From Hands On To Minds On: Labelling Interactive Exhibits

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When are words a bridge, and when a barrier? Anyone who has ever written text for museum exhibits wishes the answer was more obvious. Is it in the tone? The typeface? The title? Which layout is the most congenial and how many syllables in a phrase are too many?

The following label study took place at the Franklin Institute Science Museum in Philadelphia. It was part of the Naive Knowledge Research Project, a study funded by the National Science Foundation (See Note 1) to identify "naive notions" about science and test the power of interactive devices to alter them. Naive notions, or misconceptions, are formed by people as they explain the world to themselves. *They are widely shared, regardless of age or sex, and can interfere with the learning of accepted scientific explanations.*

Research began with interviews of a broad sample of visitors which revealed a number of widespread misconceptions about the cause and nature of gravity. The next step was to develop interactive devices to confront specific misconceptions, then ask visitors to use the devices and answer our questions.

The device which prompted our label study was designed to correct the erroneous belief that spinning pulls things in and, more specifically, that the earth's rotation generates its gravitational pull.

Four versions of the rotation device were tested before we were satisfied that it clearly demonstrated that rotation and gravity have separate, unrelated effects. The operating functions of the fourth version were then modified several times.

The final device (see photograph in Figure 1) consists of two parts. On the left side is an umbrella-like structure with two poles or arms attached at the top. There are small figures at the free-end of each arm. The arms move out as the device spins inside a transparent sphere, showing that spinning moves things outwards. Next to the "umbrella" is a globe with three small figures attached around its equator. Two switches labelled "SPIN" and "GRAVITY" visually separate the two concepts. In the initial condition, GRAVITY and SPIN are both off. If SPIN is switched on, the people fly off the globe and dangle from thin filaments. If GRAVITY is switched on, the people are pulled back to the globe. Visitors can experiment with four different combinations of gravity and spin and observe the effects.

A process of informal, iterative testing (formative evaluation) was used throughout the development of the rotation device. Visitors were asked to read all label text, use the mechanism and then discuss it. Most revisions to the physical device were attempts to achieve a clearer representation of gravity, rotation, and angular momentum. This accomplished, we turned our attention to the device's performance against the misconception, and discovered an interesting pattern.

In baseline interviews, just over *half* of the interview sample believed that the earth's gravity is generated by its rotation. In interviews from all four versions of the device, the misconception rate was reduced to approximately *one third* of the sample (plus or minus a few percentage points). This rate was surprisingly consistent, considering the variety of designs tested. It was also higher than we had hoped. We set a goal of reducing the incidence of the misconception to 25% or less before proceeding with large-sample data collection.

Formative evaluation continued, focusing now on label copy. We took a good look at the text, dissected it, distinguished its functions, classified its parts, and evaluated numerous labels with samples of roughly 20 visitors each.

Until the very last label, none of our alterations made a significant difference. The misconception rate did not gradually improve, but held at around 33%. Our label experiment was driven not only by hopes of bringing this percentage down, but also by curiosity. What was behind the persistence of the 33% statistic?

Subjects were asked to read all of the text ("cued") and generally did so. Yet, when asked "If the earth stopped spinning, would there still be gravity?" (A question only slightly paraphrased from a statement in the label) roughly a third of the respondents said "no."

In general, our labels were written in three parts, "Exploratorium style." First came "To Do," with explicit instructions regarding the on/off switches for SPIN and GRAVITY. Next was "To Notice," which described the effects demonstrated by the device's model globe. This section also introduced more general conceptual material. Finally, "Going Further" offered more information, such as an explanation of the relationship of gravity and mass.

We were trying to write a label to accomplish three tasks:

1. Give operating instructions for the device;
2. Describe the demonstration: Help visitors to observe (e.g.,"When the model spins, things fly out");
3. Teach abstract concepts: generalize from concrete observations ("Spinning always flings things out").

Operating instructions were not a problem. Visitors wanted to make the device work; if they couldn't, they read the written directions. Trying to get them to comprehend the science content, however, was far more difficult.

How could people fail to retain a piece of information, just moments after reading it? Even if the meaning had not registered, it seemed remarkable that they would not remember the sentence on hearing it repeated almost word for word!

We concentrated on simplifying label format, language and information level. We varied typeface and positioning, transferred emphasis from one statement to another. We worked hard to cut length.

For one version, the label read simply "Spinning does not create gravity" – exactly the information we wished to convey. This was particularly unsuccessful. The word "not" was often missed and the number of visitors who associated the two phenomena increased. In this case, *we seemed actually to teach the misconception.*

Another approach was to pair conceptual statements with descriptive ones. Thus, the label first described what happened on the model earth when gravity was switched off: "The earth's spinning flings things away;" then generalized from the concrete observation: "Spinning always flings things out." We hoped this strategy would substantiate the abstract information, helping visitors to accept it. But that mysterious 33% of our sample seemed impervious to everything we tried.

Finally, we saw that, after a certain point, such alterations were not significant. Early on in the process, we had found a balance between brevity and informativeness. The language was reader-appropriate, the tone was consistent and engaging, the most vital concepts had been drawn out and highlighted. We realized we could fine-tune the selection and arrangement of label attributes indefinitely. We had to make a more radical change.

Separate and Unequal Forces.
If the Earth stopped spinning,
Gravity would still hold us down.
Can you prove it?
(Use the on/off switches)

This is the label which finally broke the 33% barrier. When it was tested on the museum floor, only 25% of visitors interviewed persisted in the naive belief that if the earth weren't spinning, there would be no gravity. (The question which remains, is: "What's going on with this 25%?" but that's a question for the next study.)

We were delighted not only at reaching more people, but also with an insight we gained. We learned to look at a label in terms of relationships. The label that worked created a new dynamic between itself, the visitors and the device.

Most of our labels had acted as instructors, placing visitors in a passive, information-receiving role. Evidently, this approach was effective for some people, perhaps those who learn well from reading, but failed with other learning styles.

One of the keys to changing the label-to-visitor relationship was going back to the fact that, if people read anything, they read operating instructions. If we could fashion the concepts into operating instructions, visitors would attend to the text – we could turn "minds on" as well as "hands on."

This observation led to the perception of a more subtle relationship between label and device. As long as the label was written didactically, the two did not interact. Device and label were sequential, but not interdependent. Once a visitor understood how to operate the device, the device was used, a label was read and the visitor moved away (See Figure 2).

Nothing linked the demonstration with the relevant explanatory concepts. What we needed was a label that created a loop, sending the visitor back to the device to test the information, then back to the label to interpret experience. Our last label's challenge accomplished this (See Figure 3).

With the final label, most visitors went back and forth, using the device to reconcile the label content with their own prior "knowledge."

Now we were ready to continue the Naive Knowledge study, but first we revised our list of label functions:

1. Operating instructions: get "hands-on" ("Use the on/off switches");
2. Refer visitors to the device: get "minds-on" ("Can you prove it?");
3. Offer the concept ("If the earth stopped spinning . . .").

This label study was specific to an interactive science museum exhibit. Yet the results probably have wider application. The idea of relationships may be useful in labelling dioramas, paintings, and other non-interactive artifacts. By directing visitors' attention to specific objects or features and by posing questions to be answered through observation, comparison, and close inspection, it seems possible to awaken a higher level of involvement with an exhibit. We invite you to try.

Note

1. Grant #MDR 8751396. Opinions are those of the authors and not The National Science Foundation.

Figure 1

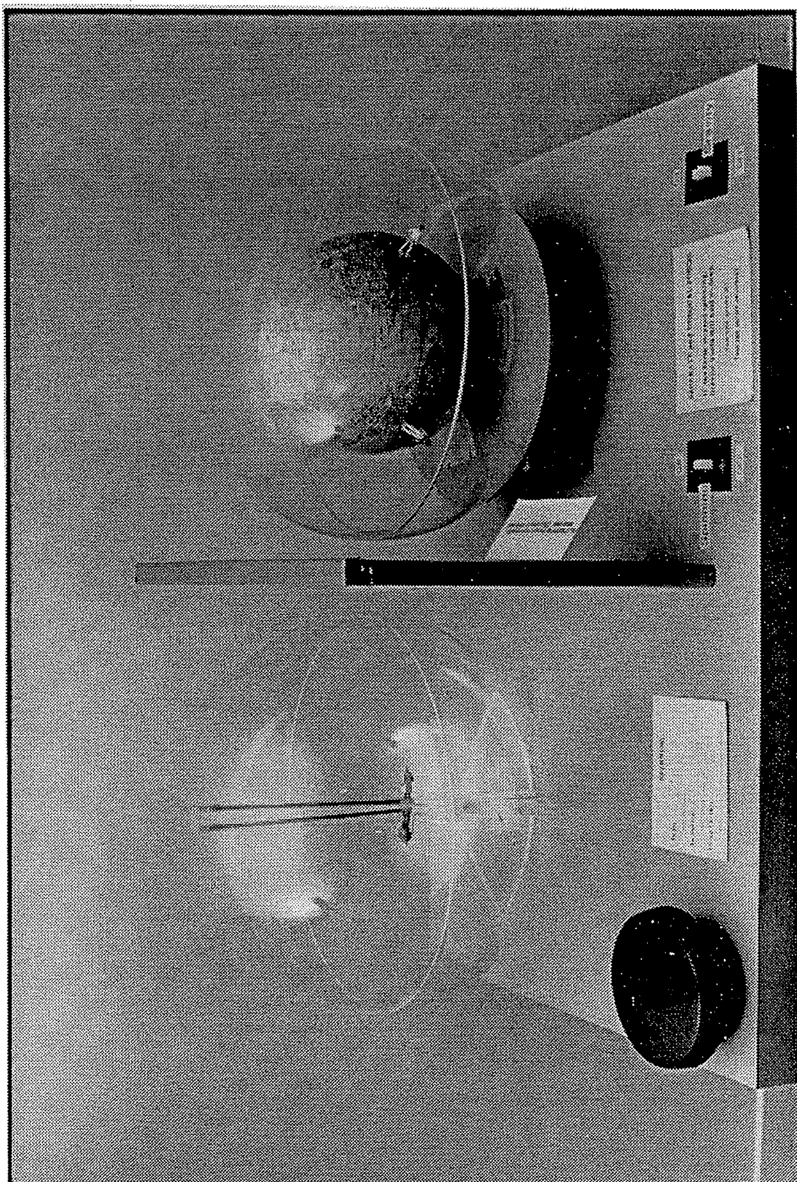

Figure 2

Figure 3