Overcoming Barriers to Participation:
An Aquarium Case Study

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Traditional exhibit mediation strategies— such as docent presentations and asynchronous audio tours— often do not adequately convey the real-time and descriptive details about animals and their habitats for visitors with vision impairment.

Participation at informal learning settings, such as museums and aquariums, is emerging as a valuable outcome of visitor-exhibit interaction that is primarily supported by design and interpretive content. Visitor participation can be supported through experiences that address *learning, entertainment, restorative,* and *social* motivations such as viewing a wall of colorful fish and talking to other visitors about what's going on in an exhibit.[1] This paper will briefly discuss the work of my dissertation to formalize and operationalize participation as a design goal for an exhibit information system that conveyed real-time descriptive mediation (RTDM) for visitors with and without vision impairment at live aquarium exhibits (for complete details of the dissertation, see the full document).[2] The RTDM system was conceived as a way to enhance accessibility for visitors with vision impairment, and evolved into an option for visitors with and without vision impairments, including people who might not be able to see over or around other visitors or obstructions. The development of the RTDM system represents several years of research funded by various grants and included partnerships with Atlanta's Georgia Aquarium, multiple disability-related organizations, and colleagues in various fields.

Addressing participation-based motivations at live aquarium exhibits often depends on the visitor's ability to see the habitat and observe animal behaviors and locations. However, consistent with the World Health Organization's International Classification of Functioning, Disability and Health (ICF) model,[3] simply providing access to exhibit-related activities only provides an opportunity for participation; it does not guarantee it. Impaired access to exhibit-related activities—such as a person with vision impairment would experience at a visual display of live animals—results in problems fulfilling a visitor's exhibit motivations and creates barriers to participation.

Despite legislation and technological advances, visitors with vision impairment have the lowest level of exhibit accessibility,[4] including difficulty locating an exhibit, knowing what is on display, and understanding the movement occurring in live exhibits.[5] Thus, it is difficult (if not impossible) for these visitors to address exhibit motivations. Traditional exhibit mediation strategies—such as docent presentations and asynchronous audio tours—often do not adequately convey the real-time and descriptive details about animals and their habitats for visitors with vision impairment. Support for participation should enable visitors with vision impairment to address their visit goals successfully: whether it be learning animal facts, visualizing animal movements, relaxing after a tough week, or reminiscing with their partner about a similar experience.

Universal Design and Accessibility
Universal design has long been recognized as an important consideration in museum design as a means to "improve visitor access, learning, and overall quality of the museum experience."[6] Designing an exhibit to meet the needs of visitors along the range of ability types and levels of function ensures that it does not segregate or stigmatize any group

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of users. Several resources and projects have explored ways that museums can leverage Universal Design principles to create multisensory and multimodal experiences that include all visitors.[7] The movement towards Universal Design was preceded by and is often still partnered with accessibility or accessible design work. Over the past several decades numerous efforts by entities including the federal government,[8] the Smithsonian Institution,[9] the National Park Service,[10] the National Endowment for the Arts,[11] and the American Association (now Alliance) of Museums (AAM)[12] have promoted improved exhibit accessibility for individuals with disabilities. However, despite these and other contributions, there continues to be deficiencies in the accessibility and universal design of informal learning experiences, the knowledge and attitudes of museum professionals regarding inclusion, and how inclusion is characterized within the field.[13] Thus, we end up with exhibits that may be exclusionary, cannot effectively support visitor-exhibit interactions, and act as barriers to participation.

Participation
The term "participation" is used in various ways in the museum field, resulting in a diverse spectrum of definitions and characterizations. In some instances, participation means being able to afford admission or simply being able to get to the institution,[14] whereas in others it means being able to interact with the exhibit.[15] In *The Participatory Museum*, author and museum director Nina Simon[16] described participation in informal earning environments as the basis of attempting to make "cultural institutions more dynamic, relevant,

essential places" and a representation of the potential for co-created content among visitors and institutions. In this view, the museum is seen as more than just a physical *space*; it is instead, a *place* where people can actively participate by collaborating with the museum in constructing their experience. Some researchers in the museum field have used participation interchangeably with interactivity and discussed it as a social experience.[17] Other researchers have investigated visitors' learning, entertainment, restorative, and social goals which could be operationalized as aspects of participation,[18] but have done so primarily as a means to understand and design for learning more fully.

Participation is an obvious outcome of visitor-exhibit interaction, yet it requires more than simply getting in the building, moving around exhibits, and looking at displays. Although participation is explicitly mentioned as an outcome in legislation, guidelines, and resources relevant to exhibit accessibility,[19] it has not been consistently defined or adequately operationalized to inform design of exhibits or improve exhibit evaluation. Universal Design has also been linked to participation given its focus on equity, social integration, and contextual integration,[20] but it has also not been given a clear definition to aid in developing measurable design criteria. The World Health Organization's International Classification of Functioning, Disability and Health (ICF)[21] identifies participation as a crucial goal of complex interactions between people and their environments and provides a framework for studying and measuring these contextual factors. It also specifically defines participation as

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Fig. 1. A small, high-resolution camera on a tripod was used to capture the view of the exhibit. This camera was connected to a computer that processed the image information in real-time. Photo by Carrie Bruce

involvement in a life situation. However, the ICF does not provide details on how to design for or measure participation.

Design of Real-Time Descriptive Mediation

Because aquarium exhibit designers have tended not to understand participation and how to apply it to visits by individuals with vision impairment, the mediation systems they have designed have inadequately compensated for access barriers. Existing information strategies—such as docent presentations or audio tours that mediate the exhibit experience by discussing animal facts—provide auditory information relevant to the visual scene. Typically, though, they do not adequately describe exhibit details in real-time for visitors with vision loss in a way that would provide effective access or support participation. To support the exhibit motivations and participation of visitors with vision loss at live aquarium exhibits more effectively, a mediation system should provide a comprehensive description of the visual scene and convey associated exhibit facts in real time.

Formative work with individuals who have vision impairment confirmed that real-time and descriptive features are critical, though often not implemented in the design of mediation.[22] They expressed a desire to know which animals were in an exhibit viewing area and how they were moving so that they could feel more included in the experience (and perhaps justify the expense of visiting a live exhibit that they have difficulty seeing). They also specifically mentioned wanting to know visual details including colors, patterns, shapes, and sizes of animals and habitat components. We define real-time and descriptive mediation design features in this way:

> *Real-Time: describe dynamic characteristics of the visual scene in a manner that effectively enables a listener to generate an understanding of location and movement.*

> *Descriptive: describe less dynamic yet salient characteristics of the visual scene in a manner that effectively enables a listener to generate an understanding of physical appearance.*

A prototype real-time descriptive mediation (RTDM) system for live aquarium exhibits was developed by computer science students as part of a larger project to create sonifications—or musical representations—of live aquarium displays.[23] This RTDM system was designed to detect and identify a single "celebrity" animal or group of animals at any one time using computer vision technology (fig. 1). A "celebrity" animal was defined as a prominent exhibit animal, such as a whale shark, with visually distinguishable characteristics (e.g., size, shape, pattern). After

Fig. 2. The "Beluga Whale Exhibit" at the Georgia Aquarium. This was one of two exhibits that was extensively studied to develop mediation information for the RTDM system. This view shows visitors standing and sitting at the lower portion of the two-story exhibit. Photo by Carrie Bruce

Fig. 3. The "Ocean Voyager Theater" at the Georgia Aquarium. This was one of two exhibits that was extensively studied to develop mediation information for the RTDM system. This view shows visitors sitting and standing near the main viewing window, which is 23 feet tall and 61 feet wide (7 m x 18.59 m). Photo by Carrie Bruce

identification of the animal or group, the system provides a message with the animal name and related information, such as descriptions of physical characteristics and typical behaviors and general species facts.

To generate the information provided by the RTDM system for the "Beluga Whale" and "Ocean Voyager Theater" exhibits at the Georgia Aquarium (figs. 2 & 3), I analyzed existing interpretive content used by the aquarium education staff and worked with advisors, including people with vision impairments, experts in vision rehabilitation, and professional audio describers. The mediation started with an introduction and orientation to the exhibit and then provided short messages related to the animals in the display. These messages would begin with the animal location (LOC), species name (LAB) and swimming direction (DIR), then follow with a description (DESC-animal or DESC-species) or fact (FACT-species). An example message:

> LOC: Near the top center
> LAB: a whale shark
> DIR: moves towards the left
> DESC (animal): These whale sharks are between 18 and 24 feet long, but can grow up to 40 feet or about the size of a school bus.
> DESC (species): They are huge,

deliberate swimmers that could almost pass for an underwater version of a slow-moving cloud.

After a message played, there would be a five-to-twelve-second pause before the next message. Some messages talked about non-celebrity fish or habitat features and did not contain location or swimming direction information. Another example message:

> DESC (group): The smaller fish slowly meander among the larger fish and seem to all move to the same rhythm. Occasionally, one or several of these fish will dart across or playfully chase one another, making it hard not to notice them as they shimmer in the blue water."

Evaluation and Findings
I evaluated the prototype RTDM system alongside representations of traditional mediation (that is, audio tour and docent presentation) for the two Georgia Aquarium exhibits. The purpose of the evaluation was to examine the effects of the different types of mediation on the shared and individual experiences of partners with and without vision impairment. A study was conducted in a testing lab at Georgia Institute of Technology with 24 adult pairs (21 males; 27 females) that were familiar to each

Fig. 4. The testing lab at Georgia Institute of Technology where the evaluation study was conducted. This image shows the arrangement of the room and presentation of the mediation's visual display. Photo by Carrie Bruce

The results of this study directly link design features and their impacts on exhibit motivations to participation.

other; each pair included one partner without vision impairment and one with acquired vision loss (i.e., became low vision or blind in their teens or after).

Recordings of the exhibits and their related mediation were used instead of live conditions to ensure that all study participants were presented with the same visual and auditory information. The mediation types (for example, RTDM, audio tour, docent) were presented randomly to each pair through a recording of a live exhibit projected onto a flat, non-reflective wall to a size of 8' x 4.5' (2.43 m x 1.37 m) (fig. 4). Audio was played through high-end stereo computer speakers and was set at a level that was reportedly comfortable to the dyad. The partners were seated in typical office chairs that they could adjust for height and move around the room to a position that was optimal for them to see and hear the stimuli.

The findings from this study show that the RTDM system, compared to representative audio tour and docent mediation, was generally more supportive of learning, entertainment, social, and restoration motivations in a majority of adult participants with and without vision loss for most participants. Entertainment motivations, while adequately addressed by the RTDM, were reported to be slightly better supported by traditional

docent mediation. The findings also revealed that the RTDM enabled equitable exhibit access, which made it possible for participants to address their exhibit motivations, and led to specific personal and social aspects of participation. These aspects include *personal understanding of the exhibit; sharing the exhibit experience; independence; and belongingness*. The results of this study directly link design features and their impacts on exhibit motivations to participation.

Conclusions
Perhaps the most significant limitation of the majority of accessibility efforts in the exhibition design field—particularly for visitors with vision impairment—is the emphasis on practices that have little to no empirical evidence base. Central to this issue is the limited conceptual understanding of the relationship between the exhibition and a visitor as a basis for designing to make participation easier and more effective. Exhibition designers are obligated to recognize and manage visitor-exhibit interaction issues that affect participation and create an experience that meets learning, entertainment, social, and restoration needs of all visitors. Participation can be facilitated by offering a well-designed mediation to all visitors regardless of their vision ability that interprets, supplements, and complements the visual display depending on the visitor's needs. Furthermore, gathering empirical evidence about the relative efficacy of different mediation strategies is imperative in a process of striving for inclusive settings that leverage accessibility and universal design perspectives to meet the needs of a diverse visitor population. ✺

Endnotes:

[1]John Falk, Theano Moussouri, and Douglas Couslon, "The Effect of Visitors' Agendas on Museum Learning," *Curator* 41, no. 2 (1998); Jan Packer, "Motivational Factors and the Experience of Learning in Educational Leisure Settings" (Brisbane, Australia: Queensland University of Technology, 2004); Lynda Kelly, "The Interrelationships between Adult Museum Visitors' Learning Identities and Their Museum Experiences" (University of Technology, 2007).

[2]Carrie Bruce, "Facilitating Participation in Adults with and without Vision Loss by Supporting Exhibit Motivations through Real-Time Descriptive Mediation" (PhD diss., Georgia Institute of Technology, 2014).

[3]World Health Organization, *International Classification of Functioning, Disability and Health* (Geneva: World Health Organization, 2001).

[4]S. Tokar, "Universal Design in North American Museums with Hands-on Science Exhibits," *Visitor Studies Today* 7, no. 3 (2004).

[5]Steven Landau et al., "Creating Accessible Science Museums with User-Activated Environmental Audio Beacons (Ping!)," *Assistive Technology* 17 (2005); Carrie Bruce, "Best Practices for Exhibits in Informal Learning Environments" (paper presented at the International Council for Building, Working Commission 084 Meeting, Atlanta, GA, 2008).

[6]Steve Tokar, "Universal Design: An Optimal Approach to the Development of Hands-on Science Exhibits in Museums" (Unpublished Master of Arts in Liberal Studies thesis, John F. Kennedy University, 2003).

[7]Museum of Science Boston, "Universal Design (Accessibility): Considerations for Designers," http://cst.mos.org/exhibitdevelopment/access/index.html; Christine Reich, "Universal Design of Interactives for Museum Exhibitions" (Master of Education in Independent Study thesis, Lesley University, 2005); Christine Reich and Anna Lindgren-Streicher, "Universal Design: Literature Review," (Boston, MA: Museum of Science Boston, National Center for Technological Literacy, 2005); "Creating Museum Media for Everyone," http://openexhibits.org/research/cmme/.

[8]U.S. Access Board, "Americans with Disabilities Act Accessibility Guidelines," ed. Department of Justice (Federal Register, 2004).

[9]Smithsonian Institution Press, *Smithsonian Guidelines for Accessible Exhibition Design* (Washington, DC: Smithsonian Institution Press, 1996).

[10]Harpers Ferry Center Accessibility Committee, "Programmatic Accessibility Guidelines for National Park Service Interpretive Media" (2012).

[11]National Endowment for the Arts, *Design for Accessibility: A Cultural Administrator's Handbook* (Washington, DC, 2003).

[12]John Salmen, *Everyone's Welcome: The Americans with Disabilities Act and Museums* (Washington, DC: American Association of Museums Bookstore, 1998).

[13]Christine Reich et al., "Inclusion, Disabilities, and Informal Science Learning: A CAISE Inquiry Group Report," (Washington, DC: Center for Advancement of Informal Science Education, 2010).

[14]Colleen Blair, "Building Capacity to Work with Schools" in *Handbook for Small Science Centers*, ed. C. Yao et al. (Lanham, MD: AltaMira Press, 2006).

[15]Sue Allen, "Designs for Learning: Studying Science Museum Exhibits That Do More Than Entertain," *Science Education* 88, Supplement 1 (2004).

[16]Nina Simon, *The Participatory Museum* (Santa Cruz, CA: Museum 2.0, 2010), back cover.

[17]Christian Heath et al., "Crafting Participation: Designing Ecologies, Configuring Experience," *Visual Communications of the ACM* 1, no. 1 (2002); Christian Heath, Dirk vom Lehn, and Jonathan Osborne, "Interaction and Interactives: Collaboration and Participation with Computer-Based Exhibits," *Public Understanding of Science* 14, no. 1 (2005); Christian Heath and Dirk vom Lehn, "Configuring 'Interactivity': Enhancing Engagment in Science Centres and Museums," *Social Studies of Science* 38, no. 1 (2008).

[18]Falk, Moussouri, and Couslon, "The Effect of Visitors' Agendas on Museum Learning.;" Jan Packer and Roy Ballantyne, "Motivational Factors and the Visitor Experience: A Comparison of Three Sites," ibid. 45, no. 3 (2002); Packer, "Motivational Factors and the Experience of Learning in Educational Leisure Settings;" Kelly, "The Interrelationships between Adult Museum Visitors' Learning Identities and Their Museum Experiences."

[19]Smithsonian Institution Press, *Smithsonian Guidelines for Accessible Exhibition Design*; Salmen, *Everyone's Welcome*; Association of Science-Technology Centers, "Accessible Practices," http://www.astc.org/resource/access/index.htm; National Endowment for the Arts, *Design for Accessibility: A Cultural Administrator's Handbook*.

[20]Jon Sanford, *Design for the Ages: Universal Design as a Rehabilitation Strategy* (New York: Springer Publishing, 2012).

[21] World Health Organization, *International Classification of Functioning, Disability and Health*.

[22]Bruce, "Facilitating Participation in Adults with and without Vision Loss by Supporting Exhibit Motivations through Real-Time Descriptive Mediation."

[23]"Accessibile Aquarium Project," http://sonify.psych.gatech.edu/research/aquarium/.

References:

"Accessibile Aquarium Project," http://sonify.psych.gatech.edu/research/aquarium/.

Allen, Sue. "Designs for Learning: Studying Science Museum Exhibits That Do More Than Entertain." *Science Education* 88, no. Supplement 1 (2004): s17-s33.

Association of Science-Technology Centers. "Accessible Practices." Last modified 2/14/2013. http://www.astc.org/resource/access/index.htm.

Blair, Colleen. "Building Capacity to Work with Schools." In *Handbook for Small Science Centers*, edited by C. Yao, L.. Dierking, P. Anderson, D. Schatz and S. Wolf, 154. Lanham, MD: AltaMira Press, 2006.

Bruce, Carrie. "Best Practices for Exhibits in Informal Learning Environments." Paper presented at the International Council for Building (CIB), Working Commission 084 Meeting, Atlanta, Georgia, 2008.

————"Facilitating Participation in Adults with and without Vision Loss by Supporting Exhibit Motivations through Real-Time Descriptive Mediation." PhD dissertation, Georgia Institute of Technology, 2014.

"Creating Museum Media for Everyone." Last modified 9/24/2015. http://openexhibits.org/research/cmme/.

Falk, John, Theano Moussouri, and Douglas Couslon. "The Effect of Visitors' Agendas on Museum Learning." *Curator* 41, no. 2 (1998): 107-20.

Harpers Ferry Center Accessibility Committee. "Programmatic Accessibility Guidelines for National Park Service Interpretive Media." 2012.

Heath, Christian, Paul Luff, Dirk vom Lehn, Jon Hindmarsh, and Jason Cleverly. "Crafting Participation: Designing Ecologies, Configuring Experience." *Visual Communications of the ACM* 1, no. 1 (2002): 9-34.

Heath, Christian, and Dirk vom Lehn. "Configuring 'Interactivity': Enhancing Engagment in Science Centres and Museums." *Social Studies of Science* 38, no. 1 (2008): 63-91.

Heath, Christian, Dirk vom Lehn, and Jonathan Osborne. "Interaction and Interactives: Collaboration and Participation with Computer-Based Exhibits." *Public Understanding of Science* 14, no. 1 (2005): 91-101.

Kelly, Lynda. "The Interrelationships between Adult Museum Visitors' Learning Identities and Their Museum Experiences." University of Technology, 2007.

Landau, Steven, William Wiener, Koorosh Naghshineh, and Ellen Giusti. "Creating Accessible Science Museums with User-Activated Environmental Audio Beacons (Ping!)." *Assistive Technology* 17 (2005): 133-43.

Museum of Science Boston. "Universal Design (Accessibility): Considerations for Designers." http://cst.mos.org/exhibitdevelopment/access/index.html.

National Endowment for the Arts. Design for *Accessibility: A Cultural Administrator's Handbook*. Washington, DC, 2003.

Packer, Jan. "Motivational Factors and the Experience of Learning in Educational Leisure Settings." Queensland University of Technology, 2004.

Packer, Jan, and Roy Ballantyne. "Motivational Factors and the Visitor Experience: A Comparison of Three Sites." *Curator* 45, no. 3 (2002): 183-98.

Reich, Christine. "Universal Design of Interactives for Museum Exhibitions." Master of Education in Independent Study thesis, Lesley University, 2005.

Reich, Christine, and Anna Lindgren-Streicher. "Universal Design: Literature Review." Boston, MA: Museum of Science Boston, National Center for Technological Literacy, 2005.

Reich, Christine, Jeremy Price, Ellen Rubin, and Mary Ann Steiner. "Inclusion, Disabilities, and Informal Science Learning: A CAISE Inquiry Group Report." Washington, DC: Center for Advancement of Informal Science Education (CAISE), 2010.

Salmen, John. *Everyone's Welcome: The Americans with Disabilities Act and Museums*. Washington, D.C.: American Association of Museums Bookstore, 1998.

Sanford, Jon. *Design for the Ages: Universal Design as a Rehabilitation Strategy*. New York, NY: Springer Publishing, 2012.

Simon, Nina. *The Participatory Museum*. Santa Cruz, CA: Museum 2.0, 2010.

Smithsonian Institution Press. *Smithsonian Guidelines for Accessible Exhibition Design*. Washington, D.C.: Smithsonian Institution Press, 1996.

Tokar, Steve. "Universal Design in North American Museums with Hands-on Science Exhibits." *Visitor Studies Today* 7, no. 3 (2004): 6-10.

————"Universal Design: An Optimal Approach to the Development of Hands-on Science Exhibits in Museums." Unpublished Master of Arts in Liberal Studies thesis, John F. Kennedy University, 2003.

U.S. Access Board. "Americans with Disabilities Act Accessibility Guidelines," edited by Department of Justice: Federal Register, 2004.

World Health Organization. *International Classification of Functioning, Disability and Health*. Geneva: World Health Organization, 2001.