To enhance the educational and recreational experiences of zoo visitors, Zoo Atlanta has developed a research program to inform the design of effective exhibit signage. The research design entails a parallel study, multi-method approach to be used throughout the Zoo. The first study utilizes a "before and after" design to evaluate the impact of sign performance on exhibit performance (attractiveness). The second study utilizes a product evaluation model to determine the impact of three sign characteristics on sign performance (learning). This paper reviews the purposes and procedures of the research program and reports the results of the initial exhibit performance study.

INTRODUCTION

Exhibition facilities, such as zoos, museums, and aquariums, use interpretive or display signage to enhance the attractiveness of their exhibits and to serve as educational resources for the visiting public. Yet, while display signage is an important way of conveying information about the animal or object on exhibit, it is extremely difficult for many institutions to develop and present appropriate educational information to the public (Weiner, 1983; Serrall, 1977, 1979). Much of this difficulty derives from the large number of content and contextual variables involved in producing informational signage. Typical problems include: text which is too advanced, technical or verbose; text which is too simple or boring; text which is inadequately edited; text which is hard to read (e.g., too small); poor typography; poor figure-ground contrast; and poor sign placement or angle (Serrall, 1983; Taylor, 1981). Moreover, because it is difficult to match signage to both the design of the exhibit as well as the processing levels of a particular audience, display signage often does more harm than good (in many cases distracting from the quality of the exhibit, rather than enhancing it). The Signage Research Team at Zoo Atlanta has developed a parallel study, multi-method research program to inform the design of exhibit signage throughout the Zoo. The first of the two studies is designed to determine the impact of signage on exhibit performance/attractiveness; the second is to assess the impact of signage characteristics on sign performance/communication. This approach will be used to conduct signage studies at each of twelve new exhibits to be built over the next three years. This paper outlines the objectives and research designs of the
two parallel studies and presents the results of the first exhibit performance study which was conducted to develop permanent signage for the new Flamingo Exhibit.

**RESEARCH PROGRAM OBJECTIVES AND DESIGN**

A series of brainstorming sessions were held with graphic designers, project architects, zoo staff and the Zoo Director, to identify the issues they felt would influence the effectiveness of exhibit signage. These issues fell into two categories: 1) those that focused on exhibit attractiveness in terms of how signage performance impacts exhibit performance; and 2) those that focused on communication in terms of how signage characteristics impact signage performance. These two categories formed the basis of the two parallel studies.

**Study I: Exhibit Performance/Attractiveness**

The primary concern of the zoo staff focused on exhibit performance, or the impact of the exhibit, as a whole, on visitor behavior and experience. Exhibit performance is typically defined by the amount of time visitors spend viewing the exhibit, that is, its attractiveness, drawing power and holding power (Screven, 1976). However, there is little empirical evidence regarding the role of signage in exhibit attractiveness.

Serrall (1977) demonstrated that there was a relationship between the attractiveness of an exhibit, measured in viewing time, and the attraction given to exhibit signage. However, it is not clear from her work whether the attractiveness of an exhibit stimulates increased interest in a sign or whether a sign stimulates increased attention to an exhibit.

**Objectives.** The research objectives for this study are to determine:

1) the extent to which signs are intrinsically attractive (that is, the degree to which they are responsible for increasing the number of people who view the exhibit and for influencing space use patterns); and

2) the extent to which signs stimulate increased interest in the exhibit by increasing viewing time.

A third objective which the zoo staff addressed was the extent to which exhibit performance influenced learning. Whereas many studies have used the amount of time that a visitor spends at a particular exhibit as an indicator of learning (e.g., Serrall, 1977) this assumption is questionable. The approach taken in this research is that learning cannot be isolated from a discussion of signage performance which is the focus of the second study on information communication.
Research Design. In order to address the objectives identified above, the first of two parallel studies was developed. This study entails a basic "before and after" design to test the effects of signage on visitor behavior. Changes in visitor viewing time, site destination (where visitors go when faced with a choice of competing exhibits), and space use (visitor movement patterns) between the two conditions are indicators of holding power, drawing power and sign attractiveness, respectively.

In this study observational techniques are used to measure visitor viewing time, site destination and space use patterns. The "before" or baseline condition involves data collection before the installation of any interpretive signs. The "after" condition occurs after installation of mock-up signs and uses the same data collection techniques as in the "before" condition.

Study 2: Sign Performance/Communication
A second concern of the zoo staff was the impact of signage characteristics on signage performance. Whereas previous research focused on a limited number of design characteristics, such as size of text and color of the background (Elting, et al., 1965; Hodges, 1978), the zoo staff identified three types of sign characteristics which they felt would have an impact on interpretive signage to communicate information: 1) informational content, 2) graphic presentation, and 3) sign location.

Objectives. Specific objectives for this study are to determine:
1. Content - the reading level necessary to communicate with zoo visitors (i.e., to increase their knowledge), as well as the type of information they want to know about an exhibit;
2. Presentation - the most effective format for attracting zoo visitors as a precondition for communicating with them; and
3. Location - the optimum placement of exhibit signs to enable visitors to see them.

Research Design. Knowledge and learning acquired from viewing an exhibit cannot be measured directly and must be inferred from
changes in what visitors know after exposure to interpretive signage (Screven, 1976). As a consequence, this study utilizes a product evaluation model to assess the effectiveness of the three sign characteristics - content, presentation and location - on visitors' comprehension and learning. Several types of baseline data are obtained from random samples of zoo visitors prior to the installation of exhibit signage. These data include: 1) what visitors know and want to know about flamingos, 2) visitors' ability to understand and recall information from signage text when it is on a typewritten handout; and 3) visitor movements in and around the exhibit.

Figure 2. Example of Flamingo Exhibit Signage

After the baseline data are collected, test data are collected using the same mock-up signs as in the Attractiveness Study. The protocol used in the pre-test phase is repeated, with the exception that the typewritten handout is replaced by the mock-up signs. The test data can then be compared to the pre-sign data to determine the effectiveness of the signs in: 1) increasing visitors' knowledge about flamingos; and 2) communicating with the visitor (e.g., are signs more effective than a handout?). This information can then be used to inform the design and installation of the permanent signage.

METHODS

A number of methods can be used to assess the impact of exhibit signage on the learning experience of zoo visitors. While previous studies have been limited by their use of singular methods to test knowledge, attitudes and learning, the research approach described here is unique in that it utilizes a multi-method, parallel study approach to data collection. This enables the research team to simultaneously determine not only the impact of exhibit design, but also the impact of signage design and location on visitor experiences. Although the discussion of
Exhibit Performance Study

Obtrusive observations. Three hundred sixty, randomly selected zoo visitors were tracked from the time they entered the Zoo’s Entry Plaza to the time they departed from it. The Flamingo Exhibit is contiguous to, and accessed from, the Entry Plaza (see Figure 3). In order to ascertain exhibit/sign attractiveness, drawing power and the amount of time spent looking at the Flamingo Exhibit (and in the “after” condition at each sign), visitors’ points of entry to and egress from the exhibit, where they stood in the exhibit, the direction of their gaze and eye-fixing, as well as the location of the birds in the exhibit were recorded.

Signage Performance Study

In this study, videotape analysis, as well as tests of information recall and general knowledge about flamingos were used to measure the effectiveness of the various sign characteristics on signage performance. Only visitors who had viewed the Flamingo Exhibit were asked to participate by completing one of the surveys or questionnaires described below.

Video analysis. Visitors’ movement patterns in the Flamingo Exhibit were videotaped at various times of the day and over a two week period. The tapes were analyzed and movement patterns mapped in order to ascertain how visitors’ use the exhibit (e.g., where people stood, the impact of the number of visitors in the exhibit, etc.).
Recall Test. Visitors' ability to understand basic signage text was tested by administering reading comprehension tests to zoo visitors after they had viewed the Flamingo Exhibit. Using the proposed signage text as the test material, visitors were asked to read typewritten handouts and answer questions about the text. In order to compare the effectiveness of informational signs to typewritten handouts as well as the reading level required to communicate with the majority of zoo visitors, visitors' knowledge about flamingos was tested after the signs were in place by asking them to answer the same set of questions used in the test exercises.

Test of General Knowledge. A test of general knowledge was administered prior to the installation of signs by asking zoo visitors to answer the same questions as in the recall test, but without the benefit of having read the informational handout first. The purpose of this test was to establish zoo visitors' knowledge of flamingos as a basis for comparison for what they knew after exposure to the signs.

Attitudinal Survey. A short, open-ended questionnaire was used to ascertain visitors' subjective responses to the design of the exhibit (attractiveness) and what they would like to know about flamingos. These data were used to determine what information, from the visitors' perspective, should be included in the signs.

RESULTS

The results of the case study reported below focus on the Flamingo Exhibit Performance Study which illustrates the effects of signage on visitor behavior.

Drawing Power. As Figure 3 illustrates, the Flamingo Exhibit is immediately to the east of the entry gate, with the zoo spine, which leads to all other exhibits, located directly ahead in the visitors' path of travel. Baseline observations without signs showed that about 76% of the 400 zoo visitors went to the Flamingo Exhibit first; whereas only 16% walked past the Flamingo exhibit and followed the main spine. The other 8% went to the gift shop or Children's Zoo. Follow-up testing with signs in place showed that the signs did not appear to affect exhibit drawing power as 75% of the sample went to the Flamingo Exhibit first.

Holding Power. The mean viewing time for the exhibit without signs was approximately 80 seconds. However, there were sharp differences in viewing time as a function of the location from which the visitor observed the exhibit. In addition, group composition also appears to influence viewing time. The 17.3% (41 people) who remained in the plaza level, spent, on the average, much less time (50.6 seconds) viewing the exhibit than
those who descended into the exhibit (92.4 seconds). In
addition, viewing time was longer when adults were accompanied by
children (82.4 seconds), or in an organized group (117.6 seconds)
than when adults came either alone or with peers (88.6 seconds).

When observations were made with the mock-up signs in place, the
mean viewing time for the sample actually decreased by almost 9
seconds from 80 to 71 seconds. This drop in viewing time is
probably attributable differences in the time of year when the
data was collected. The initial data was gathered in early fall
when temperatures were warm and the vegetation in the exhibit was
lush and green. The follow-up testing was done in February, and
although the temperature was a factor (the mean viewing time was
67 seconds when the temperature was 40 degrees versus a mean
time of 75 seconds when the temperature was 65 degrees), differences
in the appearance of the exhibit due to the effects of winter on
the vegetation may have also been a factor.

There was a similarity between the two data collection phases in
terms of group composition. In both conditions adults
accompanied by children spent more time (mean = 75 seconds in the
after condition) viewing the exhibit than did adults who either
came alone or with peers (mean = 55 seconds in the after
condition).

Although the addition of signage to the exhibit did not increase
the mean viewing time, those visitors who read the signs stayed
at the exhibit for a longer period of time than those who did not.
This increase in viewing time was slight for those who read one
sign (mean = 74 seconds), however, those who read two or more
signs spent an average of 103 seconds at the exhibit.

Sign Attractiveness. The Flamingo exhibit was designed so that
visitors could enter either by stairs directly off of the Entry
Plaza or by a shallow ramp which parallels the left side of the
exhibit. However, the observation data in the "before" phase
indicated that visitors, contrary to design expectations, tended
to enter the exhibit from the plaza (82.3%) and only rarely (6.6%)
used the ramp. Even the majority of parents with
strollers went down the stairs rather than using the ramp.

The data not only show that circulation flow within the exhibit
did not follow a linear pattern, but also that people tended to
center themselves in the exhibit. That is, zoo visitors would
walk down the center of the stairs and stand along the center of
the viewing area. However, the data collected after the Flamingo
Signage was installed indicate that the signs may have influenced
space use. First, 56% of the people who viewed the exhibit read
at least one sign. Since the signs are all located along the
perimeter of the exhibit (see Figures 1 and 3), zoo visitors
would have had to alter their tendency to center themselves as
was observed in the initial observations. In addition, 8.3%
more of the sample (97%) went into the exhibit when signs were in place, than when the signs were absent (88.7%).

DISCUSSION

Exhibit performance includes exhibit drawing power, holding power and sign attractiveness. When zoo visitors are faced with a choice between competing alternatives, the percentage of people that choose a particular exhibit is a measure of that exhibit's drawing power. The location of the Flamingo exhibit is in relation to the Entry Plaza is such that visitors could by-pass the exhibit by going either to the Children's Zoo, the Zoo Spine, the Gift Shop or the Necessities Shop prior to going to the Flamingo exhibit. As a result of this competition among attractions, the degree to which the Flamingo Exhibit was successful in capturing visitor attention was a measure of its drawing power.

Both baseline data without signs in place and data after signs were installed indicated that the Flamingo Exhibit had a large amount of drawing power with approximately 75% of the visitors in each sample viewing the exhibit before going anywhere else.

Yet, while the data did not indicate that signs play a role in attracting people to view the exhibit, they do seem to play a role in drawing people into the exhibit as 97% of the people who viewed the exhibit in the "after" condition went into the exhibit as compared to only 88.7% in the "before" condition.

A second indicator of exhibit performance, holding power, was measured by the amount of time an individual spent viewing the exhibit. Although the length of viewing time actually decreased between the two phases of this project, this finding can probably be explained by the differences in conditions between periods of data collection. As a result, additional data will be collected in the spring.

Finally, although the pattern of space use was consistent across both "before" and "after" conditions, there is evidence that signs are (to a degree) intrinsically attractive and altered space use. In contrast to the movement patterns before signs were installed, zoo visitors did not always enter the exhibit down the center of the stairs and remain in the center of the exhibit after the signs were in place. Rather, 56% went to the perimeter of the exhibit to read one or more of the signs.

In summary, although the results of this study indicate that the addition of signage does not increase the holding power of the exhibit, this finding can be questionable because of the influence of the weather. It does appear, however, that signs do influence visitor space use patterns and that a majority of visitors will adjust their "natural" patterns in order to read at
least some of the signs. Moreover, those people who read either two or all three of the signs did spend a significantly longer period of time at the exhibit (an average of 103 seconds) than would be expected from either their group composition or the amount of time that it would take to read the signs. There are two possible explanations for this. Either the signs could have stimulated more interest in the exhibit or the 17% of the sample who read two or more signs were simply more interested and that is why they read more signs.

**DESIGN IMPLICATIONS**

Although additional data collection under weather conditions more similar to the baseline conditions might clear up some of the inconsistencies in the before and after data, there are some design implications which can be derived from this study. First, signs are intrinsically attractive; visitors will go out of their way to read them, but only up to a point. Whereas 56% of the people read at least one sign, no more than 27% read any one of the three signs and only one person read all three signs. Thus, while people may their preferred behavior patterns to read one sign, they are unlikely to do it for two signs, much less three. Therefore, in order to maximize the number of signs that will be read, it is probably better to locate some of them within the natural movement patterns of the visitors. As the design (especially shape and orientation) of the Flamingo Exhibit makes this very difficult, space use analysis should be an important consideration in design. Additionally, three signs may be too many for this exhibit; however, this is difficult to determine from the data.

This study also indicates that exhibit design plays an important role in space use and attractiveness. Prior research has shown that people getting close to the animals is an important factor in the attractiveness of an exhibit (Normandie, 1986). This study indicates that perceived closeness may be as an important design factor as actual closeness. This is evident from the tendency of the zoo visitors to get as close as they could to the center of the exhibit, even though the sitting of the exhibit (which slopes uphill) is such that visitors in the Entry Plaza are probably closer to the flamingos and also have a better view.

Finally, even though the length of viewing time found in this study was comparable to previous studies, this study did not support previous findings that associated viewing time with certain quantitative characteristics of the exhibit. For example, Farrell (1977) found a relationship between exhibit size and viewing time. Similarly, others found viewing time to be dependent on: the size of the animal (Bitgood, et al., 1985), the amount of animal activity (Rodgers, 1978; Martin and O’Neill, 1982), and the presence of young animals (Bitgood, et al., 1985).
Because the Flamingo Exhibit did not display any of these characteristics viewing time may have been a function of more qualitative aspects of the exhibit such as the type of animals displayed, its design characteristics (e.g., the presence of trees, water and terrain) and the interaction between animals and the design of the habitat. In fact, the decrease in viewing time between the "before" and "after" conditions may support this hypothesis as it may have been the result of a deterioration in the landscape design features due to the winter.

REFERENCES


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