ModelingVisitor-Exhibit Interaction at Dynamic Zoo and Aquarium Exhibits for Developing Real-Time Interpretation

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Abstract. Zoos and aquaria are dynamic informal learning environments that require constant sensory (often visual) access, and are thus often inaccessible to visitors with vision impairments. There remain few guidelines for designing accessible dynamic exhibits. We present a model of mediated visitor-exhibit interaction that begins to address this class of environments. We discuss plans to operationalize and validate the model that should lead to specific design guidelines.

Keywords. informal learning environments (ILEs), accessibility, dynamic exhibits, exhibit design, vision impairment

Introduction

Over 140 million people visit zoos and aquaria each year ensuring an audience with diverse access and learning needs [1]. For the 20 million individuals in the US who experience vision impairment, these informal learning environments (ILEs) can provide unique opportunities to participate with friends and family in shared educational or entertainment activities. However, in these settings, there is heavy emphasis on the visual experience and conveyance of information through visual methods. The exhibits are dynamic in nature; they constantly change and require sensory access for visitors to understand what is happening in real-time and engage in interactive discussion that corresponds to exhibit activity. Thus, these context-relevant and socially-situated experiences that are critical to participation in zoos and aquaria are frequently inaccessible to visitors with vision impairments.

As these settings have a responsibility to understand the needs of their audiences, strive to be inclusive, and offer opportunities for diverse participation [2, 3], there is an obligation to ensure that all visitors, including individuals with vision impairments, have real-time access to exhibit dynamics. As a preliminary step in designing a system that offers access to exhibit dynamics through synchronous audio interpretation, we have examined existing models of person-environment interaction to determine their utility in identifying exhibit features and characteristics that are salient to learning and participation by individuals with vision impairments. Based on our review, we have identified specific constructs for a new model that will be used to inform design guidelines for generating meaningful real-time interpretation. This paper reviews two

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existing models, reports on the constructs for the new model, and proposes how the model will be expanded on through an examination of exhibit-relevant interactions that individuals with vision impairments have at zoos and aquaria.

1. Person-Environment Interaction

Zoos and aquaria, as informal learning environments, are designed to support free-choice learning through semi-structured visitor-exhibit interactions. The term semi-structured is used to imply that there are some assumptions about how visitors can access and will behave at an exhibit based on an individual's characteristics and the environmental features and attributes. These assumptions are based on various theoretical understandings of person-environment (P-E) interaction that emphasize the importance of context to activity and, more specifically, participation. There are numerous models of P-E interaction that describe this contextual dependence and suggest that performance outcomes are situational—the result of the interaction between personal and environmental factors [4-11]. As a result, performance is viewed as an expression of the fit or *mis*fit between an individual and the environment. An environment that fits an individual will facilitate activity performance and result in positive participation outcomes. In contrast, an environment that does not fit an individual will result in performance deficits and negative participation outcomes or prevention of participation altogether.

Among the various P-E models that have been developed over the past 3 decades, two models—the Contextual Model of Learning [11] from museum studies and the World Health Organization's International Classification of Functioning, Disability, and Health (ICF) [12]—are particularly important to understanding the demands of zoo and aquarium environments for visitors with vision impairments and, in fact, all visitors. Although each model varies in the factors that characterize the P-E interaction, each can contribute to our fundamental understanding of the role of the environment in promoting learning and participation in zoos and aquaria.

1.1. Contextual Model of Learning

Falk and Dierking [11] have developed a framework for examining the factors that affect the translation of an institution's educational intentions into visitor learning. Through this model, they acknowledge the complex nature of learning in free-choice settings such as zoos and aquaria and posit that learning occurs as a result of an individual attempting to partake in contextual meaning-making. They attribute the P-E interaction to the association among an individual's personal, sociocultural, and physical contexts. These contexts are susceptible to change over time and include 12 factors that are reportedly influential for learning in museums.

The Personal context is largely based on what the individual brings to the situation in terms of *motivation*, *interest*, *knowledge*, and *experience*, as well as a person's ability to make *choices and control* her learning. The Sociocultural context incorporates both *within-group social mediation* and *outside-of-group social mediation*. The Physical context is represented by a broad set of factors that consist of layout and constitution issues such as *architectural and large-scale environment*, *advance organizers*, *orientation to the physical space*, and *design and exposure to exhibits and programs.* It also deals with the larger infrastructure for learning that exists beyond the

museum walls and is known as the *subsequent reinforcing events and experiences outside of the museum.*

This model establishes the basis for investigating contextual factors that influence learning and participation in museums and suggests that an attentiveness to these factors can lead to a better understanding of learning in museums and other informal learning settings such as zoos and aquaria. However, while the interaction of these factors provides a conceptual basis for improved exhibit design, the model does not link specific environmental or personal attributes to performance outcomes. Furthermore, although it addresses a wide range of personal factors that have been shown to affect learning, it ignores functional ability and its potential to impact learning. As a result, it does not provide explicit guidance for investigating visitor-exhibit interactions or for improving exhibit design.

1.2. International Classification of Functioning, Disability and Health

The International Classification of Functioning, Disability and Health (ICF), developed by the World Health Organization [5], offers a potentially useful framework for understanding the impact of health and function on activity and participation in zoos and aquaria. The ICF's taxonomy identifies a number of constructs that represent the essential components of P-E interaction, regardless of setting. These include *body structure*, *body function*, *activities*, *participation*, *environmental factors*, and *personal factors*. The model assumes a continuum of degrees of ability in all people, rather than a specific set of limitations in an individual. It also associates specific environmental factors with performance outcomes by attributing the difference between what an individual can do (capacity to engage in activities and participation based on body function and structure) and what he or she actually does (performance of activities) to the influence of personal and environmental factors.

The ICF not only provides a model that describes performance as the impact of the physical environment on all components of an individual's functional ability, it also provides an extensive taxonomy of environmental features, organized in sequence from the individual's most immediate environment to the general environment, that may either facilitate or create barriers to activity and participation. However, the ICF leaves out certain environmental features that are central to zoos and aquaria such as living and non-living artifacts. Additionally, as Sanford and Bruce [13] discuss, even if these features were included, the ICF limits environmental factors to categorical descriptions of what exists (e.g., a fish), rather than quantifiable, demand-producing attributes (e.g., the 2" long, brown speckled sea horse that is moving from branch to branch looking for food). As a result, the ICF also lacks a mechanism to guide investigation of and prescribe design for specific exhibit features.

2. A Model of Mediated Visitor-Exhibit Interaction

The existing models have limitations in their functionality to address access to the dynamic nature of exhibits in zoos and aquaria, as well as the specific needs of visitors with vision impairments. Moreover, these models are much broader in scope due to their intended uses. The Contextual Model of Learning contends that it is useful for understanding learning in museums and has been used to investigate visitors' experiences at specific exhibitions (a themed collection of exhibits) and entire

institutions [11, 14, 15]. Conversely, the ICF is much more expansive and was designed to be used internationally to measure health and disability across all settings and populations.

While both models emphasize the importance of the physical environment on learning and participation, neither scale down acceptably to effectively consider basic perceptual access to exhibit dynamics, identify barriers to accessing exhibit dynamics, nor provide enough detail to develop design guidelines for conveying exhibit dynamics. We are not suggesting that larger-scale issues such as sociocultural factors are not as important in influencing learning and participation or that learning and participation aren't multi-faceted and complex processes. We are, instead, proposing that understanding and providing for basic perceptual access to exhibit dynamics is an essential component of the zoo or aquarium visit and should be explicitly addressed to ensure that visitors with vision impairments can learn and participate. Thus, there is a need to develop a more precise model that can be used to better understand visitor-exhibit interaction. The new model we present here includes the critical factors that influence access to exhibit dynamics and consequently, enhance and enable learning and participation.

2.1. Critical Constructs: Visitor, Exhibit, and Mediating Factors

Visitor factors incorporate the constructs of body structure (e.g., eyes, ears, arms, etc.), body function (e.g., seeing, hearing, reaching, etc.), and their associated capacities (i.e., what an individual is capable of). These are the factors that directly interact with environmental factors to determine whether a person can access something or not.

Exhibit factors are comprised of contextual factors that place demands on the individual and contribute to learning and participation. These factors are predominantly context-specific and include:

- *Environmental factors* consist of multiple aspects of the immediate setting. These include physical factors (e.g., exhibit features and characteristics and ambient conditions), social factors (e.g., roles and relationships with other visitors and institution staff), and institutional factors (e.g., learning goals, access policies and practices). In some instances, environmental factors can also be constrained by external forces such as legal guidance through the ADA and policies from accrediting organizations.
- *Individual factors* differ from Visitor factors in that they are typically not based on a person's abilities and are likely to change according to the situation. These include preferences, values, experience, knowledge, cultural beliefs, motivation, and interest. For example, a person may be more knowledgeable about or interested in the animals in one exhibit than those in another exhibit.

Mediation factors include strategies for facilitating the interaction between the visitor and exhibit. Mediation (i.e., interpretation) can be accomplished through people, strategies, products, and technologies in various formats. For visitors with vision impairments, this mediation (i.e., interpretation) is frequently achieved through another person (e.g., interpretive staff, volunteers, or other visitors) or via audio technologies (e.g., audio tours, speakers, or sound domes). However, these commonly used mediators often do not adequately convey exhibit dynamics to visitors with vision impairments and thus, do not truly mediate or facilitate the visitor-exhibit interaction.

2.2. The Roles of Mediation

Our model recognizes that mediators are crucial to visitor-exhibit interaction and that the relationship between the visitor and mediation can be dynamic, enabling visitors to interact more effectively with an exhibit and other visitors. As a result, our model differs from the other models discussed here in that it more actively addresses mediation and supports a "two-role" social interaction structure that includes (1) a visitor and (2) a mediator (which can be, for example, a docent, or even another visitor interacting with a docent, with signage, or with other interpretive information). Furthermore, the interpersonal interaction between visitors is variable, in terms of who plays which role, or the relationship between the "players". For example, as depicted in Figure 1a, a visitor with a vision impairment (V2) receives most information from a friend or family member (V1), who accesses the exhibit directly or interacts with a docent, audio tour, signage, etc. In another possible scenario, depicted in Figure 1b, a visitor with a vision impairment (V2) also interacts with the exhibit through mediation, making the exhibit more directly accessible. This enables a more level, two-way sharing between the visitors (V1 and V2). In yet another possible scenario, depicted in Figure 1c, social conditions may mean that the visitor with a vision impairment (V2) assumes the primary role for interpreting (e.g., a parent with a vision impairment visiting the ILE with a sighted child).

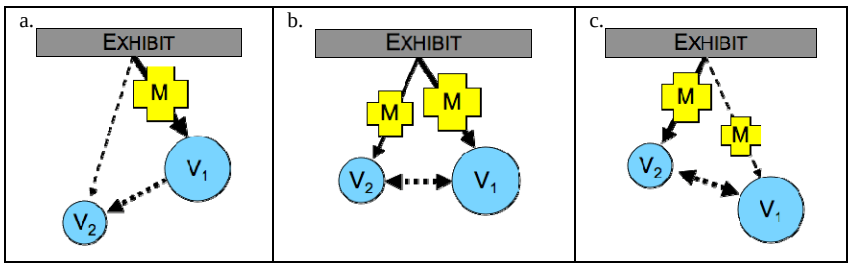

Figure 1. Model of Mediated Visitor-Exhibit Interaction. Information about the exhibit passes either directly to a visitor (V), or through a mediator (M), which can be technology or another person (e.g., a docent), or both.

2.3. Research Plan

To operationalize and validate our model of mediated visitor-exhibit interaction, we are empirically investigating and evaluating the existing interpretive strategies and technologies used by zoos and aquaria to convey dynamic and static exhibit information. These strategies and technologies include the interpretive personnel who provide live descriptions in real-time, audio technologies, signage, and other paper-based guides. To aid in expansion and validation of the model and to ensure that future design guidelines for dynamic exhibits are robust and well-informed, we have several research activities planned: 1) *resource collection* to catalog the various interpretation materials that have been developed and are in use at ILEs; 2) *study of interpretive staff* to examine the features and characteristics that they identify as salient for interpretation and the language, gestures, and objects they use in their interpretations; 3) *audio tour investigation* to assist in developing an audio tour for individuals who have vision impairments; and 4) *ethnographic studies of visitor-exhibit interactions* to observe visitors in action at zoos and aquaria using interpretive strategies and technologies.

3. Conclusion

Whereas there are existing models of P-E interaction that define the factors that influence learning and participation, these models are wide in scope and not precise enough to assess exhibit and visitor interaction at dynamic exhibits. These limitations necessitate the development of a more accurate model that is sensitive to the characteristics of dynamic exhibits at zoos and aquaria and reflects the needs of visitors with vision impairments in these settings.

Our new model of mediated visitor-exhibit interaction will be validated through examination of existing practices, visitor observations, and iterative interpretation development and testing. This model will be used to inform design guidelines for generating meaningful real-time interpretation that is synchronous with exhibit dynamics. By providing improved access to exhibit dynamics for visitors with vision impairments, it is likely that visitors with full vision will also benefit. On a broader scale, all visitors can benefit when audio interpretation enables them to learn more about an exhibit and more effectively participate in informal learning opportunities.

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