Evaluation of the *Falling Feather* Exhibit on Gravity

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The exhibit, located in a science museum at the time of this evaluation, attempted to demonstrate that, once air resistance is removed, both light and heavy objects fall at the same rate due to gravitational pull. The apparatus consisted of a large, clear plexiglass tube containing a feather and a small piece of metal shaped like a chicken. The tube was attached to a vacuum pump so that air could be pumped out. An electromagnet, when activated, was supposed to hold the metal chicken against the feather at one end of the tube which was then rotated so that the objects fell straight down. Three colored buttons were placed to the right of the tube and directions on how to use the exhibit directly below the buttons.

The following 125-word interpretive/explanatory label was attached to the exhibit on the top left side:

> "Galileo discovered that gravity pulls equally on heavy and light objects. The unexpected factor is air resistance.
>
> When the feather and the chicken fall in the tube filled with air, the feather falls slower because it has a larger size relative to its weight and encounters more air resistance.
>
> Remove the air from the tube and a vacuum is created. The feather falls as fast as the chicken. This shows that gravity works just as "hard" in holding giant planets or tiny comets in orbit around the sun.
>
> To test Galileo, Astronaut Dave Scott, on Apollo 15, dropped a falcon feather and a hammer in the airless environment on the moon. They fell slower than they would on Earth – but they arrived at the same time."

Directions were provided which must be followed in order to observe the feather and the metal weight falling under normal conditions with air and under vacuum conditions after the air was pumped out. To complete the demonstration, a total of eight manipulations had to be made by the visitor:

(1) Turn the tube so that the feather and metal object are on the bottom of the tube.
(2) Press and hold the red button to magnetize the metal chicken and hold down the feather.
(3) Rotate the tube so that the feather and metal chicken are at the top while still being held by the electromagnetic field.
(4) Press the green button to release the magnetic force and compare how fast the metal chicken and feather fall.
(5) Press the blue button to activate a pump to remove the air from the tube.
(6) Repeat step #2 (press and hold the red button).
(7) Rotate the tube so that the objects are at the top.
(8) Press the green button that releases the magnetic field and observe the objects falling in a vacuum.

Method

The exhibit was evaluated by direct observation of visitors as they approached and used the exhibit and by interviewing a sample of those observed. A total of 54 visitors were observed including male (32) and female (4) adults as well as male children (18). During the four hours of recording, no female children were observed interacting with the exhibit. For each visitor observed, the following events were recorded:

(1) The chain of responses when the visitor attempted to observe the gravity phenomenon;
(2) The total time interacting with the exhibit;
(3) The gender and age of the visitor;
(4) Whether or not the demonstration was completed successfully (i.e., did the visitor go through the correct sequence of steps and did the device operate as intended?);
(5) The number of manipulations performed by the visitor (a total of 8 were necessary).
(6) Whether or not the visitor read the explanatory label.

Results

Only 14.8% (8 of 56) completed all eight steps in their proper sequence. Of these 8 individuals, 3 were not able to compare the falling rate of the objects because the feather was not held down by the magnetic force. Consequently, when the tube was rotated, the feather fell before the metal chicken.

Total times and percentage of visitors in each time range at the exhibit were distributed as follows:

0-30 sec (18.5%)
31-60 sec (22.2%)
61-90 sec (3.7%)
91-120 sec (14.8%)
>120 sec (44.4%)

Although a substantial percentage (44.4) were at the exhibit for more than 120 seconds, only 6 of these 24 individuals were able to successfully observe the gravity demonstration. Only one visitor who stayed under 120 seconds was able to successfully manipulate the exhibit.

The number of total manipulations per visitor also varied. Table 1 shows that 59.2 percent of visitors made fewer than eight (the minimum required) manipulations. Fourteen of 22 individuals who did make eight or more manipulations were still unable to observe the gravity phenomenon because of not following the directions correctly or because the electromagnet failed to pin down the feather.

Table 1

Number of Manipulations	Percent of Visitors	
0-1	0	
2-3	25.9	
4-5	11.1	
6-7	22.2	
8-9	**14.8**	[Needed to
10-11	**11.1**	make at
12-13	**3.7**	least 8 to be
>13	**11.1**	successful]

Reading of the interpretive label was extremely rare. Only 2 of 56 visitors read the label, and only one of these readers appeared to read long enough to complete the entire label.

Inteviews with visitors found almost no comprehension of the exhibit's message. Visitors who spent a long time at this exhibit appeared frustrated that the message was not clear.

Discussion

The evaluation revealed several problems with the *Falling Feather* exhibit. First, it showed that few visitors completed the necessary chain of manipulations in order to successfully observe the gravity phenomenon. Perhaps it is unrealistic to think that visitors will spend a minimum of two minutes to complete a complicated sequence of eight steps (See Bitgood, 1991b).

A second problem was that the apparatus did not always work as it was intended. The electromagnet did not always hold down the feather as required in order to compare the falling rates of the feather and the piece of metal. Trial testing this device during its development might have revealed this problem and appropriate changes could have been made before final installation (Bitgood, 1991b).

A third problem was the placement and characteristics of the interpretive/explanatory label. It was placed on the far corner of the exhibit in a very nonobtrusive location and was consequently overlooked by 54 of 56 visitors. In addition, the fact that it contained 134 words may have served as a deterrent to potential readers (Bitgood, 1991a). Our research suggests that labels of more than 75 words are read less frequently than shorter labels.

A fourth problem was the proximity of the exhibit to a rocket engine demonstration. Every few minutes a loud rocket engine would fire and distract visitors attempting to interact with the exhibit.

A potential problem with the exhibit evaluated here was the visitors' confusion over the concepts of gravity and air resistance. In a study by Minda Borun (1990; 1991) at the Franklin Insitute it was found that many visitors believed that objects would float if you take away air resistance. It is not surprising that after a few interviews, we found that visitors were confused about the relationship between gravity and air resistance.

It was not necessary to observe a large number of visitors in this study, since the major problems were apparent after observing only a few people interacting with the exhibit. This evaluation punctuates the importance of using trial testing during the development of interactive science exhibits. Had the exhibit been trial tested with visitors while it was being developed, and changes made from this feedback, it is likely that a more effective exhibit could have been produced.

Following this evaluation, the Museum made the decision to remove the exhibit rather than attempt to make it work. However, had this study been conducted as part of remedial evaluation, it would be possible to improve the exhibit (Bitgood, 1991; Screven, 1990).

References

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