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A Study of Visitor Behavior in Informal Learning Setting: A Natural History Museum

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Abstract: This study was designed to determine whether visitor behavior at science museums differs across various exhibit styles and between Family and Non Family groups. Eight exhibits in the natural history sections of the national science museum located in Daejeon were identified to have distinctive characteristics and styles. At each selected exhibit, visitor behavior was observed for an hour. An average of eighty people stopped by each exhibit. Descriptive analyses of visitors behaviors showed that: 1) families spent more time than non-family visitors; 2) families paid more attention to exhibits, for instance, they talked and commented about the exhibits; 3) exhibit characteristics related to holding power and attention span; 4) families more frequently visited exhibits related to school curriculum rather than ones that looked attractive, fun or novel. Visitors did not play with sensory simulation types of exhibits as much as expected. This implicates that exhibit style does not guarantee long visitors holding time and attracting power. Non-significant results are explained in terms of environmental and exhibit-related factors. Several potential factors including visitor factors, setting factors, and exhibit factors are discussed and explored with topics proposed for future study.

Keywords: informal learning, visitor behaviors, time-based research

Introduction

Science educators have perceived and expected that informal institutional settings like natural history museums could play a more active role in science teaching and learning (National Research Council, 1996). There have been studies examining student cognitive and affective gains from experiences at informal settings for 25 years (Melber & Abraham, 2002). They found that learning occurred in informal settings even with better gains in understanding content knowledge as well (Allen, 1997; Boisvert & Slez, 1995; Borun & Dritsas, 1997; Falk & Dierking, 1997). Other major topics of studies in informal settings are visitor studies including visitor behavior and time-spent at exhibits (Sandifer, 2003).

The factors that affect visitor behavior in a museum can be placed into three broad categories (Falk, Koran, Dierking, and Dreblow, 1985): visitor factors, setting or environmental factors, and exhibit factors. Visitor factors have previously been investigated in Sandifer (1997), a study that explored how visitor characteristics help explain visitor behavior. Also in his later work (2003), he utilized the second category of exhibit factors and focused on the ways in which visitor behavior was affected by the exhibit. The target exhibits in this study were interactive science exhibits in science centers.

The present study furthers our understanding of the museum visit by turning to another type of informal settings which is a natural history museum. Melber and Abraham (2002) differentiated it from a science center by saying natural history museums are in a unique position as the decades old collections that are the core of their existence, bring with them their own traditions in science. Sandifer (2003) found technological novelty as one of the main characteristics that contributed to the holding of visitor attention in a science center.

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However, this study presumed that it would not be the same story in the study of natural history museums. Most exhibits in science centers are sensory stimulation types unlike natural history museums. The term of interactive science exhibits meant interacting and engaging with the exhibits physically. In contrast, natural history museum exhibits tend not to have physically engaged and sensor stimulation styles. This study explores the relationship between visitor behavior and characteristics of natural science exhibits.

Background of Study

Defining Informal Learning

Learning in museums and similar institutions is called informal learning to differentiate it from the formal learning that occurs in school settings (Diamond, 1999). Typically described as everything that school learning is not, informal learning has the following characteristics:

- It occurs voluntarily; no one is mandated to learn in a museum.
- It has no established sequence or curriculum.
- It can occur in a variety of settings, including museums. It may also occur in programs such as camps, festivals and clubs, and at locations such as homes, parks, or even street corners.
- It is ubiquitous. It occurs in many places, at any time of the day, and at any time of ones life.

According to John Falk ad Lynn Dierking (1992), informal learning has distinct advantages over its more organized counterpart. Informal learning prepares the individual for lifelong learning. It teaches people that learning is a part of everyday life, that it requires initiative, and that everyone, regardless of background, is allowed to participate. Informal learning provides no immediate external rewards, but it reinforces learning for its own sake. Most of all, informal learning reminds us that learning can be fun, that it can be enjoyed as excitement, exploration, and play.

Visitor Behavior and Characteristics Affecting Visitor Attention

Many researches report time-based statistics to describe visitor behaviors at a museum, in exhibitions, and at individual exhibits as a way to provide background information on a particular research site (Hein, 1998; Sandifer 1997). More specifically, time has been used as a powerful, unobtrusive measure of visitor attention (Falk, 1982; Serrell, 1995).

Measures of visitor attention per exhibition include total time in the exhibition, fraction of the total number of exhibits at which the visitor stops or spends a minimum amount of time, fraction of the total time in the exhibition spent at the exhibits, and amount of time spent at each exhibit. Other exhibition-level indices of visitor attention include the number of square feet per minute covered by visitors and the percentage of visitors who interact with more than half of the exhibits in an exhibition (Serrell, 1998). Other studies have specifically focused on how groups (couples, singletons, etc.) compare with one another. In her study of 1572 individuals at the British Natural History Museum, McManus (1987) discovered that couples, adult peer groups, and groups with at least one child were "likely" to visit an exhibit for at least 30 seconds, 45 seconds, and 60 seconds, respectively.

In the current study, we measure the time that visitors are engaged with exhibits. How much time visitors spend at an individual exhibit is interpreted as visitor attention and holding power of the exhibit. Also the ways visitors engaged with exhibits were observed and described for reporting. Related to visitor behavioral pattern, Diamond (1999) suggested some behaviors when making brief observations: 1) look at exhibit only: 2) manipulate exhibit; 3) talk to person; 4) comment, exhibit related; 5) comment related to graphic/text; 6) question. exhibit related; 7) talk, not exhibit related; 8) look at label/graphic; 9) read label aloud; 10) none of the above.

We employed four behaviors out of her 10 sam-

ples and added one behavior of "record and making note".

A number of exhibit characteristics relating to attracting visitors and holding time have been addressed by prior research. Large (Patterson and Bitgood, 1988), sound-emitting (Peart, 1984), or moving (Melton, 1972) exhibits have been shown to attract and hold visitor attention to a greater degree than small, soundless, or static exhibits (Sandifer, 2003). Sandifer (2003) also found that technological novelty and open-endedness were affecting increased holding time and attracting powers. We employed sensory stimulation, technological novelty, and using multi-media.

What Theories Underlie the Attraction and Holding of Visitor Attention

Although it is useful and necessary for museum educators to recognize exhibit characteristics that are successful at attracting and holding visitor attention, it is perhaps even more useful for educators to have a model for why particular exhibit characteristics have positive or negative effects on visitor attention (Sandifer, 2003). While visitors initially attend to exhibits because of sensory stimuli (noises and sounds) or other curiosity attractors (novelty, interest, and relevance), there is still nothing to guarantee that visitors will be willing to dedicate additional attention to the exhibit, whether in the form of reading the exhibit text, examining the exhibit object, manipulating the exhibits interactive components, or reflecting on the exhibit content. For this to occur, visitors must, through their engagement with the exhibit, reach an immersive experiential state of intellectual and emotional arousal (Csikszentmihalyi and Hermanson, 1995); at this point, the exhibit task has become intrinsically motivating, meaning that the task has become an interesting, enjoyable, or otherwise satisfying endeavor (Deci and Ryan, 1985; Schiefele and Rheinberg, 1997). However we proposed that the reported results from the science center should not be expected from this study for considering presumed differences between science centers and natural history museums.

Psychologists have identified some general characteristics of intrinsically motivating tasks (Csikszentmihalyi and Hermanson, 1995; Deci and Ryan, 1985; Schiefele and Rheinberg, 1997). They are clear task goals, the degree to which a person has control over the task, personal relevance, and the proper match of the task of the persons abilities (the task is neither too difficult nor too easy). These tasked can be interpreted in the context of natural history as the proper match of the exhibit text with the prior-knowledge and cognitive learning ability of the person. There are several other characteristics which affect visitor attention: exhibit interactivity (Koran et al., 1986) partially represents the visitors control over the exhibit task; concreteness (Peart, 1984), relevance (Borun and Dritsas, 1997), and the ability to make the subject come to life (Alt and Shaw, 1984) which contributes to an exhibits personal relevance; and an exhibits accessibility and multimodality (Borun and Dritsas, 1997) which addresses the issue of the appropriateness of the task to the visitors varied abilities.

Study Settings

The site of this investigation, the national science museum is located in Daejeon. The museum started in 1945 and the current one in Daejeon was opened in 1990. This government-sponsored organization consists of 102 staff members including 19 researchers. The number of exhibits and samples is 10,441 items. It has a half million visitors a year with over 60% of visits from school visits. The annual budget is over 10 million U.S. dollars and most of expenses are supported by the Korean government.

The exhibition styles are very diverse including sensory stimulation, specimen, diorama, multimedia, full-size mockup, fossils, and so on. For the study eight separate exhibits were selected and observed focusing on the number of visitors and their behaviors.

Methods

Defining the Exhibit Categories and Describing Target Exhibits

Characteristics of the natural history-related exhibits in the museum were analyzed. Based on the overall analysis, we selected eight distinctive exhibits. The most influencial characteristics were as follows:

- Using Multi-Media: The exhibits used more than one display methods except texts and samples or specimens.
- Technological Novelty: The exhibit contained state-of-art devices and illustrated phenomena that would otherwise be impossible or laborious for visitors to explore on their own. Also exhibiting something novel which is not seen in daily lives including dinosaurs was classified in this category.
- Sensory Stimulation: When the exhibit was in use or on its own, the exhibit had one or more visible parts, objects, or images that moved.
- Didactic: The exhibit provided didactically in-depth knowledge. The content is related to school curriculum or textbooks.
- Exhibiting Styles: There were several exhibiting styles, namely full-size mockup, diorama, specimen, multi-media, model, simulation, and panel or poster.

Table 1 describes the target exhibits. Exhibit 1 was "Pendulum" whose length was 8 meters and categorized to be a full-size mockup. It functions so well as what it should be meant to be with fulfilling 10 M long condition for its accuracy. It is characterized to be technological novelty in terms of being unfamiliar, its size and motion.

Exhibit 2 was a diorama of wolfs and tigers using stuffed animals. The setting was designed to present a live situation. It did not use much technological novelty or multi-media. It only provided labels consisting of paragraphs to explain Korean wild life before modern cities were developed. Also the spaces for the diorama was too small to make it come to life or be realistic. Such an exhibit would be better categorized as "taxidermy".

Exhibit 3 was a typical and traditional type of exhibition. It contained specimens of different kinds of angiosperm in a glass box with written explanations and labels as well as pictures and specimens. The styles of delivering texts were quite didactic.

Exhibit 4 was titled "Big-Bang" and explained how the universe began and was shaped. Mostly multi-media were used including flash lights, machinery, and models. It also used technological novelty effects.

Exhibit 5 was Dinosaur Mockup including fossils. It used to be quite novel to people, while nowadays dinosaurs are the most frequently used topic for Childrens TV programs. However, seeing directly big-size mockup would be still exciting.

Exhibit 6 and 7 were solar system simulation and fold/fault simulation respectively. Both stimulated the sensors and clearly are didactic for the manner of delivering the message was like reading a textbook. This kind of feature was also true for Exhibit

Table 1. Description of Target Exhibits and Their Characteristics

Exhibit Number	Description Of Contents	Sensory Stimulation	Using Multi-Media	Technological Novelty	Didactic	Exhibition Style
Et. 1	Pendulum	-	-	Clear	-	Full-Size/Model
Et. 2	Diorama: Tiger/Wolf	-	-	-	-	Taxidermy
Et. 3	Angiosperm	-	-	-	Clear	Specimen
Et. 4	Big-Bang	-	Clear	Clear	-	Multi-Media/Models
Et. 5	Dinosaur	-	-	Clear	-	Mockup
Et. 6	Solar System Simulation	Clear	-	-	Clear	Simulation/Multi-Media
Et. 7	Fold and Fault	Clear	-	-	Clear	Simulation/Multi-Media
Et. 8	Weather	-	-	-	Clear	Panel/Poster

Table 2. Number of Family/Non-Family Groups Who Engaged with the Exhibits

	Et.1 (90)	Et.2 (99)	Et.3 (80)	Et.4 (91)	Et.5 (98)	Et.6 (57)	Et.7 (100)	Et.8 (42)	Average (83)
Family	5	31	8	25	30	17	11	0	16
Non-Family	27	13	23	25	12	1	1	0	13
Total	32	44	31	50	42	18	12	0	29

( ): The total number of both visitors who passed (stayed for less than 5 seconds) and engaged with an exhibit (stayed for more than 5 seconds).

8 dealing with weather except it did not have simulation. It used only a written panel and posters without considering the heights of the visitors which was located very high on the wall.

Observing the Visitor Behaviors

Three trained researchers participated in brief observations and counting of visitors and their behaviors on one day in August, 2003. Schools were on summer vacation. Brief observations can be made using descriptions, text, design drawings, or models, In this study, we used coding of visitor behaviors such *as look at, manipulate, talk to person, read label, and record.* Visitor behavior was observed for one hour for each target exhibit. For each visitor, we recorded the following data: visitor behavior, classifying family or non-family visits and the time a visitor spent at an exhibit. Table 2 indicated ratio of family vs. non-family visitors who engaged with the exhibits for more than 5 seconds. The average of 29 visitors were observed for coding behaviors. Visitors were not aware that they were under observation.

As visitors moved about the exhibition, their involvement with each exhibit ranged from "cursory glance" to "a rich interaction such as recording and discussing". A visitor was considered to be engaged with an exhibit when she or he spent at least 5 seconds either: (1) looking at , (2) manipulating (3) talking to person and commenting related to (4) reading the label of carefully or (5) recording the exhibits. Also coding family/non-family group was done, too. The use of a 5-second cutoff is not uncommon in time-based behavioral studies (Sandifer, 1997).

Calculating Attracting Power and Holding Time

Analysis of the effect of the eight exhibits on visitor attention focused on two quantitative measures: attracting power and holding time. Their respective definitions are as follows (These measures were modified to fit the current research situation from the work of Sandifer (2003).).

Attracting power = (Number of visitors who engaged with the exhibit for more than 5 seconds) ÷ (Total number of visitors who passed the exhibit)

Holding time = (Total time spent at the exhibit by engaged visitors) ÷ (Total number of engaged visitors)

Results

Attracting Power and Holding Time

For each exhibit, attracting power and holding time were calculated as shown in Table 3. The range of holding time and attracting power are respectively from 0 to 2.6 minutes and from 0 to 0.56.

Visitor Behaviors for Each Exhibit

Table 4 summarizes the visitor behaviors at each exhibit. It indicates that most frequent behaviors are looking or glancing at the exhibits and reading the label carefully. Also talking to persons and making comments regarding the exhibits was shown in 17 percent of visitors. It is worth noting that only about 17% of visitors tried to manipulate the exhibit such as Exhibit 6 and 7. For the pushing a button, visitors could enjoy the exhibit. However, most of them just read the labels and texts.

Table 3. Attracting Power and Holding Time for Each Target Exhibit

	Et.1	Et.2	Et.3	Et.4	Et.5	Et.6	Et.7	Et.8	Average
Holding Time	0.2 min	2.5 min	0.2 min	2.6 min	2.3 min	1 min	0.5 min	0	1.16 min
Attracting Power	.36	.44	.39	.56	.43	.32	.12	0	.35

Table 4. Distribution of Number of Engaging Visitors by Their Behaviors per Each Exhibit (%)

	Look At	Manipulate*	Read Label	Talk/Comment	Record
Et.1	65		7	25	3
Et.2	34		32	25	9
Et.3	90		0	10	0
Et.4	55		13	23	9
Et.5	45		17	31	7
Et.6	0	16	67	17	0
Et.7	8	17	67	8	0
Et.8	0		0	0	0
Ave.	42	5	29	20	4

*: This category is available exclusively for Et.6 and 7.
Note: when calculating average, Et.8 was not involved.

Table 5. Visitor Behaviors for Family Groups vs. Non-Family Groups

	Look At		Manipulate*		Read Label		Talk/Comment		Record	
	Family	Non-f.	Family	Non-f.	Family	Non-f.	Family	Non-f.	Family	Non-f.
Et.1	60	67			40	0	0	30	0	3
Et.2	35	32			45	0	13	53	7	15
Et.3	62	100			0	0	38	0	0	0
Et.4	65	46			26	0	9	38	0	16
Et.5	34	75			23	0	43	0	0	25
Et.6	0	0	12	100	70	0	18	0	0	0
Et.7	0	100	18	0	72	0	10	0	0	0
Et.8	0	0			0	0	0	0	0	0
Ave.	36	60	4.3	14	40	0	19	17	1	8

*: This category is available exclusively for Et.6 and 7.f
Note: when calculating average, Et.8 was not involved.

This will be discussed the next section that follows.

In order to check if visitors behaviors of family group and non-family group are different from each other, we manipulated Table 4 by adding division of family and non-family group variable. Table 5 shows the distribution of visitor behaviors across family vs. non-family groups.

It could be found from Table 5 that there was clear distinction of visitor behavior between family and non-family group without running statistical data processing programs. When *read label* and *talk/comments* mean more engagement than glancing at the exhibits, family groups interacted and engaged with the exhibit more than non-family groups.

Discussions

Holding Time and Powers

In this study, it was found that visitors spent, on average, 1.16 minutes per exhibit. Sandifer (2003) reported a holding time of 2 minutes per exhibit from studying interactive science museums. However, in his earlier work (1997) with the ordinary

Table 6. Exhibit Characteristics and Holding Time/Attracting Power

	Sensory Stimulation	Using Multi-Media	Technological Novelty	Didactic
Holding Time	0.75 min	2.6 *min	1,7 *min	0.42 min
Attracting Power	.22	.56*	.45*	.21

*Above Average

Table 7. Exhibition Styles and Holding time/Attracting Power

	Simulation	Multi-Media	Specimen/Taxidermy	Mock-Up	Panel/Poster
Holding Time	0.75 min	2.6 *min	1,4*min	1.25* min	0 min
Attracting Power	.22	.56*	.42*	.40*	.00

*Above Average

science center, the holding time was reported to be 1.4 minutes. The result from the present study is quite encouraging for science centers which consist of exhibits that stimulate the senses and are physically engaging. Presumably working or playing with the exhibits in a science center will require more time than somewhat static exhibits in natural history museums. The attracting power of the current study was 0.35 which is an almost similar value to ones in previous reports dealing with science centers.

What kinds of factors affected the varied holding time and power? For a better understanding we picked two independent variables: exhibit characteristics and exhibition styles. For this analysis, the results were restructured; for example, in order to have a value for technological novelty, values from Exhibit 1, 4 and 5 were combined. Table 6 indicated the relationship between holding time and power, and exhibit characteristics.

This shows that using multi-media and technological novelty positively related to both holding time and attracting power. Interestingly, technological novelty was found as a convincing exhibit characteristic which resulted in more holding time in the previous study of science centers (Sandifer, 2003). Sensory stimulation and Didactic were poorly scored. One of the explanations of this non-significance is the fact that two exhibits categorized in sensory stimulation were also in didactic. The contents and explanations of each exhibit were dependent on written ones which were similar to school science textbooks. This implies that only using sensory stimulation does not guarantee capturing visitor attention.

A similar approach was employed to explore exhibition style factors affecting visitor attention. Table 7 shows the relationship between visitor attention and exhibition styles. Museum developers and designers might be interested in the result with Panel/Poster. Forty-two people entered this exhibit but no one engaged with it more than 5 seconds. Poster and panel are easy to make at a low cost. However, it can be easily ignored by visitors.

Visitor Behaviors

Holding visitor attention was high in exhibit characteristics of technological novelty and using multi-media. The visitor behavior, however, was distributed a little differently. Table 8 indicated that 97% of visitors at a sensory stimulation exhibit engaged more than glancing at the exhibit, while other characteristics accounted for around 50% of visitors engaged in those ways. However, it is too naïve to conclude that sensory stimulation is a key characteristic to encourage interactive engagement of visitors with exhibits. Rather it can support future research on the topic of "how visitor behavior and engagement is correlated to visitor learning".

According to Table 2, only 30% of visitors to enter the exhibit area stayed for less than 5 seconds or engaged with exhibits for more than 5 sec-

Table 8. Visitor Behavior and Exhibit Characteristics.

	Look At	More than Glancing-More Engagement
Sensory Stimulation	3	97
Using Multi-Media	55	45
Technological Novelty	54	46
Didactic	48	52

Table 9. Exhibit Styles and Visitor Behavior

	Look At	More than Glancing-More Engagement
Simulation	8	92
Panel/Poster	0	0
Specimen/Taxidermy	62	38
Multi-Media	55	45
Mock-up	55	45

onds. Again, half of these engaged visitors just looked or glanced at exhibits without even reading the labels. This means that 15% of the museum visitors meaningfully engaged with the exhibits. Furthermore, 85% of visitors did not have chances for learning. A similar interpretation was reported regarding the relationship between exhibit styles and visitor behavior.

Family vs. Non-Family Groups

Based on the statistics published by the target museum, over 60% of visitors are non-family groups. This means that this museum has many student visitors who come on a school visit. Even though this present research did not observe carefully the visitors coding to be 5 second cut-offs, school visit groups would be a major part of visitors passing the exhibits. Based on the statistics presented in Table 2, 60% of engaged visitors who stayed for more than 5 seconds were family-groups. Considering the total number of visitors who passed the exhibits, this leads to the conclusion that most of the families engaged with the exhibit while limited percentage of non-family groups did. Several research on time-based behavior of museum visitors have reported that family group visitors spent more time and were more deeply engaged with exhibits than non-family group visitors (Sandifer,1997).

Across the exhibit characteristics and styles, 64% of families showed meaningful interaction with the exhibits rather than just glancing at them. The result for non-families was in contrast to families; meaningful interaction was observed for 40% of non-family groups. As we consider the total number of non-families (represented as school visits), the probable percentage of meaningful engagement through school visits would range around 15% or 20%. When considering the purpose of school visits, this figure is quite disappointing.

Conclusions and Future Studies

Studies linking exhibit time and learning are few and far between (Sandifer, 1997). Cone and Kendall (1978) conducted interviews with family visitors to the Science Museum of Minnesota and were able to establish a relationship between time spent at an exhibit and exhibit recall: average visit time for exhibits that were mentioned during interviews was significantly greater than the average visit time for those exhibits not mentioned. Exhibit recall does not necessarily imply understanding, but it is reasonable to assume that memories of specific exhibits allow visitors to make connections between past visits and future events (Sandifer, 1997).

Research has already established that learning occurred in informal settings even with better gains in understanding content knowledge as well as cognitive and affective domains (Allen, 1997; Boisvert & Slez, 1995; Borun & Dritsas, 1997; Falk & Dierking, 1997). However, research needs to be done to explore some impediments in weakening its effectiveness. Similarly the findings presented in this paper reflect only 15% of visitors meaningfully engaged with exhibits. Also these disappointing results will encourage future efforts and work in exhibit design and developing efforts which needs to put more emphasis on science educational concerns. If the natural history museum was defined to be an informal learning setting, more

discussion needs to take place about the fact that just 20% of school visitors have chances to learn from the museum exhibits. Falk et al. (1978) also found that placing children in an extremely unfamiliar setting may cause sufficient stress to block any meaningful learning experience.

In summary, the major topics of studies at informal settings relate to visitor behavior and time spent at exhibits, while literature regarding learning and instruction from the perspective of educators and the educational programs they provide remain deficient (Tran, 2003). These would be topics for future study.

The present study is in the beginning stage with regard to informal learning settings. Natural history museums are not only places to keep specimens or to serve as a recreational option, but also they are learning environments which support formal education. This study searched for the possibilities of science education involvement in informal educational institutes like natural history museums. The informal education institute were interpreted and examined from the view point of science educators whose work mostly focuses on formal education. Of course there could be an argument that "informal" needs its own research method and scope instead of adopting formal scope. Nevertheless more research in the future needs to look into informal learning situation by means of previously developed tools and research ideals for formal learning situation because both formal and informal should work toward the same goal of better learning and better citizens. For instance, pre-visit and post-visit activities can be investigated in terms of better student achievement and attitude.

One of the purposes of this study is to encourage all other tries and attempts to adopt and employ well-developed science education research approaches focusing on formal education in order to investigate the potential for informal education to be a better partner of formal education seriously.

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