal activity, size of the exhibit and physical barriers between the animals and the visitor (Bitgood et al., 1988).

These studies suggest that little learning is taking place because a small amout of time is spent attending to the message (McDonough and Lee, 1990). Falk (1983) was able to correlate viewing time and visitor behavior as predictors of learning. McDonough and Lee (1990) call for studies to focus on "how" visitors learn, rather than "whether" visitors learn .

Learning has been found to increase in a variety of recreational settings when visitors use interactive exhibits (DeWaard et al., 1974; Gillie and Wilson, 1982; Birney, 1988; Derwin and Piper, 1988; White and Barry, 1984). Cohen (1987) argues interactive exhibits increase motivation, learning, retention of information and satisfaction. However, other major studies in the museum and zoo fields contradict the above studies by showing that interactive exhibits do not always lead to learning (Borun and Miller, 1980; Beer, 1987; Borun, 1989). This contradiction needs closer examination if zoos, museums and recreation programs are to reach their educational goals.

Researchers should also look at the social and pleasure elements of educationally oriented recreation environments. In fact, theories from social psychology, communication and cognitive psychology can help provide a framework to better understand how learning and pleasure are intertwined in the recreation setting.

Exhibits are a link in a communication system that begins with the overall goals and objectives of the recreational facility and ends with the cognitive mind-set of the visitor. How the visitor perceives, thinks and acts in reference to the exhibit is the result of both the exhibit and the visitor's schemata (Koran et al., 1989). Cognitive processes occur in a voluntary learning environment or recreation setting when the level of interest is enough to engage the visitor's attention and hold it long enough for existing knowledge to transfer (Prince, 1982). Modeling the process of how visitors learn in the recreation setting is vital to developing effective exhibits for diverse audiences.

Professional planners, educators and interpreters need to further explore the following: how the visitor becomes focused, how cognitive structures can be modified or changed through physical and mental involvement, and the effect of visitor perception and perceived control on the learning outcome.

PURPOSE

The purpose of this dissertation is threefold. The first is to identify variables that influence learning in the educationally oriented recreational setting. The second is to apply cognitive theory to exhibit research and explore the construct of mindlessness versus mindfulness as it applies to the visitor in the various stages of information processing. And finally, a learning model is proposed based on the cognitive mind-set of the visitor as she/he is exposed to visitor information and interactive exhibits.

Specifically, the objectives are:

1. Define the educationally oriented recreational environment as it relates to leisure constructs.
2. Identify variables that influence learning in this informal leisure setting.
3. Explore the relationships of these variables through cognitive psychology and educational perspectives.
4. Propose a causal order to the variables that appear to have the greatest effect on learning.
5. Suggest ways to test these relationships.

Chapter II reviews the literature on leisure and recreation settings. Visitor attraction to and comprehension of exhibits is explored in chapter III. Chapter IV develops a theoretical framework on how learning and memory is retained from the cognition literature. Chapter V outlines a model for learning through interactive exhibits in an educationally oriented recreation environment. Chapter VI explores how to test this model. Finally, Chapter VII provides a summary and conclusion of the paper.

Chapter II

THE LEISURE EXPERIENCE IN EDUCATIONALLY ORIENTED RECREATIONAL SETTINGS

Recreation settings include a wide variety of facilities that encourage learning during leisure time. The United States has over 6,000 historical museums (Koran et al., 1983), thousands of zoos or zoological parks, art museums, science museums, children's museums, cultural centers, arboretums, gardens, nature centers, planetariums, visitor centers and parks. They are found at all levels of management from national parks to small municipalities and non-profit organizations.

Over the last 30 years, the number of facilities for children has increased markedly. At best, they provide exciting first-hand experiences for children to explore and discover the world around them (Otto, 1979).

The first children's museum opened its doors in 1899 in Brooklyn, New York to encourage children to experience learning rather than just observing objects. Following the example of the Brooklyn Children's Museum, Indianapolis, Boston, and Detroit all opened hands-on learning facilities by 1917 (Schofield-Bodt, 1987). Today there are over 350 hands-on childrens museums in the United States and Canada (Cleaver, 1991). The driving force behind the modern children's museum is family learning. Both adults and children can learn together, each bringing something different to the same environment and leaving with a new sense of self and other (Schofield-Bodt, 1987).

The Exploratorium in San Francisco is a leader in the field of science education and discovery learning. It has been around for over 20 years providing a hands-on environment where visitors can explore over 750 exhibits dealing with physics, perception, neurophysiology, technological art and related fields (Danilov,1989). The Please Touch Museum in Philadelphia, opened in 1976, is aimed at children seven years and younger so they can use their senses to explore real-world objects (Schofield-Bodt, 1987).

Countries like Japan, the Philippines, Thailand and Indonesia are also developing interactive learning centers (King, 1991a). The city of Bombay, India converted a municipal garbage dump into a science park as a gift to the 3 million children in their city. The park offers a place to run and jump along with places to press levers, turn wheels, use pulleys, and ponder over self-made experiments (Ghose, 1986). The goal of the Children's Museum in Caracas, Venezuela is "to stimulate in the child an intense desire to know and to learn, with the idea of taking part in the endless process of change that is going on in the universe" (Alvarez, 1986, p.70).

Zoos and aquariums also see the combination of recreation and education as vital to their future (White and Barry, 1984; Polakowski, 1987). In particular, global habitat education is important for zoos to continue to harbor animals from around the world. It also helps to insure a healthier environment for all species of plants and animals (Polakowski, 1987).

Educationally oriented recreation facilities come in many forms. The best known is EPCOT (Experimental Prototype Community of Tomorrow) Center at Walt Disney World in Florida. It combines technology, science and education in a hands-on, interactive environment (King, 1991a). Other environments converted to unique learning environments include breweries, power plants, sewage treatment facilities, cemeteries (Cherem, 1977) and in England, atomic power plants (McDonough and Lee, 1990).

When referring to the educationally oriented recreational facility, this dissertation includes all educational facilities found in recreation settings. Most of the visitor studies cited here have been conducted in museums (children, science and history) and zoos. Their application, unless specified, is to the visitor in all educationally oriented recreation settings.

THE EDUCATIONALLY ORIENTED RECREATION SETTING

The educationally oriented recreation setting is a place where the visitor can learn in an informal, nonevaluative, and noncompetitive environment (Koran et al, 1983). In addition, the visitor is intrinsically motivated to learn in a setting that offers a variety of free choices (Koran et al., 1983; Falk et al., 1986).

Unlike the formal environment of school, informal learning is often based on things that can be touched or experienced. Frank Oppenheimer, physicist and founder of the Exploratorium, argues that traditional learning has failed in narrowing the gap between people's daily life and the complexities of science because it lacks "props." Learning requires "apparatus which people can see and handle and which display phenomena that can be turned on and off and vary at will." Without props, traditional learning resembles telling someone what it is like to swim without ever letting the person near water (Dackman, 1983). Herreman (1986) describes learning in the recreation environment as one with "activity, action, proofs obtained, things tried, practice, experiments and experiences" (p.72). Learning in recreation environments is often equated with a form of play, where one is free to act, wonder and explore on one's own (Cohen, 1987).

PLAY, RECREATION AND LEISURE

Play has many definitions (Ellis, 1973) and often is not associated with learning. Yet to most children play has a well defined purpose. It is one way to learn about the world around them (Piaget, 1958). Piaget argued that through play come discoveries, and this direct experience is important for the child's early (concrete) development.

Play (or leisure) is the process of exploring, make-believe, or competition and can occur in both work and leisure time (Kraus, 1984). The word "leisure" is derived from the Latin word "licere," "to be free." The early English and French words "license" and "liberty" are related and suggest free choice and absence of compulsion (Kraus, 1984). The early Greek word "skole" also meant leisure. It led to the Latin "scola" and English "scholar" making a close connection between leisure and education (Kraus, 1984). "Skole" also referred to a place where scholarly discussions were held (Kraus, 1984). The Greek meaning of the word school is "leisure for the pursuit of insight" (Etherington, 1989). When Greece was conquered by Rome, young Romans were sent to Athens for schooling and "ludus" (play), which became a reference for learning (Arnold, 1980). The word "campus" means playground (Arnold, 1980). The implications are that leisure, play and learning are all related.

While the concepts of leisure and play have changed over time, the idea of "self-directed learning" is still a component of many leisure definitions (Kraus, 1984; Kelly, 1990). In fact, for some people, self-improvement and learning are a major part of leisure time (Kelly, 1990).

Leisure Constructs

Because the visitor in educationally-oriented recreational facilities functions in a leisure mode, a closer look at the way leisure is defined and measured may be helpful in understanding visitor behavior in recreation environments.

The literature supports a variety of leisure and recreation constructs made up of the following: freedom of choice, enjoyment or pleasure, intrinsic motivation, personal commitment, facilitative arousal, lack of evaluation, symbolic interaction, and a feeling of "flow."

Suggested by philosophers and supported by research, freedom of choice is a major component of the recreation and leisure experience (Iso-Ahola, 1979; Neulinger, 1981; Ellis & Witt, 1984; Tinsley & Tinsley, 1986; Harper, 1986; Samdahl, 1988, 1989, 1991; Hultsman & Black, 1989; Kelly, 1990). The opportunity to freely choose or freely enter into an activity is vital for leisure to take place (Kelly, 1990). This is because people in recreation and leisure environments expect to control their outcomes (Propst and

Kurtz, 1989).

Studies by Iso-Ahola (1979, 1986), Backman and Mannell (1978), and Samdahl (1988) found that perceived freedom is tbe critical factor that differentiates leisure from nonleisure experience. Perceived freedom is defined as having control over one's choices or a perception of control (Iso-Ahola, 1989).

Samdahl (1988, 1991) tested a model of leisure proposed from the literature containing four dimensions: perceived freedom, lack of social evaluation, self expression (involvement and intrinsic motivation) and enjoyment. In her study, 18 subjects were given electronic pagers and asked to record, at random intervals, their experiences over a period of a week. Of the 695 questionnaires that were analyzed, perceived freedom and self-expression had the strongest influence (69% of the variance) on how the individuals perceived leisure. Enjoyment also has a causal effect ($r=.51$) on leisure (Samdahl, 1991).

People participate in activities because of internal motivation, internal rewards or satisfactions. Intrinsic motivation is identified as a second major contributor to the leisure experience (Iso-Ahola, 1979; Csikszentmihalyi, 1975; Neulinger, 1974; Ellis & Witt, 1984; Tinsley & Tinsley, 1986; Gunter, 1987; Hultman & Black, 1989; Samdahl, 1988, 1991). Samdahl (1988) refers to intrinsic motivation as self-motivation and found it strongly influenced perceptions of leisure experiences.

Csikszentmihalyi's (1975) flow theory is closely tied to intrinsic motivation and intrinsic reward. Developed from the stimulus response paradigm (Csikszentmihalyi, 1975) flow theory adds the component of mental control. The stimulus is the activity and the reward is the flow experience. Flow is described as harmony of mind-body and experienced through the loss of an awareness of time. Recently, flow has been applied to the educational/recreational experiences that occur in zoos and museums (Serrell, 1988; Csikszentmihalyi, 1988; 1990).

The theory of flow is identified as the ratio or relationship between an individual's skills and the challenge of the activity. As skills improve, so should the challenge to maintain the flow experience. According to Csikszentmihalyi (1990), the flow model can be applied to all forms of activities, including learning in a museum. The flow experience results in a sense of discovery, higher level of performance, engrossed attention, perceived control, loss of a sense of self and intrinsic rewards. Flow experiences are goal-related, require skill or action equal to one's opportunity, and include a motion or action that becomes almost effortless.

The flow model's application to visitor learning does not appear to fit logically with what is happening in informal educational settings. Visitors do not appear to be searching for a flow experience. Some recreation researchers even argue that the leisure experience is not characterized by reduced levels of self-awareness (Mannell, 1980; Samdahl and Kleiber, 1989). Leisure is much broader than what is typically referred to as flow (Samdahl and Kleiber, 1989, p. 8). Samdahl's (1991) research shows that the individual's perception of "self" is an antecedent to the leisure experience and plays a key role in one's leisure perception.

The flow model also has little empirical data to support the theory according to Voelkl and Ellis (1990). Levels of skill and challenge do not form a linear relationship across a variety of activities (Voelkl and Ellis, 1990). However, in the field of visitor studies, flow stresses the importance of intrinsic motivation as an antecedent to the leisure experience.

In addition to perceived freedom and intrinsic motivation, a third predictor of the leisure experience is the lack of evaluation (Shaw, 1985; Samdahl, 1991). People find that work environments often include evaluation and, as a result, are not a source of leisure. Extrinsic evaluation is found to have a negative impact on the leisure experience (Shaw 1985). However, internal or self-evaluation can take place during leisure and enhance the experience (Shaw 1985).

Motivation

Visitors to recreation settings possess a wide range of motivations for participation (Manning, 1985). People participate in recreational activities to meet certain goals or some need for satisfaction (Driver & Tocher, 1970). Several motivations for outdoor recreation have been identified and studied. These include meeting new people, social contacts, relaxing, creativity, escape from routine and responsibility, enjoying nature, stimulus seeking, self actualization, avoiding boredom, and risk taking (Manning, 1985).

Once the visitor is motivated to act, the experience must be positive to be successful. A preference study for interpretive media at archeological sites found four factors that had a positive influence on the recreational experience: self-fulfillment, type of interpretation, stress-release, and a social experience (Cowley and Schreyer, 1986). For example, visitors preferred self-guided trails with pamphlets and/or signs over ranger talks (ranked 4th) or even the visitor center (ranked 5th). A more positive experience results (reducing stress, self-fulfillment, or preferred social group) when visitors have a greater sense of perceived freedom (found in the self-guided trail) because visitors can go at their own pace, own time and with their chosen friends.

Visitor enjoyment or pleasure is also a key construct to the recreation experience (Smith, 1985). Vererka (1978) found enjoyment to be a major reason people visited interpretive programs in parks. Roadburg's (1983) research supports the notion that enjoyment and pleasure separate work from leisure. Samdahl's (1991) study shows that enjoyment (affect) is highly correlated with perceived freedom and intrinsic motivation.

Social Interaction

A dynamic process of leisure is found in the social setting and the resulting social interaction. This is because much of our recreation and leisure time is spent in groups with friends or family (Shaw 1985, Samdahl 1988). For these groups, the social dimension plays a key role as to why they visit these types of recreation facilities. While 50 to 60% of the visitors' attention is spent on exhibits, the balance of the time is spent on others in the group (Falk et al., 1986).

Samdahl (1988) and Shaw (1985) found that in applying a symbolic interaction paradigm to leisure, the need for interaction among people becomes vital for a leisure experience to take place. Further studies in outdoor recreation also identify social groups as influencing visitor behavior (Field and O'Leary, 1973). For example, adults edited trail brochures or information while reading to children (Kuehner and Elsner, 1978; Trotter, 1990). This type of group interaction is also documented in museum and zoo studies (Falk et al., 1986; Serrell, 1988; McManus, 1989; Diamond, 1986; Snow-Docker and Gallagher, 1987; White, 1990).

Social interaction also influences visitors' attention. Brown (1987) studied children in science museums and found that they tended to congregate near other visitors. He called the variable, "where the action was." Koran et al. (1988) manipulated this variable by having models pose as visitors viewing exhibits. They found that attention and holding power both increased when the model appeared interested in the exhibit. Indeed, visitors are more willing to participate when they see others engaged in socially appropriate behavior (Koran et al., 1989).

Many studies focused on the family unit and learning. In studies of family behavior at science museums, learning occurred within the social interaction of the family (Diamond, 1986; White, 1990). In a study of adult-child dyads, less than one minute was spent at 57% of the exhibits and three minutes or more at 18% of the exhibits. While at the exhibits, parents and children engaged in show and tell behaviors 22% of the time. Graphics were primarily used by parents and texts read 11% of the time by adults (Diamond, 1986). In terms of family members' behavior, it is common for the children to be the first at an exhibit and the first to leave (Patterson and Bitgood, 1988). Parents in the Please Touch Science Museum in Philadelphia were found to direct the child learning under different conditions. Novel exhibits encouraged interactive exploring while familiar exhibits encouraged children to play and the parents to observe (Snow-Docker and Gallagher, 1987).

Involvement

Several leisure scholars (Neulinger, 1974; Csikszentmihalyi, 1975; Gunter and Gunter, 1980) suggest that involvement is also central to the leisure experience.

The involvement construct is used in a variety of ways that include ego involvement, issue involvement, task involvement, and response involvement (Fiske and Taylor, 1984; Dimanche and Havitz, 1990). Much of the research conducted in the consumer behavior field is in the ego domain (for a review, Costley, 1987). Research in recreation on the involvement construct has focused on indirect measures, such as memberships, to predict behavioral outcomes (for a review on involvement, Reid, 1990). An individual's levels of involvement has also been found to encourage minimum or maximum levels of cognitive processing (Chaiken, 1980).

In conclusion, the leisure and recreation mind set has a strong influence on the intended outcome of visitors to educationally oriented recreation facilities. It is based on a variety of components: individual perceptions of freedom, levels of enjoyment, motivation and involvement, lack of evaluation, and interaction with others. These components are what make the recreation setting both an exciting and a difficult place in which to learn. This may be the true meaning of the Greek and Latin word "schole."

LEARNING

Studies of museum visitors' goals show that 53% come to gain knowledge for themselves and 22% visit museums to gain knowledge for a child or friend (Beer, 1987). Visitors, in general, come to educationally orientated recreational facilities with a desire to learn and a perception that they can become involved with interesting and stimulating things (Falk et al., 1986). However, visitor perceptions are not reflected in what visitors actually learn (Beer, 1987; Falk et al., 1986).

While mission statements of educationally oriented recreational agencies often list education as a primary goal, visitor perception of the learning environment and reasons for participating are not always the same as those of the agencies.

Studies show that the goals of visitors coming to informal educational facilities have been recreational in nature (Shettel et al., 1968; Koran et al., 1983; Serrell, 1988). This is supported by a study of three zoos across the country which found visitors' goals to be social and recreational, although staff goals for the visitor were educational (White and Barry, 1984).

Some studies point out that the visitor does not expect to learn much from a museum or zoo experience (Moscardo, 1988; White and Barry, 1984). In fact, studies show children below the age of 19 are not reading labels or attending to the message (Borun and Miller, 1980; Beer, 1987), and children under the age of 10 have little interest in written text (Dockser, 1989). This may be due, in part, to the developmental stage of the visitor or the concept of a "free-choice" setting where visitors select limited amounts of information to attend to.

Freedom of choice is a concept highly prized in the leisure and recreation fields as a key motivator of participation. However, in an educational environment it has a negative impact upon learning. For example, when viewing a video students learned very little when told that they were viewing a video for fun ($r= -.09$). However, viewing the video to learn produced learning ($r= .59$) (Salomon and Leigh, 1984). Given the choice of whether or not to learn, students did not learn.

Linn (1980) studied the free-choice variable and it's relationship to how children learn science. Sixty students (age 12) were provided 40 separate experiments. Lecture-demonstration, where teachers provided minimal guidance, was compared to a free-choice environment. The students' ability to understand and criticize experiments was measured. Results showed that subjects were most likely to profit from a free-choice environment when they had an intervention session prior to free-choice. In a prior study, Linn et al., (1977) found that children, ages 11 and 12, could operate responsibly, follow directions, and carry out experiments

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in a free-choice environment. Both studies showed that children spent little time exploring but instead followed directions or other peers when it comes to completing their experiment. In conclusion, the free-choice environment is a great motivator for children to learn if preceded with advanced organizers (Linn, 1980; Rice, and Linn, 1978). This suggests that free-choice has limits in educational settings.

In contrast, the recreation setting encourages a "free play" environment. The use of "please touch" exhibits are aimed at interaction (Dockser, 1989). When labels are added for adults to read and share with their children, it discouraged free play. Dockser, however, questions the idea that free play leads to self-directed learning. It may even lead to inappropriate behavior of the type found at the Brooklyn Children's Museum which attempted to discourage free play because visitors were often injured from horseplay (McLean, 1987).

<u>Fun Mode</u>

The research implies that most visitors enter the educationally oriented recreation setting in a "fun" mode where they show little interest in learning. This is suggested because visitors spend little time and showing minimal knowledge gained from the educational experience (Shettel et al., 1968; Koran et al, 1983; Moscardo, 1988). The more time spent viewing a specific topic yields more information that is learned (Craik and Lockart, 1972). However, this is not to suggest that learning and fun do not coexist.

In reviewing several studies, Beer (1987) found that exhibit viewing time varied from less than ten seconds (four studies), 20 seconds or less (two studies), 30 seconds or less (four studies), to 40 seconds or less (two studies). Melton's (1972) research of art and historical museums shows that the average viewing time is close to eight seconds. Animal viewing in zoos is consistently less than a minute per animal (Bitgood et al., 1988). Beer (1987) also found that almost half (43%) of the exhibits in museums are skipped entirely. Exhibits with text only are visited 32% of the time, and picture and text exhibits are visited 58% of the time.

Empirical research by Screven (1969), Shettel (1973), and DeWaard et al. (1974) found no significant difference in knowledge from a control group who had just visited exhibits over a pretest group that had not seen the exhibits. Visitors continue in the fun mode, not reading labels/signs and leaving with the same misconceptions with which they arrived (Clement, 1982; Birney, 1986; Finlay et al., 1988; Borun 1989; D'Amico and Pokirny, 1990).

A few studies suggest ways to encourage learning. Shettel et al. (1968) looked at visitors' viewing time and motivation and found that by offering a test (external motivation) and unlimited viewing time, visitors increased their knowledge. More importantly, without external motivation, there was no learning. Both the control group tested before viewing the exhibit and the casual visitors tested after their visit were found to have the same knowledge about the exhibit. Screven (1974) had the same results with casual visitors viewing a skull exhibit.

In summary, little learning occurs unless the visitor is motivated, directed to a specific learning outcome, has a specific learning intent, or is motivated by an adjunct device, i.e., a self scoring punchboard, tape cassettes or interactive computers, (Shettel et al., 1968, Screven, 1969, 1974; Shettel, 1973; Salomon and Leigh, 1984; Morrissey, 1989).

VISITOR PERCEPTION

Perception also influences the way people view learning in a recreation setting. It plays an important role in getting the visitor to visit a museum, art center, park, etc. For example, Kelly (1984) found that some visitors visit art museums for a status symbol, to be perceived by their friends as "having been" to such an inherently enriching site. Science museums, on the other hand, suffer from an image that science is only for the "smart" select few (Hood, 1985).

A growing effort over the last 20 years has been to use science museums to change misconceptions about science. A common belief is that misconceptions held by children can be replaced through formal instruction, but misconceptions also appear to be wide-spread among adults (Borun, 1989). A study by D'Amico and Pokirny (1990) found that misconceptions were held onto even when visitors were given a pretest measure that primed them to what they would see. After visiting the exhibit hall that presented the correct information, visitors did not change their beliefs. It was unclear if these results were due to the quality of exhibits or the fact that visitors' beliefs are difficult to change. The study also supports the notion that people do not approach an exhibit with a "blank slate." Existing beliefs appear to effect what people learn or do not learn (D'Amico and Pokirny, 1990).

Studies are usually done on those who visit educationally oriented recreation sites, but non-users are also occasionally studied. Hood (1985) looked at why people don't visit museums and found that people's perceptions influence their motivation. A study by Bitgood and Thompson (1987) found that potential visitors had different perceptions of art museums, science museums, zoos, state parks, and theme parks. They also found that art and science museums, when compared to zoos and parks, were viewed as more adult oriented than child oriented, more bland than spicy, more formal than informal, more complicated than simple and more work than fun. This suggests that attracting potential visitors to make first visit requires a strategy that addresses visitors perceptions and misconceptions.

SUMMARY

Leisure in a recreation environment is a free-choice, intrinsically-motivated experience. The recreation environment is an informal setting that allows the individual to learn through direct hands-on experiences or by using objects and text. Visitors participate in these settings for a variety of reasons. Learning is seldom the main reason and is more often secondary to enjoyment or the social aspects of the visit. The recreation setting offers a learning environment where the visitors are often self-directed and learn at their own pace. However, research shows that little learning is actually occurring in recreation settings. The visitor appears to be in both a fun mode and a mode where little motivation goes into attending to the message of educational exhibits.

The next chapter looks at how exhibits can attract visitors, motivate them to comprehend information and help them learn.

Chapter III

PRESENTING VISITOR INFORMATION

The informal learning environment of the recreation setting influences the way information should be presented. Koran et al. (1989), in a review of 27 studies on learning during museum field trips taken during school, found that in 19 of 20 studies (in the last ten years), visitor knowledge increased[1]. Museum studies show that the informal educational environment is a way to learn (Koran et al., 1989). However, the visitor is under no obligation to learn. Therefore, information presented in this recreation environment needs to interpret objects and facts (Tilden, 1957).

The use of the word "interpretation" or "interpreter" to describe the informal education environment was first coined in 1918 in Gilman's book, "Museum Ideals" (Bassett and Prince, 1984). Today, the word "education," has been

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[1]. It should be noted that the school setting had an influence on these study results because students knew they would be tested after their visits.

replaced in most museums, zoos and parks with "interpretation." The educator or nature guide is now called "the interpreter." The applied area of study based on visitor learning in the recreation setting is called "interpretation".

The philosophy of interpretation is that the recreation setting is an excellent place to learn if the materials are presented correctly. The National Association for Interpretation, and Interpretation Canada support this philosophy, in their journals and conferences.

Interpretation is defined as "a communication process designed to reveal meaning and relationships of our culture and natural heritage, to visitors through first hand involvement with an object, artifact, landscape, or site" (Tilden, 1957). Tilden (1957) first presented three guiding principles of interpretation: information presented in a recreation setting needs to "provoke" curiosity, and "relate" to the audience while "revealing" factual information. He believed that interpretation was not the same as instruction and that educational messages must relate to the audience's developmental levels, experiences, and interests. Tilden's three principles are supported by the cognitive psychology literature (Ham, 1986).

Cherem (1977) adds to Tilden's principles the need to address the whole or larger picture while striving for message unity or theme. When a particular theme, or mood is added to a story line (beginning - middle - end), learning is improved (Cherem, 1977; Jones, 1986). Because it lacks incentives, such as grades, interpretation must also entertain (Ham, 1986).

Understanding the visitor is the first step in developing programs that relate to the mental and physical diversity of one's audience (Propst and Roggenbuck, 1981). Visitors are often heterogeneous groups with varying degrees of prior knowledge, interest areas, experiences, motivation and other learner characteristics (Falk et al., 1986; Mullins, 1991). Visitor segments behave differently, requiring different services and interpretive approaches (Machlis and Fields, 1984). Machlis and McDonough (1978), for instance, review children's interpretation and the different developmental stages that effect learning from preschool through adolescence. Bultena et al. (1978) study of the elderly provides several recommendations to use when working with senior citizens. Beechel (1975) provides guidelines and recommendations for interpretation for the disabled. Knowing and speaking the language of your audience is another important step in getting the message across (Machlis and McDonough, 1978).

STUDY OF EXHIBITS

Exhibits are traditionally the main way information is presented in educationally oriented recreational settings because they can reach a large audience at all hours of the day (Jones, 1986).

An exhibit is defined as a three-dimensional expression of an idea (LaFlame, 1977) that tells a story, displays objects, uses more than one stimulus or sense and ties everything together with one theme (Ackert and McDonough, 1986). Exhibits can include both moving and non-moving components and encourage either active or passive viewing (Cherem, 1977).

The role or purpose of exhibits should be to encourage or act as a catalyst to learning. They should arouse both curiosity and imagination (Jones, 1986). The casual visitor is one who knows little about a specific museum or center and has virtually no contact with professional staff (Jones, 1986). Therefore, exhibits are the professional presentation of ideas and objects and a major tool for educating the casual visitor (Jones, 1986).

What the Visitor Attends To

Exhibits and exhibit labels have been studied in three areas: attracting power, holding power and teaching power (Bitgood et al., 1986a). The three assume a hierarchical order. Attracting power is the ability of the exhibit to attract the visitors' attention. Its success is measured by percentages of visitors who stop. Holding power addresses and measures how many seconds the visitor stays at the exhibit. The ideal time is long enough to read all labels

(Bitgood et al., 1987a; Robinson, 1928). Teaching power addresses the area of learning. How much does the visitor learn from the exhibit and the labels? (Bitgood et al., 1986a). Teaching power is typically measured with interviews or questionnaires.

Cueing

Preparing the visitor for what they will see, through advanced organizers or precueing, increases learning. Gennaro et al., (1982) sent students preparatory information before visiting a science museum, zoo and arboretum and found that these groups performed significantly higher in a posttest evaluation than groups that had not received the materials. Using advanced organizers also had a positive effect on visitors' attitudes about the facility (Gennaro et al., 1982). Hayward and Brydon-Miller (1984) studied visitors to an outdoor history museum and found that using an advanced organizer in a previsit orientation experience resulted in the visitor learning more facts and staying at the site significantly longer than those with a postsite interview only.

Advanced organizers are effective in a variety of recreation/educational settings. They act as a cueing device that helps the learner choose how to spend mental energy. They also help explain to visitors why they should attend to certain information (visitor objectives) and help them perceive what is important i.e., "People are telling me this is important, it must be important" (Koran et al., 1983).

Spatial Arrangements

Studying visitor behavior in 13 zoos around the United States, Bitgood et al., (1988) found the following variables influenced viewing time: animal size, animal attractiveness, animal activity, viewing order or spatial arrangement of the exhibits, size of the exhibits, and the types of physical barriers between the animals and the visitor. Viewing time doubled when infant animals were combined with their mothers, or animals were moving about their cages. Size of the exhibit had no influence on the viewing time (Bitgood et al., 1985). Exhibits near the exit sign had the least viewing time. Other studies show that visitors pay more attention to displays on the right side of a room and near the entrance. However, Beer's (1987) work shows that spatial arrangements alone produce no consistent patterns of visitor attention.

Action

Exhibits that require more then one sense (sight, sound, or touch), permit greater satisfaction and involvement with the subject matter (Washburne and Wagar, 1972). Washburne and Wagar (1972) found that three-dimensional dynamic exhibits, along with action, animation and change, (i.e., flashing lights, movies, and audio along with violence and destruction) held people's attention longer than flat work and static exhibits. Mammals and birds also held the visitor's attention. Holistic messages, cause and effect messages, stories and themes all produced high attention levels.

A study by Brown (1987) found similar results. Children under seven years old attended to live reptiles and live bees for over 70 seconds, but terrariums and wall signs held their attention for three seconds or less. Exhibits combining high interaction and involvement (fossil rubbing and the sand beach) ranked third and fourth in terms of time and interest levels (Brown, 1987).

A study of 17 visitor centers in Britain, conducted by the Countryside Commission in 1978, found that successful exhibits include animation, are physically involving and dynamic or changing, and capture the attention of all age-groups and social backgrounds (Moscardo and Pearce, 1986). The use of "cause and effect," "parts that make up a whole," scaled models, and/or artifacts were also preferred by visitors (Prince, 1982). Again, exhibits with text only were least preferred (Prince, 1982; Landay and Bridge, 1982).

Labels

Labels are a vital communication link between the object that is being presented and the visitor's ability to learn (Bitgood et al., 1986a). Important to this concept of communication are two assumptions: the message is attended to, and the message is comprehensible (Hunter, 1991). Both of these assumptions must be tested when addressing the effect of labels. Serrell's (1983) list of label rules provides a guideline for more effective labels. What follows is a review of empirical research on labels and the variables that affect both attraction and comprehension.

A common lament shared among museum professionals is the idea that "visitors don't read labels." However, McManus (1989, 1990) by using hidden microphones, found that visitors read labels and comment on the information in the labels to people in their group. This type of measure, when compared to the traditional measures of time spent in front of an exhibit, more accurately assess label reading (McManus, 1989). No matter how long or short the text, it is unlikely the entire text will be read because visitors are also concerned with enjoyment and social relationships (McManus, 1990). Visitors allow labels to establish the topic of conversation, but do not allow them to "hog" the conversation. Secondly, visitors scan labels and confirm information they have already predicted (McManus, 1990).

Studies have found that the number of words in a label influences visitor reading (Serrell 1983; Weiner, 1963; Borun and Miller, 1980; Bitgood et al., 1986a). While, labels with over 100 words are seldom read (Bitgood et al., 1986b), exhibits with texts divided into segments of 50 words or less, a technique called "chunking," increase reading from 11 to 35 percent (Bitgood et al., 1986b).

Young and Witter (1988) studied the effects of chunking the information in brochures to make it more understandable or easily digestible. They also made the information more legible or concrete by providing detailed descriptions of environmentally appropriate behavior. The two variables were incorporated into an educational brochure on the gypsy moth. The results, determined by a questionnaire measuring increased knowledge, showed that both legibility and chunking made the information more easily understood. Shorter chunks of text in brochures also more effectively teach than longer blocks of text.

The reading level of labels and the ease of comprehension are important when targeting messages to certain audiences (Ackert and McDonough, 1986). Though not important for attracting power, comprehension is important for holding power (Bitgood et al., 1986a). The components include the number of words per sentence, the number of syllables per 100 words and the grade level score for the materials. Serrell (1983) suggests that the average adult reads at a sixth-grade level, thus signs should be written at that level for the general visitor. In addition, text should be kept to 10 to 20 words per sentence and range from 130 to 150 syllables per 100 words (Serrell, 1983). An empirical relationship between readability and holding and teaching power has not been documented (Bitgood et al., 1986a).

Letter size also influences label reading (Serrell, 1983; Bitgood et al., 1986b). For instance, increasing the letter size from 18 to 35 point produced a 15 percent increase in attracting power of the label (Bitgood, et al., 1986b).

The location of the labels influences the percentage of visitors who stop and read the text. Researchers have found the closer the label is to the object, the greater the percentage of readers (Borun and Miller, 1980; Bitgood et al., 1986b). The label has what researchers call a visual context with the object which increases reading (Serrell, 1983). Visual content is information that directs the visitor's attention to the exhibit. This can be accomplished by asking a question (Serrell, 1983).

Using questions in label titles such as: "Do Polar Bears Hibernate?"; or "Were Samurai Firemen?," may provoke visitor curiosity, but do they increase reading? Hirschi and Screven (1990) found that by adding label-directing questions to traditional exhibit labels, both reading time and holding power increased significantly in a museum setting. However, while visitors spent more time reading, they only read enough of the label to answer the question. The value of questions is a frequent topic of exhibit research. Tilden (1957) said that using questions increases an audiences desire to learn. In an underwater exhibit at the Michigan Historical Museum, visitors were invited to solve a problem by answering a series of questions. The questions and puzzle were intended to help the younger visitors, but equal interest was created in adult visitors (Ostrander, 1991). Questions are traditional in school environments because they induce thinking. Responses can also be used to measure understanding. Questions are a tool to activate cognition, though they do not guarantee learning.

There are three levels of questions used in exhibits: "recall," "process," and "application" (Tennyson, 1989). The most basic level are recall questions. They ask the visitor to repeat the information in the sign or exhibit. Recall questions require little mental effort which results in poor remembering. The second level, process questions, draw from relationships among data, and infer or explain what is taking place at a given time. Application questions, the third level, encourage higher level thinking, hypothesizing, evaluating and model forming. At levels two and three, information is accessed from one's memory. This type of questioning encourages cognition, but as the level of questions increases, more effort is required by the visitor, which loses some of the audience (National Park Service, 1976). Unless the visitor is motivated, questions may fall on deaf ears. To maintain a high level of visitor involvement, the three types of questions need to be varied (NPS, 1976).

Borun (1991) argues that labels must create a dynamic relationship between the object and the visitor. Studying labels in an interactive science museum, Borun (1989, 1990) explored visitors' ideas about scientific knowledge and found that inaccurate ideas and misconceptions are shared by both adults and children. As discussed in the previous chapter, these perceptions are difficult to change. For example, over fifty percent of the visitors said (erroneously) that the spinning of the earth holds people on the earth. Changing label size, color, texture, location, text and message resulted in minimum increase in understanding gravity. Visitors' beliefs about gravity stayed somewhat the same (35% thought spinning held one on the earth). Borun found visitors' typical patterns were to try the device first then read the label: "device --> label --> leave." Borun attempted to get visitors to return to the device after reading the label; "device --> label --> device." The study found that the most effective method for achieving this goal included a title that described the lack of a relationship between gravity and the spinning of the earth. The subtitle addressed previously held ideas. "Can you prove it?," invited the visitor to once again interact with the exhibit. Borum's results suggest that labels not only have to be short and to the point, but follow an instruction type format where visitors can observe cause and effect relationships (Borun, 1989, 1991) (Figure 3.1).

Using illustrations or graphics in labels is generally believed to increase visitors' attraction power to the label, but there is insufficient data to support this belief (Bitgood et al., 1986a). In one study, text was equally as effective as diagrams in attracting children in a science museum (Borum and Miller, 1980). In another, illustrations in an Egyptian mummy exhibit did not increase attracting or holding power (Bitgood et al., 1986b).

Brochures have a similar effect. Birney (1988) found that 55% of the visitors used brochures to supplement signs

Figure 3.1

Dynamic Sign for Interactive Exhibit on Gravity

<u>Separate and Unequal Force</u> If the earth stopped spinning, Gravity would still hold us down. Can You Prove It? (use on & off switch)

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in the primate area of the Brookfield Zoo. The illustrations on the brochures helped identify the animals and their behavior. While the brochure helped increase knowledge, it failed in its goal to alert visitors about the degradation of the rainforest (Birney, 1988).

In summary, labels are one link the visitor has to understand the intended message of an exhibit. Attention to labels is based on letter size, location, the number of words and the way they are laid out (chunks). Comprehension of labels is based on visual content and reading level.

Senses

Using one or more of the senses in addition to sight; i.e., touch, sound, smell and taste, can increase both attracting and holding power of an exhibit and encourages active participation (Washburne and Wagar, 1972; Cherem, 1977; Bitgood et al., 1986a). Sensory exhibits have a higher appeal, require visitors to have less interest at the beginning and encourage more learning in the end (Washburne and Wager, 1972; Cherem, 1977). Adding audio (sound), for example, to an exhibit increases by 50% the holding power of the visitor to the exhibit (Beer, 1987). Traditional wall panel exhibits improve their educational effectiveness when combined with an audio-video program (Landay and Bridge, 1982) or an interactive computer (Morrissey, 1989).

The interpretive literature often suggests that people learn about 10% of what they hear, 20% of what they read, 50% of what they see, and 90% of what they do (Lewis, 1983). In reviewing education literature, Magnesen (1983) finds that learning and memory retention increase to 90% when students are actively involved and interact with one another. Learning drops to 10% with reading only, 20% with hearing only, 30% with seeing only, 50% with both seeing and hearing, and 70% with oral participation (Magnesen, 1983). The more the senses are stimulated, the greater the chance for learning and retaining information (Magnesen, 1983).

Recent research refutes the holding power of audiovisual exhibits. Beer (1987) claims they are unable to hold the attention of even half of their audience for the length of the program. Beer's results were duplicated in a rain forest exhibit at the Milwaukee Museum. The exhibit had five video theaters where 50% of the visitors stop to view the films. The average length of stay was less then 2.5 minutes even though video lengths were 6 to 8 minutes (Korenic and Young, 1991).

On the otherhand, a highly-sensorial experience is being encouraged with hands-on exhibits in discovery rooms and childrens museums. There visitors handle and manipulate all kinds of objects. These types of exhibits attract visitors of all ages, and increase both interest and holding power (White and Barry, 1984; Koran et al., 1986; White, 1990). Hands-on exhibits work especially well in these settings and children touch and manipulate more objects then adults (Koran et al., 1986). In a hall on reptiles, when hands-on exhibits were added, visitors increased their stay from 15 minutes to 27.5 minutes (White and Barry, 1984). In terms of retaining the information from a discovery room, a telephone survey found that after three months visitors still had vivid images of what they did and learned in the lab (White and Barry, 1984). In addition, most reported that they had used the information, purchased additional books or shared their information with friends (White, 1990). The effectiveness of a highly sensory experience may be reflected in the fact that over 200 discovery rooms have been added to zoos and museums over the last 15 years (Zucker, 1987).

INTERACTIVE EXHIBITS

Studies of interactive or participatory exhibits show successful results at attracting and holding the visitor's attention, stimulating learning, and reducing museum fatigue (Screven, 1975; Shettel, 1973; Koran et al., 1986; Cohen, 1987). Interactive exhibits also increase learning in both museum and zoo settings (DeWaard et al, 1974; Gillie and Wilson, 1982; Birney, 1988; Derwin and Piper, 1988). Cohen (1987) argues that interactive devices activate both intellectual and physical variables, and challenge visitors to think, try, analyze, make choices, synthesize, and/or role play. The result is both learning and pleasure (Cohen, 1987). In science museums, interactive exhibits more effectively teach scientific principles than vocabulary learning or demonstrations (Flexer and Borun, 1984).

Interactive exhibits work because in part they allow the visitor to make some behavioral response using the information in the exhibit (Moscardo, 1988). In addition, interactive exhibits give the visitor an opportunity for feedback by supplying the correct answer (Screven, 1974).

Interpretive exhibits often employ adjunct devices that supplement or enhance an exhibit (Screven, 1974). Examples of adjunct devices are electronic punchboards with questions and feedback (Screven, 1975), study guides (Gennaro et al., 1982), slide-tape presentations, study cards (DeWaard et al., 1974) and computers (Morrissey, 1989). Adjunct devices focus the visitor's attention, cue the visitor to the intended learning, and elicit participation. They are also practical alternatives to static exhibits (Koran et al., 1989).

Moscardo (1988) reviewed seven studies on participatory exhibits that used quiz cards and found that the exhibits increased learning and cognitive activity. In addition, interactive exhibits improved psychomotor skills, increased holding power and visitors left with a positive attitude about the exhibit.

Interactive environments are multi-dimensional in nature. They encompass various parts of the following:

first-hand learning (direct experiences); multi-sensory exposure (hands-on); manipulation of variables and feedback (interactive devices); a degree of physical and perceptual penetration of the display; provision for realistic, imaginary, and fantasy role-playing; allowance for egocentric and ethnocentric/cultural identification, and authenticity (Cohen, 1987).

Computers as an adjunct device for interactive environments are very popular. When combined with video technologies, computers provide a new media to enhance learning in educationally oriented recreation environments (Morrissey, 1989). Adding interactive video gives the visitor control of both moving and still video images, along with the use of a two track audio system, computer text and colorful graphics. Even though the computer prompts the user with a range of choices, instructional pathways, lesson pacing and individual feedback, the visitor controls the medium (Morrissey, 1989). Also, the learner can repeat a video, control the speed of the video delivery, stop the action or scan materials at high speeds (Steinberg, 1989).

Results from a meta-analysis of sixty-three studies of interactive video (IV) instruction in a classroom setting indicate that IV effectively encourages learning (McNeil and Nelson, 1991). However, IV was most effective when used as a supplement and not as a replacement for instruction. McNeil and Nelson (1991) warn that IV must not be viewed as the ultimate delivery system in the school setting. Results from their analysis support the notion that IV can be an effective supplementary teaching tool, but should not be allowed to stand on its own. Studies of learner control versus program control show that when individuals are confronted with an incorrect answer, they benefit most from guidance or suggestions on what to review (Steinberg, 1989). Guided control made up 8.2% of the learning variance (McNeil and Nelson, 1991).

Klein (1985) studied the impact of computers in traditional German museums and found the results varied across different user groups, but in general computers disrupted the milieu of the museum (Klein, 1985). On the other hand, Morrissey's (1989) study in a museum setting found that using the computers as an adjunct device increased visitors' attention and holding power to a bird exhibit.

Worts (1990) found benefits and drawbacks to using computers in an art museum as a bridge between the visitor and art objects. Holding power (mean time) of an exhibit was found to increase from 5.4 minutes to 16.3 minutes, visitors tried at least one of the computer programs, and the "above average" satisfaction on follow up surveys increased from 23% to 70%. Observers also noticed a change in the social atmosphere. Visitor behavior was more animated and more information was shared within the group (Worts, 1990). Some drawbacks were found where computers did distract visitors away from the art, and some visitors had anti-computer fears and attitudes (Worts, 1990).

Beer (1987) found that visitors are less likely to read the instructions on interactive exhibits. Instead visitors learn by trial and error or by watching others. Visitors did not even take time to read the "Out of Order" signs on the computer (Beer 1987).

Cohen (1987) warns that not all interactive exhibits transmit ideas, knowledge, values or skills. Contrary to previous studies, Beer (1987) found that interactive devices alone did not cause a major increase in attraction power. Visitors skipped these exhibits 63% of the time, almost as much as text only exhibits (68%) (Beer, 1987). However, interactive devices that were combined with audiovisuals and texts were highly attractive (Beer, 1987).

In summary, interactive devices used in exhibits appear to motivate the visitor by increasing physical involvement and providing a choice that leads to learning (Korn, 1987). They are most effective when they present real phenomena, allow for creative experimentation, reinforce the correct answer and give the user control over the outcome (Screven, 1975, Shettel, 1973; 1986; Cohen, 1987; White and Barry, 1984; Korn 1987; Korn and Vandiver, 1988). They also can produce high levels of satisfaction (Korn, 1987; Screven, 1986; Cohen 1987; Chabay, 1987; Morrissey, 1989).

SUMMARY AND CONCLUSION

Simply presenting information or facts in the recreation setting is not enough. Information needs to be interpreted and relate to specific audiences, i.e., adults or children. Visitors must be motivated or encouraged to actively process that information. This can be done with using sensory rich exhibits, brief labels, story lines, and questions.

Visitors are attracted to certain types of exhibits. For example, children are especially attracted to exhibits with live animals or animation. Hands-on and interactive exhibits are also effective as long as visitors receive feedback to their answers.

Attraction and holding power increase when visitors are involved with interactive devices. In a free-choice recreation setting interactive devices seem to leads to increased learning and satisfaction. The next chapter builds a theoretical base for how people process information and why certain exhibits may be more effective then others.

Chapter IV

THEORETICAL FRAMEWORK FOR LEARNING

If exhibits, signs and brochures are to achieve their intended goals, it is important to understand how people process information. This chapter emphasizes how the visitor perceives, thinks, and acts in relation to exhibits and information. It explores theories of psychology, social psychology, education and information processing. The primary assumption in this chapter is that learning and memory are the result of cognitive processing.

Cognition

The field of cognitive psychology is concerned with the way messages are attended to and/or processed in the brain. Cognition is defined as "the mental process or faculty by which knowledge is acquired" (Webster, 1970). Cognitive processes are operations performed on incoming information: looking at certain aspects, drawing inferences, storing information, retrieving it when needed, identifying a plan of action, and implementing plans (Hewes and Planalp, 1987).

Cognition depends upon a person's prior knowledge, what is on their mind at the time of the visit, the amount of time they have to think about the topic, and whether the experience conjures up memories of similar information. Theories of cognition help explain how two visitors to the same museum, zoo, or nature center can come away with totally different views of the exhibits and the experience.

The basic assumptions of cognitive psychology are:

- Mental processing exists and people are active information processors.
- People use past knowledge in any new learning situation.
- One's reaction time to complete a task is the speed of one's mental processing. The accuracy of recalling words or associations with words represents mental structures and mental processing (Ashcraft, 1989).

Important to the concept of cognition is the element of time. Craik and Lockhart (1972) found that thought or thinking correlated with memory and learning. The longer the time used to process information, the greater the depth, which in turn leads to a greater degree of cognitive analysis (Craik and Lockhart, 1972). On the other hand, shallow information processing is non-attended and the verbal/nonverbal materials are lost within seconds. Their th

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theory of "deep/shallow" processing supports using time to measure cognition.

Schemata

Cognitive psychology suggests that people construct functional systems, called schemata, that allow them to store information about their environment (Bartlett, 1932). Schemata are bits of information that include stored knowledge, stored organizers, and rules by which one functions. Schemata give meaning. They tell the observer what to expect, what to select, and how to deal with incoming information. As the individual moves through the environment, these schemata are constantly being changed to accommodate new materials. Incoming information or stimuli are coded and then given meaning by referring to existing schemata. Smith (1982), in a review of cognitive schemata, calls the concept an interrelated set of "interpretive and behavioral rules containing pre-determined action sequences" (p. 332).

Schema theory has become widespread in psychological research, and schemata have been described as the building blocks of cognition (Mandler, 1984). Knowledge about a subject, event, personality trait or social norms are combined into a network of stored information. Schemata are activated as one experiences things that function according to schematic principles (Mandler, 1984). Going to the store calls up a number of schemata; searching for the item, comparing product cost and quality and/or paying for the item. Schemata add to comprehension and memory function as well (Anderson, 1983). When a schema is not available, the individual cannot understand the specific behavior or information (Gibson, 1969).

In terms of visitor studies, schemata need to be activated for people to understand the messages of exhibits and displays. Applying schema theory in the educationally oriented recreation setting is supported by leisure research (Chase, 1975; Miles et al., 1982; Prince, 1982; Hammitt, 1984; Roggenbuck et al., 1991). In addition, Kaplan and Kaplan's (1978) concept of familiarity parallels schema theory and is often used to discuss learning in the recreation environment. They note that familiar images are stored and then recalled as they are applied to new visual images (Kaplan and Kaplan, 1978).

But schemata are only bits of knowledge stored in one's brain. How then are schemata retrieved from memory, moved around and changed? The theory of information processing has evolved over the last 20 years to help answer this question.

INFORMATION PROCESSING

Cognitive psychology and the theory of information processing evolved when behavioral psychology failed to address how people think and process information (Broadbent, 1958). The field paralleled the development of the computer which provided a metaphor to better understand how memory and learning work. Both the brain and computer interpret symbols fed into them and perform the operations those symbols specify (Ashcraft, 1989). Information is organized and stored in memory and made available for recall. This analogy of humans as computers, first presented in 1958 by Newell and Simons, provided not only the framework, but also the jargon for mental processing, i.e., input, output, storage, and retrieval (Ashcraft, 1989). Atkinson and Shiffrin (1968, 1971) are credited with the first linear model of human memory which included the idea of three different memories: sensory, short-term and long-term (Figure 4.1).

FIGURE 4.1

INFORMATION PROCESSING MODEL

Atkinson and Shiffrin, 1968

Sensory memory -> Short-term memory -> Long-term memory.

Newell and Simons (1972) added the concept of "limited-capacity" for mental processing in any given channel. Derived from telephone communication engineers, limited-capacity of mental processing implies that the brain has built-in limits to receive and process information. In the short-term memory, also called working memory, information can be processed through two or more channels. An example would be reading the newspaper, watching TV and talking to a friend all at once. Miller (1956) found that the limited-capacity for mental processing is six units of information, plus or minus two. However, Kahneman (1973) adds that when an individual becomes mentally engaged in a topic (i.e., reading a book), he or she has unlimited mental capacity, expends little effort and has high information recall. Combining these theories provides the basis for understanding how stimuli move through different memory stages: sensory memory to the short-term memory (STM), stored and retrieved in the long-term memory (LTM) then back to the short-term memory.

Information processing theory has spread beyond cognitive psychology to other areas including communication science (Hewes and Planalp, 1987), persuasion (Petty and Cacioppo, 1981), consumer behavior, education (Phye & Andre 1986), and museum science's (Koran et al., 1983).

Information processing theory has had an enormous impact on modern cognitive research. Some suggest that it has reached the status of a learning paradigm (Palmer and Kimchi, 1986). This section reviews information processing concepts: sensory memory, short-term memory, and long-term memory.

Sensory Memory

Sensory memory information, or stimuli, is input into the brain through the senses. The operations of sight, sound and smell are recorded in sensory memory which are an automatic part of cognitive processing (Phye & Andre, 1986). Most research has been conducted on the senses of sight and sound.

The function of visual sensory memory is to hold incoming information for a very brief time, between 1/4 and 1/2 second (Ashcraft, 1989). Visual information held longer than 1/2 second is transferred to the short-term memory. The process may be similar to time-lapse photography in that pictures are held long enough to be tied together.

Visual memory is very acute. For example, subjects were able to remember, with 97% accuracy, slides of a landscape they had seen 30 days earlier (Dwyer, 1978). One study allowed a year before retesting and found similar results (Dwyer, 1978).

Auditory stimuli are stored and encoded in the sensory memory for a very brief time (Neisser, 1967). This information takes time to receive because no single millisecond can contain enough information to be useful. All messages received are encoded, but they may not all be understood. This is due to the ability of the brain to tune out noise and listen to only a primary message. While information is being encoded, other components of the memory system have access to it for further mental processing. Auditory information takes longer to store (from 4 to 20 seconds) than visual information, (Darwin et al., 1972; Eriksen and Johnson, 1964; Watkins and Watkins, 1980). Pictures can be recalled in 1/4 to 1/2 second while audio processing takes between two to five seconds (Matlin, 1983). Thus, information presented either with pictures or sound needs to be presented no faster than it can be processed in the short-term memory.

Short-Term Memory

The short-term memory (STM) is loosely equated with consciousness. Information that has recently been attended to is held in STM. STM acts as a memory buffer to all types of information, accepting some and rejecting others (Broadbent, 1958). STM functions much like a "scratch pad" of the memory system where mental notes are added or discarded (Ashcraft, 1989). Most importantly, it is the area of the brain where comprehension takes place and ideas are formed.

As its name implies, information in STM is not held long, unless one continually thinks about or rehearses the information. STM encodes information from both the sensory and long-term memories. It has a limited capacity to hold information and acts as a bottleneck, allowing only certain amounts of attended information in the brain to be analyzed or responded to, filtering or squeezing out unattended information (Broadbent, 1958).

Information in STM is processed through multiple channels or "parallel" processing, all at approximately the same time, i.e., hearing, seeing, smelling, or touching. Separate messages can also be registered at the same time. An example is holding a phone conversation with someone and listening to the radio at the same time. As one becomes more proficient at one activity, the easier it becomes to do two or more things at once. When first learning to drive a car, it is difficult to be attentive to both the sides, the rear and the front of the car all at once. After practice, one can drive, listen to the radio and talk on a car phone in what appears to be the same time. Much of the behavior is done automatically.

Long-Term Memory

Long-term memory (LTM) is where information is stored. Using the computer analogy, it is the hard drive of the brain. Information from STM is transferred to LTM and saved. Research by Craik and Lockhart (1972) found LTM to not only hold words but also pictures, faces, voices, and tunes. There appears to be no limit to the amount of information that can be stored in the LTM (Ashcraft, 1989). Current theories suggest that information cannot be lost in LTM, but can become modified when new information is added. What limits the LTM is the unwillingness to commit the amount of energy needed to store information (Gagne, 1985). Once stored, LTM information can be randomly accessed.

Information is stored in certain locations of the brain and is accessed much like a library card catalog system. As new information is integrated, old knowledge is replaced, revised or updated (Ashcraft, 1989). Two types of memory storage are found in LTM: episodic memory and semantic memory (Tulving, 1972).

Episodic memory is where events in one's life are stored (Tulving, 1972; Calfee, 1981). These events are autobiographical, based on their relationships to one another in time and space. They are tied together because each event is a part of many ongoing events. For example, an individual's graduation is made up of family participation along with a history of school and class-mates.

Semantic memory is where general knowledge is stored that is used to understand language and experiences (Tulving, 1972). Semantic memory acts like a mental thesaurus. It organizes knowledge, words, meaning and relationships. These relationships include rules, formulas, and algorithms (Tulving, 1972) and are the bases of schemata (Phye & Andre, 1986). They give meaning to an event and help solve problems or make choices. Semantic memory is a network of schemata joined by associations. Meaning is found only in the individual and not the object. The famous "goblet/two faces" drawing illustrates this. Because the drawing is ambiguous, meaning is found only in what one sees in the picture. Communication literature also stresses that communication is not what the sender of the message said, but what the receiver perceives the meaning to be (Littlejohn, 1980). Perception is based on information stored in the long-term semantic memory and may be a key to the amount of energy one is willing to invest in mental processing or learning (Salomon, 1983).

Information Processing Model

Information processing involves the movement of information from LTM to STM and back again. "Bottom up" processing is driven from new information entering STM and relies exclusively on new stimuli derived from the environment. It is assisted very little by memory-based knowledge. "Top down" processing is driven by memory. Also referred to as "conceptually driven" processing, it is based on past knowledge stored in LTM. In most common mental tasks, comprehension involves information from stimuli as well as inferences drawn from conceptually driven processing (Ashcraft, 1989).

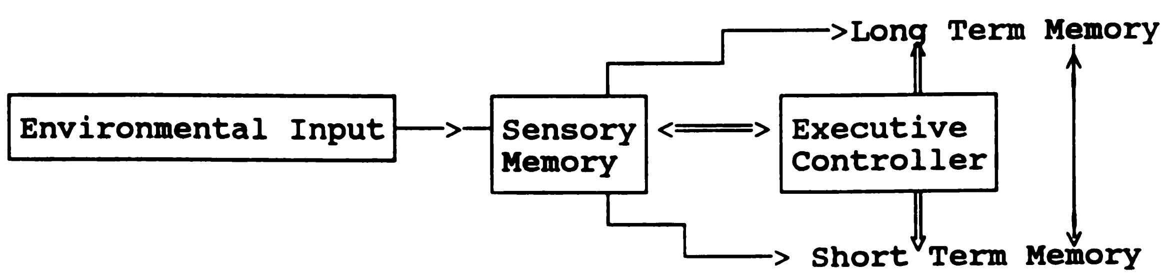
Atkinson and Shiffrin's (1968) linear model of human memory (Figure 4.1) was modified by Ashcraft (1989) to include a circular relationship between each memory stage

(Figure 4.2). This revised model eliminates the linear and sequential order of operations from stage to stage. It also adds another component called the "executive controller." The executive controller is homunculus, the "little thinking person" inside the "thinking person" (Ashcraft, 1989). It is commonly referred to as the unanswered black box of the memory system. Homunculus takes care of what needs to get done and orchestrates the whole memory system. For purposes of simplicity, the executive controller "doles out attention for the completion of various tasks" (pp. 67).

Figure 4.2

EXECUTIVE CONTROLLER MODEL

Ashcraft, 1989



Information processing theory represents a mapping of information flow. The abstractness of the theory lies in the abstract nature of information itself (Palmer and Kimchi, 1986). In other words, any message or signal, because of the way it is processed, either top down or bottom up, can carry different meaning to different people.

Summary of Information Processing

Information processing theory (IPT) suggests that learning begins with the intake of stimuli which is then processed in stages: sensory memory, short-term memory, and long-term memory. The result is output. Comprehending the message is the result of the stimuli or information (bottom up processing) and previous general schema (top down processing). The STM retrieves information from the LTM, adds it to environmental stimuli in STM and returns new or modified schema to LTM (Gagne, 1985). Thus, cognitive processing is based on previous knowledge, new stimuli and the nature of the instruction which help its transfer into long-term memory (Gagne, 1985). The executive controller orchestrates priorities or strategies for task completions and is responsible for moving information between STM and LTM (Gagne, 1985). External events such as instruction, "may support internal processes by activating a mental set that affects attention and selective perceptions" (Gagne, 1985, p.86).

There are three assumptions of IPT: 1) the message needs to be attended to; 2) serial processing implies a series of mental processes that occur one at a time with no overlap and the result is conscious response (Ashcraft, 1989); 3) two or more processes occur at the same time (parallel processing) resulting in automatic responses (Craik and Lockhart, 1972; Norman and Bobrow, 1975; Ashcraft, 1989).

Five areas of research are discussed in this chapter in relation to how the brain prioritizes or doles out information: perception, attention, serial processing versus parallel processing, automatic versus conscious response, and the nature of instruction. They are reviewed in the following sections.

PERCEPTION

Whether with sight, sound or touch, perceptions are largely controlled by the individual. They are based on schemata and stored in LTM. Perceptions do not just happen, they are guided by one's model of the world (Alt and Griggs, 1984). No two people perceive the world in the same way due to individually different models. Perception is important because it can influence early stages of attention and participation. Visitors have varying perceptions of recreation settings that may be based on false pretext or past experiences, i.e., museums are boring (Bitgood and Thompson, 1987).

Perception not only pertains to what people visit, but also to how they learn. Krendl (1986) looked at students' (3rd - 10th grade) perception of certain media and found that they vary across three fundamental dimensions: preference, perceived difficulty, and learning. Computers ranked high in all three, but reading ranked high in learning and low in preference.

However, the perception that easy medium (TV, video or computers) increases learning may be misleading. Salomon (1983, 1984, 1985) argues that learning is based on how one perceives different sources of information. For instance, people put forth different levels of energy for print, television or computers. That which requires more mental effort (depth/thoughtfulness/mindfulness) leads to greater learning, while those media that require little mental effort have the opposite effect.

Salomon identifies two mental levels based on perception and one's "amount of invested mental effort" (AIME). AIME is the interaction of two dimensions: the perception of difficulty and the proficiency one feels toward the medium (self-efficacy). It reflects both cognitive and motivational attributes. Motivation and mental effort invested are not equal. Motivation is the driving force, but learning is based on relevant meaningful mental activity; i.e., computers are perceived as difficult, I lack the skill so therefore I will not try the exhibit.

Television demands far less mental effort than print media. With story and content kept constant, TV was perceived to be more shallow and less variable than the printed media. Even when working within the same media, TV perceptions altered learning when subjects were told that the show was presented on the Public Television System (PBS) or on a commercial network. Greater learning took place when subjects believed that programs were shown on PBS (Kunkle, 1981). Another study found that children learned very little while watching children's programs unless an adult was present during the viewing. Greater importance was placed on the program when the adult was in the room. Under that circumstance, TV was not just for fun (Salomon, 1983). In summary, perception of the environment or the media is important because it influences the individuals willingness to invest mental energy or attention to the message.

ATTENTION

Attention theories focus on the ability of the individual to perceive certain stimuli while ignoring others. The process of focusing or concentrating mental activity on a specific subject matter is called attention (Matlin, 1983).

Much of the attention research focuses on moving people from a non-attentive state into a mental concentration state. Getting a person's attention is the first step. With exhibits, that first step involves attracting visitors visually. To that end it is important to understand how vision, in particular peripheral vision, works.

Perceiving motion is one of the basic functions of the eye (Matlin, 1983). In fact, motion is first recognized in the peripheral area of the retina (Sekuler, 1975). Peripheral vision picks up movement, color and flashing lights, forcing one to be attentive (Sekuler, 1975). For example, the flashing, colorful lights of police cars and emergency vehicles are often seen long before their sirens are heard (and light travels faster than sound).

In addition, research on attracting visual attention has found that color attracts attention better than shape because the eye's peripheral vision detects color more quickly than shape (Matlin, 1983). The more easily seen colors from the greatest distance are red and green whereas yellow or blue appear as white (Wasserman, 1978). Red is also a color that excites the cones in the eye and quickly draws one's attention (Wasserman, 1978). That is why fire trucks, stop signs and exit signs are easy to spot.

Items and letters larger than their surroundings also increase attention (Eriksen and Schultz, 1979). This applies to titles and sub-titles on exhibit labels.

The same types of attention-getting devices that attracted the individual to a message, i.e., flashing lights, movement, questions, colorful designs, or sounds, can also distract or interrupt a person from processing or engaging in the information (Ashcraft, 1989).

Attention studies also support schema research. Visual patterns are easier to find when searching for individual letters or numbers, or related combinations such as "1-2-3." When searching for words, related letters such as "t-h-e" are not seen as individual letters but as a word. How "chunks" (schema) of information are stored and retrieved is the basis of information processing.

There are limits to what the mind can process. As mentioned, Miller (1956) found that the brain can hold six units of information, plus or minus two. This increases as the information is placed into related chunks (Miller, 1956). Random letters, for instance, are hard to remember (I.B.M.Y.M.C.A.), but when organized into groups (IBM, YMCA), they are easier to recall. The best example is a phone number which, in the United States, is broken up into two or three units or chunks of information. Young and Witter's (1988) research on chunking blocks of script (discussed in Chapter III) also supports this notion.

By organizing information into meaningful units or schema, attention span can be increased. As a means of organizing the information is discovered by the individual, information becomes more meaningful (Alt and Griggs, 1984).

Selected Attention

Researchers in attention have also explored selective attention, which means seeing and hearing only one type of message. A "selection-attention model" means that one attends to specific information while being directed away from other information. The selective-attention model is supported by the situations in which the listener ignores one message while shadowing another message and readers ignore some materials while concentrating on other materials (Ashcraft, 1989).

Selective attention is found when pre-questions are used in a reading assignment, which causes one to focus attention on the questioned subject matter, but little else (Wittrock and Lumsdaine, 1977). In one study, students paid little attention to other materials when presented with pre-questions on reading assignments. Additional research showed curiosity-arousing pre-questions enhanced retention over fact-finding pre-questions (Bull and Dizney, 1973). Stating the learner objectives resulted in selective attention in the learner (Wittrock and Lumsdaine, 1977).

In the educationally oriented recreation setting, examples of selected attention are found when visitors receive question cards before visiting exhibits. The results show that visitors answer the questions but learn little else about exhibits (Koran et al., 1984). Studies of self-guided nature trails often show the same results. Much is missed because attention is focused on finding the next stop along the trail (McDonough, 1988).

A major area of research in selected attention has been the use of two messages heard at the same time. It addresses the question, "can people attend to more than one message at a time?" Using a shadowing technique, people repeat what they hear while they listen to two messages. Little is recalled from the unattended message (Cherry, 1953). However, the subject can tell the gender of the unattended voice, whether their name was used, and semantic characteristics, such as using a word to suggest meaning to the attended message (Matlin, 1983).

Bottleneck theory, discussed earlier with STM, suggests that the unattended information is not analyzed or responded to and gets filtered out (Broadbent, 1958). Because some of the second audio message can be attended to at the same time, such as hearing one's name, identifying gender, or semantic characteristics, the bottleneck theory has been modified. All information is attended to. Filtering or the bottleneck comes after the information is analyzed but before the individual responds (Treisman, 1965).

In summary, attention research supports the notion that not all information can be attended to simultaneously. The brain has limits. Attention is encouraged by both visual and audio stimuli if the target or object contrasts with its surroundings. It is also encouraged by adding color, movement, or if the target forms a natural set such as 1-2-3. Once attended to, the information is processed through either serial or parallel processing.

SERIAL AND PARALLEL PROCESSING

The basic assumption of the earlier information-processing model (Figure 4.1) is that information bits are processed in serial order, one at a time with no overlap. Only when one step is complete can the next step begin. This seems to occur in a highly conscious state of information processing (Craik and Lockhart, 1972). For example, reading instructions on how to put something together follows a logical sequence and requires serial order if the task is to be complete. On the other hand, in a situation where the task is well learned or fully automatic, other mental processes are likely to occur in parallel. This allows for more than one thing to take place in the brain at the same time. As certain actions become automatic, attention can be shifted to other tasks. For example, a child learning to walk will fall down if her mother calls out her name, because both walking and attention occupy the conscious resources. As walking enters more of an automatic mode, the child can shift her attention without falling down (Ashcraft, 1989). A second example is research in which skilled typists were trained to recite nursery rhymes while typing at high speeds (Shaffer, 1975). This is further supported by Salthouse (1984) who studied professional typists and found that they can complete up to four tasks at the same time but have little recall of the content of their typing. This parallel processing goes on in the working memory, and as discussed, has limits as to how much can be remembered (Miller, 1956).

Norman and Bobrow (1972) theorized that people have limited amounts of mental effort or resources to devote to a task. These limited resources must be divided among competing tasks. If the performance of the task can be improved with practice or becomes automatic (i.e., typing), then the task is resource limited (speed of the typewriter). On the other hand, if it cannot be improved by practice (i.e., following instructions), then the task is data-limited (limited information). This helps explain why some of the research on divided attention seemed to imply that people can attend to two messages at once, when in reality they have developed one channel of information in an automatic state (Norman and Bobrow, 1972). This line of research is discussed further in the sections that follow.

Kahneman's (1973) theory on elastic capacity also supports the idea that people process information with both multi-channels (parallel) and single channel (serial). More importantly, as information increases in importance, the individual is more attentive to content cues and the brain demands more mental capacity. At this point, the processing d

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capacity of the brain stretches or is elastic to hold more information, thus the theory's name, elastic capacity (Kahneman, 1973). During this high level of personal involvement, content-related cues are processed using only one channel (Kahneman, 1973).

AUTOMATIC VS. CONSCIOUS MENTAL PROCESSING

A great deal of research supports the theory that people function in an automatic state (Scheider and Shiffrin, 1977), with scripts (Abelson, 1981), using heuristics (Petty and Cacioppo, 1981; Chaikens, 1987) (also called a mindless state, Langer et al, 1978). During this time, mental processes are assumed to be "fully automatic," versus "fully conscious," allowing for two channels of information to be processed simultaneously or in parallel.

A number of researchers have explored the constructs of automatic versus conscious mental processing (Figure 4.3). The following review highlights this line of research as it applies to an information-processing model.

Both automatic and conscious mental processes are used in a communication environment. As stated earlier, when learning to read, a child must pay attention to each of the letters and the sounds of each letter. This takes conscious mental processing. After time, the coding process of letters and their sounds becomes automatic and the mind no longer focuses on the individual letters, but focuses on the

Figure 4.3

THEORIES OF AUTOMATIC VS. CONSCIOUS MENTAL PROCESSING

thoughtful / scripted	(Abelson, 1981)
controlled / automatic	(Schneider and Shiffrin, 1977
deep / shallow	(Craik and Lockhart, 1972)
systematic / heuristic	(Chaiken, 1987)
central / peripheral	(Petty and Cacioppo, 1981)
mindful / mindlessness	(Langer et al 1978)
high road / low road	(Salomon and Globerson, 1987)

combinations that make up words and sentences. In time, words are read and understood in a fraction of a second (LaBerge and Samuel, 1974).

Schneider and Shiffrin (1977) demonstrate two modes of information processing called "controlled/automatic." In the automatic detection mode, information is stored in complex nodes or schema in the LTM, normally in a passive state, ready for recall. The automatic state doesn't require attention and appears not to use up memory capacity. It is initiated by appropriate stimuli and then proceeds automatically, without demanding operational attention.

Experience brings about an automatic state of processing where some information is processed in parallel up to a filtering level. At the filtering level, the capacity is reached and the individual switches into the controlled state of mental processing (Schneider and Shiffrin, 1977).

Scripted research also looked at patterns of behavior that are predicted (Abelson, 1981). Scripts are a subset of schemata. For instance, visiting a restaurant is made up of various restaurant scripts from ordering food to paying the bill. Scripts are reinforced when expectations of the script are fulfilled.

Scripts are stored in long term memory. When called up, three things occur: the individual has a cognitive representation of a particular script; context for the script has been evoked; and the individual enters the script without much thought (Abelson, 1981).

Research by Petty and Cacioppo (1981) and Chaikens (1987) are examples which address persuasion as it relates to two routes of information processing, central route and peripheral route. The central or systematic route involves more cognitive input (high involvement) while the peripheral or heuristic route is automatic or scripted (low involvement). For example, students responded differently when told that comprehensive exams would be required before graduation and implemented either the following year (high involvement) or ten years down the road (low involvement).

Petty and Cacioppo (1981), found that if a receiver is not interested or motivated, or is unaware of the subject area, the peripheral route of information processing such as credible source, will be more persuasive in changing their attitudes to support comprehensive exams. On the other hand, if the receiver is highly motivated or involved in the topic, a systematic route containing sound, and detailed and logical arguments is more persuasive (Petty and Cacioppo, 1981). Their research supports the idea that people more fully process information if they are motivated by high levels of involvement.

Eysenck (1982) argues that all cognitive tasks involve some balance between automatic and conscious mental processing. The faster the task is performed, the more an automatic mode is being used. In a fast processing task, individuals are unaware of the conscious effort it takes to complete the task which can take as little as one or two seconds (Eysenck, 1982). Slow processing tasks take longer, from five seconds up to several minutes and heavily rely on a conscious effort (Eysenck, 1982).

Craik and Lockhart's (1972) research on "deep/shallow" mental processing, discussed earlier, supports the premise that information processing is on a continuum from "shallow to deep" and is measured by the use of time. Time, in essence, measures the "depth" of information processing (Eysenck, 1982; Craik and Lockhart, 1972).

In summary, there exists strong support for both serial versus parallel and automatic versus conscious processing of information. When information processing occurs without intention, cannot be recalled, is processed with multi-channels at one time, and can be improved with practice it is called automatic information processing. Conscious information processing, on the other hand, occurs only with intention, under full awareness, requires full attention, has unlimited mental capacity, and under most conditions is processed in serial order in one channel of information, unless the second activity is fully automatic. As new information is learned and added to one's long-term memory, it can be processed fully automatic.

Mindfulness and Mindlessness

Langer et al. (1978) introduced a theory called "mindfulness and mindlessness" that goes beyond the two levels of information processing just discussed and addresses the individual's state of mind. In a mindful state, content information is processed and schemata are accessed and modified (Langer, 1989). Based on both automatic and conscious theories, Langer adds the aspect of "self-control" to one's mental state. In a mindful state, one is in control, has knowledge of the task environment, finds pleasure in learning, and has high recall of the information (Langer and Imber, 1979). In a mindless state, where one has over learned the task, attention is not paid to the individual components of a task, which gives up self-control (Langer and Imber, 1979). The theoretical foundation of mindfulness/mindlessness is based on the philosophical and phenomenological writings of Husserl, Heideggger, Gibson, Rogers, and Murry (Langer, 1989).

The mindful state results in self-control, detailed attention paid to the task and analytic processing of information. Thinking becomes fun and effortless (Salomon & Globerson, 1987; Langer, 1989). Mindfulness is induced when schemata are modified, and information is provocative, personally involving, ambiguous, novel, contradictory, or conflicting (Berlyne, 1965; Langer, 1989; Salomon, & Globerson, 1987).

Mindfulness happens to everyone when analyzing a book or movie, solving a problem, generating an idea, or elaborating on concepts. Mindfulness is encouraged through the senses, questions, or conflicts. It is a feeling of intense concentration when thoughts mesh together and ideas are formed. It results in a high level of perceived control and pleasure. A key dimension of mindfulness is that experiences are stored in one's long-term memory and can be called up later (Langer, 1989). In contrast to mindfulness, people can also function in an automatic or mindless state.

Langer et al. (1978) demonstrated that people perform mindless acts when filling out forms, obeying requests, and perceiving others in both written and oral communication.

Doctors filled out and returned a nonsense questionnaire and secretaries returned a memo made with congruent requests (r=0.90) versus incongruent requests (r=0.60). The congruent request was determined by evaluating past memos in the secretaries' garbage bins. When the request was congruent with past experiences, 90% of the secretaries and 55% of the physicians complied with meaningless communication. Subjects also gave way to an oral request to use a copy machine. When the request was small, 5 copies or less, subjects were helpful and gave way to the request. They operated in a mindless state, calling up prearranged "helpful" scripts. However, with large requests (20 plus copies), subjects scrutinized the request and did not give way to the request (Langer et al., 1978). They no longer functioned in a mindless state and did not give up control (Langer et al., 1978). Langer (1989) argues that control or the perception of control is vital for people to become mindful.

Perceived Control

Perceived control is believed to be an underlying motivator to a number of attributional processes. It becomes especially important when it is challenged or lost (Fiske and Taylor, 1984; Langer, 1989). The loss of self-control can affect one's mental and physical state (Taylor, 1979; Piper & Langer, 1986). It can also lead to a feeling of helplessness, anxiety, and passivity where one is unable to take in information (Taylor, 1979). Taken to its extreme, it can lead to self-induced dependency (Langer & Benevento, 1978).

Control is linked with job related stress, social economic status (Syme, 1990), life satisfaction, coping skills, disease, health, psychological well-being, social support systems (Rodin, 1985, Rodin et al., 1986), self-esteem (Fiske and Taylor, 1984) and a mindful state (Langer, 1989).

It was argued early in the psychology literature that the desire for control is basic to human behavior (White, 1959). Cognitive-dissonance theory by Festinger (1957) is based on maintaining self-control by engaging in rationalization and reducing mental conflict. Festinger states that cognitive control is the desire to encourage or maintain a feeling of control, while perceived control is having the power to participate in making decisions (Rodin et al., 1986).

Perceiving control may be more important than actual behavioral control (Rodin, et al., 1990). Langer's (1975) study on gambling shows that people over-estimate the amount of control they have in chance situations. This suggests that people are motivated to believe that they can control their environment because it makes the world appear predictable when it is not (Wrightsman & Deaux, 1981).

Iso-Ahola (1989) argues that perceived control leads to intrinsic motivation and is reflected in behaviors that are inherently pleasurable and self-satisfying. The opportunity to choose an activity enhances intrinsic motivation. One study found that children's level of intrinsic motivation was reduced when adults chose their play activity (Swann and Pittmann, 1977). In another study, college students spent less time and had lower intrinsic motivation when they had no control over choosing their tasks (Zuckerman et al., 1978). When applied to the leisure setting, freedom of choice appears to be necessary for intrinsic motivation (Iso-Ahola, 1989).

Propst and Kurtz (1989) suggest that an increase in perceived control in the recreation setting has a positive impact on an individual's psychological well-being. Deci and Ryan (1985) show that noncontrolling environments can reduce aggressive behavior and promote perceived competence and self-esteem.

Conversely, externally controlled environments have negative consequences. Studies show that controlled environments lower creativity of children, impair cognitive learning of college students, induce a negative feeling in general, and create a less positive view of others (Deci and Ryan, 1985).

Weisz (1990) argues that there are two types of control: primary (environmental) and secondary (self). The first is important in predicting events, conditions and solving problems. The second is important for the self because it reduces anxiety, avoids unpleasant thoughts, shows alignment with individuals and groups, and increases coping skills. Too much environmental control can have negative effects. Too little self-control can also have negative effects, as in nursing homes or army life. Research reported by Rodin et al. (1986) suggests that older people in highly controlled environments, when given a sense of self-control, improve psychological and cognitive functions.

A precondition to a sense of control is a perception of ability (for a review, Fiske and Taylor, 1984). Control is based on two preconditions: contingency judgment and competence judgment (Weisz, 1990). Contingency judgment is the degree to which an individual perceives that they will make a difference. Competence judgment is the capacity, ability or skill to do the intended action. It grows with age and mental development. Judgment about control is based both on one's perception of impact and one's perception of ability (Weisz, 1990). The perception of ability has been called the individual's self-efficacy (Bandura, 1977).

Self-efficacy is a precondition to perceived control (Rodin et al., 1986). The individual's judgment or perception of his/her own abilities in executing different levels of performance is one's self-efficacy. Self-efficacy can influence levels of motivation, cognition, emotions and behaviors in coping with adverse events (Rodin et al., 1986). Salomon's (1983, 1984, 1985) work with the perception of media (discussed earlier) also suggested that learning from certain media, such as computers, can be influenced by one's self-efficacy.

Piper and Langer's (1986) research shows that an increase in perceived self-control, even in a setting of low environmental control, can also have a positive impact on one's physical well-being. Working with elderly people in nursing homes, Piper and Langer have explored how perceived control can enhance the quality of life through mindful experiences. The physical and social environment in nursing homes generally promotes a lack of control and a mindless state. When elderly nursing home patients were encouraged to make decisions, provided with decisions to make, and given a plant to care for, they were happier, more alert, more active, and lived longer than a control group. Rodin's (1985) work with the elderly also showed that increased self-control reduced feelings of stress, increased problem-solving ability and, most importantly, reduced long-term corticosteroid levels associated with physiological stress.

"Perception" of control plays an important role in any setting. However, in the recreation setting as was argued earlier, freedom (low environmental control) and intrinsic motivation (high self-control) are important for the leisure experience (Samdahl, 1989). In the educationally oriented recreation setting, visitors want a sense of being in control while management would like to protect the resource from being overrun. For these reasons, a fine line exists in recreation settings between actual and perceived control (Propst and Kurtz, 1989).

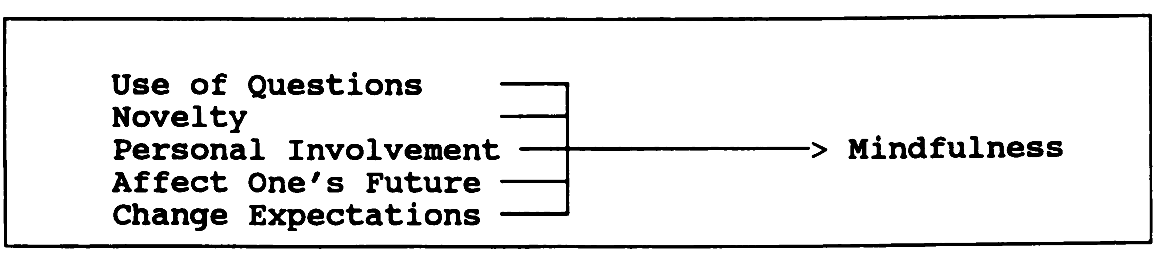
NATURE OF INSTRUCTION

Langer (1989) has identified five variables that activate the cognitive process of instructional-induced mindfulness: questions, novel items, personal involvement, making the event relevant to one's future, and changing expectations (Figure 4.4). Application of these variables to

Figure 4.4

VARIABLES THAT ACTIVATE MINDFULNESS

Langer 1989



exhibits found in the educationally oriented recreation setting was reviewed in chapters II and III. Each of these variables can lead to increased involvement. The involvement variable, as discussed in chapter III, plays a key role in encouraging learning. As a motivator, involvement has been studied in three ways: personal, mental and physical.

Personal Involvement

As discussed earlier, Petty and Cacioppo (1981) found that people process information using the central route (mindful) when the information directly affects their immediate future. Undergraduate students who were asked to judge the value of comprehensive exams before graduation processed the information more mindfully when it affected them personally (personal involvement). When the exams were to be administered at another time or another university, they processed the information with heuristic cues, rules or shortcuts instead of absorbing the content of the message. The situation encouraged less personal involvement and resulted in mindlessness.

Cacioppo and Petty (1982) also found that a small minority of people naturally enjoy greater cognitive activities. These people are highly motivated to learn, have a high need for cognition and process most information in a systematic way. Individuals with a low need for cognition are generally more susceptible to persuasion, show less aptitude in formal school environments, show less knowledge in general areas, and enjoy less mentally demanding tasks (Salomon, and Globerson, 1987; Kruglanski & Klar, 1986). The "need for cognition" was found to be an antecedent to involvement (Cacioppo and Petty, 1982).

Mental Involvement

Mental involvement has also been studied in exhibit research as a variable called engagement. When engaged, the visitor spends more time, interacts with the topic, and becomes more mindful of the subject areas (Wise & Okey, 1983). Hands-on activities or interactive materials that require manipulation are found to be more engaging. Illustrative materials were also found to increase engagement compared to verbal materials. Colored illustrations were more effective than black and white and even more effective when combined with verbal materials (Clark & Angert, 1980). This research is well supported in the museum and interpretation research cited in Chapter III.

Physical Involvement

The involvement variable appears to be one of the strongest influences for the recreation setting. As described earlier, hands-on interaction can motivate visitors and increase levels of attention. Physical involvement may act as a foot-in-the-door to mental cognitive processing. As a compliance theory, foot-in-the-door theory says that individuals respond positively to large requests if they have previously responded to smaller requests (Freedman and Fraser, 1966). Homeowners were asked to sign a petition to support a bill on safe driving (small request). A week later, homeowners were asked to put a bright, large, unattractive sign in their yard that read "Drive Carefully" (large request). Over 55% of the subjects complied with the second request while only 17% of a control group, who were not asked to sign a petition, complied (Freedman and Fraser, 1966). Langer's research suggests that the first request was responded to mindlessly and the second response, mindfully. It implies that even in a mindless state, information is being processed (recalled for later response). Physical involvement appears to act as a catalyst or spark to the cognitive mind-set. When combined with a high level of self-control (perceived control) it appears that the two encourage cognitive processing.

Cognitive Levels and Involvement

A study in the recreation setting suggests that the cognitive level of visitors affects how they learn. Greenglass (1986) studied the different components of exhibits (interactive devices, leading questions, etc.) and compared them with visitors' levels of cognition. Results indicated that visitors with low cognitive levels benefited from high interactive structure but visitors with high cognitive levels learned as well with or without the interactive structure. Thus, using interactive and attention getting devices such as leading questions, benefits low cognitive level visitors but does not decrease the learning experience for high cognitive level visitors (Greenglass, 1986).

Salomon and Globerson's (1987) theory of "high road" and "low road" learning supports this study. The high road of learning is mentally more demanding, non-automatic, and incorporates past knowledge and skills (mindfulness). The low road of learning is mentally undemanding, more automatic, and takes less time (mindlessness). It typically is based on tactile knowledge, skills, attitudes, beliefs, habits, and behavioral patterns (Salomon and Globerson, 1987). Salomon and Globerson (1987) argue in order to get from the low road to the high road, individuals must go through a mid-level stage which requires mental effort before engaging in a cognitive mind set. Langer's (1989) work suggests that one's perception of control is an intervening variable to mindfulness. Control appears to open or close the learning door.

Mindfulness in the Educationally Oriented Recreation Setting

Langer's work is very relevant to educationally orientated recreation facilities and the area of interpretation. Her research suggests that mindfulness has a direct relationship with knowledge gained, awareness, perceived control, participation, satisfaction and enjoyment (Langer, 1989). Traditionally, research on visitor information has only measured knowledge gained or satisfaction levels.

Two studies have attempted to apply the mindfulness/mindlessness theory to the educationally oriented recreation setting. Moscardo and Pearce (1986), in a study of 17 centers (3000 subjects) in England, used the mindfulness / mindlessness theory on visitor information centers to evaluate exhibits. Contrary to Langer's theory, they found that information recall and enjoyment were not related in all cases ($r = -0.013$). A relationship was only found among visitor centers with highly specific interpretive themes such as history or conservation. Subjective knowledge (what they thought they learned) and enjoyment were highly correlated ($r = 0.647$). Moscardo and Pearce measured mindfulness with a four item scale: visitor's subjective knowledge, score on informal recall, score for wanting more information on the topic, and a score for wanting more information provided by the visitor center. But, this scale did not find out if subjects engaged in pleasurable thoughts or increased their curiosity when viewing the exhibits. In addition, there was not a measure of self-control. This study supports other findings by Beer (1987) that show interactive exhibits can produce high satisfaction but little learning.

Moscardo's (1988) work with the same data set attempted to provide a model to fit the mindful paradigm to exhibits in visitor centers. Her previous study showed no direct link between satisfaction and information recall, but a direct relationship of satisfaction to mindfulness (Moscardo and Pearce, 1986). In this research satisfaction was correlated with complexity and style of information presented. A curvilinear relationship between mindfulness and complexity of the exhibits was hypothesized. As the information became more complex, the visitor would lose interest. However,the relationship was found to be linear (Moscardo, 1988), possibly the result of the above-mentioned limitations or the fact that she used secondary data that was gathered with different objectives in mind. Moscardo raises questions about Langer's theory in that she found no direct link between satisfaction and information recall.

In summary, the literature on visitor studies suggests that hands-on exhibits work some of the time but not all of the time. This implies that an intervening variable such as perceived control could influence cognitive learning. Most of the findings show an increase in affective learning over cognition (Falk et al., 1986; Marten & O'Reilly, 1988). Both low and high levels of learning are taking place, but not at the cognitive level for which exhibits are intended. Providing visitors with a perception of control without taking actual control away from exhibit management may be an important way to maximize learning and enjoyment in these educationally oriented recreation settings.

MINDFULNESS/MINDLESSNESS AND INFORMATION PROCESSING

The major differences between theories of mindfulness and information processing lie in the research in which each theory is based. Mindfulness/mindlessness is based in social psychology, while information processing is based in cognitive psychology. Cognitive psychology supports the idea of single context (serial) processing, while this is less true for social psychological research (Langer, 1989). Although cognitive research has been used to interpret social phenomena (Taylor, 1981), in this paper, it describes the process of learning in informal education and recreation settings. The marriage of these two separate lines of research was suggested by Taylor in 1975. A review of the theories supports this suggestion.

In the mindfulness theory, information is assigned meaning based on the individuals level of control. This theory focuses on both the state of mind of the person and his/her behavior (Langer, 1989). Based on schemata theory, mindfulness/mindlessness also involves the creation of categories. Adding to or modifying these categories to create smaller and more discrete categories is compatible with information processing theory's (IPT) concept of adding bits of information to one's long-term memory.

The mindful mode can enlarge one's mental capacity while the mindless mode has a fixed or limited mental capacity. This also is compatible with IPT. Langer (1989) describes mindlessness as single-minded awareness, not single-channel processing. Once information has been processed mindlessly, it is no longer available for active conscious use (Chanowitz & Langer, 1981; Langer & Imber, 1979). If presented again and under different conditions, this information could be processed mindfully (Langer, 1989).

IPT suggests that while people are in a mindless state, information is processed in multiple channels or in parallel. Research by Kahneman (1973) supports multi-channel limited capacity processing. Both theories suggest that mindless behavior and STM processing are pervasive, are typically faster than mindful processing, and can be the result of both one-time exposure and repeated exposure to information. Mindfulness is a sensitivity to the context and gaining control over it, while mindlessness is the submergence in a context without control (Langer, 1989). Combining the two theories by adding the control variable to IPT suggests that LTM is accessed when one perceives he or she is in control.

SUMMARY AND CONCLUSION

The research from the field of visitor studies and interpretation suggests that little learning is taking place from exhibits in educationally oriented recreation settings (chapter III). Visitors passively attend to messages (like window shopping). This chapter uses theories from cognitive and social psychology to support the idea that people process information in two levels, mindful (conscious) or mindless (automatic) (Langer, 1989).

Information processing theory suggests that one must first attend to the stimuli. Visual stimuli (color, movement, patterns, size and pre-questions) and audio stimuli (volume of the message) are attention getting. Learning starts with the intake of stimuli. Information is then prioritized and processed through a series of memory stages i.e., sensory memory, short-term memory and long-term memory. Comprehension is based on stimuli (bottom-up processing), schema (top-down processing) and the nature of the instruction (Gagne, 1985). Semantic memory is what is needed in order to understand new information or experiences.

Information is processed in either serial (single) or parallel channels, and the response is either conscious or automatic. Priorities for which channel or response is set by the executive controller (Gagne, 1985; Ashcraft, 1989). In a highly conscious mental state, information is processed in serial order, single channel and has access to one's long-term memory. In a low conscious mental state, information is processed in parallel, multiple channels, there is minimal access to LTM and the task (behavior) is automatic (Ashcraft, 1989).

Langer (1989) argues that learning takes place when the individual is motivated by a sense of perceived control. Rodin, et al. (1990) and Weisz (1990) argue that a precondition to control is self-efficacy. The involvement construct has also been shown to be an important motivator to learning, specifically, the nature of instruction. It is most important when individuals are in a state of low motivation, mindlessness, "low road" or "low need for cognition." Involvement does not distract from individuals who were highly motivated (Greenglass, 1986).

Using the theories discussed in this chapter, the following chapter builds a causal model that shows how learning can be encouraged in educationally oriented recreation settings.

CHAPTER V

MODEL FOR LEARNING IN EDUCATIONALLY ORIENTED RECREATION SETTINGS

Education in the educationally oriented recreation environment is unique because the visitor is under no obligation to learn. Although an individual's cognitive process is the same in all environments, the opportunities for learning in the recreation setting are different from formal educational environments (Korn, 1991). The formal educational environment is often based on what the teacher or curriculum dictates the pupil should learn. This external motivation can limit true learning (information added to long term memory) (Korn, 1991). On the other hand, the recreation and leisure experience is an informal learning environment based on how an individual perceives freedom and an intrinsic motivation (Samdahl, 1989; Iso-Ahola, 1989).

Education research shows that learning variance can be explained by intrinsic motivation (Fraser et al., 1987). Works by social psychologists Rodin and Langer show that this self-directedness (perceived control) leads to greater satisfaction, increased learning and improved health.

The educationally oriented recreation setting is argued to be an ideal environment for self-directed learning (McDonough, 1986; Mullins, 1991). Visitors have the opportunity to learn while handling objects and being involved with the subject (Screven, 1973; Koran et al., 1983). But, is it possible to measure the "gleam" in the visitors eye?

Creating effective learning environments in recreation settings is often referred to as the "art of interpretation." Although it has been described as impossible to quantify or turn into a science (Ham, 1986), interpreters think they know when the "gleam" exists. Engaged visitors ask more questions, spend more time at programs or exhibits, and provide various behavioral cues such as nodding, eye contact, smiling, hand gestures and sharing information with others in their group (McManus, 1989; Bitgood et al., 1986b; Screven, 1990; Soren, 1991).

Communicating meaningful messages to this leisure-minded audience is difficult because little is known about what motivates the visitor (Korn, 1991). Research cited in this paper indicates that minimal learning takes place in these settings. Visitors spend little time viewing, reading and thinking about exhibits unless they are motivated (Shettel et al., 1968; Koran et al., 1983; Screven, 1973; Miles, 1987; Moscardo, 1988). Chapter III provided a review of what visitors attend to in museums, zoos, and visitor centers. Chapter IV reviewed cognition research on how information is retained and processed.

This chapter uses previously cited research from leisure, communication, education, museum science, visitor studies, cognition and social psychology to build a theoretical model that reflects processes going on within the visitor's mind at educationally oriented recreation settings. Represented as a causal model, it attempts to sort out, quantify and explain key motivational constructs that encourage learning in educationally oriented recreation settings. In addition, a causal relationship between variables is proposed.

Defining A Model

Important to the understanding of models is the understanding of causality. Social science research does not set out to determine that people have no free will, but instead looks at the factors or forces that have the greatest amount of explainability, represented with the fewest number of causal variables (Babbie, 1979). Causation assumes that the causal variable (X) has an effect on another variable (Y). Social science attempts to answer how Y is a function of X or under what operational definitions is this true (Babbie, 1979). A causal model can also add intervening variables between Y and X to better explain under what condition X causes Y. In addition, a model can also address antecedent variables which help explain the conditions of X.

Mill's "Canons of Causality" identifies three assumptions of causality. First, the cause must precede the effect in time. That is, if X causes Y, then X precedes Y in time. Second, there must exist a concomitant variation (functional relationship) between the cause and effect. Third, this relationship must not be spurious (false). Causality cannot be observed, only inferred (Babbie, 1979).

Thus, a causal model attempts to identify what happens to an individual under certain conditions during a given event. It is, by definition, the operationalization of a theory. Models outline causal relationships within the given event by transforming theoretical ideas into a mathematical model. Mathematical models estimate the relationship between variables and determine if the data fit the theory and represent the testable form of a theory. By definition, models represent the population (Hunter and Gerbing, 1982).

In summary, a causal model begins with theoretical constructs such as abilities, attitudes, desires, policies, or perceptions. To test the relationships in a model, constructs are replaced by variables and coded as numbers (Hunter and Gerbing, 1982). In essence, a causal model identifies an event that sets something in motion which results in a feeling or a behavior such as learning. Variables map the process and are a definition of reality.

Because the model supports a theory or is the basis of a theory, it should represent the best thinking on the topic or subject (Hunter, 1991).

Why A Model?

The purpose of building a causal model is to examine the relationships between variables and individuals to see if they reflect reality. By building a causal chain that includes antecedent and intervening variables, a model can be a stronger predictor of reality (visitor behavior), both conceptually and statistically (Hunter and Gerbing, 1982).

The development of learning environments in recreation settings traditionally has not taken into account the visitors frame of reference or perspective (Korn, 1991). By applying a model which reflects learning in educationally oriented recreation settings, one can improve the communication of information in these settings.

MODELS FOR LEARNING

Education is a major component in the mission statements of all educationally oriented recreational facilities. Building a theoretical model about how people learn in recreation settings is important because people are motivated differently than they are in traditional classrooms. Models or theories that depict learning, such as Bloom's Taxonomy or Hines, Hungerford, & Tomera's environmental education model are not adequate to predict learning in the recreation setting.

Educational models are at the core of many educational programs found in schools. Bloom's (1956) taxonomy of the cognitive domain is found in every introductory education class. It contains six major components that reflect a linear process of learning, (Figure 5.1).

The model assumes that learning is hierarchical and starts out with the simplest process (acquiring knowledge) and moves to more complex process (evaluation knowledge). Each step must be completed before the next step takes place (further review, Bloom, 1956). However, after 35 years of working with Bloom's taxonomy, researchers can find little

Figure 5.1

BLOOM'S TAXONOMY
(Bloom, 1956)

1. Knowledge
2. Comprehension
3. Application
4. Analysis
5. Synthesis
6. Evaluation

if any data that shows that knowledge leads to evaluation (Anderson, 1990). In an environment where people are under no obligation to learn, the model appears to have little application.

Environmental education models also exist. The one proposed by Hines, et al. (1986), suggests that awareness leads to knowledge, then to a change in attitude, moves to an increase in skills, and finally to action (Hines, et al., 1986), (Figure 5.2).

Based on a meta-analysis of 128 studies they found these variables to contribute to the environmental education process, but the variables follow in no specific order.

Figure 5.2

ENVIRONMENTAL EDUCATION MODEL

(Hines et al., 1986)

1. Awareness
2. Knowledge
3. Attitudes
4. Skills
5. Participation or Action

This model has no empirical data to suggest causal relationships. Hines et al. (1986) suggest adding the variables "locus of control" and "situational factors" as a better predictor for environmental behavior.

Korn and Dierking (1991) developed a theoretical model for museum studies that suggests that learning is based on four contexts: the individual's previous knowledge, the physical object or subject, the social context of the setting, and the immediate experience. Korn and Dierking argue that all four contexts are inter-related and must be analyzed at the same time to understand the impact of museums on the visitor. Because learning is in the hands of the learner, it is based on an interaction of the visitor with the object or "sense-making" activity (Korn, 1991). Empowering the visitor is addressing the visitor's framework, perceptions, emotions, and physical needs.

Korn and Dierking call on the works of anthropologist Nelson Graburn (1977) and geographer Sheldon Annis (1986) to support their premise that museums fulfill three human needs: reverential (intensive, higher order,sacred), social and educational. Korn and Dierking's theory has not been tested but appears to be supported by other visitor study research (Korn, 1991). Their theory sheds light on the idea that the museum experience is made up of more than seeking new information. Learning is only one part of the experience (Korn, 1991).

All of the above mentioned models are based on two assumptions: 1) people want to learn, and 2) people process information in a logical sequence. However, the research from the previous chapter on automatic versus conscious processing suggests these are both false (Abelson, 1981; Schneider and Shiffrin, 1977; Petty and Cacioppo, 1981; Chaiken, 1987; Langer, 1989).

PARADIGM SHIFT

There is strong support in psychology to suggest that humans are "cognitive misers" (Taylor, 1981). The brain has been designed to take shortcuts whenever possible. We attend to messages with the least amount of mental effort and we use heuristic techniques whenever possible in calling up scripts that guide decision making (Nisbett and Ross, 1980). Moscardo (1988) suggests that the field of visitor information and interpretation should no longer view humans as active information processors but as visitors who process little or no information. The field of social and cognitive psychology and research on communication and persuasion strongly supports this premise (Langer et al., 1978; Taylor, 1981; Petty and Cacioppo, 1981; Nisbett & Ross, 1980).

A new model is needed to address the idea that visitors choose to learn, or not learn, based on the behavioral setting (Roggenbuck et al., 1991), the messages presented to them (Petty and Cacioppa, 1981), their perception of mental energy involved (Salomon, 1983), and their cognitive structures or schemata (Lee and Uzzell, 1980). Before a new model is theorized, clues from other learning models applied in the educationally oriented recreation setting will be discussed.

THEORETICAL MODELS FOR EDUCATIONALLY ORIENTED RECREATION SETTING

Combining four models by Moscardo (1988), Koran and Koran (1983), Roggenbuck et al.(1991) and Tennyson (1989) provides a framework to better understand learning in educationally oriented recreation settings.

Moscardo's (1988) conducted research in five Forestry Commission Centers in the United Kingdom (reported in Chapter IV.) supports applying mindfulness/mindlessness as a cognitive model for visitors in recreation settings. Moscardo's work, based on Langer's theory, claims that visitors function in a scripted or mindless state until jarred out of it by a visually stimulating or interactive exhibit. With this in mind, Moscardo proposes a model of the museum visit that includes both exhibit and visitor factors that encourage mindful or mindless outcomes (Figure 5.3).

The Roggenbuck et al. (1991) model suggests that learning benefits found in the leisure setting are based on three antecedents: the social experience, individuals personality and the physical environment (Figure 5.4). When visitors enter a leisure experience, they bring certain

Figure 5.3

PROPOSED MODEL OF MUSEUM VISITORS

Moscardo, 1988

1. Exhibit Factors

Moderate Complexity	Extreme Complexity
Variety of Media	Repetition
Participation	No Participation
Highly Relevant Content	

2. Visitor Factors

High Interest in Content	Low Interest in Content
Low Fatigue	High Fatigue

3. Cognitive State of the Museum Visitor

Mindful	Mindless

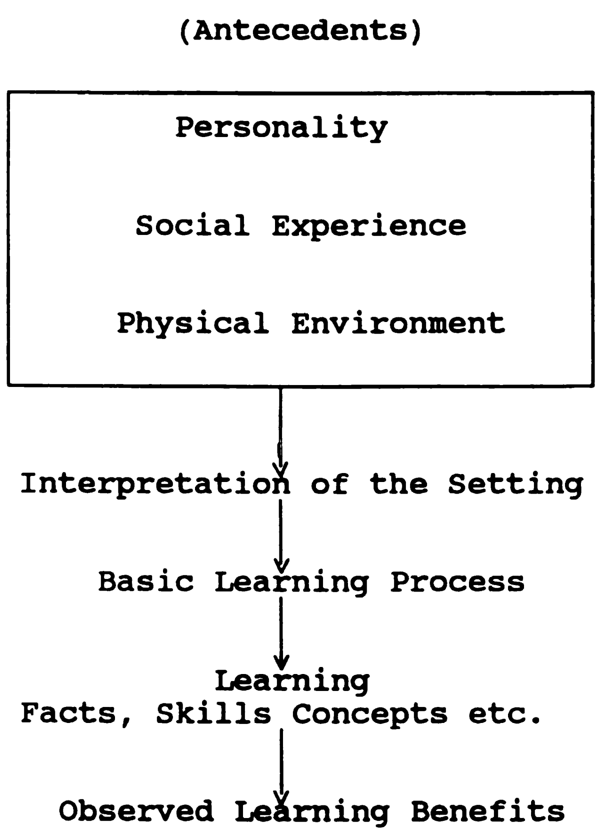
4. Outcomes

Satisfaction	Low Satisfaction
Learning	Poor Learning
Curiosity	Boredom

Figure 5.4

INTEGRATED MODEL OF LEISURE LEARNING

(Roggenbuck et al., 1991)



expectations and individual learning preferences are often a part of a social experience (Chapter II).

Koran et al. (1983) developed a model that applies information processing theory (IPT) to a museum setting. Information processing theory suggests that the individual first has to attend to the message (stimuli), code the information (based on perception), add it to memory, and retrieve it from memory. The components of a cognitive system include sensory receptors (sight, sound, touch, smell, taste), perception, short-term memory and long-term memory (storage and retrieval). Their linear model is seen in Figure 5.5.

Tennyson (1989) also applied information processing theory (IPT) to the way people learn with interactive computers (Figure 5.6). He modified the linear model of IPT by identifying higher levels of cognition with the use of a feedback loop from long-term memory to perception. The basis for this added path is that higher levels of cognition encourage creative thinking which, in turn, changes or modifies perceptions. Just recalling information is characteristic of the automatic function of cognition which is represented in the linear diagram. Creative knowledge involves the entire cognitive system. Individuals internally create and solve problems by integrating new knowledge with present scripts, forming new schema (Tennyson, 1989).

Figure 5.5

INFORMATION PROCESSING MODEL FOR MUSEUM VISITORS

Koran et al., 1983

```
Stimuli -> Attention -> STM -> LTM -> Information -> Response -> Reinforcement
(Exhibit)               (Coding)      (Retrieval)    (Behavior)   (Perception)
```

Model Limitations

The above models have some limitations or problems when illustrating causal relationships. Moscardo (1988) operationalized exhibits as mindful or not mindful when she could have used people and probably with much different results. Second, information processing theory, used in Koran and Koran (1983) and Tennyson's (1987) models, provides no way to test relationships between the constructs STM and LTM. Third, some actions may appear to go on at the same time, such as behavior and learning, and this is difficult to separate in any of the above model examples.

Figure 5.6

COGNITIVE SYSTEM MODEL

Tennyson, 1987

```
External --> Sensory --> Perception --> STM --> LTM
Information  Receptors       |                    |
                             | (Feedback Loop)    |
                             └-<--------------<---┘
                           Creation of Knowledge
```

This dissertation proposes a new model with a number of alternatives to the Moscardo (1988), Koran et al. (1988) Tennyson (1989) and Roggenbuck et al. (1991) models. The proposed model begins by looking at the visitor prior to the experience and examining mental processing (mindfulness). It describes mindfulness from the visitor's perspective, not that of the exhibit. Next, it uses information processing theory, i.e., short-term and long-term memory, to help explain mindfulness and mindlessness. The model assumes IPT is the underlying basis of cognition theory. Finally, it looks at constructs that have causal relationships which can be operationalized.

MODEL FOR VISITOR LEARNING

It can be argued from the discussion in chapter IV that people process information in one of two mind-sets, either consciously (mindful) or automatically (mindless). Information processing theory suggests that mindful processing (adding information to LTM) requires a good deal of mental energy. Mindless processing is based on schemata, scripts and automatic behavior. Little if any modification of LTM goes on during mindless processing.

The research in visitor behavior strongly suggests that little learning takes place in the educationally oriented recreation setting (Shettel et al., 1968; Screven, 1969; DeWaard et al., 1974; Shiner and Shafer, 1975; Lime, 1979;

Clowes and Wolff, 1980; Landray and Bridge, 1981; Koran et al, 1983, 1988; Bitgood et al., 1988; Moscardo, 1988; D'Amico and Pokirny, 1990; Doering, 1991). Miles (1987) claims visitors in the educationally orientated recreation setting function as if they are "window shopping." Langer's (1989) work suggests that the visitor is in a scripted or automatic mind-set she calls "mindlessness." In this mind-set, the individual processes a wide range of information (in their STM) with a variety of channels (in parallel), though not very deeply (Craik and Lockhart, 1972). An individual's mental capacity is limited to six items, plus or minus two (Miller, 1956). In addition, the individual appears to tire mentally when receiving too much stimulation and tunes out incoming information. Called museum fatigue, this phenomenon was first recognized and studied in 1928 by Robinson.

Research has also shown that visitors can and do learn from interactive or participatory exhibits (also called adjunct devices) (DeWaard et al., 1974, Gillie and Wilson, 1982 Birney, 1988; Derwin and Piper, 1988; White and Barry, 1984; Moscardo and Pearce, 1986). Cohen (1987) argues that interactive or participatory exhibits are more successful because they attract and hold visitor attention and reduce museum fatigue. Screven's (1974) research shows that adjunct devices can lead to increased knowledge in the museum setting. When visitors were asked questions and given feedback to their answers using flip cards, punchboards or with interactive computers, greater learning resulted (Screven, 1974, 1975, Morrissey, 1989).

Applying information processing theory to the uses of interactive or "hands-on" exhibits, suggests that individuals can process information in a higher stage or in their long-term memory when using these types of exhibits. At this cognitive stage, information is accessed randomly from one's long-term memory, processed in a single channel and given unlimited mental capacity (Kahneman, 1973). Therefore, an important construct for the educationally oriented recreation setting is the use of participatory or hands-on exhibits. But, hands-on exhibits were found to work only under limited conditions (Borun and Miller, 1980 Beer, 1987; Borun, 1989). Studying the setting and the individual(s) at the same time provides a better understanding of how the learning process operates.

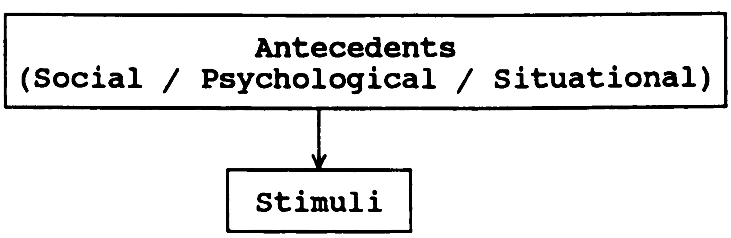
Antecedents

The first step is knowing your audience: age levels, developmental levels, learning styles, and social arrangements. These various attributes or components are antecedents to the learning experience (Figure 5.7). Materials or message need to be designed for the developmental levels of the target audience (Boram, 1991). For example, if the message requires abstract thought (i.e. forces in gravity) then the target audience needs to be at the necessary developmental stage to comprehend something they cannot see. Learning will not take place if the visitor is not developmentally ready (Boram, 1991).

The individual's learning style can also influence learning. Some individuals have a natural interest in all levels of learning and will read everything. These "high need for cognition" individuals process information in a systematic way (Cacioppo and Petty, 1982). In addition, the interaction within the social structure (peers or adult-child) has been found to increase learning (Diamond, 1986; White, 1990). The variable "where the action is" shows that

Figure 5.7

ANTECEDENTS



people are drawn to other people because they believe that something important is about to happen (Brown, 1987; Koran, et al., 1989).

Situational antecedents are events or situations that make certain topics more salient to people who normally would have no interest. These topics spark an interest which could result in a visit to a given site, gallery or exhibit.

Collectively, why the visitor is attracted or what they bring to the educationally oriented recreation setting (social, psychological and situational) can influence the willingness of the individual to attend to the stimuli.

<u>Stimuli</u>

The stimuli is the educational exhibit, message, or display that vies for the visitor's attention. It includes the brightness, size, color, pattern and interactive device of an exhibit. It may also be a sign to orient the visitor or inform them of management policies (i.e. "Take only photographs, leave only footprints"). Stimuli are designed to attract the visitor's senses of sight, sound, smell, touch, or taste. The stimuli go on even if the visitor is not attending. Like the tree that falls in the forest, if no one is around, the tree makes no noise yet sends out sound waves (stimuli). Stimuli are measured in terms of visitor attraction power to the exhibit. Does the visitor see the exhibit? Do they then attend to it?

Schemata research suggests that the attracting power of an exhibit increases when a visitor's previous scripts are called up. Examples are asking question when the message has a direct impact on one's future, or when using novelty which changes one's expectation (Langer, 1989). The stimuli aims at gaining the attention of the visitor.

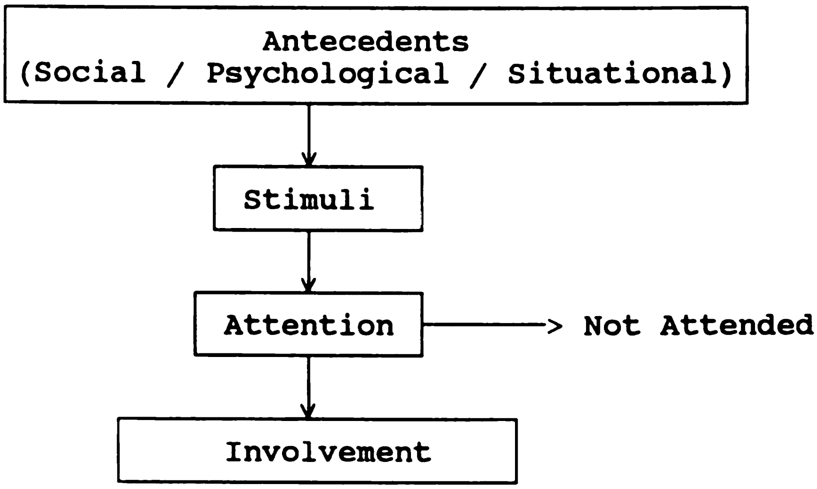
Attention

For information to be learned, it first must be attended to by the visitor (Figure 5.8). Levels of attention are encouraged based on the stimuli's color, movement, size, shape, contrast to one's surrounding, vivid image or natural set such as "1,2,3" (Matlin, 1983). Visitor attention has been studied as the "holding power" of an exhibit (Bitgood et al., 1986a). Stimuli enter one's short-term memory where information is processed as part of the working memory - visual, audio, smell and touch. For example, Koran et al. (1984) found that cueing the visitor as to what to attend to can also lead to increased attention. Important to understanding attention is that the same stimuli that can get one's attention, such as calling one's name, can also interrupt cognitive processing. If the information is not seen or heard by the visitor, then the message goes unattended.

Information in the attention stage of the model is processed in STM and stays for a very short period of time. It can be lost forever if not added to one's long-term memory (Ashcraft, 1989). Salomon's (1984) work on perception

Figure 5.8

ATTENTION



of media suggests an intervening variable between attention and involvement.

Perception

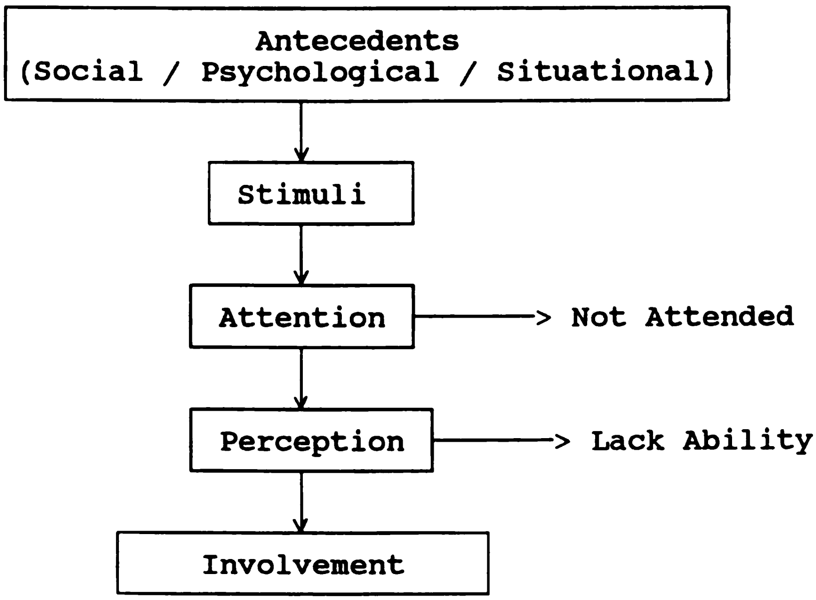
Perception of the media can influence an individual's willingness to participate or get involved (Salomon, 1984). Perception is based on scripts and schemata that the visitor brings into the recreation setting. The willingness to invest energy to attend to the message is based on past experiences. If the environment does not appear real, or is of poor quality, the visitor is not likely to invest the energy needed to understand the message (Salomon, 1984, 1985). The "amount of invested mental effort" (AIME), influences the mental effort the individual will put forth for the task at hand (Figure 5.9).

Perception of the media influences factors that lead to achievement. Salomon (1984), for example, found that learners perceive television to be easier than print media and invest more mental effort in text-based lessons. Self-efficacy (perceived ability), as proposed by Rodin et al. (1986), takes place prior to perceived control. In other words, one has to believe they have the ability to use the interactive device (such as a computer) before they will use it.

Visitors are ready to interact or become involved with the exhibit if they perceives to have the ability to use the media. As cited earlier, the involvement construct has been

Figure 5.9

PERCEPTION



shown to lead to learning or mental engagement.

Involvement Variable

Involvement acts as an introductory request to the cognitive process. The working memory calls up schema (Ashcraft, 1989) which suggest that this may be fun or interesting. The Compliance theory ("foot-in-the-door") states that people are more likely to comply with a larger request if given a small request first (Freedman and Fraser, 1966). Physical involvement acts as that small request resulting in a larger request for cognitive processing.

Physical involvement (hands-on) can be introduced to provide a way that low mind-set visitors can engage in learning (Greenglass, 1986). These include adjunct devices such as: flip cards, picture matching and button pushing, interactive video, tape or audio services, interactive computers, and punch board score cards with feedback (Screven, 1974, 1975; Washburne and Wagar, 1972; Morrissey, 1989).

Physical involvement activates or encourages visitor cognitive responses (Cherem, 1977; Ackermann, 1987). More than just an open-ended activity, the visitor is able to make further choices, find answers and call up additional scripts (Screven, 1974, 1975).

The behavioral psychologist would view the use of an interactive device as a reinforcement to the learning process and search for no other explanations as to how exhibits teach. However, major studies in the museum and zoo fields show that interactive exhibits do not always lead to learning (Borun and Miller, 1980; Beer, 1987; Borun, 1989). Screven (1975) and Cohen (1987) both warn that interactive devices alone do not guarantee learning. The field of cognitive psychology, theory on information processing, works by Rodin et al. (1990) and Langer (1989), writings by Korn (1991), and research on interactive computers suggest that some intervening variable affect cognitive processing.

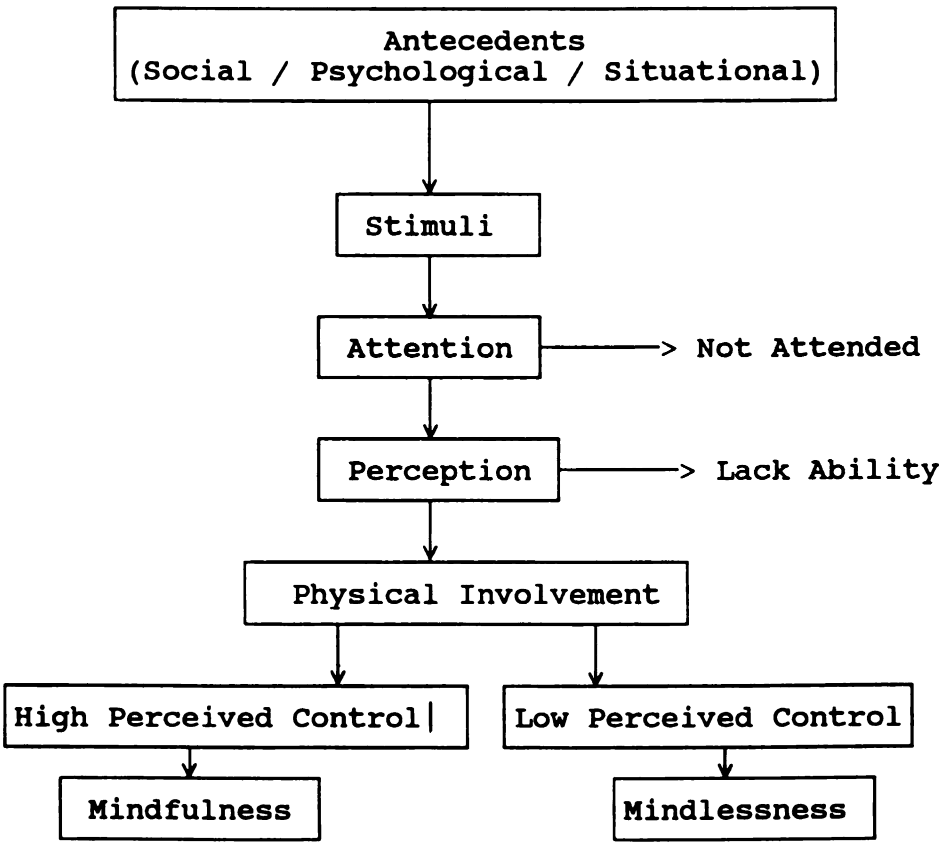
Intervening Variable: Perceived Control

Langer (1989) argues that people must feel in control of their environment for the experience to be mindful. The intervening variable is the individual's perception of control. Having the opportunity to participate in making decisions, feeling in control or being able to manipulate possible outcomes results in a more mindful experience (Langer, 1989).

Perceived control influences the visitor's willingness to attend mindfully or mindlessly to the message. High levels of perceived control encourage mindfulness, but low levels encourage mindlessness (Langer, 1989). If the environment doesn't allow the visitor to take control with minimum instruction, the individual maintains his or her low motivational state, or mindlessness (Figure 5.10). The visitor may continue to participate with the interactive device for a number of reasons but most likely because it is

Figure 5.10

INTERVENING VARIABLE: PERCEIVED CONTROL



fun. New information is not likely being added to one's LTM.

To be effective, interactive devices should provide a sense of control which allows the visitor to make choices and to explore in an area of their own choosing. Using devices should lead toward making decisions or choices, feeling responsible, or taking ownership. Visitors then gain a sense of self-directedness.

In summary, in a free choice environment learning is encouraged because visitors are allowed choices that match their interests and/or needs. Choices motivate each visitor to control their own learning environment. Greater levels of perceived control encourage both higher levels of cognitive processes and pleasure in learning (Langer, 1989). The visitor enters into an engaged mental state.

The model has looked at constructs leading to learning, but has not yet addressed actual learning or mental engagement.

Mental Engagement

Learning is based on cognitive processes which include previous knowledge, the nature of the instruction, situational events, the stimuli and mental engagement (Gagne, 1985). Comprehending information is the mental linking of information itself (bottom up processing) with an individuals previous general schemata (top down processing). Elaborating on present information (stimuli) and previous schemata helps facilitate information transfer into long-term memory. Information is randomly accessed from one's memory and processed in a single channel resulting in unlimited mental capacity (Kahneman, 1973). The visitor attends to the message and processes the information. He or she is fully aware of conscious mental processing because it occurs with intention (Gagne, 1985).

Although engaged visitors may be aware of what they are learning, at the same time they may be unaware of what is going on around them. IPT suggests this is because they are processing information in a single channel. Engaged visitors may talk to themselves as they try to solve an interactive computer program or share the newly learned experience with someone else in their group (Soren, 1991).

The engagement construct has been studied as a multi-variable construct based on measures of time, single-channel processing, pleasure, learning and satisfaction. Mental engagement has been measured by using the following: holding power of the exhibit (Falk, 1983); response time to a secondary task (i.e., engagement results in a slower response time) (Ashcraft, 1989); and recalls knowledge gained (Screven, 1986, 1990). Tennyson's (1989) research suggests that mental engagement includes the whole cognitive system. As this takes place, previous perceptions or schemata are modified or changed. This mental elaboration is represented by a feedback loop to perception.

Feedback Loops

The linear model proposed so far does not represent the dynamic processes that go on during cognition. These changes in schemata are best represented as feedback loops (Figure 5.11). The assumptions of the feedback loops are that, in the mindful state, mental processing encourages further perceived control and changes both perceptions and levels of involvement (Tennyson, 1989).

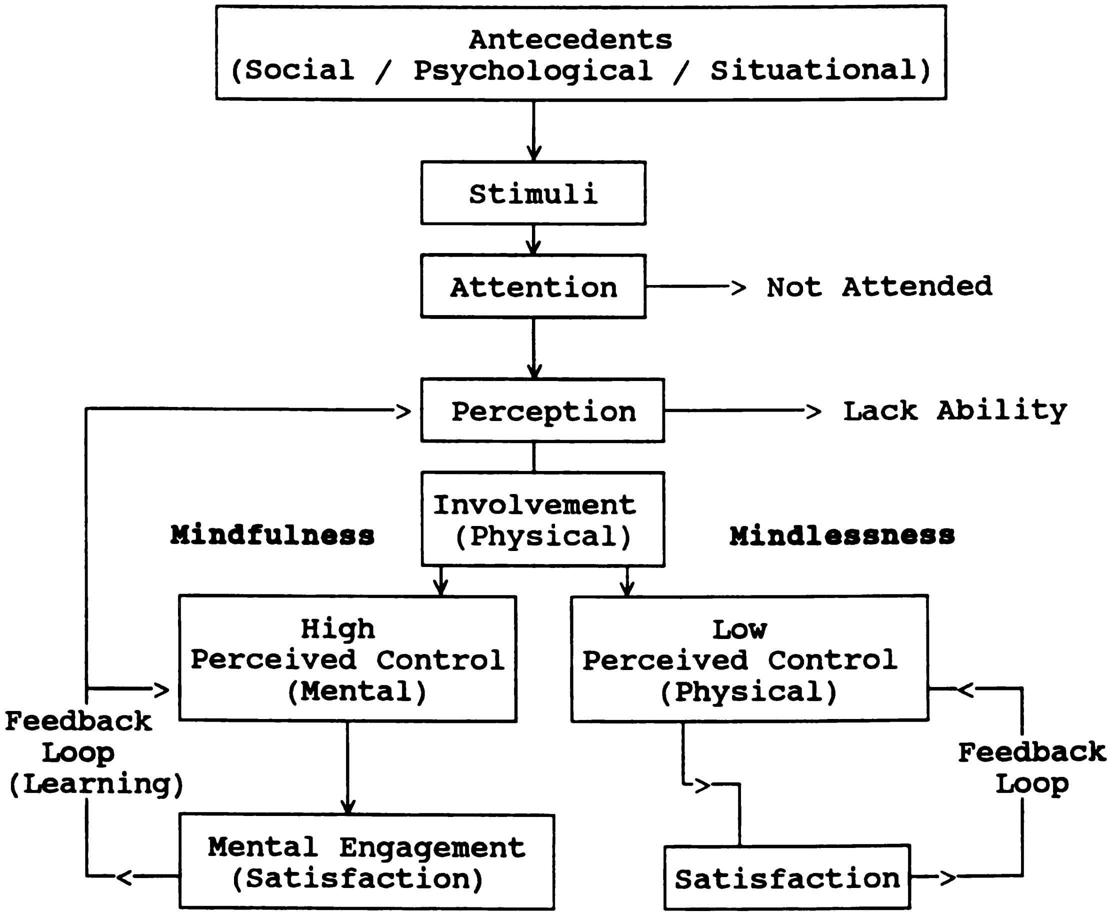
In the mindless state (right side of the model), physical involvement may not encourage perceived control, but may lead to high levels of satisfaction or pleasure, resulting in repeated behavior without high levels of cognitive processing. This mental state may be best represented with short-term memory in that limited cognitive processes occur, but information is not added to one's long-term memory. Moscardo and Pearce's (1986) study supports this statement finding no correlation between satisfaction and high levels of recall suggesting that pleasure can result without learning.

However, in a mindful state (left side of the model), learning encourages cognitive complexities which, in turn, encourage higher order thinking strategies (Tennyson, 1989). By using differentiation, integration, creativity, and problem solving skills, cognitive capacity is expanded. Throughout this mindful stage, perception is modified and changed (Tennyson, 1989).

Figure 5.11

LEARNING MODEL FOR EDUCATIONALLY ORIENTED

RECREATION SETTINGS



After using interactive devices (involvement), visitors gain a new sense of their abilities and skills. Their perceptions of the media may also change. For instance, computers may appear less threatening as skills increase. As the willingness to try an interactive devices increases, a desired result would be that visitors may find art and science less threatening and more open for exploration (Korn, 1991).

Suggested earlier, involvement is a hands-on interactive experience that acts as a foot-in-the-door to the cognitive processes. Involvement alone may not encourage mindfulness and is located, therefore, as an intervening construct between perception and perceived control. High levels of perceived control should lead to engagement (traditionally studied as knowledge gained).

In the mindless state, pleasure comes from participating in the activity. A scripted mind-set results in a return to (or maintenance of) a passive mental state where less attention is paid to the information. If the task appears too difficult to engage in, there is minimum mental effort (Salomon, 1984). The visitor may choose to not learn for a variety of reasons, yet gains a certain amount of pleasure from the experience. This is backed by countless studies which show that the greater majority of visitors enjoy their experience yet learn very little (Doering, 1991). This suggests that satisfaction, as a single item measure, is a poor reflection of what people learned.

Learning Model Summary

The proposed model identifies a causal relationship which results in two different mind-sets for the visitor, mindlessness or mindfulness. Information processing theory provides the foundation of how each mind-set works.

If learning is to take place (left track of figure 5.11), information must first catch the visitor's attention and then be perceived as important. Then, physical involvement can act as a spark or motivator to cognitive processes, which can lead to a sense of perceived control and then to engagement. Mindfulness (learning) is the process of adding information to one's long-term memory and is measured in terms of perception, involvement, perceived control and mental engagement.

If the mindless state is maintained (right track of figure 5.11), even though the individual is attending to the stimuli (interactive exhibit), he or she lacks motivation to process or relate to the information. The mindless state is encouraged when interactive exhibits do not lead to a sense of perceived control. Visitors, accessing their short-term memory, may continue to interact with the exhibit and gain a sense of satisfaction, but never add information to their long-term memory. Therefore, satisfaction is a poor measure of learning or knowledge gained.

STRENGTH OF THE MODEL

The contributions of this model to understanding learning in the educationally oriented recreation setting are twofold. Learning is tied to both the mind-set of the visitor and to the way information is presented. The model is based on the idea that learning requires mental effort from the visitor. It suggests that the role of information is to motivate visitors to engage in cognitive processing. This is done by first getting the visitors' attention and then encouraging them to become physically involved with the information. When the involvement construct encourages a high level of perceived control, it acts as a spark to encourage mental cognition. The idea that higher levels of cognition are dynamic is identified by the feedback loops, which continue to increase control and modify past perceptions or schemata.

In a mindless state, visitors may continue to interact with an exhibit without learning (feedback loop) because they gain a sense of pleasure and the task has low difficulty. The model also identifies pleasure (affect) as a viable outcome of the recreation experience in both mind-sets. Last, but not least, it supports the notion that learning and pleasure can take place in the educationally oriented recreation setting. In the mindful state, learning is fun. In the mindless state, physical involvement is fun.

LIMITATIONS OF THE MODEL

The model is based on information processing theory which has some inherent flaws. The theory's abstract nature lies in the abstract nature of information itself (Palmer and Kimchi, 1986). IPT uses the analogy of the computer to represent the brain. Some argue that the computer analogy assumes that learning can be turned on and off like a computer but this is not so (Csikszentmihalyi, 1988). IFT implies that mental processing goes on within single or multiple channels in one's STM and LTM memory which is difficult to disprove or falsify (Ashcraft, 1989). In addition, the orchestration (or priorities) of the memory system are established by the executive controller or homunculus (the little thinking person inside the thinking person) (Ashcraft, 1989). In other words, the black box still exists (Palmer and Kimchi, 1986).

Benoit and Benoit (1986) argue that the theory of mindlessness and mindfulness, cannot be falsified. Challenging Langer's research, they show that for each of her studies other explanations could be derived to explain the mindless state. As in IPT, there is no way to disprove or falsify this construct (Benoit and Benoit, 1986).

The model assumes that the visitor is intrinsically motivated upon entering the site. Earlier cited research by Iso-Ahola (1989) suggests that when people are provided choices they become motivated. This implies that intrinsic motivation occurs somewhere between perceived control and engagement.

The model also suggests a causal order between variables in a specific direction. Involvement and perceived control, as motivational variables, could also take place at the same time or in opposite order. For example, being provided a choice may encourage one to become involved with the interactive device. Perceived control would then be located before involvement, suggesting a different model.

Finally, Syme (1990) argues that research on the "perceived control" construct has suffered from inconsistent definitions such as mastery, locus of control, learned helplessness, controllability, predictability, desire for control, sense of control, powerlessness, hardiness, self-efficacy, and competence. Rodin et al. (1990) argues that self-directedness (perceived control) is based on some combination of the above items.

CONCLUSION AND SUMMARY

This chapter addressed education models and causation. It proposed a causal model which more accurately reflects the learning process in educationally oriented recreation settings. By understanding visitor behavior, professionals can improve the learning experience for the visitor.

Visitor studies traditionally have assumed that people attend to the message. This chapter argues that this is true only under limited conditions. It suggests a shift in the visitor information/interpretation paradigm and proposes to answer the question, "Why are people not recalling information or leaving with misconceptions when visiting educationally orientated recreational settings?" One answer is that visitors cognitively function in a path of least resistance (mindlessly). Unless visitors come with prior motivations, learning is not naturally going to occur.

A model was proposed which identifies a causal chain of motivators that influences learning. It suggests that when visitors function in a low-need-for-cognition mode, attention, perceptions, involvement, and perceived control are variables that can influence learning in the educationally oriented recreation setting. It also supports the idea that learning is fun and suggests that satisfaction is a vital outcome of visitors' mind-sets and, therefore, should not be used as a single measure for learning.

Getting one's message across can be greatly improved by answering the following questions:

1. Who are the targeted audiences and what is their <u>present knowledge</u> and mis-conception about the topic?
2. How will the stimuli attract <u>attention</u>?
3. How will the <u>perception</u> of the chosen media affect willingness to expend mental energy?
4. What type of <u>involvement</u> or interactive device is available to encourage cognitive processing?

5. How will one be given a sense of <u>control</u>?

6. How will <u>engagement</u> encourage higher levels of learning?

The following chapter provides an overview of each of the proposed constructs, a research agenda and a way to test the model's relationships with the use of path analysis.

CHAPTER VI

TESTING THE LEARNING MODEL

Models are developed to reflect the real world and can provide a way to better understand and predict certain behavior. A model can either support a theory or provide the basis of a theory. A prediction can be made about a population when a model effectively outlines the relationships within a given event (Hunter and Gerbing, 1982).

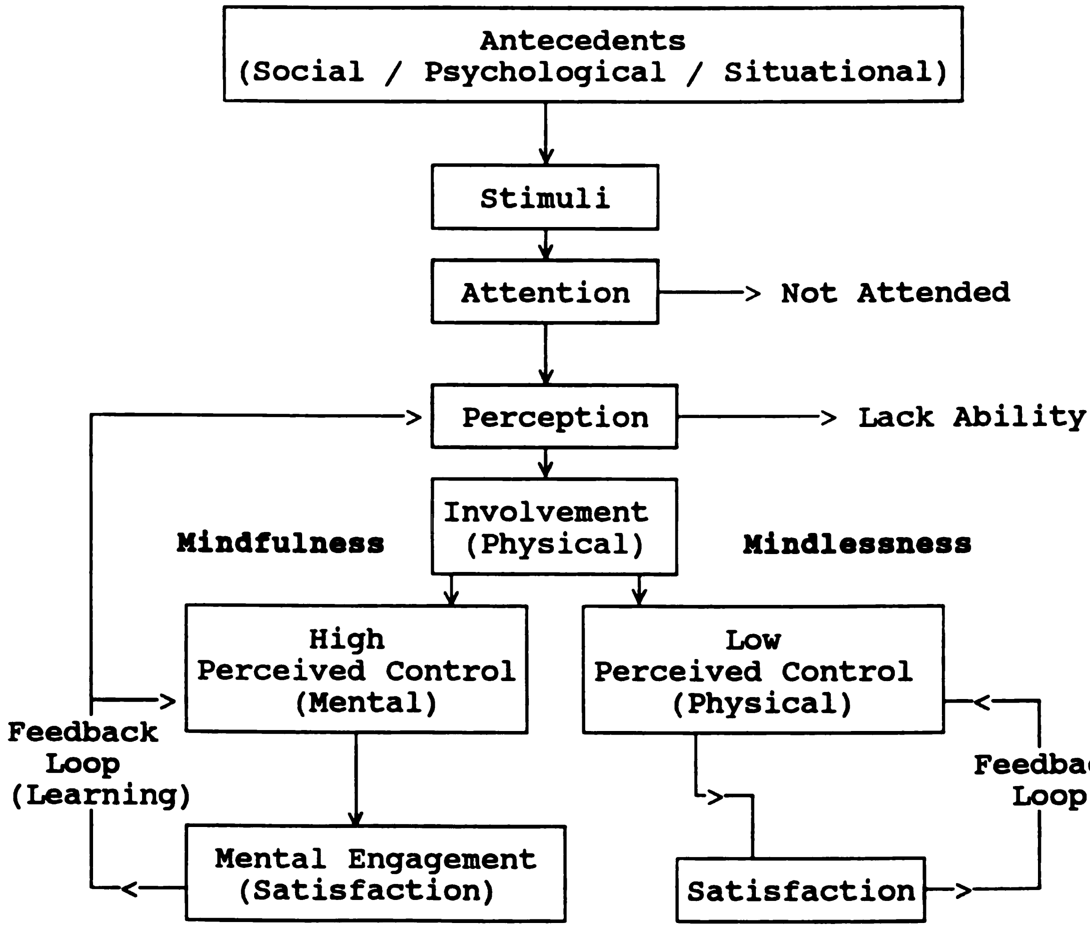
In Chapter V, a learning model was identified that described the way visitors learn through the use of interactive exhibits in an educationally oriented recreation settings (Figure 6.1). The model assumed that the casual visitor is in a leisure setting, on free-time and intrinsically motivated. Also, the information presented is assumed to be aimed at the developmental level of the intended audience.

The learning model represents the following path diagram of predicted causal relationships: antecedents to

Figure 6.1

LEARNING MODEL FOR EDUCATIONALLY ORIENTED

RECREATION SETTINGS



the learning environment (social, psychological or situational); the stimuli (exhibit or message that is designed to attract the attention of the visitor); visitor attention to the message; visitor perception which influences participation in the media; visitor involvement through touching of the interactive device; the interactive device which offers a high level of perceived control; visitor engagement in the message; and modification of visitor perceptions (left track of the model). The path diagram also suggests that if the interactive device offers a low level of perceived control, then the visitor may continue to participate in the interactive device without learning the intended message (right track of the model).

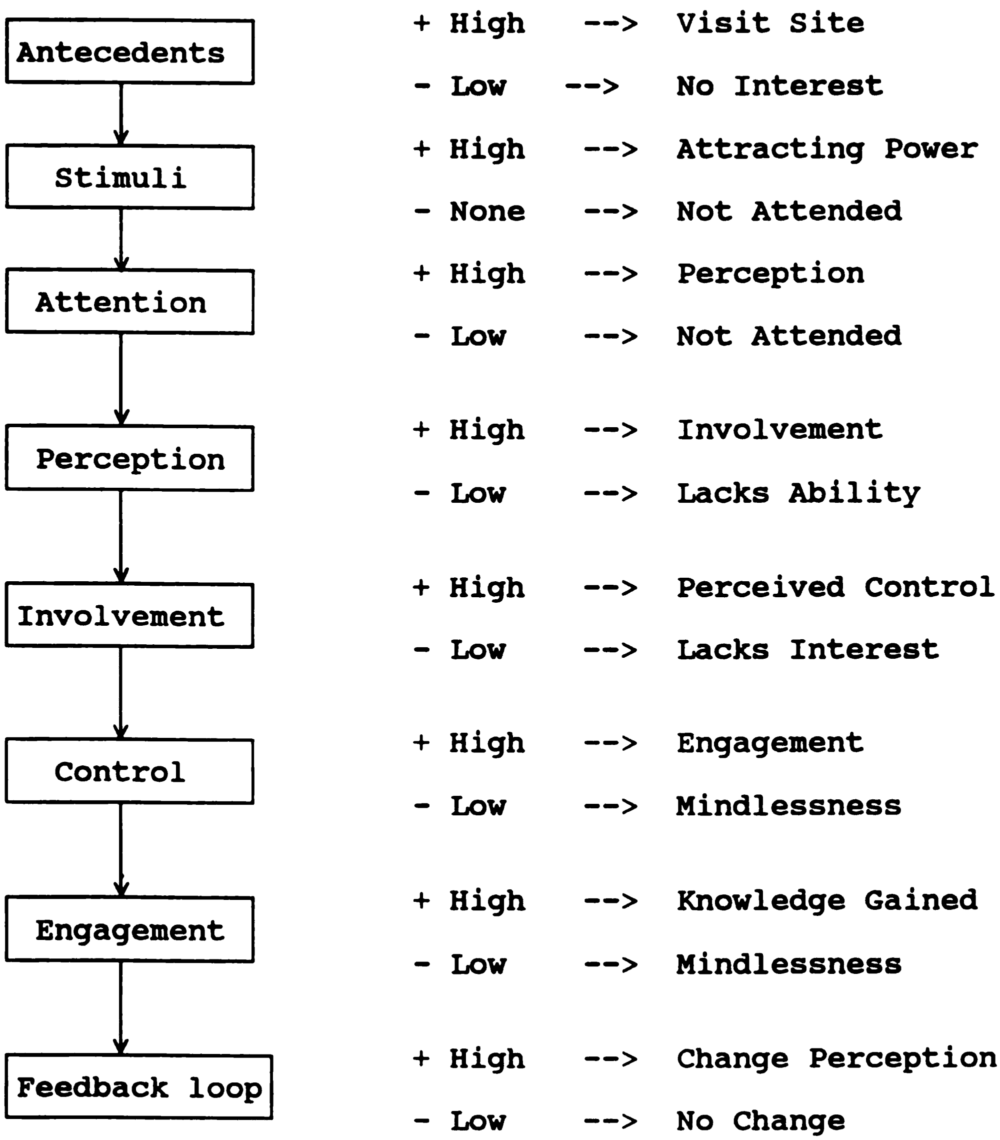
This chapter provides an overview of each construct and a proposed research agenda to test the learning model.

CONSTRUCTS IN THE LEARNING MODEL

The seven constructs developed in Chapter V are the theoretical variables which model learning in educationally oriented recreation settings. To understand the causal relationships in this model, it is important to recognize that each construct is measuring different components of the total learning experience. The model predicts direct relationships between the constructs and the order in which they are proposed (Figure 6.2). Imperative to model testing is recognizing that each of the variables in this model

FIGURE 6.2

MINDFULNESS MODEL FOR THE RECREATION SETTING



Path diagram of MINDFULNESS suggests that high attention leads to perception, involvement, perceived control, and then to engagement which can change perception.

are also indirectly related each other. This section will define, summarize and operationalize each of the constructs. The greatest amount of learning is encouraged when these constructs are considered as a whole, in a specific order. An important question often ignored is "who is the visitor?"

Antecedents

The visitor is a complex combination of prior knowledge, interest and comprehension levels. Personal agendas, expectations and anticipated outcomes are all part of what the visitor brings to the site (Falk & Dierking, 1992). In general, antecedents are social, psychological, and situational and impact both the visitor's willingness to enter the site and the information they leave with (Roggenbuck et al., 1991; Loomis, 1992).

In Chapter II, social aspects of the recreation environment are reviewed. Most of the available research is about how social groupings impact attention in recreation environments (i.e., groups stay longer, share information and have more verbal and non-verbal gestures). These studies review the influence that social groups such as staff, adults, children, families, and other visitors have on "the intent" for learning to take place.

Snow-Docker and Gallagher (1987) addressed social interaction as it relates to certain types of exhibits. Further research of this type should continue. This can be done by manipulating the script and objects within an exhibit and assessing visitors visual and mental responses using both observation and surveying methods. The results of these assessment can be used to identify social groupings that are more attractive to certain exhibits.

Only a few studies have looked at psychological aspects of the visitor in relationship to the amount of learning that takes place. Chapter IV reviewed several studies in psychology indicating that cognitive complexity impacts the way an individual prefers to learn. The Myers Briggs Type Indicator (MBTI) was used in two leisure setting studies to measure learning styles. The first study used interactive computers and varied the program to match individuals to learning styles. They found that learning styles did effect the way certain types of people preferred to learned and the speed at which they learned (Kern and Matta, 1988). A second study found similar results by matching both intuitive visitors to intuitive labels and sensing visitors to sensing labels (Vance and Schroeder, 1991).

Further research should continue to explore how visitor learning style and levels of cognitive complexity may influence the way people learn in the recreational setting. In both laboratory and natural settings, the assumption that visitors with certain cognitive skills or learning styles may find certain environments easier to learn in should be tested.

Situational antecedents are events or situations that make certain topics more salient to people who normally would have no interest. Visitors tune into different events that tie into their willingness to visit a given site, gallery or exhibit. For example, the summer of the Yellowstone fires resulted in record numbers of visitors to the park.

Tracking situational impacts on visitors should be done in the natural setting by observing events that influence visitation. Attendance records should be collected daily and charted to compare days of the week, other years, seasons or facilities. Results should be discussed in terms of outside influences that may impact visitors to certain sites or galleries. Visitor surveys could also confirm trends in visitation related to situational antecedents.

Information gathered about social, psychological, and situational antecedents help answer the important question of what brings the visitor to the educational site. Once on the site, the visitor is exposed to a variety of educational messages through exhibits and signs that are designed to stimulate thinking which results in learning.

The Stimuli

The stimuli is the exhibit or display that vies for the visitor's attention and is designed to attract the visitor through sight, sound, touch, or smell. Exhibit designers carefully apply elements such as color, brightness, motion, action, patterns, or the use of interactive devices to encourage attraction. In addition, the exhibit's language, objects, title, subtitle and labels are all part of how the exhibit communicates to the visitor.

A good deal of information is known about what attracts the visitor (Bitgood, 1989). Attacking power is measured simply by the percent of visitors that stop at the exhibit. By manipulating different components of an exhibit in a laboratory environment, an understanding of how color, light intensity, movement, sound intensity, language or size influences the attracting power of an exhibit. Studies should then be repeated in a natural setting to find out if results are similar. Interactive effects from other exhibits or the overall museum experience should be factored out. Critical to this line of study is understanding the competition between various stimuli which vie for the visitor's attention.

Attention

More has been written about attention then any other construct in the model. This is because of the assumption that attention equals learning. Professionals refer to effective exhibits as having "holding power" (Bitgood et al., 1986a). Holding power is measured by the amount of time visitors spend in front of an exhibit (Falk, 1983). Exhibits with low holding power go unattended, while exhibits with a high holding power receive visitors attention. Naturally, museums and park/recreation staff want exhibits with high holding power. Two methods are generally used to measure attention: observation studies (Falk, 1983; Soren, 1991) and visitor surveys (Screven, 1990).

Observation studies measure both time spent at exhibits and behavioral patterns/gestures of the visitor. Time spent by a visitor at an exhibit is reported by the number of seconds invested at the exhibit and often compared to the average amount of time required to read the exhibit. To improve reliability of the time measure, results should be recorded for separate populations such as those that read the labels and those that breeze through the exhibit (Falk and Dierking, 1992).

Recording visitor behavior patterns provides a wealth of information on a wide range of expressions, gestures, and communications. Typically, these studies are conducted with the use of video cameras or coders that follow visitors through an exhibit. To insure reliability, studies should include two or more independent observers who are unaware of the study hypotheses. Inter-scorer reliability (alpha) of the independent observers should also be reported. In addition to visual observation, adding audio listening devices (through the use of hidden microphones) also is a reliable measure of attention (McManus, 1989).

Surveys and interviews are also used to measure attention. For example, visitors are shown a list of exhibits, both found and not found on the site, and asked to choose which exhibits stood out. Studies reviewed in Chapter II show that surveys or interviews, taken right after the visit, measure only the "fun" mode. To measure the impact of attention over time, surveys or interviews should be conducted one week or one month after the visit.

Measuring attention should occur in the natural setting and variables that interact with attention should be factored out. These may include time of day, location of the exhibit, age level of the visitor, noise levels, time of year, sequence of the exhibit during the individual's visit (beginning, middle, or end) and number of previous visits to the exhibit. Low scores on holding power indicate that the visitor is basically ignoring or not attending to the exhibit. The learning model identifies a causal order where attention is necessary before perception scripts can be retrieved.

Perception

Visitor perception of the media opens or closes the door to learning. Perception calls up schemata that answers the questions, "How demanding is the media and do I have the ability to understand the information?" Perceptions of media influence peoples willingness to invest mental effort towards the message (Salomon, 1984).

Salomon's (1984) research on perception provides a framework that is applicable to visitor studies. He identifies two dimensions of perception: perceived demand characteristic (PDC) of the media and visitors' perceived self-efficacy (PSE). PDC refers to how difficult the media is perceived to be and PSE is how proficient one feels with that medium. The interaction between the two dimensions is defined as the amount of invested mental effort (AIME).

Salomon's AIME instrument is easily adapted for informal settings and example questions are found in Appendix A. The model theorizes that perceptions come before the visitor becomes involved with an exhibit's interactive devices.

Involvement

Involvement is defined as hands-on or physical interaction with an interactive exhibit where the visitor makes a behavioral response (i.e., flipping a card, pressing a quiz board button, or using an interactive computer). Increased involvement leads to greater cognitive processing. Learning is encouraged when people are involved in the subject matter (Costley, 1987; Fiske and Taylor, 1984; Dimanche and Havitz, 1990; Petty and Cacioppo, 1981; Wise and Okey, 1983; Freedman and Fraser, 1966; Greenglass, 1986).

Measuring involvement focuses on the visitor's willingness to interact with the exhibit. Each action the visitor completes (i.e., pushing the buttons, flipping the cards, or selecting audio programs) is counted which determines the level of involvement. Separate involvement into two groups, high and low, and compare with perceived control. As an observed variable, inter-scorer reliability (alpha) of the independent observers should also be reported.

If the visitor is involved, he or she is asked to make choices. The act of choosing leads to a sense of perceived control.

Perceived Control

Perceived control is defined as "having the power to participate in making decisions in order to have a desirable outcome or consequence" (Rodin et al., 1990). It leads to a mindful experience where people are motivated to learn (Langer, 1989).

Perceived control is the key variable to the model. It determines if the visitor will either attend mindfully to the exhibit (left track of the model) or function in a mindless state, only accessing STM (right track). Components of perceived control include choices which impact one's future, a feeling of success or usefulness, and/or expression of oneself. Developing interactive's with appropriate options (choices) that lead to a visitor's sense of control requires knowing your intended target audience. What works for senior citizens would probably not work for teenagers. For example, an exhibit on endangered species may appeal to a wide audience but for different reasons. By allowing the visitor to choose what is interesting or appealing to them about the exhibit (the beauty of the species, what it means to me, the type of habitat they live in, fun facts about the species, or what action can be done to protect them) the visitor is encouraged to have a sense of control over the learning environment.

Testing the perceived control variable would require setting up an experiment with varying levels of perceived control accessed by the visitor. The low level condition for perceived control would allow the visitor limited or no choice. The high level condition of perceived control would provide multiple options to visitors and allow them to believe they are specializing their message. The message for both conditions would be the same. Comparing high or low conditions would demonstrate the relationship between perceived control and engagement. A paper and pencil measure would also confirm if choice leads to perceived control (Appendix B).

An interactive device that leads to higher levels of perceived control is hypothesized to lead the visitor towards increased learning of the exhibit's topic. An interactive device that does not lead to perceived control would encourage little learning. Perceived control leads to engagement (Appendix B.).

Engagement

The teaching power of an exhibit is reflected in the visitor's opportunity to become engaged (Bitgood et al., 1986a). When a visitor is engaged he/she is learning, accessing and adding new information to his/her long-term memory (Gagne, 1985; Ashcraft, 1989). Engagement depends on the readiness of the visitor, the stimuli's ability to gain attention, visitor perception of the media, exhibit ability to involve the visitor and encouragement towards a sense of perceived control.

The engagement variable in the learning model suggests that a low level of engagement represents a mindless state by the visitor towards the exhibit, while a high level of engagement represents a mindful state by the visitor toward the exhibit. Satisfaction is proposed to correlate highly with both mind-sets, but long-term learning is only found in the mindful side of the model. Therefore, exclusively using time or satisfaction as a measure of engagement produces misleading results (Moscardo, 1988; McManus, 1989; Soren, 1991). Visitors could score high on both variables, with no long-term learning taking place because information is processed only in STM on the mindless side of the model.

Visitor satisfaction is a difficult construct to measure. Langer (1989) suggests satisfaction is found in both the mindful and the mindless constructs. Doering (1991) supports this after five years of surveying visitors at the Smithsonian Institution. Seldom has she found a dissatisfied visitor. Doering (1991) concludes that the measure is not getting at the satisfaction construct because dissatisfied visitors still score "highly satisfied" on a Likert scale. Several researchers concur that satisfaction is a difficult variable to measure in the recreation setting (Propst and Lime, 1981; McDonough,1980). Future work on this variable should concentrate on developing a reliable instrument that reflects variance in this construct.

The engagement construct has been measured in a variety of ways which includes time spent at an exhibit and recall questions about the exhibit's message (Screven, 1990). As time increases, the "holding power" of an exhibit has been shown to increase (Craik and Lockhart, 1972; Falk, 1983). But, as a single item measure, time can be a misleading measure of learning (Moscardo, 1988; McManus, 1989; Soren, 1991).

A questionnaire is an appropriate measure of engagement because the individual knows when they are engaged (Gagne, 1985). A concern with using questionnaires are visitor pre-knowledge (before entering the setting) and the Hawthorn Effect (telling the researcher what they think they want to hear). To avoid these problems the study designs should consider a Solomon 4 design (Tull and Hawkins, 1987).

Engagement has also been measured by single and multiple channel processing studies where response time to a secondary task is measured (Ashcraft, 1989). The assumption is that one's response time to a secondary task (pushing a button when a bells goes off) would be slower in single-channel processing (left side of the model) and faster in multi-channel processing (right side of the model). Engagement is reflected by the slower response time. No single or multi-channel processing studies were found outside of a laboratory setting. This may be due to the difficulty in controlling sounds in a natural setting. With the special considerations of modern technology and the extensive use of computers in exhibit halls, it may be feasible to set up an experiment to measure single and multi-channel processing by using vibrating pagers along with a computer. Pre-testing the technique and instrument is recommended in the laboratory setting prior to a field setting.

In summary, measuring engagement should be done with a combination of measures:

* observation (gestures, pointing, reading, time),
* questionnaire (recall and application questions which reflect changes in knowledge schemata)
* single-channel time processing.

An engagement score would be determined from the correct number of answered questions plus the time to respond to a secondary task. The use of response time to a secondary task could be designed into interactive computer programs. Seldom used out of a laboratory setting, this approach could work in a visitor center setting where computers and interactive exhibits are common. Examples of questions for measuring engagement are found in Appendix C.

Once visitors are engaged, they are processing the information presented in the exhibit. This information processing at best either reinforces previous knowledge or adds new knowledge to LTM. It is important to understand that mental engagement may still not lead to understanding an exhibit's message. Different factors may prevent the correct message from reaching the visitor's LTM. For instance, visitors do not come with empty minds ready to be filled, but process information from their own point of view or schemata.

The exhibit's ability to change the visitors long-term memory is influenced by previous constructs in the proposed learning model. As new information is added to LTM, scripts are modified and previous information is changed. This is reflected in the models feedback loops.

Feedback Loops

Learning is the process of adding new information to one's LTM which results in changes in perceptions (Tennyson, 1989). The added feedback loops represents this dynamic process found in higher-order thinking strategies. It suggest a causal relationship from engagement to perception. This implies that engaged visitors change their perception of the media and their ability to interact with it. These engaged visitors are adding new information to their LTM which in turn changes schemata. The more that feedback loops are activated, the more the visitor learns. Successful exhibits are hypothesized to stimulate this feedback loop. If no learning is taking place, perceptions do not change. The visitor in this state of mindlessness still interacts with the interactive device because he or she gains a short term sense of satisfaction and involvement.

Learning is the result of the total cognitive process from beginning to end and takes place while the visitor is in a mindful state (left side of the model). If the model is correct, each variable makes up part of the total learning construct. Behavioral and response cues should correlate with the visitors level of learning, such as asking questions, sharing information, and interest levels expressed on the topic.

Measuring learning should include a questionnaire administered at various times during the experience which addresses the interest levels of the visitor. In addition, observed behaviors should be recorded along with content analysis of both questions asked to docents or guides and information shared with others in the group.

The learning constructs can be further tested by using a method called Second-Order Confirmatory Factor Analysis (Hunter and Gerbing, 1982). If a high correlation exists between variables in the model's correlation matrix, it suggests an over-riding variable. By applying Second-Order Confirmatory Factor Analysis to this variable, a hierarchical model can be tested to determine if the factor called learning or "mindfulness" exists (Appendix D.).

When measuring both engagement and feedback loops, a longitudinal design is suggested. By sampling visitors at various times during their learning experience (beginning, middle, end, or 1 week later), comparisons can be made that reflect changes. This follow up study design reflects changes in schemata that have lasted over time.

In summary, the model predicts that each variable is causally related to one another and that the variables are found in a certain order. For example, visitor engagement is preceded by perceived control, but also indirectly effected by the entire process of moving through each construct in the model. The implications are that this model theoretically explains the learning process found in educationally oriented recreation settings.

RESEARCH AGENDAS

The learning model has a large number of both direct and indirect relationships to test, especially when considering the feedback loops. The following suggests four interrelated research agendas:

1. develop a study that establishes a reliable measure for each variable,
2. test the direct relationship between variables next to each other in the model,

3. build towards a causal string of variables and
4. identify the order of causation by testing the complete model including the feedback loops.

A research agenda that establishes a reliable measure for each variable requires a minimum of four items that measure the same variable or factor (Hunter and Gerbing, 1982). Each item must be conceptually sound (content validity) before the measure can be mathematically tested. Testing the content of each factor using Confirmatory Factor Analysis will determine if the variables are measuring each construct (Confirmatory Factor Analysis is described in the Appendix D.). Once the measure is reliable, then relationships between factors can be tested.

A second research agenda would be to test the relationship between involvement, perceived control and engagement. The focus of this research would be to test the assumption that perceived control is an intervening variable between involvement and engagement. Important to this study is how the intervening variable of perceived control effects engagement.

Perceived control should be measured with multiple indicators such as making choices, feeling useful, increased competence level, encouragement to express oneself, and feelings of success (Rodin et al., 1990). Research designs for studying perceived control would require visitors being tested after exposure to an exhibit with or without choices. For example, set up an exhibit with inter-changeable interactive devices that lead to different levels of choice. Then, expose visitors to the different levels and record results (Appendices E and F).

To understand targeted audience's levels of perceived control, use a panel of experts and well conducted focus groups. In a laboratory setting, these focus groups could be exposed to different levels of perceived control to see how choice leads to engagement. This setting allows for adjustments to be made such that the interactive device does indeed lead to perceived control. A Likert-type scale is recommended to measure levels of perceived control. Examples of the types of questions found in a perceived control scale are found in Appendix B.

It is important in this study to develop both an interactive exhibit with varying levels of choice and an instrument that can measure and compare the various components of perceived control. Elements of perceived control are expressed in terms of feeling useful, expressing oneself and experiencing choice, all of which lead to a feeling of success. Important questions to ask might be, "How much choice and where does choice help or hinder learning? Does increase in choice increase museum fatigue?" Test the direct relationships, first between each variable and then test the following path diagram using path analysis: Involvement -> Perceived Control -> Engagement.

If the involvement and perceived control variables are found to influence engagement, than a longer causal string of variables (attention -> perception -> involvement -> perceived control -> engagement) should be tested. This longer string of variables is important to address because it provides an understanding of the causal order of how learning takes place in educationally oriented recreation settings. If the causal string is established, then the percentage of the variance that each variable contributes to the learning processing can be found. Also, this study could answer important questions related to the mindfulness/mindlessness construct.

Confirmatory Factor Analysis and path analysis will test the relationships between and within variables. They are appropriate tools to test the learning models relationships for the following reasons: there are more than two variables, the data are interval level, more than one dependant variable (DV) and independent variable (IV) exist, the relationships between variables can be treated as additive, the relationships are proposed to be linear, and the model has at least one intervening variable (Hunter, 1991).

Path analysis is a powerful tool for theory testing (Hunter and Schmidt, 1990) because it systematically combines partial and multiple correlations (coefficients) to compare causal connections between variables (Hunter and Gerbing, 1982). The strengths of these causal relationships are measured by the partial correlation of the IV on the DV. The path coefficient between each variable (X -> Y -> Z) is the standardized regression coefficient, which is also the percentage of the variance each variable contributes to the total learning model.

The last research agenda is a longitudinal design that establishes the direction of causation in the learning model. The longitudinal study design will also measure changes in perception which are represented in the feedback loops. The direction of causation can be determined by comparing the same variable at different points in time. If the model is correct, correlations would be found in only one direction. The study design would require visitors to wear some type of beeping device that sounds or vibrates at random intervals, at which point they would then fill out questionnaires about what they are learning and doing.

Important to model testing is recognizing that the causal order may flow in a different direction. In Chapter 5, an argument was developed, based on the literature, that visitor perceived self-efficacy would be an intervening variable between attention and involvement. However, if the data does not support this premise, then alternative hypotheses should be tested.

In summary, four research agendas are recommended to answer different questions the model proposes. The first is to establishing a reliable measure of each construct in the model. The second is designed to test if perceived control is an intervening variable between involvement and engagement. The third addresses the causal relationships that influence learning. The fourth tests the causal order of the models variables along with the theory that perceptions are changed when information is added to long-term-memory.

SUMMARY

This chapter identifies the operational definitions of each construct for the proposed learning model. A four part research agenda is proposed that outlines priorities and answers different questions about the model. Path analysis is suggested to measure the variables and empirically test the relationships between the variables.

CHAPTER VII

SUMMARY AND CONCLUSION

SUMMARY

Chapter I introduces the idea that science and natural resources education in America is at an all time low in comparison to other developed countries. Yet, the attendance at museums, science centers, nature centers, zoos and aquariums, are at an all time high. Over 200 new children museums have opened their doors in the last 15 years. Interpretation is a tool that is used to motivate visitors to learn in these educationally oriented recreation facilities. Exhibits are a medium employed by agencies to get their message across to the visitor. These informal environments might be ideal places to learn, but this hypothesis is not supported by research. This dissertation applies cognitive theories to the understanding of interactive exhibits in order to gain a better understanding of how visitors can learn at recreation facilities.

A discussion of leisure and recreation settings in

Chapter II found them, in part, to be free-choice experiences that are intrinsically motivated. Learning in the recreation environment is informal. People appear to learn best from first-hand experiences. Pleasure and social factors play an important role for the visitor in the recreation setting and may be a more important than the learning. Research shows that little learning actually takes place in educationally oriented recreation facilities. Visitors appear to be in a "fun" mode where minimal motivation goes in attending to exhibits.

Chapter III identifies different ways information and exhibits have been studied and supports the idea that while learning can take place in the recreation setting, it depends upon how the visitor is motivated. To encourage motivation, information needs to relate to a given audience and be "interpreted." Chapter III also documents the theory that hands-on or interactive devices do increase learning in the recreation setting. However, it also provided research results where hands-on exhibits did not increase learning and suggested that other factors may influence learning.

In Chapter IV, theories from cognitive psychology and social psychology help explain how people process information and apply these theories to learning in the recreation setting. Learning is based on past schemata, the nature of the instruction and the message. This chapter builds an argument that people process information one of two ways, either mindfully (consciously) or mindlessly (automatically). Information processing theory (IPT) is explained to help understand how people attend to messages, process the information in their short-term memory and add new information to their long-term memory. Information in STM is processed in multiple channels with limited storage capacity (six items, plus or minus 2). Information in LTM is processed in a single channel with unlimited storage capacity. Mindfulness is encouraged when people are provided with a sense of perceived control.

A learning model is built in Chapter V that suggests causal relationships between variables found in the educationally oriented recreation setting. This chapter explains how models can help understand the visitor and improve the effectiveness of the exhibit's message. Current education models are explored that are not adequate in explaining how people learn in recreation settings. The model proposed suggests a causal order to learning which includes the following: visitor antecedents, the stimuli which attracts visitor attention, visitor perception of the media which influences willingness to get involved, a feeling of perceived control and mental engagement. Mental engagement can also lead to a change in perception where information is being added to or modified in LTM. The model also suggests that if involvement does not lead to high levels of perceived control, than information is processed in STM through multiple channels and not added to one's LTM.

Chapter VI operationalizes the constructs, identified ways to measures each variable and explained how their relationships could be tested by using path analysis.

A research agenda is suggested along with how to empirically test the casual model using path analysis and confirmatory factor analysis.

CONCLUSION/IMPLICATIONS

At the beginning of this paper, the need for improving science and natural resources education in America was discussed. An educational topic of particular importance is conservation of the earth's natural resources, vital for the survival of all species. The educationally orientated recreation setting is an ideal environment to teach this important connection between human beings and the survival of the land because it presents visitors with educational opportunities to interact with natural objects, concepts and processes.

Visitor studies, interpretation and environmental education have long claimed that getting people involved in hands-on activities increases learning and satisfaction. But the research suggests that minimal learning is going on in educationally orientated recreation setting because people are processing information mindlessly. Support for these differing assumptions has lacked a theoretical base.

This dissertation attempts to build a theoretical base and proposes a causal order for encouraging mindful processing in the educationally oriented recreation environment; visitor's antecedents, perception, involvement and perceived control which leads to engagement. It presents a model for improved learning through interactive exhibits. Exhibit designers can create better exhibits by understanding how people interact with and learn from an exhibit. When applying involvement, choices and control, the learner finds science less threatening, resulting in a greater desire for exploration.

The employment of "user friendly" interactive devices or computers could help encourage visitors to explore a subject area they are unfamiliar with. To effectively practice Salomon's AIME theory, professionals needs to pay close attention to what learning devices and materials are being used in an exhibit. For instance, given that computers have a high perceived demand characteristic (PDC) and a high potential for learning, the visitor who is unfamiliar or afraid of computers will score a low perceived self-efficacy (PSE) towards computers. For this individual the exhibit appears useless and little learning will take place.

If the exhibit is going to lead to learning, professionals must have an understanding of how certain media can limit or enhance the amount of energy a visitor is willing to invest in attending to the message. Designers concerned with the process of learning and with what the visitor brings to the site will greatly improve the quality of the exhibit. The generic audience with "blank minds" ready for learning should be a strategy of the past.

Becoming aware of the way people process information is a way to more effectively get one's message across. The following questions may stimulate a more effective communication strategy:

1. Who are the targeted audiences and what is their present knowledge and mis-conception about the topic?
2. How will the stimuli attract attention?
3. How will the perception of the chosen media affect willingness to expend mental energy?
4. What type of involvement or interactive device is available to encourage cognitive processing?
5. How will one be given a sense of control?
6. How will engagement encourage higher levels of learning? (Appendix G.)

Visitors have varied interests and needs, yet are predictable. For example, most visitors will be in groups, get tired, want to eat, need to use the restroom, spend about 10 seconds at an exhibit, and read only titles and subtitles. Beyond these outward behavioral responses is a predictable inward process theorized in the learning model which leads towards a mindful experience.

It is also important to recognize that the "fun element" is an integral part of learning in all educationally orientated recreation settings. Discussing visitor satisfaction, Chambers (1988), from the Denver Art Museum, claims that the "ultimate goal of providing a discovery opportunity is to give visitors a sense of being competent and in control and a chance to find new, personally significant insights in the activity." She further states, "These feelings of satisfaction - not the information learned - motivate the repeat experience and continue learning" (p. 214-215).

This paper examines variables that help us understand why visitors learn or not learn in educationally oriented recreation settings. It suggests that when visitors are provided with interactive devices, elements of free choice, and opportunities to have perceived control or ownership over the outcome, both fun and learning occurs. These components of learning could also benefit a variety of formal educational settings.

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APPENDICES

APPENDIX A

PERCEPTION MEASURE

PDC: Learning from a __________ (quiz board, hands-on, video, written text, etc.) is:

	1 2 3 4 5	
Fun	_ _ _ _ _	Work
Easy	_ _ _ _ _	Hard
Simple	_ _ _ _ _	Difficult
Deep	_ _ _ _ _	Shallow
Resourceful	_ _ _ _ _	Poor Source

PSE: I find __________ as:

Challenging	_ _ _ _ _	Simple
Save Time	_ _ _ _ _	Waste of Time
Slow	_ _ _ _ _	Fast
Interesting	_ _ _ _ _	Boring

My skill level with <u>computers</u> is:
Beginner _ _ _ _ _ Skilled

AIME: How easy is the <u>computer</u> to understand?
Easy _ _ _ _ _ Hard

How much did you concentrate at the <u>computer</u> ?
None _ _ _ _ _ A Lot

How hard did you try at the <u>computer</u> ?
Very Little _ _ _ _ _ Very Much

APPENDIX B.

PERCEIVED CONTROL MEASURE

At the quiz board:
(matching, computer, hands-on, flip cards, audio selections)

1. I was able to make my own choices most of the time.

   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

2. Options always provided clear choices.
   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

3. Choices lead to more wanted (needed) information.
   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

4. Choices help me focus on only what I wanted to learn.
   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

5. Options provided gave me a sense of competence.
   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

6. Having to make choices was difficult for me.
   Strongly Agree _ _ _ _ _ Strongly Disagree
   1 2 3 4 5

7. Options provided a sense of power.
   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

8. I felt good about _____ exhibit after experiencing it.
   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

9. Following the _______ program was easy most of the time
   Strongly Agree _ _ _ _ _ Strongly Disagree
   5 4 3 2 1

(Cite specific names for each exhibit used)

APPENDIX C.

Engagement Measure

Recall Questions:

1. What message does the (exhibit name) tell us?" (open ended)

2. The (exhibit name) explains the ____________ reaction. What elements were included in that reaction?
   a. ____________ and ___________
   b. ____________ and ___________
   c. ____________ and ___________
   d. I do not know

Inference making Questions:

3. I learned the most from the following exhibits: (open ended)

4. One thing I never realized today was: ....

* Use at least four questions to test knowledge about each exhibit or concept.

Note, open ended responses allows the visitor to answer with higher levels of cognitive processing instead of selecting from a list of answers. Both types of measures are suggested but extra time is needed for coding opened ended responses.

Satisfaction:

5. I found ________ exhibit to be the most satisfying."

6. Rank the following exhibits from most enjoyable (5) to least enjoyable (1):

   A. X exhibit ____
   B. Y exhibit ____
   C. Z exhibit ____
   D. A exhibit ____
   E. B exhibit ____

APPENDIX D.

PRE-TESTING THE MEASURE

Vital to good measures is knowing that both the treatment and instrument are measuring what it is intended to measure. This is done by pre-testing the both with visitors and professionals.

The interactive exhibits are pilot tested by providing a comparison of a pre- and posttest with the interactive exhibit alone. The treatment reliability (alpha) should be reported. During the pretest, the interactive exhibits should be modified to reflect the desired learning that the questionnaire is trying to measure.

Observed measures need to be pretested by setting up video cameras and reviewing their location and visitor tracking ability. Time, both at certain exhibits and in the hall, needs to be measured from the camera's location. In addition, behavioral responses to the interactive need to be observed from video locations. Camera locations should be modified to reach the three observed measures.

The questionnaire should also be reviewed by a panel of experts (site staff) and pretested with visitors. The visitors should be asked if they have any problems understanding the questions or specific wording in the questions. The questionnaire should then be modified to reflect the changes suggested by the visitors and piloted a second time or until few problems exist.

<u>Sampling the Visitor</u>

A random stratified sample of visitors is recommended for all those studied by age groups, race, gender, and days of the week. The sample should consist of visitors attending or visiting the site. Visitors should be alerted on entering the facility that a study is being conducted and that they may be asked to participate. Participation in the study would include filling out the questionnaire during the visit.

<u>Sample Size</u>

Sample size is influenced by budget, the amount of time needed to conduct the study, and the type of study. The larger the sample (in most cases) the more reliable the results. Sample size will be determined by: review of past studies using path analysis (estimate of 150 for the second research agenda), consulting with a statistician, and/or using the sample size formula in Tull and Hawkins (1987).

APPENDIX E.

THE ANALYSIS PROCEDURE FOR TESTING THE LEARNING MODEL

To understanding causal models, it is imperative to understanding how they can be tested. A causal model predicts that X causes Y and Y causes Z, but X does not directly influence Z. Path Analysis is the accepted tool used to test these relationship (Hunter, 1991).

<u>Path Analysis</u>

Path analysis is an analytical tool that can be used to investigate causal relationships among a set of variables (Hunter and Gerbing, 1982). It is an appropriate tool to test the learning models relationships for the following reasons: there are more then two variables, the data is interval, more than one DV and IV, the relationships between variables can be treated as additive, the relationships are proposed to be linear, and the model has at least one intervening variable (Hunter, 1991).

Path analysis is a powerful tool for theory testing (Hunter and Schmidt, 1990) because it systematically combines partial and multiple correlation (coefficients) to compare causal connections between variables (Hunter and Gerbing, 1982). The strength of these relationships are measured by the partial correlation of the independent variables (IV) on the dependent variable (DV), while other IV are held constant. The strength of the DV on a set of IV's, is the multiple correlation measure of the model. The path coefficient between each variable (X -> Y -> Z) is the standardize regression coefficient which allows the comparison of each IV on the DV.

Path analysis assumes that the error term for each variable (residual error) is uncorrelated. This analysis also takes into account the error of measurement and corrects for it (i.e., correction for attenuation). Other experimental designs, such as ANOVA or MANOVA, cannot apply this correction because they do not address correlations between variables.

In path analysis, there are two ways to estimate the parameters of a multiple group measurement model: centroid oblique (PACKAGE) and maximum likelihood method (LISREL). This paper recommends PACKAGE (Hunter & Cohen, 1969) over LISREL (Joreskog & Sorbom, 1978) because of the way each program handles the error term. LISREL tends to spread the error related to mis-specified equations (measurement error) throughout the entire model. PACKAGE localizes the error of mis-specified equations and allows the researcher to remove items that have a lot of error (Burt, 1976).

Mathematical Models Testing

Models are assessed in terms of how the data fits the model. Every model should be evaluated in terms of both content and statistics. The content of the theory needs to be sound before statistical testing can be performed. In addition, to test a model is to realize that measurement error exists. Measurement error is made up of random error and specific error (Thorndike, 1951). Without correction for lower observed score or attenuation, a model can be rejected when it is actually correct (Type II error). (for review of attenuation see Hunter and Schmidt, 1990.)

Path analysis can be conceptualized as two separate models. The first is the measurement model, with multiple indicators, that validates the construct validity of the individual variable or factor. The second model measures the causal network of constructs by applying path analysis to factors from the first model. The two models share conceptual and statistic similarities which include:

- Construction of the model
- Estimating the value of the parameters from the data
- Testing the fit of the model by comparing observed correlations with the correlations among the variables predicted by the model (Hunter and Gerbing, 1982)

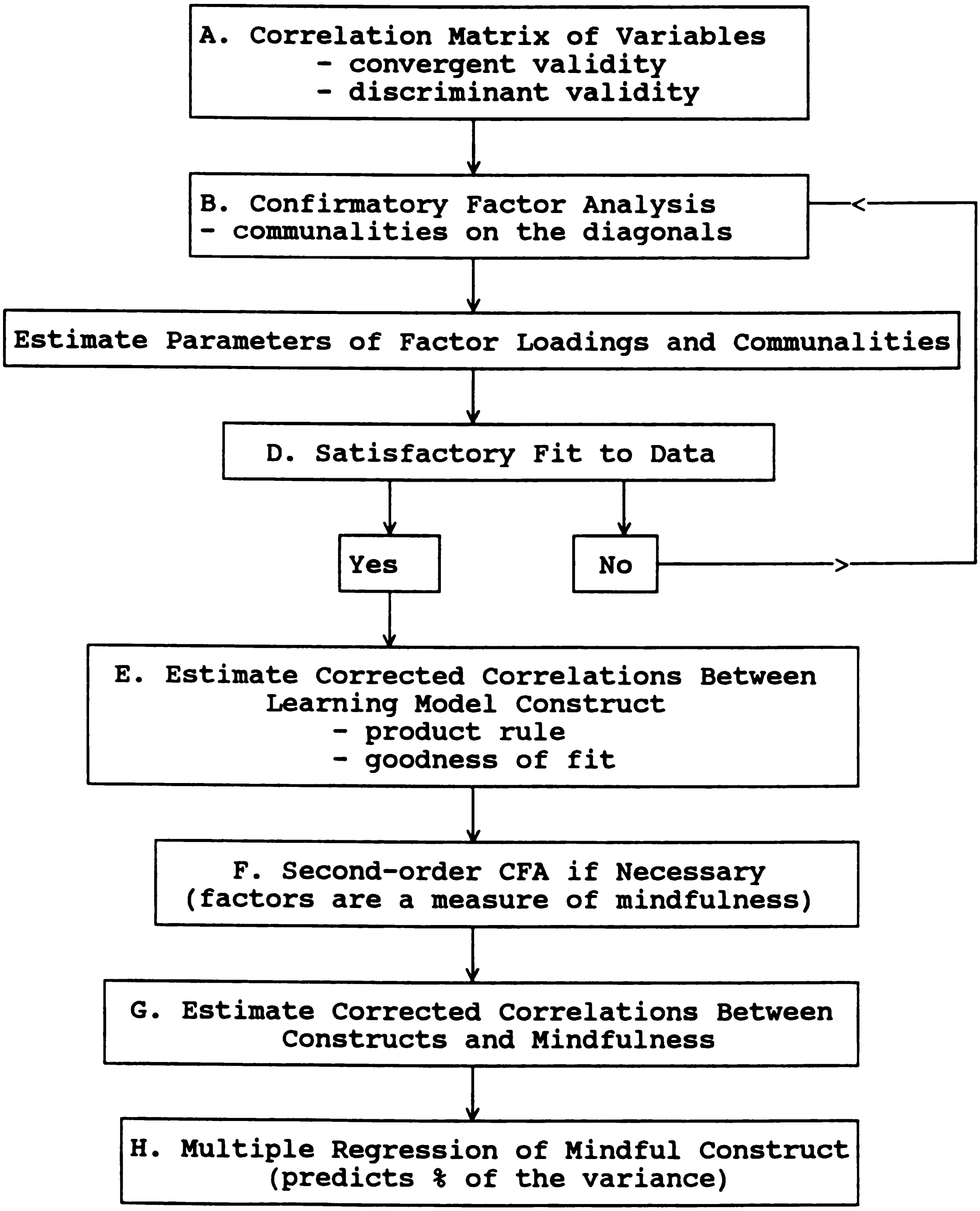
A flow chart of the analysis procedure for using confirmatory factor analysis is found on the following page (Figure E.1). The path diagram is a picture of the relationship between each factor in the measurement model.

The "fit" of the model is how well the data reflects or fits the proposed theory. If the model is linear, the fit is the product of each correlation. The product rule is applied to the correlations between each variable in a single causal chain and should equal the spurious correlation between the first and last variable. Testing the fit of the causal model also requires an over-identified model with more correlations than parameters to estimate. Testing variables against paths that are not predicted (Chi square goodness of fit test), should result in uncorrelated relationships (to within sampling error). The error terms of each variable should also be uncorrelated (Hunter and Gerbing, 1982).

Note that in the analysis stage, a theory is hypothesized a-priori and tested. The data may suggest that something else is happening other than that proposed. Other theories, in full

Figure E.1

FLOW CHART OF THE ANALYSIS PROCEDURE FOR TESTING THE LEARNING MODEL



or part, can also be explored using the same data. For a review of the path analytical procedure, see Hunter and Gerbing (1982), or for application in the recreation field, see Yokoyama (1991).

A summary of the steps taken to reach the findings would include a review of the constructs, pretest measure, sampling frame of the visitor, and data analysis. It also includes a summary of the demographic information which would help support the antecedents construct (age, gender, race, socio-economic status, education, distance traveled, and time spent on site). The findings procedure, which includes reporting on statistical implications and recommended tables and graphs, is included in Appendix F. A flow chart of the procedural steps in testing the model is represented in Figure E.2.

A. Correlation Matrix

The first step is to create a correlation matrix with all the items in the measurement model. This matrix is suggested in order to examine the relationships of items to each variable and to look at each variable's convergent and discriminate validity. The matrix will be set up with the variables running the same way they are proposed in the model.

Analyzing the correlations within each square and between squares can address some of the validity issues. Items should correlate with each other within squares and correlate or discriminate between squares.

B. Confirmatory Factor Analysis

The measurement model is constructed to determine the quality or reliability of the measure. It requires multiple indicators (minimum of four) for each variable. Applying confirmatory factor analysis (originally called "Least Squares" by Carl Spearman, 1904) to each construct determines the internal consistency of the measure (Hunter and Gerbing, 1982).

To build the measurement model, confirmatory factor analysis (CFA) is conducted on the correlation matrix using the program called PACKAGE (Hunter and Cohen, 1969). When using the PACKAGE program, the 1.00 on the diagonals are replaced with the communalities. Communalities of an item are hypothetical correlations of the item to other items in the factor. It is also the amount of variance shared with all other variables included in the factor analysis (Hunting and Gerbing, 1982). Using communalities in the diagonals automatically corrects for measurement error (attenuation).

Scales and/or measures are full of noise or error. It is to important to know, within accepted limits, that one is providing a clear, or "best possible," measure of each construct. The first step is to make sure that the constructs can be represented by a variable (content validity). The question, "Are you truly measuring the right construct?," needs to be answered for each item that represents a factor.

Coefficient alpha is commonly used as a measure of reliability. It is a measure of random error and can be calculated with a test-retest or with parallel forms. It is only appropriate if the scale is unidimentional. It does not measure specific error.

Confirmatory factor analysis is a statistical tool that tests for the internal consistency of each variable and is a good measure of reliability (Hunter, 1991).

Each variable needs to have more than one measure to test for internal consistency of the measure (parallel forms' reliability) and ideally four items (Hunter and Gerbing, 1982). The items are combined to make up a factor. Each factor is given a factor loading that represents the correlation among each item (Hunter and Gerbing, 1982).

C. Estimate Parameters

Internal consistency is the first test of unidimensionality for multiple item factors. The observed correlations of all items in a factor must conform to the product rule for internal consistency (to within sampling error). Items in a factor must be similar (correlations are the same), also referred to as "flat." The residuals (error terms) of each item in a factor should also be zero (to within sampling error). The uniform quality of the items may be ordered from a "strong to weak gradient."

The second test for unidimensionality is external consistency or parallelism. This specifies how items should correlate to variables outside of their cluster. The product rule is applied by comparing items to external variables. Parallelism looks for consistent proportionality across clusters (Hunter and Gerbing, 1982). In practice, internal consistency should be conducted before external consistency. If the measurement model fails this test, it must be modified or reconstructed before is tested for external consistency.

D. Satisfactory Fit to Data

The reliability measure (alpha) should only be interpreted after the criteria for unidimensionality of each cluster (factor) has been satisfied.

E. Estimate Corrected Correlations

After obtaining satisfactory results through the analysis of the measurement model for each factor, the theoretical model can be tested by using path analysis. If, on the other hand, high correlations exist between some of the factors, this may suggest a higher order factor which should be tested for by applying second-order factor analysis.

F. Second-Order Confirmatory Factor Analysis

If a high correlation observed in the corrected correlation matrix, between constructs exists, it suggests the existence of a higher level construct or latent variable. By applying second-order CFA to these constructs, a hierachtical model can be tested. The hierarchical model, in essence, tests the combined factors that correlate highly to determine a new factor, in this case, called "mindfulness."

G. Estimate Corrected Correlations

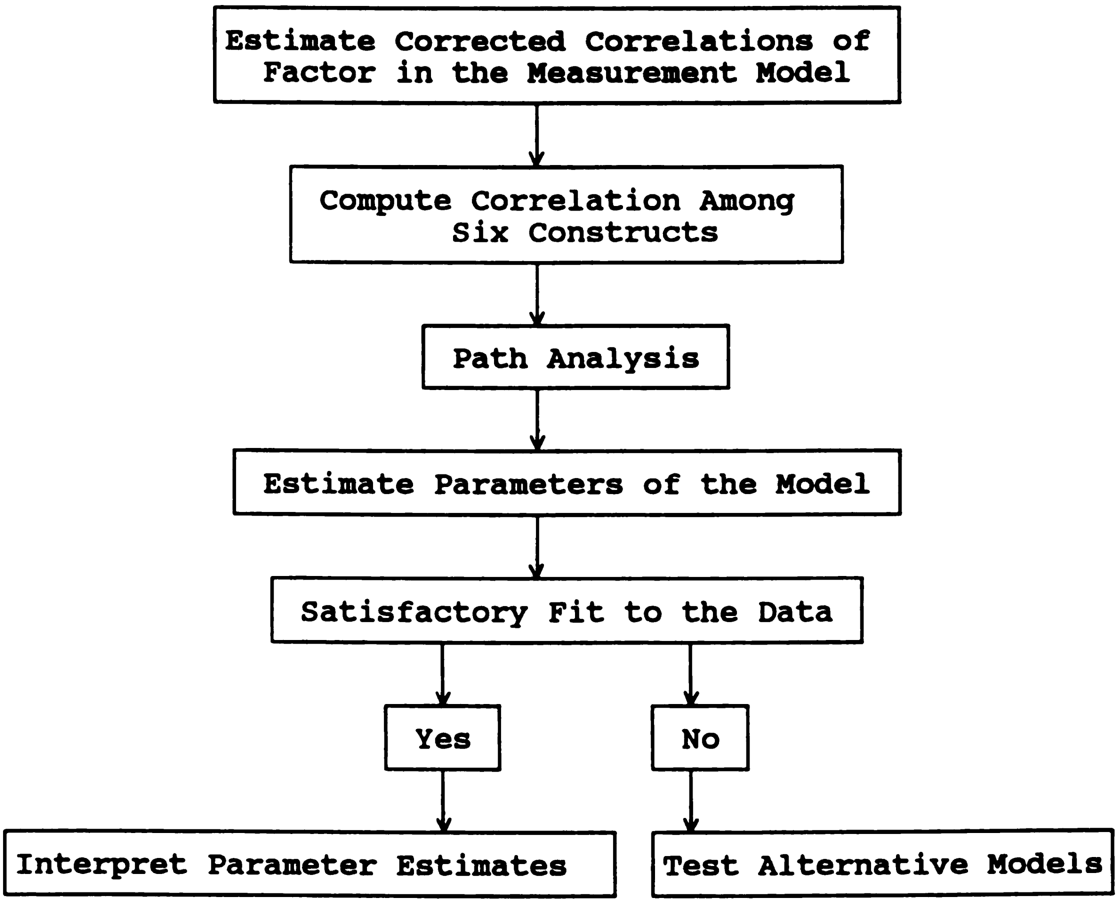
The same steps are followed that were used in CFA to develop a unidimensional measurement model, now using factors instead of items for the model.

H. Multiple Regression of Mindful Construct

Multiple regression is used on this newly formed construct to address multicollinearity issues and to verify the relationship of each construct to the newly formed mindfulness construct. The multiple correlation coefficient, R-Square (% of the variance), Beta (standardized partial regression coefficient estimate), standard error of the estimate, and the 95% confidence level for the given sample size is used to determine each construct as independent variables (lacking multicollinearity). The explanatory power (Beta) of each construct on the dependent variable is used to assess the overall percentage of the variance each variable contributed to the mindfulness construct. Factors not found to contribute much to the overall explanatory power are removed and the multiple regression is conducted again until satisfactory and meaningful results are reached.

FIGURE E.2

FLOW OF PATH MODEL ANALYSIS



APPENDIX F.

REPORTING ON THE FINDINGS

Both histograms and cross tabulations should be reported and discussed. A summary of the correlation matrix should be presented in a table and include the means and standard deviation for each item.

Confirmatory factor analysis should be applied to the correlation matrix for each construct. Factors are determined a-priori to their loadings. Factor loadings, communalities, reliability coefficient and comparison of observed and reproduced correlations should be used to evaluate the unidimensionality of each construct. Each factor is evaluated for a "goodness of fit" test. A good fit is found when items correlate to each other in a given factor (internal consistency), there is homogeneity of item content, and there are similar correlations with outside measures (parallelism). A table should be presented for each factor that shows the factor loading, alpha level, difference between observed and reproduced correlations and communalities for each item.

The higher the factor loading, reliable alpha, communality and the smaller difference between observed and reproduced correlations, the better level of unidimensionality with each construct. Experience and logic are the guides when determining whether an item is removed from a factor. There is no agreed upon criteria, but generally accepted factor loadings are 0.40 or higher. CFA would be done a second time removing items until a satisfactory level of unidimensionality is reached for each construct. Results of each CFA run should be reported on.

If a high correlation exists between constructs, as seen in the corrected correlation matrix, it suggests the existence of a higher level construct. By applying second-order CFA to these factors, a hierarchical model can be tested. The hierarchical model, in essence, tests the combined factors that correlate highly to determine a new factor called "mindfulness." A table should show the alpha level, factor loadings, communalities, and the difference between observed and reproduced correlations of this new factor.

Multiple regression should then be used on this newly formed construct to verify the relationship of each variable to mindfulness. A table should present the Multiple Correlation Coeffients, R-Squared, Beta, Standard Error, and the 95% confidence intervals for the given sample size. Exploratory power of each variable on the dependent variable (mindfulness) should be discussed and summarized.

Path analysis should be used to examine the "goodness of fit" of the model to the data. A table should include the correlation matrix corrected for error of measurement by using the Spearman-Brown formula (communalities on the diagonals). Path estimates should be presented within the 95% confidence interval. A comparison between corrected and reproduced correlations, based on path coefficients, should also be discussed and presented in a table. The present learning model is over-identified (with 3 degrees of freedom) so the Chi square goodness of fit test could be used to see if the data fits the model. The predictive power of each variable is reflected in the path coefficient between constructs. These findings should be interpreted and discussed as they apply to the predicted model.

The model attempts to predict a linear chain of causation. In addition, high perceived control leads to high engagement while low perceived control will leads to low engagement. Satisfaction should be the same for both groups and would be best predicted by levels of involvement. The findings should support or reject this model at the .05 level of significance.

APPENDIX G.

ELEMENTS OF EFFECTIVE DESIGN

Exhibit designers need to provide visitors the opportunity to be involved and gain a sense of control over their environment. The following list should be considered when planning an interactive exhibit.

I. Attention: attract or gain ones attention

- A. Attracting Power
  - * Visually
    - Movement / Action
    - Color / Line / Texture
    - Forms / Shapes
    - Lights
    - Novel (the unexpected)
  - * Audio
    - Affect (mood setting)
    - Novel (the unexpected)
  - * Olfactory (Smell)
    - Familiar
    - Novel
  - * Touch
    - Novel textures
    - Familiar textures
- B. Holding Power
  - * Use of Questions (Why is a leaf green?)
  - * Impact on One's Future (It depends on you!)
  - * Change in Expectations (use of humor)
  - * Use of Novelty (Hippo in the farm pond)
  - * Pre-cuing the Visitor (This is important)

II. Perception: willingness to attend to the message.

- * Written text too long and boring
- * Computer image complicated or fearful
- * Exhibit appears to be fake, not real
- * Science or math is too hard

III. Involvement: acts as a spark to encourage cognition

- * Action
  - i.e. Turning cranks, making bubbles, listening devices, body movement
- * Interactive Devices
  - Matching items, flip cards, quiz boards, interactive computers,
- * Recognition for the correct answer

IV. Perceived Control: empower the visitor

* Allowed to make choices
* Have early experience with success
* Encouraged to express themselves (explore)
* Feel a sense of usefulness and competence
* Feel a sense of ownership

V. Engagement: cognition measured by changes in

* perception
* long term memory
* mis-conceptions
* knowledge gained