

Exhibit Design Relating to Low Vision and Blindness

Research on Effective Use of Tactile Exhibits with Touch
Activated Audio Description for the Blind
and Low Vision Audience

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Introduction

Imagine going out for a day with a friend or with your children. There is a new exhibit at your local museum that sounds interesting. You've heard that there will be hundreds of artifacts on display and there are lots of the newest interactive exhibits available with the latest computer interfaces and audio-visual media connections. You've also heard that all the exhibits are creatively designed and displayed with numerous labels that explain the exhibits. The day promises to be full of new and exciting experiences with many new things to learn about.

There is only one problem... you are blind. You can't see any of the colorful graphics or the objects on display, and because the objects are in glass cases, you cannot touch them either. There is an audio tour available but that's about all there is available to make your visit worthwhile. Perhaps the museum has a guide to explain what you cannot see. Then again, perhaps it would be easier to just download the audio tour, listen to it in your own home, and save the effort of going to the museum.

“Three of my four children have some level of visual impairment... I would just like to be able to take all my kids to a museum where they can all share the experience together... instead of the way it is now, where the three who can't see have to wait for their sighted brother to tell them what he is looking at.”

This quote was taken at an exit interview with the mother of four children following their participation in a unique research project sponsored by the National Institute for Disability Rehabilitation Research (NIDRR). It says much about the museum experience for people with visual disabilities. This research project, the “Talking Tactile Fish Project,” was conceived and developed by RAF Models, Inc to explore ways that exhibits can be programmed and designed to make museum exhibits accessible to visitors who are blind or have low vision. The project has focused on the use of tactile exhibits, the development of design guidelines and methodologies, and on a new technology that is useful for making museum exhibits and exhibit information accessible to visitors with visual impairments.

For RAF the inspiration for this project sprang from the observation that most informal learning environments, such as museums, visitor centers, historic sites, zoos and aquariums, provide very few ways for the visiting public who have visual impairments to have access to the information about exhibits. Part of a conversation we had with a blind visitor at a major new museum exhibition perhaps best sums it up. When we approached and asked about his experience at the exhibition he said:

“...I often come to museums with my sister but don't really expect to find anything for me to experience... but I do like spending the day with my sister, and she likes to go to museums...so I'm kind of along for the ride...”

We hope through our current research to change this paradigm and bring exhibits out from behind the glass.

We had two basic objectives for this research project:

- 1.) develop guidelines for the design and fabrication of tactile exhibits;
- 2.) develop the technology for a touch activated integral audio system that integrates exhibit information with tactile exhibit objects for use of the entire audience, while being easily accessible to the blind and low vision audience.

The research data collected during the three year grant period provides important information to support a set of design guidelines for the development of tactile exhibit elements by exploring the effective use of tactile form, shape, and texture coupled with informational content.

The technological goal of the project was to develop a simple, inexpensive system where touching or exploring a tactile exhibit element initiates an audio description or interpretation without the need for buttons, switches or complex computer programs.

Our goal was to use these “hyper-artifacts” to integrate the interpretive information and the underlying theme of an exhibit program with the tactile experience. It is our hope that these touch-respondent “hyper-artifacts” will promote multimodal learning by linking interpretative messages to an exhibit learning experience that can be shared by all. The guidelines, based on Universal Design principles and best practices, are applicable to all 3-D exhibits in museums, visitor centers, historic sites, and other informal or recreational learning environments.

Historically, museums had their earliest beginnings in the late eighteenth and early nineteenth century during the age of exploration and enlightenment as the private collections of academics, wealthy intellectuals, and explorers. As they began to crisscross the world, they collected and brought home objects, “curiosities,” from faraway places... souvenirs of their travels. Cultural and societal interest in these “curiosities” quickly increased. As it did, the size of the collections also increased. What could initially be displayed in the collector’s home or in a private university setting soon overwhelmed the space available, giving rise to the museum as an institution whose mission became to collect, preserve and interpret these “curiosities” as part of the history of world culture and civilization. While museums today wear many hats and carry many labels, they have their foundations firmly grounded in their “collections.” For this reason museums can be referred to as institutions for object-centered learning.

Over the years museums have primarily presented their collections to the public through purely visual means with the objects often being located behind glass. If objects or sculptures were not located behind glass, there was a clear directive that the objects not be touched. In recent years museums have often added audio tours for the audience to listen to as they look at the objects. These methods have proved to be difficult or

inaccessible for persons with visual impairments because they do not provide an equivalent experience to that which is available to the sighted audience.

As a result the population who is blind or has low vision has been significantly underserved with respect to exhibits and their intellectual content. The introduction of tactile exhibits that include touch activated audio interpretive information will create a new paradigm of visitor experience for the blind or low vision populations.

For those not familiar with tactile exhibits, the following definition might be useful.

Tactile exhibits are exhibits that include objects designed to be touched, handled, or manipulated by the visiting public and serve as an integral part of an information system or interpretive program.

Tactile exhibits can include original objects, but generally they are specifically fabricated reproductions of real objects. A tactile object's size and scale differ widely. Large objects such as models of building and landscapes can be scaled down so they can be explored in their entirety. Small objects such as models of insects or small animals are scaled up so they can be examined in detail. Frequently, sections or parts of objects, such as building ornaments or mechanical engine parts are represented. Again, they can be scaled up or down as necessary to communicate the desired information.

Textures can be added to either represent features of the actual object or to serve as a tactile indicator of some interpretive point of interest. In most cases the tactile representation of color and contrast is incorporated as texture to provide the same information to the visually impaired audience that is being given by the color and contrast that is displayed in the original object.

The materials used to fabricate tactile exhibits can vary widely. They can be rigid or flexible, but must be strong enough to withstand constant touching by the public.

By far the most powerful aspect of tactile exhibits is that they serve all people. Generally, tactile exhibits are used to represent objects that are "out of touch" because they are too big, too small, too delicate, too dangerous, too precious, too far away, or, as with aquariums, from an alien environment. By making them accessible to all museum visitors you spark interest and curiosity provoking an exchange of interpretations, ideas and experiences for everyone, regardless of their abilities

RAF has completed over 30 tactile projects of varying types including landform maps, battlefields, historic buildings, natural landscape features, people and animals and various artifacts. Construction materials for the models have ranged from molded plastic, fiberglass, various types of rubber, epoxy, and bronze. To the best of our knowledge all of these models are still in service.

The Project

“The Universal Design of Tactile Exhibits with Touch Activated Audio Description for Aquariums,” known as the “Talking Tactile Fish Project” for short, was a three-year Field Initiated Development Grant funded by the National Institute for Disability Rehabilitation Research, US Department of Education. The project was organized around two research phases culminating in a demonstration exhibit installation at an aquarium. An aquarium was chosen as the location for the demonstration because if an aquarium exhibit could be made accessible then almost any exhibit could be made accessible. The North Carolina Aquarium at Pine Knoll Shores, one of the three aquariums in North Carolina, agreed to be the test site for the final talking tactile fish installation.

The Research

Phase I research was designed to collect data on the communication effectiveness of three different forms of tactile objects in the context of an exhibit program at an aquarium. Specifically, which form of tactile fish representation: raised line drawing; bas-relief; or full round representation is the most effective in communicating exhibit information related to form and shape?

Phase II research was designed to develop data on the effectiveness of using textures on tactile models of fish to communicate patterns of color. For this experiment, three general patterns of fish coloration were identified: spots, stripes and countershading. Each of these general patterns of fish coloration was further broken down into more specific patterns that related to how fish might use colors to adapt to their environment. Specifically, can textures be used in conjunction with physical form (Phase I) to communicate complex exhibit information about fish and the environment in which they live?

The primary objective of these first two phases was to gather and develop statistical evidence to support the development of design guidelines that will define the various physical and three-dimensional aspects of a tactile exhibit to make it useful to the blind or low vision audience as an interpretive tool. In addition, these two phases helped define a “user-fit” methodology that is useful in the design and development of effective tactile exhibits.

The third and final phase of the project proposed that a small talking tactile exhibit be designed, fabricated and installed at the participating aquarium to demonstrate the results of the research and allow us to perform field initiated data gathering to test and quantify the effectiveness of the touch sensitive “hyper-artifacts” in a public setting.

The testing for Phase I & II took place at The Governor Morehead School for the Blind and the Alliance for Disability Advocates- Center for Independent Living in Raleigh, North Carolina. The models of fish used in the testing were designed and fabricated by RAF Models, Inc. Four individual testing administrators conducted the testing that took place in a small classroom or a conference room environment. One test administrator would give the test to a single participant at a time. Generally there was an assistant

present to help manage the testing materials but they did not speak to the participant other than to be introduced.

The Participants

Phase I & II included ninety-two testing participants in 5 visual acuity groups. Thirty six participants were blind (18 blind since birth, 18 adventitious); 33 had low vision (18 low vision since birth, 15 became low vision); and 23 had normal or corrected normal vision. To the extent possible, each group was equally represented by age: youth (age 9- 18 years) and adults (18 years and above). The age of the participants ranged from 9 to 65 years.

Data were collected to document age, type of vision (blind or low vision), and age at which vision was lost or began to deteriorate. No record or data was recorded about the clinical reason for the participant's vision loss or other associated health issues.

The Procedure

Phase I –Shape and Form

The test procedure and purpose of the study was introduced to each participant using a standardized verbal description. This introduction included a discussion of the natural variety of fish species and described the ways in which the body form and shape of each variety is related to their specific habitat and feeding characteristics. The three types of representation (raised line, bas relief, and full round) used in the testing were introduced using sample models of a pear. The participants were allowed to take as long as they wanted to explore the three different models of the pear until they felt they understood the distinction between the three model forms. The participants were encouraged to ask any questions they might have at any time during the testing.

Participants were then introduced to five fish species that were each modeled in each of the three styles of representation. Each of the five fish species represented a different specific body shape and form that related to their particular habitat and feeding characteristics.

Phase II – Textures

The test procedure and purpose of this portion of the study was introduced to the participants using a standardized verbal description. Included in the introduction was a discussion of the natural varieties of fish coloration and the ways in which fish utilize color and color pattern to adapt to their representative habitat.

Three general patterns of fish coloration were verbally introduced to the participants (spots, stripes and counter shading). As the verbal description was read, participants were given tactile texture examples of each pattern to touch. Each of these general color patterns was divided further into different variations of each pattern (Spots - large bold spots, small random spots, and small evenly spaced spots; Stripes - horizontal stripes, vertical stripes, and wavy stripes; Countershading - even countershading, and wavy countershading).

Participants were introduced to the different types of color pattern by using a verbal description that explained how each fish would utilize its particular color pattern to blend into its environment. For instance, the stripes on a fish serve as camouflage if they live among aquatic grasses. During the verbal description participants were given sample tiles with each of the color texture patterns to explore. The sample tiles were grouped by their general characteristics; spots, stripes and countershading and represented all of the varieties discussed. Three groups of fish were modeled to represent the three general styles of fish coloration. Each group represented a different fish species. Each member of a group was modeled to represent one of the color patterns in that group. This process resulted in the development of, a total of eight (8) different color patterns.

Testing - Phase I & II

Utilizing a standard questionnaire format, a randomized selection of the fish models was presented for the participants to touch and explore with their hands.

The participants were asked two sets of questions about their experience with the tactile models they had been presented. The first set of questions was **fact-based** and related to their tactile experience and recall of the interpretive information they had been provided at the beginning of the experiment. These answers were recorded as being correct or incorrect.

The second set of questions consisted of series of *qualitative* questions about each participant's **preferences** related to the tactile model forms and textures, as well as any additional thoughts or information about their experience with the models that they wanted to share.

Summary of Findings -Phase I & II

The test results indicate that shape, form and textures on models of fish can be easily recognized and correlated with descriptive information about the fish and the habitat in which they live. The test data indicated a strong correlation between strong contrasts, such as smooth to textured, or fat to thin, and the ease with which elements are differentiated. In addition, the participants reported a strong preference for more robust forms, shapes and textures. Comments from the participants indicated a keen interest in verbal information associated with a tactile experience.

Fact Based Questions

Participants identified answers correctly an average of 8% more frequently when presented with full round models than with bas-relief models, and 12% more frequently than with raised line models. Participants answered correctly an average of 82% of the time for textures indicating patterns of fish coloration.

Qualitative/ Preference Based Questions

Participants rated their enjoyment, ease of perceptual interpretation, and the strength and quality of their experience with full round models almost 33% higher than with bas-

relief models and 50% higher than with raised line models. In addition, participants found that bas-relief and raised line models were more difficult to form a mental image from. With regard to textures, participants rated their enjoyment and perceptual interpretation higher for the more robust textures. The participants indicated a preference for more complex patterns such as random spots and wavy stripes. These patterns were considered more challenging but far more interesting. Conceptualizing subtle gradations of textures like countershading was found to be difficult. It should be noted that the data did not identify diabetic participants who might be less sensitive to touch.

Phase III- Aquarium Exhibit Installation

Our original plan for the installation was to have a small temporary exhibit that contained 3 or 4 touch activated talking tactile fish models. This would be enough tactile fish to allow us to conduct on site audience interviews in order to gather data on the effectiveness of the combination of the tactile models and the audio interpretive message.

As we talked with the aquarium staff their excitement grew and the exhibit expanded. The “Fintastic” exhibit is now a 1500 square foot permanent exhibit that includes several new live fish exhibits. There is now a total of eight talking tactile fish models ranging in size from a 14” long cow fish to a 9’ foot long hammerhead shark. The fish models are represented in a “full round” configuration and are life size. All fish models are presented as realistically as possible using modified fiberglass fish mounts similar to trophy fish mounts. Fish that exhibit different patterns of adaptive coloration are modified with textures so the color patterns become tactile. Each tactile fish model is fabricated to be a touch sensitive “hyper-artifact,” each with a separate touch activated audio interpretive track that discusses habitat, shape and form, and coloration. Additionally, each fish is mounted in front of a tactile background illustrating the type of environment in which they live.

What began as a small temporary exhibit primarily intended for audience testing has grown to the point that it fills an entire room and allows Pine Knoll Shores Aquarium to say that they are the first Aquarium to have an exhibit that is accessible to the entire audience, including those people who are blind or have low vision.

Guidelines

It seems appropriate at this juncture to discuss a bit about our thoughts on how the results of this research could best be used. We do not advocate the adoption of strict standards and rules for the design of tactile exhibits because the type of objects that lend themselves to tactile representation vary so widely. Tactile objects are tied closely to the exhibit’s interpretive theme and defy the same standardized approach that can be applied to an exhibit’s mounting height, door size and location, or text size. Nor do they fall into the same category as an “appliance” or computer interface that might have a standard operating procedure and standards such as the location and arrangement of text and numerical keypads.

Where and how tactile exhibits are used will depend on many of the same factors that influence any exhibit project like theme, artifact resources, scheduling, and budget. That being said, we believe that tactile exhibits should be given equal status to any decision being made during the design process about effective communication of exhibit information and thematic content. The role tactile exhibits can play in providing a multi-modal approach to learning and an “equivalent” museum experience for all is engaging, effective and profound.

Guiding Principles

We encourage an inclusive and holistic approach to guide the museum staff, exhibit curators, designers, and fabricators through the process. To that end, we have developed some guiding principles that we think are useful in approaching the use of tactile exhibits.

Perhaps the place to begin is to look at the fundamental goals that all exhibits share. In their treatise on the evaluation of science exhibits the National Science Foundation suggests the following measures for success:

1. Increase **awareness, knowledge or understanding** of a particular topic, concept, phenomena, or theory;
2. Increase **engagement or interest** in the theme(s) of the exhibit;
3. Change **attitudes** about a particular topic, concept, phenomena, or theory;
4. Change **behavior** about an exhibit topic
5. Increase perceptual, observational, and interpretive **skills** as a result of the exhibit experience.

To many, these goals might seem self-evident. While it is difficult to predict to what degree any particular exhibit will be successful in achieving these goals, they do provide a structure of purpose at the beginning of the exhibit design process and an important backdrop for any decision making process. These goals also provide a useful foundation for measuring communication effectiveness in an exhibit evaluation process.

In addition to these fundamental goals we suggest the following guidelines for the development of tactile exhibits.

1. The exhibit design team should include a consultant or museum staff member who is blind. Their role is to evaluate whether the proposed tactile exhibit communicates clearly to the blind or low vision audience. If possible, more than one visually impaired consultant should be engaged in order to provide different perspectives.
2. The inclusion of tactile exhibit elements as an integral part of the exhibit should be introduced at the earliest thematic and programming stage of the exhibit design process. Tactile elements should not be added on later as an after-thought.

3. The use of touch and tactile exhibit elements should be recognized as a part of a multi-modal learning strategy. Touch is one of our most basic experiential learning tools but it is frequently overlooked in our visual and auditory dominant world.
4. Tactile exhibit elements should include an audio component. Audio information, description, or interpretation should be carefully scripted and explicitly connected to the tactile experience of the tactile element. When possible, the audio information should be accessible on a hands free basis. Tactile exploration with both hands is important for the development of effective mental images
5. Ideally a visitor should be able to explore an entire tactile piece while standing in one spot, which gives an overall dimension of approximately 50" wide by 30" deep. In the instance that a tactile exhibit needs to be larger (a very large map perhaps or the life sized model of a large creature), care should be taken to make sure that the audio track can be heard from any point on the model or, if using a tactile key, that more than one key should be included so the visitor can always explore the model and a key at the same time.
6. Tactile elements of an exhibit should retain their original dimensional characteristics as much as possible. To reduce a three-dimensional object, such as a building, to a raised line drawing does not provide a clear understanding of the object. For people who have visual impairments the ability to develop dimensional concepts and mental images is greatly enhanced when tactile information is presented in a fully robust form.
7. When representing an item in which pattern or color change is an important part of the concept, for instance the stripes on a zebra, texture can be added to highlight the pattern. This addition of texture must be clearly explained in the audio description so that no confusion arises. We do not advocate the use of a particular type of texture to always represent a particular color.
8. Tactile exhibit elements should fulfill the guiding principles of Universal Design:
 - a. Are useful for people with diverse abilities;
 - b. Can accommodate a wide range of preferences and abilities;
 - c. Are simple and intuitive to use;
 - d. Provide the added dimension of communicating perceptual information regardless of the ambient conditions or the users sensory abilities;
 - e. Have no moving parts that are hazardous to use;
 - f. Can be used with a minimum of effort;
 - g. Exemplify a design that accommodates an easy approach and use regardless of the user's body size, posture, or visual acuity.