Beliefs in the Science Museum: An Exhibit Evaluation

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Scientific exhibits that attract and hold visitors' interest and attention can prompt positive attitudes toward scientific explanations and foster desirable inquiry strategies and search behaviors. Live models have been shown to be attractive enough to influence attention and cognitive coding activities (Koran, Koran, & Foster, 1989). It is necessary to find similar arrangements for situations or content areas where live models cannot be used directly. Such is the case of most phenomena studied by physical science.

In this area, attractive and interesting elements can be enhanced if the phenomena chosen for display are not encountered by the public frequently enough to be taken for granted, but close enough to be in their immediate environment. Such is the case of eclipses. They can be considered real natural physical events which take place in our immediate environment, but occur relatively infrequently.

Puzzling occurrences such as these have been found to have special meaning for culturally differentiated groups. Explanations of those not so frequent, but vivid, phenomena sometimes take the form of beliefs and myths and are often considered to be scientific knowledge.

Beliefs, myths, and scientific knowledge are explicitly explained and are therefore culturally shared. On the other hand, naive notions (also called pre-conceptions, misconceptions, alternative schemes, etc.) are not (Gilbert, Osborne, & Fenshman, 1979; Pines & Novak, 1985; Novak & Gowin, 1984).

The impact of scientific knowledge will be different in different cultural settings. As Shymansky and Kyle (1992) put it,

> "Scientific knowledge and practices are extended by adaptation of locally situated practice to new local context. Thus scientific knowledge and practices must be interpreted within specific social context." (p. 750)

This situation can also be seen in the development of science itself, and its applications throughout history (Selin, 1993). Acknowledging these variations in people's knowledge and cultural backgrounds is very important when planning science exhibits.

Based on the cultural differences between social groups, science educators must consider creating and sustaining settings that are respectful of

individual differences and group membership, where learning is valued, engagement is nurtured, and interests are encouraged (Atwater, 1993). Thus, it is important that the museum experience not be felt as uncomfortable or aggressive.

UNIVERSUM Science Museum

UNIVERSUM Science Museum is located on the main campus of the Universidad Nacional Autonoma de Mexico (UNAM) in an area dedicated to cultural activities in Mexico City. This university is the main institution of higher education in Latin America and one of the oldest in the Americas (see Note 1). The museum has 12 halls, each one dedicated to a specific scientific field or topic, within 27,000 square meters (see Note 2).

The main goals of the museum are:

1) To foster scientific values and favorable attitudes towards science.
2) To develop interest and appreciation towards science.
3) To show what science is about, how it is made and up-to-date scientific information reflecting conceptual precision, congruence, and structure.

According to these goals, exhibit content is selected with societal and technological criteria in mind. In this way, the museum serves an important purpose in helping to attract students to science. This has particular importance because enrollment in science and mathematics has been declining in the last ten years. Therefore, in this museum and others that are now about to be open in other cities of Mexico, non-formal education becomes an important educational alternative in which high school students can experience science in a new and interesting way.

We have stated that exhibits must be presented in such a way as to convey updated scientific information in an attractive manner. We should also add that, given that most exhibits are established at a high school level of knowledge, it is very important to have evaluation systems to detect their impact on visitors—particularly among the target audience of high school students.

In this paper we will review the evaluation process which is being carried on for this purpose at an exhibit about eclipses—a natural phenomenon which is vivid, infrequently occurring, scientifically known, and which has been given mythical or otherwise non-scientific interpretations throughout the ages.

The Evaluation Process

Prior to the opening of UNIVERSUM Science Museum, in December, 1992, about 15 traveling exhibits were designed not only to test exhibits as material objects, but also to study audience reactions during and after

interaction with them. Thus, temporal and partially completed exhibits on a variety of topics, that would later become permanent exhibits in the Museum, were displayed at different sites in Mexico City and in other cities. Exhibits were located in a diversity of environments (from subway stations to university halls) and were tested with visitors of different educational backgrounds (elementary level to specialists). We had general guidelines for designing exhibits, but little knowledge of how "real visitors" would behave in these environments. Since the success of any design depends on visitor characteristics, an evaluation of exhibit characteristics and their impact was conducted. This is particularly important in our context, since this science museum is the first of its kind in Mexico City, and most of the audience has nothing similar with which to compare it. Although there are many history, anthropology, technology, and art museums, the goals and visitor behaviors of such settings differ significantly from those of an interactive science museum.

The Study

This study was conducted by the UNIVERSUM Evaluation Department, which is not at any point involved with the exhibition planning or design process. It works independently within the museum's goals and activities framework (Perez de Celis & Gaspar, 1991), and its findings are presented regularly, under a plan which is set for every exhibit, to specific departments (Audiovisual, Written Media) and Hall Chairs. The evaluation results are discussed and changes and improvements, both large and small, are made when needed. The Evaluation Department is staffed with two Researchers, one Research Assistant, five Information Analysts and ten Fieldwork Assistants.

Eclipses: A Description of the Exhibit Which Was Studied

The solar eclipse that took place on July 11th, 1991, could be seen in most Mexican states, so the staff of the Science Museum considered it important to prepare a scientific exhibit on this phenomenon, prior to its appearance. The exhibit was designed at a high school level of knowledge, and its main goals were:

- To provide visitors with updated scientific information on eclipses;
- To illustrate how different cultures understand and experience eclipses;
- To teach safe procedures for observation of the coming eclipse.

The last of these three goals was considered to be very important, since educating the public does not mean merely giving information, but also helping people to be aware of the possible dangers which natural phenomena may present to them. That is, science education needs to foster both science literacy and social responsibility as a primary goal. By doing so, responsibility may enhance overt behavior in the form of meaningful

participation, positive control, and dealing with responsibility, etc., according to the findings of many science literacy writers (Ramsey, 1993).

This exhibit, now part of the permanent exhibit in the Universe Hall of UNIVERSUM Science Museum, was temporarily displayed at a subway transfer station in Mexico City. The station (La Raza), connecting two subway lines, has a long, wide walkway for exhibits, and is now commonly know as "The Science Tunnel." More than 110,000 commuters use this station daily.

The total exhibit area was 525 sq. meters. The core concept of the exhibit dealt with the eclipse, but information about safe procedures for solar eclipse observation and information on the myths surrounding this phenomenon were also included, following the ideas discussed above.

Interactive devices were set up to give people easy access to basic information on eclipses (such as their nature, stages, and the like). Detailed maps showed where the eclipse could be seen in Mexico. Videos ran constantly on TV monitors in strategic locations throughout the exhibit to provide audiovisual information on eclipses. A professional eye dissection booth was also set up to give the public first-hand experience in the health risks of eye exposure to sunrays during an eclipse. At the same time, docents previously trained by an ophthalmologist dissected a live pig's eye and placed the dissected segments on a microscope attached to a TV monitor in order to show the different layers of the retina, as well as possible damage which could occur. All of this was complemented with a collection of animal eyes, and pictures of healthy and damaged retinas.

On the cultural and artistic side of the exhibit, a series of batiks on the subject of myths which have been constructed around eclipses by different cultures were displayed in a section of the exhibit which was accessible to all commuters. One of the most common and prevailing myths in Mexico about eclipses is that if a pregnant woman watches an eclipse, or is exposed to one, her baby will be born with a cleft palate. It is believed that such an affliction can be cast off by hanging a sharp object by a red ribbon.

This traditional knowledge and practice was depicted in a respectful manner, side by side with a scientific view of the phenomenon—a situation that was very important to include (Fierro and Doddoli, 1993).

Procedure

Multiple techniques and instruments were required for this study. Different instruments were developed to identify sample characteristics, visitor's attitudes towards the exhibits, and their impact. Two questionnaires and a path map for each area were also designed.

The first questionnaire was based on 12 items (6 open-ended and 6 multiple choice). This form was intended to elicit demographic data and general interests. The second questionnaire had 10 items (8 open-ended and 2 multiple choice) on demographic data, specific interests related to the

exposition topics, opinions regarding the information on myths and eye-dissection, as well as on perceptions of the arrangement of the exhibit.

These questionnaires were given directly to each individual in the sample, in an interview mode. A total of 283 visitors completed questionnaires. This sample was randomly selected from those visitors who:

1) Had used the interactive facilities of the exhibit—considered to be an indicator of curiosity; and
2) Had visited the whole exhibit—considered to be an indicator of interest.

Results and Discussion

Slightly more than half of the visitors were men (54%). This could be due to the fact that more men than women use the subway as a means of transportation. Nevertheless, the differences in number between men and women was so low that it can be said that the exhibit was attractive to both men and women. This is very important, since this type of exposition usually attracts more men.

The educational background of the total sample of 283 is shown in Figure 1. As can be seen, the largest proportion of visitors had a high school background. Hence, our target population was reached.

Visitor responses regarding safe ways of observing the oncoming eclipse are displayed in Figure 2. The high percentage of correct answers regarding safe ways of observing the oncoming eclipse indicates that this exhibit reached one of its main goals. However, some unsafe ways of observing the upcoming eclipse were also considered to be safe (see Figure 3). The multiple unsafe ways that would be used by people to watch an eclipse indicate that more effort is needed to inform the general public of safe procedures. From these results, we learned that more emphasis needs to be given to describing the relationship between vision and eclipses.

Visitors were also tested for their knowledge of the damage caused by eclipses with true/false questions. When visitors were asked to identify the harmful effects of eclipses, correct answers were given in most cases (Figure 4), but because of the impact which incorrect beliefs can have on visitors' health, we consider these percentages to be unacceptably low. Those who gave incorrect answers (Figure 5) by indicating birth defects such as harelips and baldness, while low, are in turn, higher than desired. It is interesting to note that men and women who mentioned such effects indicated that they had learned this information from their mothers or grandmothers—that is, independent of their formal educational background. This gives us an idea of the importance which traditions still hold for a high proportion of visitors.

Some visitors stated that they did not hold any myths about eclipses. Nevertheless, they considered there to be a relationship between birth defects

and eclipses. One visitor mentioned that there is a relationship between eclipses and wars.

Information on beliefs and myths was gathered in a pre-post format. Myths were presented in a narrative manner (see Figure 6). When comparing the upper and lower halfs of Figure 6, it can be seen that the exhibit presented information which encouraged 16% of the sample to change their responses. Although we do not consider this to be a conceptual change, we can say that the change was a shift in perception or point of view.

Content selection of scientific exhibits is very important for attracting and holding public attention. In our case, mass media constantly announced the event that would take place, but an emphasis was given to the harmful effects of eclipses. A science museum cannot limit its attention to only one aspect of a phenomenon; it needs to provide the public with updated scientific explanations in such a way that people understand that such interpretations are cultural products which can offer better explanations than other culturally valid ones. When attempting to change incorrect beliefs, issues must be approached in a respectful, nonjudgmental manner. Beliefs are part of visitor's knowledge, and they give a sense of group belonging. Scientific explanations need to be seen as cultural productions also, and social responsibility must be stressed. In this study, self responsibility was centered on self-health care.

It is in this sense that science museums can have an impact in changing people's view about science as a different, but sound, way of explaining the world around them. This shift in perception could be a first step towards conceptual change.

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Notes

1. The University of Mexico was officially opened on September 21, 1551. Since that time, it has undergone major changes as a reflection of different historic periods. It's actual name is Universidad Nacional Autonoma de Mexico.

2. The exhibition halls of UNIVERSUM include:
   1) Matter Structure
   2) Energy
   3) The Universe
   4) Ecology
   5) Biological Diversity
   6) Mathematics: Nature's Language
   7) Human Biology and Health
   8) Animal Behavior and Society
   9) Agriculture and Nutrition
   10) A Nation's Infrastructure
   11) Our City: Science and Social Responsibility
   12) Chemistry

Figure 1
Educational Background of Sample

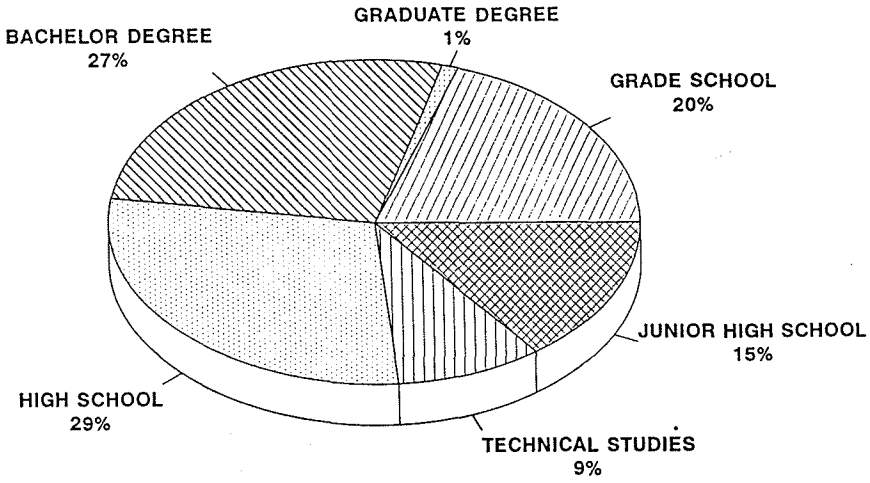

Figure 2
Safe Ways of Observing Eclipse

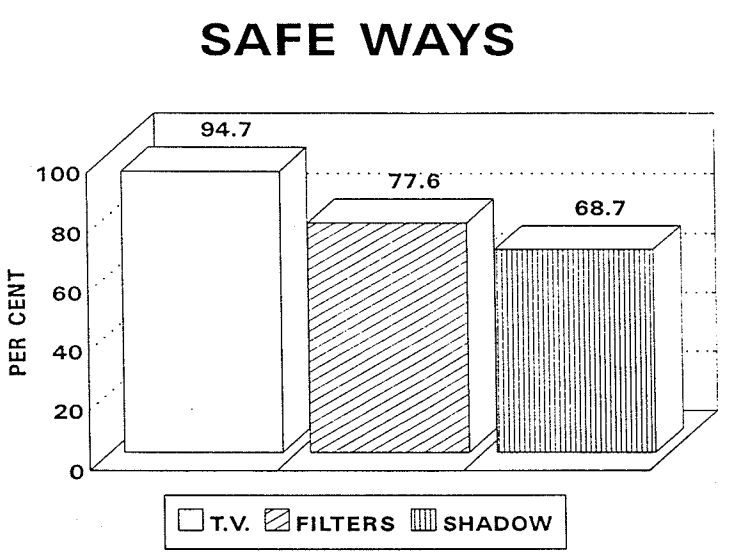

Figure 3
Unsafe Ways Considered Safe

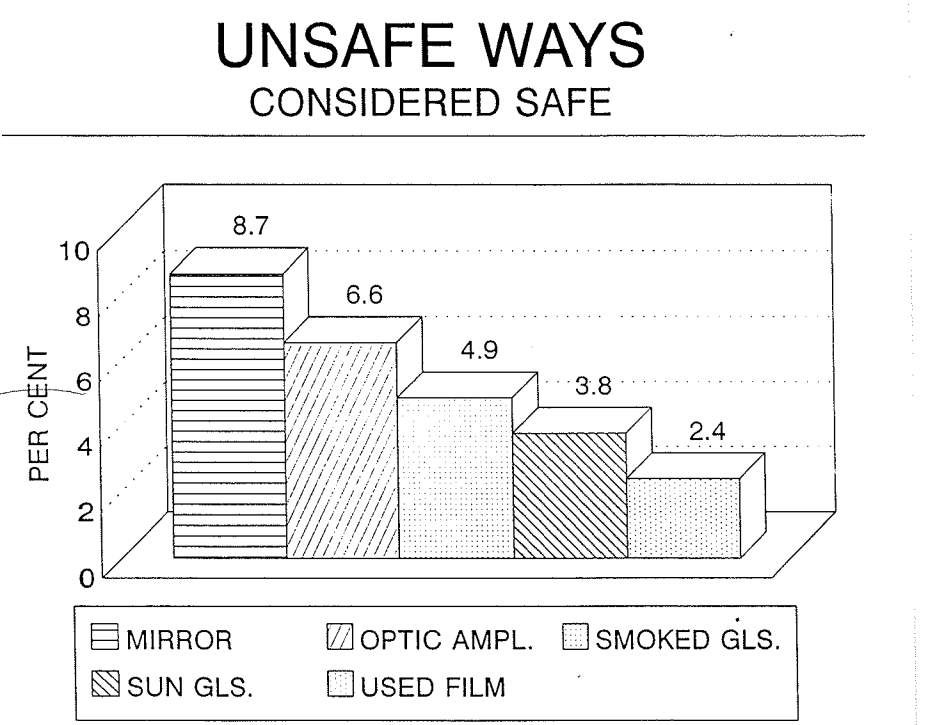

Figure 4
Harmful Effects of Eclipses

TRUE

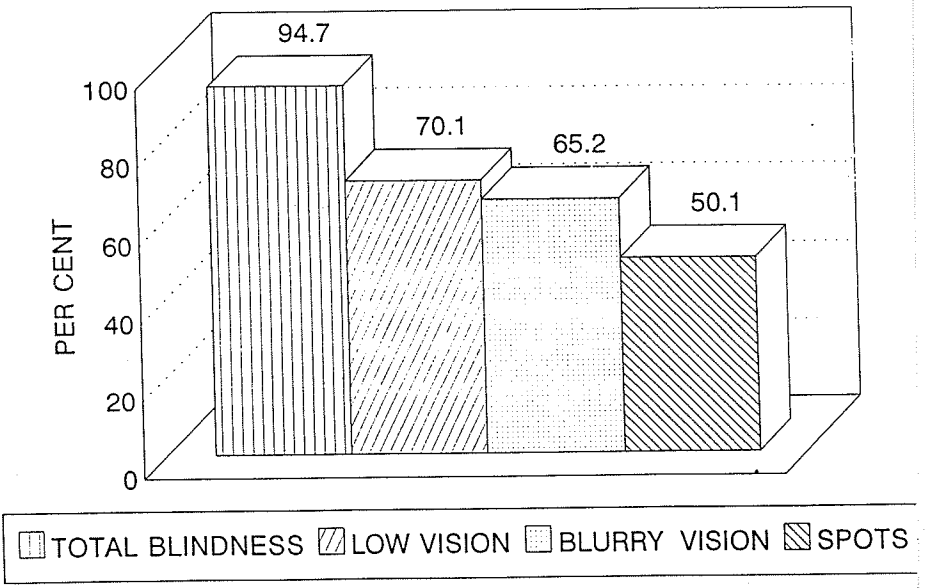

Figure 5
Incorrect Answers to Harmful Effects Question

FALSE

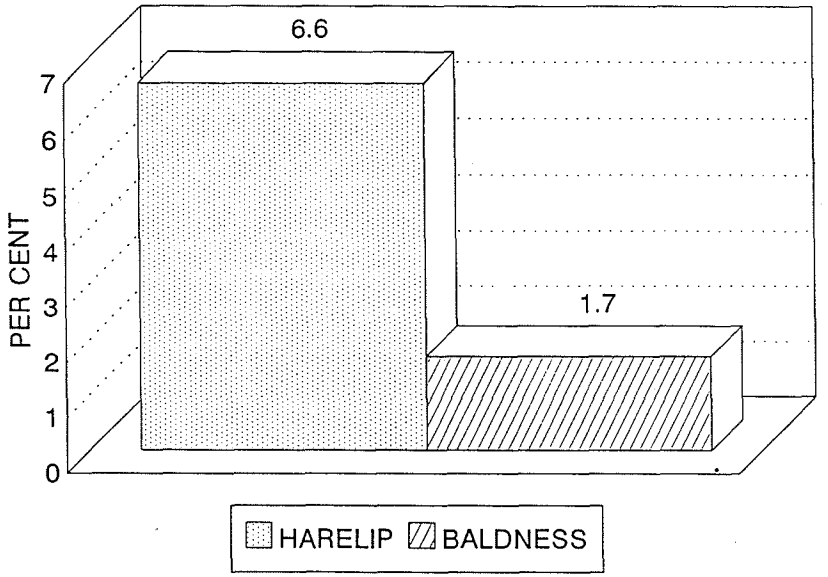

Figure 6
Beliefs and Myths Before and After Viewing Exhibit