

Audio Elements:

Understanding Current Uses of Sound in Museum Exhibits

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A thesis

submitted in partial fulfillment

of the requirements for the degree of

Master of Arts

University of Washington

2015

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Program Authorized to Offer Degree:

Museology

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**ABSTRACT**

Audio Elements: Understanding Current Uses of Sound in Museum Exhibits

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Sound is increasingly used as an interpretive tool in a variety of museum exhibits, but currently accepted practices are not well understood by professionals across the field. This study surveyed eight exhibit design professionals across four museums in the Pacific Northwest, to describe the motivations and factors that influence their use of sound. This study targeted museums well known for using sound in exhibits to convey information or meaning. Results show that exhibit designers are either experience-motivated or content-motivated when they use sound. Participants were aware of the challenges posed by using sound, and many have worked to devise specific strategies and methods to solve problems that arise. More research is required to determine how or why particular methods of using sound in museum exhibits are effective or how specifically sound affects the visitor experience.

*Keywords: sound, audio, museum exhibition, exhibit design*

## **ACKNOWLEDGEMENTS**

First and foremost, I'd like to thank my committee chair, Jessica Luke, for sticking with me throughout the thesis process; as well as my committee members Wilson O'Donnell and Taylor Felt for being so enthusiastic about my topic and offering fresh insight when I needed it the most. Additionally, I'd like to thank all the participants in this study – without whom I would have nothing to write. A special thanks goes to my mom, dad, and sister for always being supportive and willing to talk through difficult times. Last but certainly not least, I would like to thank my partner, Aubrey Koch. Without her love and support over the years, I don't know how any of this would have been possible.

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## Chapter 1: Introduction

For many of us, sound and hearing are major aspects of perception, while for some, they are a primary mode of experiencing the world. Within museums, however, many have argued that there exists a “sense hierarchy” which “elevates and privileges sight above other senses” (Levent and Pascual-Leone, 2014 p.xviii). While most museums rely on images, text, and silent objects to communicate their message, there has been a recent move to integrate other senses into the museum experience as well.

In 2014, the American Alliance of Museums and the Center for the Future of Museums' *TrendsWatch* report described a “growing demand for multisensory experiences,” and encouraged museums to experiment with other “sensory modalities” (p.20). They noted that “the demand for multisensory experiences is accelerated by discoveries documenting the utility as well as the artistic challenge and the sheer fun of engaging all the senses” (p.17), and that soon “people may become less interested in traditional experiences that appeal primarily to one sense at a time” (p.16). Recent research and contemporary understandings of the brain, neurology, and memory further emphasize the potential utility of multi-sensory learning.

While new technologies that utilize senses like smell, taste, and touch can be experimental, unproven, and expensive, many museums are already using sound in some capacity.<sup>1</sup> Sound is an extremely important and evocative sense: it can be descriptive, informative, and powerful. When used as an interpretive tool in museum exhibits, sound can easily convey information and meaning to visitors, while simultaneously providing entertaining and immersive learning experiences.

Sound in museums is a multi-faceted and complicated topic. Thus, the specific phenomenon targeted by this study should be articulated. This study sought to describe uses

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1 See Bedford, 2014, p.108-109 for a cursory examination of some examples.

of interpretive sound, which consists of sound used to further an exhibition's goals, topic, or content. This consists of both “open air” and headphone sound, as long as it was included in the overall exhibition design. This excludes many artistic uses of sound, which most often exist to further the message of an artist; incidental sound created by visitors and staff, as this is an unavoidable reality of existing in an acoustic space; as well as many audio guides or tours, which are often individualistic and exist separately from the exhibition.

Nikos Bubaris (2014) makes a similar distinction between types of sound, drawing from film sound design, he refers to “diegetic” and “non-diegetic” sounds:

“...the term 'diegetic' refers to the world of the story presented (e.g. the voice of the protagonist) and the term 'non-diegetic' refers to sonic information that is dramaturgically outside the world and the actions of the story presented (e.g. the film music composed to dramaturgically 'colour' the voice of the protagonist).” (p.394)

These two types of sounds may be found in audio-guides (primarily non-diegetic), ambient audio (often diegetic, though music is often non-diegetic), and in topic content (often diegetic, though a narrator's voice is most often non-diegetic). The types of sound most often discussed and examined throughout this study are diegetic sounds.

Even though sound has become more common throughout museum exhibitions, most examinations of these uses are cursory, though a few in-depth studies have been done.<sup>2</sup> Some literature outlining how to effectively use sound in an exhibit environment also exists, but it is scattered and brief. Some professional publications have touched on the topic<sup>3</sup>, but there is little in the way of guidance for designing, installing, and managing interpretive sound in museum exhibits. This study therefore surveyed a number of museum professionals in order to better understand the ways in which sound currently is used in these settings. An

<sup>2</sup> See Quin's 1999 study of the Mashantucket Pequot Museum and Research Center's soundscape design.

<sup>3</sup> The Spring 2004 edition of the National Association for Museum Exhibition's *Exhibitionist* journal, dedicated to multisensory exhibitry, touched on sound in a few sections, while the July/August 2007 edition of the Association of Science-Technology Centers' *Dimensions* journal was entirely dedicated to the topic of sound.

understanding which can then serve as a foundation for future work in implementing and evaluating sonic experiences within museum exhibitions.

The purpose of this research study is to describe the ways in which exhibit designers and museum professionals in the Pacific Northwest use sound as an interpretive tool in museum exhibits. Two research questions guided this study:

1. Why do exhibit designers use sound? What do they hope to accomplish?
2. What factors guide the use of sound in museum exhibits?

Research into the use of interpretive sound in museums has great potential for a variety of museum professionals. If an articulated “best practices” for using sound as an interpretive tool in museum exhibits were to be accepted within the field, it could improve many aspects of museum operations. The effective establishment of such practices would mean that curators and exhibit designers could better use sound to convey information and create meaningful experiences for visitors of all ages and needs, evaluators would be better able to understand the nuances of the visitor experience and how ambient environmental factors like sound affect that experience, visitor services staff members will enjoy their work more due to an elimination of particularly annoying or repetitive sounds, and educators will be better able to reach students of all ages and needs with exhibit audio that has been better designed to engage visitors and enhance the learning experience.

## **Chapter 2: Literature Review**

In order to gain a solid understanding of sound in museum contexts, it is important to familiarize oneself with various, disparate bodies of literature, including: a) historical context reviewing trends regarding the use of sound in museums over the latter half of the 20<sup>th</sup> century into the present; b) studies of the visitor experience, including stress-studies and accessibility studies; c) theories of education involving immersive and multi-sensory learning; and d) available exhibition design literature pertaining to environmental sound control and utilizing sound in exhibits. A familiarization with these bodies of literature will emphasize the importance of not only sound in museums, but of utilizing other sensory experiences in museums as well.

### ***Sound's Trajectory Through the Museum***

While there has been a “long-standing belief that museums are places of silence,” changing museum practice has led to a situation in which “sound-making is no longer considered a problem by default, and a variety of sounds are often introduced to enhance visitors' experience,” (Bubaris, 2014). Even though museums have been encouraged to use multimedia or “mixed-media” in exhibitions for decades (Kissiloff, 1969), this trend has picked up speed in recent decades due to the increasing popularity of interactive museum experiences and the more recent abundance of available digital technology and media (Trentlage, 2004). Current participatory models of museum practice are often prone to sound and abhor atmospheres of silence - they elicit conversation, interaction, play, and other sound-producing activities (Simon, 2010). Within modern museum spaces which do not require silence, sound has flourished.

Currently, a wide variety of museums across the field use sound in their exhibitions.

Museums like the Franklin Institute Science Museum in Philadelphia and the Field Museum in Chicago, have employed sound in their exhibits in order to communicate context or content and engage visitors of all ages (Bedford, 2014). The Mashantucket Pequot Museum and Research Center in Connecticut is well known for its large exhibits that heavily utilize sound (Quin, 1999), smell, and life-sized, walk-in dioramas in order to create the experience of a 16<sup>th</sup> century Pequot village “frozen in time,” (Beliveau, 2012). A number of science museums like the Boston Museum of Science (Davidson, 1991), the Science Museum of Minnesota (Pollock and Newlin, 2007), and the Exploratorium (Diamond, 2007) regularly use sound in their exhibits. The Children's Museum of Indianapolis is well known for their use of sound in their *Dinosphere: Now You're in Their World* exhibit, which involved “hearing dinosaur calls,” “thundering footsteps,” and “ambient animal sounds” (Donnelly, 2004). While these uses range from ambient soundscapes to concrete demonstrations of concepts or ideas, the use of sound in exhibits has been increasingly common across museums in recent history.

This growing trend of sound-use has also been mirrored in the art world. Art historians have thoroughly documented that over the past fifty years, sound has been increasingly incorporated into art museum exhibitions. Cluett (2013) estimated that between 1966 and 2013 there were “at least 350 sound-themed group exhibitions,”<sup>4</sup> in art museums, while “dozens of pieces, practices, and practitioners, and a substantial number of solo sound exhibitions, exist well before 1966” (p. 110). This trend has picked up speed in recent years: in 2013, New York's Museum of Modern Art (MoMA) opened its first major exhibition of sound art, entitled “Soundings: A Contemporary Score,” (Gopnik, 2013), and the 2014 Whitney Biennial was noted for its extensive inclusion of sound and time-based works (Eppley, 2014).

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4 That number is further broken down into “an initial constellation of about ten exhibitions between 1966 and 1972, followed by about three to five exhibitions per year until 1979, when another constellation of twenty or so exhibitions appears that lasts until roughly 1982. From 1982 on, the yearly count increases to ten to fifteen per year until a steady twenty exhibitions per year over the last fifteen years.”

### ***Sound, Noise, and the Visitor Experience***

Like any sensory stimuli, sound can have a very profound effect on our day-to-day, moment-to-moment experiences. Unlike other sensory perceptions, however, the subject of perception has much less control over the experience of sound than of sight, taste, or touch. In discussing the senses, Salome Voegelin (2010) notes that:

“vision, by its very nature assumes a distance from the object . . . seeing always happens in a meta-position, away from the seen, however close,” while “hearing does not offer a meta-position; there is no place where I am not simultaneous with the heard. However far its source, the sound sits in my ear. I cannot hear it if I am not immersed in its auditory object, which is not its source but sound as sound itself.” (p. xi – xii)

In other words, sight is an observation and interpretation of the external interaction between light and objects in space. Hearing, on the other hand, is internal to the experiencer; no matter where the source of the sound, the sound itself “sits” in the ear, the physical site of hearing.

Vision, being an internal interpretation of an external phenomenon, is easily diverted or avoided: we can close our eyes or look away. Hearing, on the other hand, is an internal interpretation of an internal process (i.e. the perception of the vibration of air particles on our eardrum). By nature, sound is much more pervasive and difficult to escape (just ask anyone with a noisy neighbor or a snoring spouse). Sound is so pervasive, in fact, that the human brain actively suppresses many sounds for us, rendering them at a level below our awareness while still using them to glean information about our surroundings, often registering information about the size of the space we inhabit, the distance and size of objects in our vicinity, our proximity to walls, etc. (Arnott & Alaine, 2014). While these sounds may be rendered below the threshold of awareness, they nevertheless can have an effect on human experience, both positively and negatively.

Studies have shown that noise and sound pressure fluctuations created by standard

ventilation systems can cause mental fatigue and negatively impact concentration after a few hours of exposure (Persinger, Tiller, & Koren, 1999). Uncontrollable environmental stressors like noise have even been shown to trigger learned helplessness and psychological distress (Evans & Stecker, 2004). This has profound implications for the museum field, and the realm of visitor studies in particular. Some studies have shown that noise in museums can have a profound effect on visitor outcomes and experiences. While studying the effects of ambient noise on visitor dwell times, Jakubowski (2011) found that “sounds congruent with visitor expectations of an exhibit are more likely to yield a restorative experience,” with excessive or incongruous noise yielding lower dwell times in exhibits, and “sound designed to match (to be in congruence with) a given context [having] a positive impact on [visitor] behavior and well-being” (Jakubowski, 2011). Compared to the added sound of human voices, classical music and bird song yielded much higher visitor outcomes in both an art and natural history museum setting.<sup>5</sup>

While studies such as this have shown that multi-sensory stimulation like sound can improve visitor attention and dwell-times, these studies often note that “caution must be employed by museum professionals not to overstimulate visitors, as this may decrease [their] enjoyment” (Harvey, 1995 p.88). There is, however, no clear consensus as to what amount of stimulation visitors can generally handle. Cognitive neuroscientist Ward (2014), for instance, asserts that “the brain is quite capable of avoiding 'sensory overload,' provided the sensory information is not conflicting” within the exhibit (2014, p.281). In addition to sensory overload, some in the field have spoken of a “sensory disorientation” that might “result from incorporating several different, and at times contradictory, sensual logics within a museum

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5 Interestingly, Jakubowski found that, for the natural history museum, the highest results overall came from the control group, which had no extra sound added to the gallery space. This ultimately was due to the experimental sound being masked by the ambient noise of the gallery, and getting lost in the overall noise of the environment. This particular aspect of Jakubowski's findings highlights the nuanced and complicated relation of sound to the visitor experience.

space,” a phenomenon which Morgan (2012) argues also has great productive potential for the museum.

Throughout these studies, a theme emerges of the delicate balancing act between sound and noise: while one can yield very positive visitor outcomes, the other can have very negative effects on visitor well-being. Often this balance depends on influence of environmental noise, congruency between sensory elements, and interplay between sensory elements. This balancing act only emphasizes how difficult using sound can be, and how important it is to utilize sound effectively.

This inquiry into visitor studies and environmental stressors has most recently found expression in the discussion of museum atmospherics, “a model derived from the retail and services literature,” which “has been presented as a possible framework for studying the visitor–environment dynamic” (Forrest, 2014). This model works to quantify both ambient and prominent environmental factors (non-visual stimuli like noise included) in order to better understand the visitor experience in museums. Museum atmospherics shows great promise for articulating the connections between stimuli and visitor response, especially when considering those stimuli that are below the threshold of awareness (ambient noise, lighting, odor, color, traffic flow, etc.). Forrest's work bridges an important gap between exhibit designers and museum evaluators, and presents a model that can be used to better articulate aspects of the visitor experience that have remained elusive. Under the model of museum atmospherics, it would be easier to extrapolate why certain stimuli yield particular results, bringing a cohesion to the studies of environmental factors and their effects on visitor experience.

### ***Visitor Experience and Accessibility***

One of the primary realms of visitor studies regarding sound in museum exhibits involves accessibility for blind and low-vision visitors. This has been a specific concern for art museums, with programs and collections that appeal to vision above all other senses. Art Education for the Blind, founded in 1987 and now called Art Beyond Sight (ABS), is one of the leading organizations working to expand art museums' appeal for people with varying degrees of visual impairments (Art Education for the Blind, 2005). In addition to producing research and publications regarding low-vision accessibility for art museums, ABS has also hosted a number of conferences, showing how “museums and educators are creating ways to include people with vision loss and other disabilities into the museum experience by incorporating: touch, sound, smell, drama, verbal description, and the use of artist tools and art making” (Simon, 2012). This, however, is not a trend of art museums alone: a variety of studies have been conducted to evaluate the needs of visually impaired museum visitors more generally. Handa, Dairoku, & Toriyama, (2010) surveyed a number of visually-impaired museum visitors and identified a number of priority needs, including the ability to experience objects through hearing, touch, or smell.<sup>6</sup>

In fact, making museums accessible and enjoyable for the most diverse audience possible has long been a goal of many in the museum field, especially those in exhibit design (Thompson & Thompson, 2014). A number of museum exhibition manuals, like Dean's *Museum Exhibition: Theory and Practice*, (1998) explicitly mention utilizing sound as a way of making exhibits more accessible to blind and low-vision visitors, and accessibility is often a topic of conversation for those throughout the museum field. While it is not easy to make audio elements that communicate effectively with visually-impaired visitors, it has been a

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<sup>6</sup> Additional needs included: easily navigable spaces, well-publicized services for the visually-impaired, well-maintained and publicized touching collections, accessible audio-guide devices, braille labeling, staff assistance being available when needed. (p.228-233)

common practice in a variety of museums to utilize audio elements in their exhibits to great effect (Davidson, n.d.). Studies suggest that the utilization of multi-sensory stimulation in exhibits is not only beneficial to disabled visitors, but also elicits greater involvement from all types of visitors (Davidson, 1991). In studying visitor responses to an exhibition renovation at the Boston Museum of Science, Davidson found that the addition of multi-sensory interpretive materials elicited greater visitor attention and outcomes than the pre-renovation exhibition<sup>7</sup>. Thus, while including non-visual sensory stimuli in museums may offer a greater accessibility to a specific portion of museum visitors, it can also greatly benefit all visitors more generally.

There are, of course, other accessibility considerations to be mindful of when dealing with sound. It is important, especially for exhibits that heavily utilize sound, to be cognizant of the needs of people who are deaf and hard of hearing (see Pollock and Newlin, 2007 for an example). Information that heavily relies on sound should also have a visual representation of some type (subtitles, diagrams, descriptive labels, etc.) to assist these visitors. One of the more recent and less explored concerns involves those museum visitors on the autism spectrum, for whom lights and sounds can trigger unpleasant experiences and anxiety (Rais, 2012). Sound and its relation to accessibility is a complex topic, but the research shows that, if utilized effectively and conscientiously, it has great potential for all kinds of museums.

### ***Immersion and Learning***

Immersion, as described by Stephen Bitgood (1990), is “the experience of feeling engrossed, absorbed, or deeply involved in an exhibit,” and is often sought out by exhibit

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<sup>7</sup> While these changes benefitted a large group of visitors, Davidson did note that it did not benefit everyone. She remarked: “The gallery has changed from a rather quiet, secluded place favored by adults to a livelier hall populated by families and children. The noise level has increased, and the mood has altered. During the collection of baseline data, we observed many adult couples in the gallery who appeared to appreciate the relative seclusion and quiet of the gallery at least as much as the exhibits. This population does not appear as frequently after alteration. Museums may want to consider the possible negative impact of modification on some audience segments before they remove all of the quieter galleries.” (p.288)

designers in order to create more powerful experiences, and by extension, better learning outcomes (p.27). Bitgood posits that “learning associated with immersion is more experience driven than it is information driven. Instead of emphasizing the acquisition of facts, concepts, etc., a more pervasive understanding of the subject matter is sought – one that includes feelings of experiencing another time and/or place, curiosity, excitement, etc.” (p.31).

Thompson's (1993) study of immersion in museum exhibits suggests that even a small amount of context, specifically “contextually sympathetic environments” can assist an exhibit's ability to produce a more immersive experience (p.147). Thompson compared the perceived immersiveness of museum exhibits<sup>8</sup> with “sympathetic” and “unsympathetic” context (i.e. museum objects in exhibits that provide context vs. museum objects on their own). Even though Thompson's study focused on architecture, and was concerned solely with visual contexts and environments, it could be suggested that a similarly effective method for adding context and creating immersive exhibition experiences would lie in the utilization of multi-sensory stimulation. Bitgood (1990) for instance, noted that “if the visual stimuli in the exhibit are paired with other sensory inputs (sounds, smells, texture, temperature, etc.) greater immersion is likely to be created,” and by extension, greater learning outcomes are likely to be achieved (p.34). In fact, a study by Harvey (1995) illustrated perfectly how changes to the exhibition environment intended to encourage immersion. In studying the effects of exhibit renovations at the Denver Museum of Natural History, he found that changes, including the “use of touch specimens, sounds, and smells to compliment the objects,” elicited greater visitor attention, though due to the number of changes made during this renovation, it is unclear as to “which of these design change feature changes caused the observable differences in visitor behavior if any individually did,” (p.70). Regardless of which individual

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<sup>8</sup> Strangely enough, choosing to study exhibit immersiveness by showing participants images of artifacts with and without the context provided by a contextually sympathetic exhibit, instead of bringing participants to an actual museum exhibit.

factor increases visitor attention, these studies seem to indicate that exhibits which encourage more immersive experiences can elicit greater visitor attention, and by extension learning outcomes.

### ***Multi-sensory Learning***

It has been shown that engaging more than one sense when learning greatly increases information retention and recall (Ward, 2014). A massive body of literature exists stretching from psychology to neurology, far outside the bounds of traditional museum literature, leading to our current understanding of sensory perception and the human brain.

Neurologists Pascual-Leone and Hamilton (2001) trace this historical path of understanding<sup>9</sup> and suggest that “based on the data presented, the visual cortex seems to be a metamodal structure that receives not only visual, but also auditory and tactile stimuli,” and go on to propose that the brain, itself, “is made up of metamodal operators,” (p.15). This means that processes like sensory perception can (and do) occur in multiple parts of the brain, not just in specialized regions commonly known for favoring specific processes (e.g. the visual cortex).

This new metamodal model of the brain contributes greatly to our current understanding of memory, recollection, learning, and sensory experience. Ward (2014) notes that “memories consist of a constellation of different attributes (sensory, emotional, verbal, et.) that are distributed throughout the brain but bound together in different hubs,” (p.273). Ward specifically applies this model of memory to a museum context, and notes that “the extent to which information from different senses can be meaningfully integrated is of primary importance for subsequent remembering” (p.281). Through an extensive review of psychological literature, Ward also shows how the simple pairing of words and sounds has

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<sup>9</sup> Pascual-Leone and Hamilton draw upon a massive body of neuroscience and psychology literature to support their claims, citing Gregory and Wallace, 1963; Lomo and Mollica, 1962; Jung et al., 1963; Murata et al., 1965; Howard and Templeton, 1966; Spinelli et al., 1968; Morell, 1972; Sur et al., 1990; Roe et al. 1990; Stein and Meredith, 1993; Pascual-Leone and Torres, 1993; Rauschecker, 1995; Hamilton and Pascual-Leone 1998; Kujala et al. 2000; Sharma et al. 2000; Melchner et al., 2000; and many, many more.

been shown to increase information recall in a number of studies (p.278-281). These studies seem to suggest that due to the metamodal nature of the brain, multi-sensory exhibits may be an effective approach for museums seeking more positive learning outcomes.

### ***Sound in Exhibition Design Literature***

Due to the fact that a museum is a physical space filled with air, it is an inherently acoustic space. Every surface affects the movement of air-particles, reflecting or absorbing energy, directing and redirecting movement (Everest & Pohlmann, 2009). Even if sound is not produced by the objects within a museum, sound is still present within its walls. As Salomé Voegelin (2014) has observed, “the museum is not a visual place but an audiovisual environment, unfolding its space in the time of ricocheting footsteps, sincere whispers, loud echoes of children's laughter, security guards' fuzzy walkie-talkies, tour guides' hushed lectures, and a few audiovisual works that remind us that even the work is not as quiet as we might expect” (p.120). This is the nature of sound in the museum: sometimes it is intentional, often it is incidental, but regardless it is present and an inherent quality of the museum space.

While some have advocated for designated soundscape designers working closely with exhibition design teams (Bubaris, 2014) little has been done in terms of articulating how museum professionals, who often lack access to such specialists, can work with sound. Nevertheless, many museum professionals are aware of the effects of the environment on the nature of sound in the museum space. As one contributor to the *Manual of Museum Exhibitions* notes, “the gallery's structure, materials, and finishes are the three factors that can be used or misused to control noise levels resulting from visitor load, building mechanicals, and even an in-gallery sound system. In general, noise levels should be neither so low that visitors feel inhibited nor so high as to be disturbing” (Maximea, 2014). Additionally, she notes that “*noise transmission* from elevators, washrooms, workshops, and

mechanical rooms may require sound attenuation,” and that “acoustic buffering and control materials may be required in . . . galleries that tend to be noisier”<sup>10</sup>(p.79).

In fact, a number of resources emphasize the importance of noise control and the overall architectural design of the museum space. Exhibit designer Tamara Trentlage, (2004) notes that “from the outset noise control needs to be accomplished by proper acoustic design of the space . . . visitor foot noises on hard surfaces, HVAC and other building noises all need to be addressed (p,17). Andrea Weatherhead (2004), of the Weatherhead Experience Design Group Inc., identifies three primary factors that “affect the quality of the sound experience in a given museum space,” they are: cavernous spaces (large lobbies, high ceilings with reflective surfaces, etc.), reflected sound (often discussed in terms of reverb, or “how long it takes for a sound to fade”) and sound bleed (transmission of noise from unintended sources or in unwanted areas) (p.4-7).

The most accessible yet comprehensive collection of acoustic-considerations for exhibit soundscape design and sound-control comes from Andrea Weatherhead, who distills some of the most common acoustic problems in museums and pairs them with succinct solutions and strategies for their management. Her ten suggestions are as follows:

- “1. Avoid hard-surfaced, highly reflective materials – i.e., stone, glass, metal, and concrete. They reduce control over where sound travels. Likewise, avoid components that will act as reflectors and bounce sound around the spaces, unless that is the desired effect.
2. High ceilings, especially those treated with absorbent materials, are better than low ones. Avoid domed ceilings which can focus sound in unwanted “hot spots.”
3. Bass sound waves are long and difficult to control: consider using bass shakers which replace bass audio with physical vibrations, tricking visitors into believing they are hearing those frequencies rather than merely feeling them.
4. In areas with multiple sound sources, provide ways to deliver sound close to a visitor's ears. Competing sound sources need to be far enough apart that one is at least 10 decibels (dB) louder than the other. Take advantage of a predominant

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10 She concludes that “the appropriate *sound transmission criteria* (STC) number for each space should be determined by the architects and acousticians based on adjacent occupancies,” and states that “*design noise criteria* (NC) ratings should be close to NC 30 in exhibition and research areas, up to NC 35 in related public areas, and as low as NC 25 in auditoria.” those this means little to the standard museum professional.

sound to mask other competing sounds.

5. Use circuitous routes between spaces to achieve acoustic isolation without the need for doors and ceilings.
6. Budget enough money and space for acoustic treatments; commercial sound-absorbing panels can run \$10 to \$40 per square foot. Cheaper materials exist, but you will need to budget time and labor for mounting them. Remember that absorption materials take up valuable space on floor plans, making walls, ceilings, and ducts thicker.
7. Consider carpeting areas of greatest sound intensity.
8. Ensure that spaces are free of excessive mechanical noise (e.g., do not locate exposed air units in the gallery).
9. When planning audio with video, you may want to use focused sound devices. A video monitor's integral speakers are usually designed to cover as wide an area as possible.
10. Take special care with location and orientation of mini-theaters; sound bleed out the rear can interfere with adjacent exhibits. Doors are not needed if speakers and materials are chosen and placed wisely.” (Weatherhead, 2004 p.7)

There are many other suggestions for managing sound in museum exhibits throughout the literature. Some practitioners suggest utilizing headphones, near-field speakers, and enclosures for containing and controlling sound in especially audio-heavy exhibits (Pollock and Newlin, 2004). Others have suggested methods of sound proofing, isolating sound sources, controlling decibel levels to prevent sound bleed, and utilizing directional speakers and sound domes (Weatherhead, 2004). Still others recognize the possibility that exhibits themselves may produce unwanted sounds via their motors or functioning parts, and suggest solutions like adding acoustic baffling between particularly noisy exhibits; isolating, soundproofing, and reducing vibrations caused by motors; and utilizing surfaces that direct absorb acoustic energy to contain and unwanted sound (Fry, 2002).

Specialty solutions for museum audio also exist in addition to the myriad of directional audio solutions and sound-control options. The Intelligent Sound System™ (ISS™) computer program, used at the Mashantucket Pequot Museum and Research Center, is able to create informed, yet “randomized” soundscapes according to predetermined parameters, and can also adjust overall sound levels in relation to the visitor noise level in the museum space

(Quin, 1999). The ISS™ program is just one of the many commercial solutions available specifically to manage sound in museums. The emergence of these resources in recent decades points to an growing understanding that sound shapes experience, and therefore exhibit designers must intentionally control sound in order to shape the visitor's experience.

While the National Association for Museum Exhibition's (2012) *Standards for Museum Exhibitions and Indicators of Excellence* encourages the use of audio and audio-visual content in exhibits, it offers little guidance on how to utilize audio effectively. Other best practices regarding sound often center around accessibility for deaf and hard of hearing visitors, like the ASTC's best practices for the accessibility of recorded and live media (Association of Science-Technology Centers, n.d., accessed 2015).

While there exists a scattered collection of tips, strategies, and specialty products for mitigating and solving the challenges that arise when using sound in a museum exhibit, there currently exists no field-wide agreed-upon set of best practices for utilizing audio in exhibits. The closest one can get to a single list of “best practices” for controlling sound in museum exhibits is the previously mentioned list of suggestions by Andrea Weatherhead or collections of tips (and ADA regulations) for making exhibitions accessible to visually-impaired visitors.

### **Conclusions**

After reviewing these very different bodies of literature, a number of trends become clear. Of the utmost importance is that of an increasing appreciation for the value of multi-sensory experience in memory formation, cognitive function, and learning. This has great implications for the increasing number of museums and informal education institutions that are utilizing sound and other senses in addition to traditional visual representations of information. Additionally it is clear that exhibit designers are beginning to recognize these developments, especially where sound is concerned. Literature that has emerged in the past

two decades on exhibit design has increasingly concerned itself with the effective use and of sounds used in museum exhibitions, though this literature is few and far between. This study seeks to bridge a gap in the literature that exists between the ways in which museum professionals currently use sound in these spaces and the disparate tips for approaching sound in these spaces.

### **Chapter 3: Methods**

This research sought to describe developing best practices in the ways in which exhibit designers in the Pacific Northwest use sound in museum exhibits. This study specifically targeted museums that used sound in exhibits as an interpretive tool to convey information or meaning to visitors. Two research questions guided this study:

1. Why do exhibit designers use sound, and what do they hope to accomplish?
2. What factors influence their use of sound?

A case study approach informed this study, with data collected through semi-structured interviews of exhibit designers at four museums.

#### ***Sampling***

Case study sites were selected according to three key criteria. One, the researcher targeted museums in the Pacific Northwest that used sound in one or more exhibit in the last year. Two, the researcher excluded art museums, children's museums, and science centers as potential sites. Art museums were not included because of their unique focus on sound art, which did not fit with the nature of the topic being investigated here. Science centers and children's museums were not included due to the typically chaotic and active acoustic environments of these types of museums. Three, the researcher consulted with two museum experts in the area, asking them to identify museums that effectively used sound in their exhibits to convey information and meaning to visitors. A total of four museums were identified; The Museum of History and Industry (MOHAI), The Museum of Flight, The Experience Music Project Museum (The EMP), and The Burke Museum of Natural History and Culture (The Burke). All four of these museums were included in this study.

Inquiries and requests for volunteers were sent to exhibit department emails obtained through museum websites and professional contacts. Two museum professionals from each

institution volunteered to participate, and were subsequently interviewed. At the Burke, interviews were conducted with one exhibit designer who had worked on every current exhibition on display, and a newer employee who had only worked on the temporary *Here and Now* exhibition. From MOHAI, interviews were conducted with two exhibit designers that had worked on both the *Real Northwest*, and *A Place at the Table* exhibitions to varying degrees. At the EMP, interviews were conducted with one curator who designed the *Nirvana*, *Horror*, *Jimi Hendrix*, and *Indie Game* exhibitions, and another curator who worked extensively on the *Fantasy* and *We Are 12* exhibits. Finally, both interviews at the Museum of Flight were conducted with exhibit designers who had worked extensively on the *Spaceflight Academy* exhibition. All of the museum professionals who participated in this study had worked with some form of sound in a museum exhibit.

### ***Data Collection***

Semi-structured interviews were conducted, in person, with a total of eight exhibit designers across the four chosen institutions. Introductory emails clearly outlined the scope and purpose of the research study. Those professionals who received the email and were interested in discussing the topic replied and scheduled interviews, nobody refused to participate in the study. All interviews were conducted between March and April of 2015, at each case study museum or an affiliated off-site location. A variety of questions were asked about specific exhibits within the participant's museum that utilized sound in some way (see Appendix A for the interview guide). Interviews typically lasted between 30 and 45 minutes, and were digitally recorded for later analysis.

### ***Data Analysis***

Following a review of the transcribed interviews, key words, concepts, and phrases were identified and noted in order to identify any emergent patterns or themes. Once this

initial list was constructed and sorted into a coding rubric, sections of each interview were reviewed and coded to give a more complete understanding of common themes (see Appendix B and C for the coding rubrics). Results were then reviewed and interpreted.

In order to determine the underlying themes across these interviews, a process of analysis was undertaken to distill the most salient topics. Individual questions from each interview and corresponding responses were divided and entered into a spreadsheet. Each piece of each interview was then read independently, with salient themes being noted separately. Then, a master list of themes was compiled for each research question. Interviews were then reviewed in concordance with this master list, with individual mentions of each topic being noted along with the code for each interview the theme appears in. This final list served as the foundation for the subsequent interpretation.

### ***Limitations***

As previously mentioned, this study's sample excluded art museums, children's museums, and science centers. These exclusions, while limiting the generalizability of the study, were necessary to provide clarity of purpose and results. The use of sound in most art museums is artistic in its nature, and thus resides outside of the scope of this study. Though the results of this study may still be applicable to art museums that use sound in exhibits, it was determined that this study should focus on sound for the museum's sake, whereas most uses of sound in art museums is for art's sake.

The decision to exclude children's museums and science centers from this study was difficult, but was necessary for feasibility's sake. In discussions with the expert informants when determining case study museums, it became clear that these two particular types of museums are well known for having chaotic and very active sonic environments, often due to their emphasis on interactive learning and direct targeting of children. While sound

management and implementation may be very important for these types of museums, the specifics of their acoustic environments would have proven difficult for a study of this scale. It is highly recommended that future work be done to incorporate science centers and children's museums into future work on this subject, as their unique challenges and strategies for sound implementation will undoubtedly prove useful for the field as well.

This study's sample was also centered in a single geographic region: the Pacific Northwest (specifically Seattle, Washington), which could have a number of limiting effects on this study. The close proximity of these museums may have an influence on exhibit design through a cross-pollination of ideas – a regionally based group of peers consciously or subconsciously influenced by each other's work. This could create a bias in the final results by portraying practices that are regionally prominent as being universal across the entire field.

Additionally, there were a number of exhibitions that could not be thoroughly included in this study, though they may be cursorily mentioned. This limits the study by preventing the researcher from examining a number of exhibitions that may have been mentioned throughout the interviews. At the Burke, the *Pacific Voices* and *Life and Times* exhibitions both previously contained audio-visual exhibit elements that are no longer present. While one current staff member in The Burke's exhibits department was also working at the time of their implementation, these elements could not be reviewed by the researcher. At MOHAI, one exhibit designer had worked heavily on *Celluloid Seattle*, an exhibit that closed in 2012 and was unable to be examined by the researcher. Finally, the exhibit designers at the time that the *Personal Courage Wing* was developed at the Museum of Flight no longer work at the museum, and were not able to be interviewed.

## Chapter 4: Results

Each case study museum had a different history and relationship with sound, a fact which was mirrored in the responses of each participant. In order to understand the perspectives of each participant, it is necessary to first examine the audio-content of each museum's exhibits. Results are therefore presented following a brief description of the audio usage in each museum's exhibits, and are organized by research question.

### ***Burke Museum of Natural History and Culture***

The Burke Museum of Natural History and Culture was founded in 1885, and designated the State Museum of Washington in 1899. It is a part of the University of Washington, and at the time of this study was preparing to begin work on a new, \$95 million building project to update the museum's facilities.

The *Pacific Voices* exhibition, on display at the time this study was conducted, examines a number of different cultures located in the Pacific Rim region, and utilizes several looping videos throughout the gallery (including one with a digital-interactive component), and a push-button-activated recording of a hawaiian chant and music. The music is accompanied by blinking lights within the exhibit case indicating which instrument playing.

*Life and Times* is an exhibition that traces the geologic, biologic, and archaeologic history of Washington State. This exhibition also home to the museum's only use of environmental, ambient sound. In one portion of the geology section, the visitor walks into an immersive model of a volcano, complete with a low-frequency rumbling sound. All other uses of sound in this exhibition are byproducts of looping video. In addition to the audio sources that were present during this study, the *Pacific Voices* and *Life and Times of Washington State* exhibitions previously had a number of video stations and touch-screen video-interactive stations that were no longer present in the museum gallery.

Also present in the Burke during the research was a temporary exhibit entitled *Here & Now: Native Artists Inspired*, which showcased works by contemporary Native American artists. This exhibit's use of sound involved four headphone listening stations and a single open-air audio film, shown on a television in the back of the gallery. An additional iPad video station which also uses headphones was added immediately following data collection for this study.

### ***Museum of History and Industry (MOHAI)***

The Museum of History and Industry (MOHAI), formed in 1911, currently resides in Seattle's South Lake Union neighborhood. The museum relocated from its previous Montlake neighborhood location in 2012, renovating and taking up residence in Seattle's Naval Reserve Armory. Upon entering MOHAI, one is struck by the architecture of the building it inhabits. The building's atrium, with its wide-open spaces and very tall ceiling, serves as the main lobby and is bordered by the *Bezos Center for Innovation*, which utilizes a number of videos with “open-air” audio, one looping-video and two touch-screen interactives mounted directly to the room's back wall, and 3 touch-screen videos housed in a number of column-like structures evenly spaced around the *Bezos Center's* periphery. One column also has a touch-screen interactive table which emits sound when in use.

MOHAI's permanent exhibit, *True Northwest: The Seattle Journey*, makes heavy use of sound throughout its videos and interactives. At the entrance (and exit) of the exhibition is a moderately-sized movie theater, showing an introductory film at each quarter hour. Following the museum's intended path, the visitor enters the pre-contact section of the exhibit, and is greeted with the sounds of running water, birds, frogs, and other natural, environmental sounds. The majority of the exhibition utilizes videos, playing various historical footage, interviews, oral histories and recreations, while a number of interactive

exhibit elements also produce or elicit sound. One particularly notable use of sound in this exhibit is the “Fire Theater,” a multimedia presentation created by Weatherhead Experience Design, also based in Seattle. This award winning<sup>11</sup> multimedia presentation involves a multi-channel audio installation, video projection, and lighting effects to create a truly engaging, informative, and entertaining 7-minute performance. Artifacts from the Great Seattle Fire perform a Broadway-esque musical about the history, causes, and effects of this historic disaster.

During the time of this study, another sound-utilizing exhibition was on display at MOHAI, entitled *A Place at the Table: Over 100 Years of Greek Restaurants, Culture, and Entrepreneurial Spirit*. This exhibit utilizes a number of tools, sound included, to recreate the interior of a Greek restaurant. Along with interior design, the exhibit has Greek music playing from a radio behind the register. The exhibit also features a video station with oral histories, which visitors listen to utilizing hand-sets.

### ***Experience Music Project (EMP) Museum***

The Experience Music Project (often known as The EMP or The EMP Museum) is a private nonprofit museum in Seattle Center. Originally a museum dedicated to music, the EMP grew to incorporate the Science Fiction and Fantasy Hall of Fame and the Science Fiction Museum in 2012, and is now dedicated to contemporary pop culture.

Every exhibition in the EMP utilizes sound in some way. *Hear My Train a Comin': Hendrix Hits London*, and *Guitar Gallery: The Quest for Volume* are two galleries that primarily utilize audio from film and video: both rooms have films that are central to the exhibit and provide context as well as atmosphere and music for each of the galleries. The temporary exhibition *We Are 12: The Seattle Seahawks and the Road to Victory*, and *Indie*

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<sup>11</sup> Winner of the American Alliance of Museums Bronze MUSE Award for Multimedia Installations

*Game Revolution*, both utilize videos and interactives that create sound, but to differing effects. While *We Are 12* has a number of videos of football games that fill the gallery with the sound of cheering fans, *Indie Game Revolution* utilizes a single video, displaying information about musicians and composers who work on independent video games, to provide a unified soundtrack for the gallery space.

The EMP's *Nirvana: Taking Punk to the Masses* marked a dramatic shift in the way the museum used sound in its exhibits. The *Nirvana* exhibit has two pieces of associated music: an introductory piece and a main piece, both multi-channel ambient compositions bearing no resemblance to the music created by the subjects of the exhibition. This exhibit also heavily utilizes headphones with seven ipod listening stations and a number of video and touch-screen stations. There are a few open-air-audio televisions, but they are scattered throughout the gallery, are at relatively low volumes, and subtitled.

*Fantasy: Worlds of Myth and Magic* also uses a wide variety of sounds throughout its design. The introductory section is filled with the soothing sounds of soft harps, sweet music, and distant birdsong. The following sections of the exhibition feature various atmospheric sounds, music, and effects – including a large, snoring dragon. The exhibition features a number of small videos and touch-screen interactives, but they are relatively quiet, often restricted to headphones, and limited in number.

Finally, the museum's most pervasive uses of sound are seen in the exhibit, *Can't Look Away: The Lure of Horror Film*. In order to enter this exhibit, visitors walk down a spiral staircase filled with the sounds of distant screams, spooky bells, and various forms of creepy, ambient music. The main area of the exhibition also has a soundtrack. Similar to that of *Nirvana* and *Fantasy* it is atmospheric, multi-channel, and intentionally travels throughout the space. On three opposite ends of the gallery are large television screens showing videos of

interviews with different movie directors, while in the center of the gallery is a small maze of carpeted, semi-enclosed theaters which play film clips. A number of other video stations are scattered throughout the room, but all utilized headphones. This exhibition utilized sound in a number of interactives, including one about different musical techniques used in horror films.

### ***The Museum of Flight***

The Museum of Flight officially began at its current location in 1975 when *The Red Barn* was saved from demolition and floated by river barge to its current resting place. It was later restored and became the first permanent location for the Museum of Flight. One use of ambient sound can be found in the exhibition installed in the original Boeing factory building, now attached to the museum's main building. In addition to the natural creaking of the old wooden structure, speakers play the sound of hammering, machinery, and talking workers throughout the space.

However, the most immersive uses of sound are the WWI & WWII exhibitions that reside in the *Personal Courage Wing*. This exhibition utilized sound in a number of push-button and motion-sensor video stations as well as a number of enclosed theaters. Multi-channel audio recreated these sound of airplanes flying overhead in addition to an extensive use of sound in their interactive elements. The exhibition features a number of engine models with push-buttons that trigger the sound of that particular engine, as well as text panels featuring interactive elements – a radio that plays various audio recordings from different times throughout WWII. These radios are scattered throughout the exhibition, play relatively short audio clips, and do not use headphones.

Another exhibition, *Spaceflight Academy*, heavily utilizes sound in this exhibit interactives (either in their content or physical operation) and videos. One theater, under the rear end of the Full Fuselage Trainer (FFT) that sits in the middle of the gallery. While it did

not occur during this study, the exhibit does have the ability to create a large launch-sequence sound in the gallery via a sound-system under the FFT.

Even though each of these case study museums used sound in different ways and contexts, a number of commonalities in their practice emerged. Each interview was divided into sections and sorted into categories corresponding with each of the four research questions, key phrases, words, and themes were pulled from each quote and analysis was subsequently performed.

### **Research Question 1: Motivations for Using Sound**

A number of interview questions were designed to determine why exhibit designers use sound in their work, and what they hope to achieve by doing so. While responses varied depending on each institution and its staff's varying experiences, a number of salient themes emerged that illustrate these professionals' motivations for using sound in their exhibitions.

#### ***Content-Driven Sound Usage***

Participants from all four case study museums used sound in content-driven ways. Many of these were used to orient visitors to some aspect of the exhibition's content (setting, environment, narrative, etc.) while others involved sound as the direct result of content (i.e. recorded film or audio). For instance, when discussing the *We are 12: The Seattle Seahawks and the Road to Victory* exhibition, one curator from the EMP noted one of the ways in which the exhibit's soundscape mirrored an aspect of the content:

“We were talking with the Seahawks, and one of the points that they were bringing up was the pride that they have that CenturyLink [Field] is so loud...So we knew from the beginning that we wanted some element of suggesting to people how loud it was and we built an interactive around that one, but we also knew we needed to contain that [interactive's sound].”

In this instance, the exhibit designers were able to include a very literal aspect of the exhibit's subject (the soundscape at CenturyLink Field) into the exhibit's content.

Extremely common throughout the interviews was a mention of sound produced as a direct result of content (films with audio, oral histories, musical recordings etc.). In reflecting on an exhibit about film, *Celluloid Seattle*, one designer from MOHAI noted “it was all about movies, so we knew we were going to have a lot of music, well not music but sound...” In this instance, the exhibit audio is a direct result of its content – the films being showed in each of the five theaters. While the Museum of Flight is filled with videos, film, and accompanying audio, it is also used a number of historical sound recordings in its exhibits. One designer of the *Spaceflight Academy* exhibit discussed working to portray the experience of a shuttle launch, noting: “...we tried to find the highest definition audio of the launch that we could, that wasn't too distorted or any of that sort of thing, so it wasn't just to *re*-create it, like, we didn't try to recreate it using anything else, we tried to use an actual historic launch sound.”

For some practitioners, content and sound are so intrinsically linked that separating and abstracting them, even in the context of an interview, was difficult. For example, an exhibits staff member from the Burke asked,

“Are people comfortable just extracting sound from content? Like in your conversations...because I find it very difficult...like [you say] *sound in general*, and I'm like 'Well what story is it? Or what individual? Or what's the music and how does it relate to the artifact or specimen that you have next to it?'

This same participant went on to note that the use of sound in one exhibit was “much more a byproduct of content we wanted in, rather than sound, itself... There were very few discussions about *sound*...it was really content and much less about what the sound experience would be.”

Sound is often used to orient visitors to an aspect of the content like location or setting. One exhibit designer at MOHAI noted such an instance,

“In the *true northwest* exhibit, the main exhibit upstairs, one of the first things that you hear is the babbling stream and the birds and the brook which helps set the mood for the gallery that you're about to enter, which speaks to the native

experience, before first contact.”

In this section of the exhibit, the sounds of the stream and forest wildlife help orient to visitor to the setting of the exhibition's content: pre-contact Puget Sound.

An exhibit designer from the Museum of Flight discussed that content played a role in determining the exhibit's overall audio elements, effecting its overall soundscape. He noted that the exhibit design team ultimately decided:

“With the push-button video stations, those tend to be more oral history type interviews or historical accounts that require some verbal explanation, so we'll provide sound for those, if we have a rocket launching we'll provide sound for that, because watching a rocket without sound is much less impressive than watching it with sound. But wherever we could, if we could do something with just visual, have just visual in there, so there wasn't conflicting soundscapes.”

In this instance, the exhibit design team made deliberate decisions to prioritize specific content-driven sounds (oral histories and the sounds of rockets launching) over other possible sound sources.

Another exhibit designer from the Museum of Flight commented on the role that content had on using the launch-sequence sound associated with the full-fuselage trainer in the *Spaceflight Academy* exhibit, noting that “We don't usually use such a large sound, because it may be too distracting. But in this case, because of the content [it worked].” Due to the nature of the exhibit content (rocketry), the exhibit design team was able to justify acting against their normal design practices.

Each of these practitioners discussed utilizing sound to communicate something specific about the exhibition's main topic, message, or content. At times sound was directly linked to content, like in the case of oral histories or exhibit films. Other times sound was used to orient visitors to an aspect of content, like the natural soundscape of a Pacific Northwest Forest, or the sound of a rocket launch.

### ***Experience-Driven Sound Usage***

Another motivation was mentioned by participants from all four case study museums, though it was mentioned by fewer participants overall: six of the eight participants specifically mentioned or discussed using sound in relation to a visitor's experience. All eight spoke about affecting experience in some way, including evoking feelings or emotion, creating immersion, or providing orienting context, but only six explicitly mentioned affecting the visitor's experience with sound.

Seven of the eight participants specifically talked about using sound to create an atmosphere or environment. For instance, one exhibit designer from MOHAI noted that “the space feels warmer, cozier if there's some sort of sound. We've had exhibits open that didn't have any sound, but then we added sound. We just decided to play some music at the end because it just felt too quiet.” A curator from the EMP noted that sound is “a good way to color the gallery and add a lot of atmosphere right from the beginning.” Throughout these eight interviews, participants repeatedly referred to the use of ambient or environmental sound, either as a way of providing the visitor with an immersive, engaging experience, or in order to orient the visitor to context in order to better communicate the content of the exhibition as a whole.

One exhibit designer from MOHAI summed it up best:

“I think in broadest, generalist terms, you want people to have an experience, you wanna create an environment where they can leave their day behind and experience what we're trying to tell them...Audio experience is kind of a backdoor to their mind to allow this suspension of disbelief to happen and create an interesting, lush...experience, in a way that overall has to be welcoming and intimate, in a way that's not threatening and challenging...”

This desire to create an experience for visitors was echoed by an example given by another MOHAI exhibit designer, who stated: “Sound was considered early on [in our houseboat

exhibit] because we wanted people to experience the houseboat community, and we thought sound was very important to that.” This instance also provides an example of a case when a sound is both content *and* experience driven. In describing that particular use of sound, this designer noted:

“They were all calming ambient sounds that you would hear on a dock. There's something soothing about hearing the clanging of the docks, and the ducks, and the seaplanes, it's just kind of...it was there but then it'd be gone, and you didn't really notice it leave, and it'd just kinda fade in without being jarring...”

Thus, while this use of sound was intended to create an experience, it was also intrinsically linked to the exhibition's content.

Creating an experience that the visitor is “there” was a recurring theme throughout the case study museums. The Museum of Flight, for instance, had a number of exhibits that used audio to create an experience or sense of immersion. In discussing the *The Boeing Story: 1916-1958* exhibit, one designer noted that “the Red Barn itself is a giant artifact, so we wanted people to get the feeling like you're walking into this working factory, and so the audio was a big piece of that.” In this case, the fact that the artifact itself is immersive is used as an opportunity to provide an even greater experience through the use of sound. This focus on experiential exhibits can be seen in a number of exhibits at the Museum of Flight, like the *Personal Courage* exhibit. Another designer described the initial process behind designing the sounds for the *Spaceflight Academy* exhibit: “I think in knowing that the subject was going to be rocketry, we wanted to have something that was capable of having that sort of experiential feeling like you're there.”

One curator from the EMP described the decision to create listening rooms in terms of creating an experience:

“I really felt it was critical that people could listen to music, and I didn't want them on headphones, which is very isolating. I wanted it to be a communal

experience...so we built these small rooms where three to four people at a time could go in, they could select what they wanted to listen to from a particular album, and they could listen to it on speakers together...”

This professional was concerned with providing the communal experience of folk music when a much easier option is to provide visitors with headphones – which ultimately creates an individual experience.

### ***Voice, Authenticity, Representation***

A less prevalent but no less important motivation for using sound came from a very likely place – the human voice, which was brought up repeatedly as a popular way to use sound in an exhibit. Due to humans' strong relationship with the voice, it can be a powerful and engaging design element. Participants from all four of the case study museums mentioned using oral histories or the human voice in some capacity. One EMP curator remarked, “It's great to hear the sound of an individual's voice...that's always a distinctive thing” and in a separate response noted “ If I'm doing a thing on Chicago blues I wanna hear Muddy Waters' voice, not some narrator telling you about Muddy Waters. Or a narrator can set it up but here's what Muddy Waters or Howlin' Wolf actually sounds like. And that, just the timbre of somebody's voice, you know again is something we always try and work in there as well.”

One practitioner at the Burke described “want[ing] to find a way to inject the voices of the artists into the space,” for the temporary *Here & Now* exhibit. This exhibit not only includes recordings of the artists' voices in four listening stations, but utilizes their words on the object labels and interpretive materials. This use of an individual's words and voice is not only used as a way to engage listening, but is also used to add a voice of authenticity in an exhibit.

Much like the Burke's *Here & Now* exhibit, voices are often used to add authenticity to representations of Native American peoples. One exhibit designer at MOHAI described this

situation during the design of the core exhibit: “To bring the voice of authenticity to the exhibits...for example, in the *true northwest* exhibit, the main exhibit upstairs...you hear the voice of Richard Fernandez telling native stories, and it's another layer of authenticity...He, we felt, was the most authentic voice to tell that story, and it's a very sensitive subject, for a museum to be telling another culture's story, so we wanted that to be beyond question.”

### ***Interactive-Produced Sound***

Finally, participants from three of the four case study museums discussed using sound in their interactive exhibition elements. One curator from the EMP described the use of a music interactive in the museum's *Horror* exhibit as being well-integrated with the exhibit's overall soundscape, noting, “the score really works well with that music interactive that we have in *Horror*, where you know with the music interactive we're breaking down all these different techniques that different composers and sound designers use to create and generate suspense in horror films.”

While some interactives use audio that's directly centered around content, many use audio to provide the visitor with feedback, letting them know that a task has been accomplished or done correctly. At the Museum of Flight, for instance, there is a “medical bay” interactive which utilizes “magnetic little patches on a human figure.” To learn about the effects of being in space on a human body, the visitor uses a hand-held scanner-like device and hovers over one of the magnetic patches. As one of the museum's exhibit designers described, “you can tell that you've hit that spot because there's a scanning sound that's kind of futuristic.”

Still other sounds produce a sound in the interaction itself. One exhibit designer from MOHAI noted “my least favorite sound is the railroad interactive. Which is only because it's so well received by our young visitors that...when they get going on it you can't do anything else

in that room and because this is an old concrete building, that hammering resonates throughout the building. You can hear it remarkably well.” One of the participants from the Museum of Flight also mentioned sounds that result from the physical operation of interactives, but with a much more positive attitude. He stated: Once we got the rocket launch - the air rockets, installed, just that constant “pss...pss” of the rockets going up...there's something about that I really enjoy, and I know it wasn't...we knew that it was going to make a sound, but it just helps...I dunno, it helps the gallery feel active. While this third type of sound is less well-represented than the previous two, this could be due to a lack of science centers or children's museums in the case study samples.

## **Research Question 2: Influencing Factors**

### ***Sound-Bleed, Containment, and Control***

Professionals at all four case study sites expressed concern regarding controlling sound to prevent unwanted interaction between different sounds. This included sound-bleed, containment, control (including reflection, directionality, etc.), as well as the competition between different soundscapes.

When asked about least favorite audio elements in the museum, one curator at the EMP responded, “Well I think for me it's any time that there's a clash of competing audio. And that can happen...you know you might be hearing audio from *Nirvana* or *Spectacle*, and then suddenly, you know, an exhibit or a film comes on Sky Church<sup>12</sup>, and it's not a good feeling...” Sound-bleed was very common in throughout discussions of what was challenging about working with sound. An exhibit designer from the Museum of Flight described issues that emerged during the early phases of the *Spaceflight Academy* exhibit:

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<sup>12</sup> The EMP's website states: “A concert venue capable of holding up to 800 guests, Sky Church boasts 70-foot ceilings, state-of-the-art sound and lighting, and a mammoth indoor HD LED screen.”

“...There is that sound bleed, especially in a giant open gallery like that, it resonates...sound can travel quite a bit...and we found that early on...We put video stations up, and people would hit a button on one side of the gallery, and even with the large artifact in between, on the other side, you could hear that, and that'd be distracting because you'd hear somebody talking about some other subject while you're on something else...”

This problem is by no means limited to large gallery spaces, however. One curator from the EMP described similar difficulties with a much smaller space: “We don't have very big exhibit spaces, so our biggest gallery is 4,000 square feet, so trying to create some separation between those elements is often our biggest challenge...” That same curator described a recent example that illustrated the challenges they faced:

“When we did the *We Are 12*, it's such a small space, with so many reflective surfaces, and as we worked on it there was a reluctance on the part of some of the stake holders to have headphones, because they're like 'Oh, this has gotta be on speakers,' so the result is you get what it kind of feels like to be in CenturyLink, which is OK for a little while, but can really wear you out.”

Sometimes trouble with sound-bleed was also discussed in terms of equipment limitations. One practitioner from the Burke said:

“We knew that the video that you see upstairs near the mask was gonna be just blaring out, because...I didn't have the equipment to control sound any better. So it was like coming out of [built-in television speakers]...we knew that we were gonna have that sound and we were conscious of the fact that it would go out into the gallery, which is why you see that wall that's put up in an attempt to try and mitigate that sound and keep it in the back.”

While many practitioners build structures to mitigate sound bleed and create separation, limitations to exhibition design more generally can also create problems. A curator from the EMP recalled a situation like this in their *Fantasy* exhibit: “The good and evil section...that section never really turned out the way that we wanted...the exhibit designers wanted it to be more cavelike, and they really wanted it closed in, and we didn't close in the lid, so there's a little bit more sound-bleed than is ideal, and it diminishes the overall effect.”

In addition to building structures and utilizing soundproofing techniques to control sound, half of the participants discussed either aiming speakers or using special, directional speakers. An exhibit designer from MOHAI discussed their experience with directional speakers, noting,

“there's some in the core exhibit. We've used them in the past in our temp shows, especially traveling shows they often come with them where they'll be the plastic dome. Normally we just kind of aim the speakers strategically. We haven't used those plastic domes in the ones we've created in house...We make an effort, but we try to do it with more flexible materials.”

Another MOHAI practitioner described the strategy in their permanent exhibit: “The speakers were as much as possible 'ear level.' We bypassed the monitor speakers and used add-on speakers that were better quality and better positioned.”

Some institutions find themselves dissatisfied with their sound-delivery options, and are constantly working to make improvements. A curator from the EMP, for example, remarked:

“The sonic tubes, you know...we've never really been very satisfied with those. So we've experimented with 'do we create a bench where the speakers are on the side where the arm rests are?'...constantly sort of playing to figure out 'is there a better way to deliver the sound so that people have a really good experience, they're not straining?' because you know it's tiring to be in a museum. If you're absorbing all this information, and you're having to work hard to get that information, you just slowly wear them out. So we're always trying to deliver it as easily as possible, and also make it be...a *pleasant* experience.”

Regardless of how much exhibit designers work to mitigate these problems, it is often impossible to completely eliminate them, the challenge then becomes integrating them. One curator at the EMP described his philosophy:

“I think that the challenge is just integrating the different elements...for us often we've got at least two and often three or four things that are happening potentially at the same time. So there might be an audio tour, there might be an exhibit sound track, there might be exhibit films, you've got people talking...so all these things are going on, and you don't want any one of those things to be blaring at you or feel oppressive, and then *they've actually got to work together.*”

## ***Space and Architecture***

Participants from three of the four case study museums expressed concerns regarding the physical space that sound inhabits. Often this involved concerns about architecture, open space, sound reflection, separation of sounds, and other related challenges. One exhibit designer at MOHAI described the museum's previous location, which the museum inhabited before the recent move to Seattle's South Lake Union neighborhood: “We were in another site for sixty years. It was concrete, tile ceilings, just...sound bouncing left and right. We'd have traveling shows come in and it was really hard to control the sound. So sound was very much taken into consideration in [the set-up of] this [new] museum.”

Another member of MOHAI's exhibit design staff also commented on the old building, saying, “Our previous experience with sound in our Montlake site was very challenging...It was concrete floors, walls, and ceilings. It was a very “bright” environment, and we were constantly struggling with any audio that you introduced bleeding into every experience you didn't want them in. And we never really did control it...So when we entered into the design of this [the new building] that's something that was very early on. We didn't know what we were gonna say or what it was gonna sound like, but we knew there had to be a lot of investment into the acoustic environment to allow for whatever.” One MOHAI staff member commented that “The Innovation Center, which is on the perimeter of the atrium, and that's the most difficult gallery to control sound...because it's wide open space.”

Challenges with space and architecture were also concerns for practitioners at the EMP. One curator noted,

“It's really easy to overwhelm people with music, and I think that a lot of our open gallery structure doesn't help with this...so even with *Nirvana* where there's actually an Intro [space], there's a separate [sound] piece that's right at the entrance to the *Nirvana* exhibit that I feel like I can only hear part of the time because there's so much bleed from what's happening in the Sky Church area, there's bleed potentially from whatever exhibit's happening above in level three,

and I feel like that's the hardest part for me, is trying to create these sonic spaces, but having that interference...even in Nirvana there's no lid on it, so you're hearing shit from up above...I feel like the sound bleed, the, you know, idiosyncrasies of the space itself, of that Frank Gehry architecture where shit just bounces off in strange places is really...a challenge. It's a big challenge.”

This sentiment was echoed by another EMP curator who said, “I think for us always one of the big challenges is the physical space, itself. So we spent a lot of time and money thinking about how to mitigate the architectural elements, so there are hard concrete tile floors, which reflect sound, so we've put down carpeting in most of the galleries.”

Many of the participants discussed building structures to control sound. One practitioner from the Burke, for instance, said

“we knew that we were gonna have that sound and we were conscious of the fact that it would go out into the gallery, which is why you see that wall that's put up in an attempt to try and mitigate that sound and keep it in the back...we consciously tried to keep that sound back there...”

A curator from the EMP discussed utilizing sound proofing and building structures to control sound:

“You know...that material that makes up the thicket in the middle [of the *Horror* exhibit], it's the black stuff is this acoustic material called *T-MAX* that we use, and uh there's a sort of plex reflector in there as well that's in the center of that and each of the the film pods, the films don't start until you enter the rooms, there's a little electric eye sort of thing, and all of those speakers are directional speakers, and there's also these triangular things hanging from the ceiling that are made from *Clearsorber* it's like a plastic sheet with micro-perfed holes in it which also is a sound absorber, and then the floor helps with that as well, because there's like carpeted floor in there. But uh it's amazing how much it actually helps, I mean you go into those spaces and you can really hear how the sound drops, so it, for me it was like magic. It's just like 'oh my god this works *really* well.' I had no idea that it was going to I thought I mean we could very well just have a giant mess of sound, but it kinda works well, and you know the stuff that does bleed, like if you hear someone screaming in the scream booth, or whatever, it just works perfect with it, so...you know I think that was one of the spaces where we've had to think about a lot of that stuff. And it luckily for us worked.”

Finally, half of the participants discussed being aware of the limitations and nuances of

each acoustic environment. For example, one designer from MOHAI, in discussing the design of the South Lake Union location, commented:

“I think I like the overall acoustic experience, it's very rich and varied. It's also . . . our architect, our creative design lead, Anne Farrington, was very aware of the acoustic environment, and put a lot of effort into the sound deadening to create the kind of negative space to contrast the voices and sounds that you do hear, that we want you to hear. And that was very successful, but you have to look very hard to notice it.”

***“I Hate That Sound!” (a.k.a. Annoying Staff)***

Interestingly enough, the most frequently discussed challenge had nothing to do with the visitor experience, content, or sound delivery – instead its primary focus was the staff experience. Participants from all four case study museums were concerned with noisy soundscapes, repetitive sounds, and distracting interactives - specifically how they influence staff. While it was generally understood that annoying sounds would affect visitors as well, the effects these sounds might have on museum staff was discussed with more frequency than any other perceived challenge. One practitioner from the Burke noted an experience from a previous museum, where “There would be bleed-out into the lobby of the museum, and I would hear it from the Visitor Services [desk], and so aside from just what visitors want, there's just practical implications to sound for the operations of the museum.”

Another such concern came from an exhibit designer from MOHAI, who described a video in the *Bezos Center for Innovation*: “It's...a little jangly...kid's voices and kind of a humorous take...it's great the first couple of times around, but it doesn't stand up to the test of time, and there's no escaping it in that space, it's just always there.” When asked if this problem mainly affected staff, he replied, “Yeah, I think the visitor could care less, and would probably enjoy it.” Regardless of the specific qualities of each instance, looping audio consistently came up in conversation.

One exhibit designer at the Museum of Flight noted: “...the lunar landing simulator has

a very short loop of the chatter during the final moments of the landing of the Apollo 11 mission, and that, if you spend any amount of time in that gallery, gets really repetitive and gets a bit jarring after a bit.” This practitioner also described an instance while working in a different museum:

“Well one of the things about working [at the Pacific Science Center], it feels like their soundscape is just very...lots of dings and rattles and looping sounds...I used to work as a member of the floor staff there and it [the sound] got really...repetitive and really redundant there...”

One practitioner at the Burke felt very strongly on the matter, noting

“...probably the least effective and the most annoying [audio element], is a bad quality recording of three different storytellers, which runs, which loops continuously. And that in itself I think is a *really bad idea*. Abysmally bad. Never ever in my opinion should you have a looping video or audio that is not activated by choice by the viewer. Perhaps it's some background noise like water or wind or something that is appropriate, I mean that's different...but I think that for the people who actually have to work in the exhibit, for example, after a while it becomes *extremely* annoying, to listen to the same videos over, and over, and over again. To the point where you probably know pretty much exactly what's coming next.”

***“What? I can't hear you, it's too loud in here!”***

Participants from all four case study museums were concerned with volume levels, granted this theme involved a variety of names and concepts. Many were concerned with not contributing to an overall din or cacophony in the gallery. One practitioner noted, “One thing that we always wrestle with at EMP as a museum where originally we were all about, you know, music...there'd tend to be sort of a din throughout the entire space because there were so many competing audio sources, whether it was video or audio, so the overall feel wouldn't be very satisfactory. I mean it might work in one element but not overall.” One exhibit designer at the Museum of Flight said, “I think more along the lines of...it might be a bad idea to *add sound* if you already have a very active, you know, if you're already in a very noisy

gallery, and it would contribute to that cacophony in a gallery.”

Participants at three of the four case study museums discussed volume control. Some were concerned with having general volume levels too high or too low, while others were concerned with having the ability to adjust volume levels when needed, but it was generally understood that volume control is an important factor to consider when using sound in exhibits. One MOHAI practitioner commented on the volume levels throughout the museum:

“...the volumes were all set so there was not a conflict...we have a universal volume control that I can access with my iPad, remotely if I need to. So...I have the ability to control the volume - in large chunks, that is. I can do the atrium floor for the Bezos center all at once, the second floor all at once, and the fire theater individually...so when there's a large crowd in I can turn the volume up to 100%, and if the crowds are more sparse or more typically if there's an event going on in the space that the ambient sounds would conflict with, I can set it down. So I can take it down to 30% and the guests for the evening event can have their event and still experience the exhibits. So yeah, that was all designed into [the exhibit].”

Volume concerns also need to be considered when dealing with educational programming. One designer at the Burke noted,

“We have children in groups coming through, and of course, again, this is where if it's looping especially, the educators wanna turn that thing off because it's a major distraction...either that or the volume just is turned down to where it's less of a distraction. And *that's* where also you want to have subtitles, because if you have a tour going on at the same time you have people nearby on their own...self guided, they may still wanna watch the video. That's where subtitles come in.”

Subtitles were mentioned by participants at two different case study sites as a preferred strategy for making audio-related material more accessible and easily understood.

Professionals at three of the four case study sites also discussed actively working to avoid creating too much noise, distraction, or competition between sounds. One exhibit designer from the Museum of Flight commented on the noise created by video interactives: “A lot of the time we try not to have too much noise in push button videos because it can unnecessarily kind of busy up the exhibit and be distracting...” Another exhibit designer from

the Museum of Flight recalled thinking, “How do we do this...and provide audio on some of those, without creating something that just becomes a cacophony any time there are visitors in there?” during the planning phases of the *Spaceflight Academy* exhibit.

Study participants also felt that an interactive design element's use (or misuse) can create unwanted noise in a gallery space. One practitioner from the Museum of Flight remarked,

“...the amount of time that kids are running around, or visitors are running around, hitting buttons and not watching a video... They usually go for the lowest button, or something close by, and if they hit that button, then you just hear that sound repeat over and over again...But whatever audio is in a video, the amount of times it gets repeated, it starts becoming a little distracting and a little annoying for people that are in the exhibit...”

Volume concerns also encompassed visitor-created noise, and the difficult process of altering exhibit volumes to match. One practitioner at MOHAI commented,

“I can control the sound in the exhibits from an iPad, you know? And I can turn them up but they all go up together or they all go down and sometimes we get 'It's too loud.' Well...half hour ago there were 30 people in that room and it was too quiet, so... I mean, I think that's the most difficult thing to control, you know, the sound is so important by the number of people in a gallery, and that can change so quickly, that you turn it up because you think people can't hear, and then 20 minutes later you get complaints that it's too loud. We often get complaints that the Innovation Center's too loud, and we did go through and fine tune and adjust each element individually at times, but as a whole it's like sometimes it's hard to please everybody.”

Participants also noted that design elements can contribute immensely to a gallery's sound, which requires adjusting or modification. One EMP curator remembered

“...having gone out to practice for the Seahawks, music is a big tool that Pete Carroll uses when he does practice. He feels like it gets people pumped up, he wants them to get used to a lot of distractions. So originally we thought ‘Ok, we're gonna have audio going in there, we'll have music going in there, we'll have the sounds of, you know, announcers yelling.’ And you know once we started to add in all those elements, the first thing we took out was the music, because it was just *overwhelming*. And then you know now what I'd like to do is just dial back on a few of the things, put them on headphones so we can separate a couple of

the films so that you *do* hear the crowd excitement and hearing the excitement of a game and hearing an announcer yell, but you don't feel... it's exhausting to have that much noise coming at you.”

Sometimes, however, even making adjustments can create challenges. One practitioner at the Museum of Flight recalled a situation with the *Spaceflight Academy* sound system:

“...we continue to tweak [the volume levels] a little bit, especially because we also have live presentation space in there, where if you're in there on a quiet day, the standard settings seem to work well for a presentation. But I was in there with someone giving a presentation on a weekend when the gallery was otherwise very noisy, and I think even the master system had limits set by the company that installed it, and we had to have them come back in to adjust those upwards so our tech services staff could adjust the volume enough to let...yeah, they're very proprietary about who tweaks their stuff. When I talked to our tech services staff they said, 'Yeah, we told them that we would need the ability to adjust the volume, and they didn't want us messing with that installation.'”

While this situation highlights the problems that can arise when working with outside companies that may use proprietary systems, it also shows that the challenge of volume can be a double-edged sword, because if the gallery is too loud it might render the audio too quiet.

Participants from two case study museums specifically discussed limiting the number of ambient audio sources in an exhibit – which was the approach taken for *Spaceflight Academy*. One designer recalled, “...ultimately we decided on...'ok with the push-button video stations, those tend to be more oral history type interviews or historical accounts that require some verbal explanation, so we'll provide sound for those, if we have a rocket launching we'll provide sound for that, because watching a rocket launch without sound is less impressive than watching it with sound.' But wherever we could, if we could do something with just visual, have just visual in there, so there wasn't conflicting soundscapes.”

In addition to limiting the number of ambient audio sources, participants from three of the four case study museums discussed headphones, advocating for their thoughtful application. One curator at the EMP commented that “some of the films are hard to hear so

the idea is to actually put some of those on headphones just so we can separate competing audio.” Another practitioner, at the Burke, made a similar observation, noting

“...we made the choice that we would use headphones for the four listening stations, so we didn't...we just couldn't it would have been “*aaah!*” blaring, four of them...it just wouldn't have been good.”

This struggle between open-air audio and headphones was discussed in-depth by an EMP curator, who noted,

“...even within a gallery that you can close, it's always that struggle of like, do you have more stuff open audio, or have a lot of stuff on headphones and limit the, you know...and I've kind of gone to this place of trying to have as like a very limited amount of ambient audio, but have that be really meaningful, and powerful and impactful if possible, and then having the rest be through headphones. Just because too much and it's like you're head's gonna fuckin' explode.”

He concluded,

“...it does suck if your entire exhibit is like locked down into headphones, but at the same time it's like there are times that headphones might ultimately be the best option because otherwise you're massively limiting the number of audio sources you have to the detriment of the content.”

Another EMP curator, however, provided insight into another side of the open-air/headphone debate, asking:

“...how much are people having to take off headphones and put on headphones? I mean that's a big factor, not only how to they compete with one another, but what's the physical experience for the visitor in terms of 'I've got a pair of audio tour headphones on, now I have to take those off in order to listen to the music, here I have to put another pair of headphones on.' And try to realize those kinds of things.”

This sentiment was echoed somewhat by a practitioner at the Burke, who noted:

“We just recently added a 4<sup>th</sup>, [iPad] app that you can hit, and it's a video that plays, but because of the bleed-out from the video, we had to do headphones there as well, which is just to me, it's too many headphones. That's a lot of headphones in one gallery. You can't just walk into the sound. You can't just feel differently from walking into the sound. I wish you could.”

***Is that really practical?***

Participants were also concerned with the administrative, pragmatic side of utilizing sound in a museum. Specifically, people at three of the four case study sites expressed practical concerns including inadequate budgets, equipment failure, and subsequent repair costs. One practitioner from the Burke who had knowledge of exhibit elements that were no longer in the gallery space recalled,

“The equipment failed enough times so that finally it became too obsolete to replace within our budget. We eventually had to take out all of the interactive touch screen audiovisual elements, which were in the Pacific Voices exhibit...it was extremely expensive after a while. We had – for those interactive videos I described in Pacific Voices – and also for the ones upstairs in Life and Times as a matter of fact – we had full size laser discs, and the laser disc players would often need repair. And there was a whole laser disc player for each of those kiosks, so we had about 8 of them at least, maybe more...and the last time I tried to get one repaired, which was a few years down the road, because we opened in 1997, the cost was gonna be about \$600 to repair two of those players. At which point we just said “Ok, that's it. Bye bye.’ And we took all the kiosks out. We extended the life of those as long as humanly possible, and the budget, and then we just decided that's it...that's enough...”

Equipment failure and the subsequent repair costs are especially problematic, due to the oftentimes limited budgets that most exhibits have to work with.

Participants also noted that sound is rarely allocated a large portion of an exhibit's budget. One practitioner at the Burke said,

“I think because...the budget it's given and it's lack of priority in general to an institution...you don't have to talk about [sound] if you don't want to... [and] I think just the budget that you're able to allocate out of your larger total exhibit budget is rarely high enough, and I think it's rare that museums have internal sound engineers, and it's an expensive thing. It's a very expensive thing when you want sound and you don't have the files and you don't have the content, so you're paying someone to identify them or you're paying them to do voice recordings, and then you need somebody to mix it, and then you typically need people to install it.”

This struggle was voiced by a number of other participants. For example, a curator at the EMP

said,

“...you know I think we all like the idea of having what we would characterize as an exhibit soundtrack. It's not necessarily expensive, but it's not cheap. So again, you have to pay for it. And if you wanna get, if you want it to have the effect that you hope it'll have, you've gotta hire somebody who's talented to do it.”

This concern with the cost of hiring a consultant or contractor to work with sound was a common one in the data. Due to the specialized knowledge required to work with sound, many museum professionals said they were forced to look to outside help in order to use sound effectively. One practitioner from the Burke said,

“I don't talk in hertz or amps and wavelengths, I don't do that. I walk in and I say 'That sounds good' or 'That doesn't sound good' so you need somebody who can speak the sound engineer's language so if you do invest the amount of money on equipment you don't waste it. It's not like me turning up the volume or turning it down when you have 15 other functions that sound can be manipulated on your board, so I think those are the challenges.”

This concern was echoed by a curator at the EMP, who said,

“I play music but like I do not understand or know the intricacies of how sound really works or interacts with things. To me it's all very, you know, magical, and so I think for me it's always trying to be really careful about how sound is implemented in a gallery because I'm not sure *how* it's going to interact and I guess you know, ways to mitigate that anxiety is to hire someone to be a sound designer to help out with that...”

In fact, every case study museum reported that at some point they had hired an outside contractor or consultant to work on some aspect of sound.

### ***Autism Accessibility***

Another sound-related challenge that was mentioned was making the museum space accessible for people with autism, who may be sensitive to sensory stimulation like sound and light. Participants from two of the four case study museums mentioned this important challenge. An exhibit designer from MOHAI said,

“...something that's come up that we wanna try and address is how to make an

experience for visitors who...we're trying to think about how to make the galleries accessible for people with autism. And that has a huge deal of sound and light that would have a huge effect on how they experience the galleries. And that's something we haven't made any plans with, but it's something we wanna start talking about and figuring out what to do in that situation...so we're getting in touch with people that would be good partners. People that are more knowledgeable than us, so that's something to think about – galleries for all, and sound is a huge part of that...”

An exhibit designer from the Museum of Flight echoed these concerns, noting that,

“...you might wanna take advantage of that opportunity to have a silent space, whether you're trying to do a reflective exhibit, or for instance if other parts of your museum...are more sound intense, having an opportunity to have that break from sound can also be very important. Especially if you're...making museums more accessible to autistic members of the community.”

### ***General Understanding of Effectiveness***

In order to understand what factors influence exhibit designers' use of sound, questions were asked that were intended to determine how participants evaluated their use of sound in exhibits. Responses to these questions were not as strong as those from other lines of inquiry, but the data does yield some common themes.

Participants from three of the four case study museums described effective use of sound in an exhibit as being somehow experience enhancing, with two participants adding the caveat that it not detract from the overall experience. When asked to define what constitutes effectiveness regarding sound in exhibits, one practitioner from MOHAI said,

“Um the experience is made better?...[and] Well, kinda how I find something effective if it adds to the experience, but sound's a bad idea if it detracts from the experience. Like if you have a very text-heavy exhibit it makes it...sound is a huge distraction, if it's something like, vocal especially, or if you have a video playing in the background.”

This sentiment was echoed by a practitioner from the Museum of Flight, who stated,

“In this situation I would define effectiveness as contributing something to the exhibit experience without otherwise detracting from it so that something could either be information...just adding to the visual...in order to create a more

immersive...to immerse the visitor in the environment of what they're experiencing...yeah, and then without detracting...without, you know contributing to visitor fatigue where if you're in there a long time you just start to feel overwhelmed like it's too noisy in here, preventing conversation, and then annoying staff.”

One curator from the EMP noted, “You don't want [the sound experience] to be where it distracts from what you're trying to communicate.” He concluded,

“...if it's something's playing, and it keeps people from focusing on either the artifacts or the music or the story that you're telling, then you've gotta figure out, 'OK why are we doing it?'...it is a powerful thing...I do think more and more that if you get [the sound] right, it can really contribute, subconsciously, to the experience that people have in an exhibit.”

Participants from two of the case study museums also showed some interest in or discussed some form of evaluation. One practitioner from the Burke remarked,

“Well, [effectiveness of sound] could be one of the questions that you ask in an evaluation, so that's one way you would ask. I don't know if I've ever asked about sound in an exhibit evaluation, because I'm so much more focused on the content.”

Pinning down what makes for a “good” or “effective” use of sound in an exhibit could be a challenging task. One curator from the EMP noted,

“I dunno if people would say that they notice [sound], I don't have many people comment about the music, I think it's just one of those things, it's an overall feeling, and this is what we sorta find with the exhibit design in general, it's if you get it right, people might not be able to point out the discreet details but they like the feeling of it overall. It'll be like 'god there's just something about this exhibit that feels good,' and I think if all those things are working harmoniously, then you've done it right.”

In addition to evaluating an exhibit after its installation, one practitioner remarked:

“you really need to do testing beforehand to see what works, and modify it before you install it...and as far as I know I don't think that was done here. And often it isn't done...but it's very important otherwise the whole thing might be totally ineffective for one of these goofy reasons.”

## **Chapter 5: Conclusions**

### **Research Question 1: Why do exhibit designers use sound?**

Professionals in this study were driven by two main motivations for using sound in their exhibits: the desire to provide an experience, and the desire to provide content. These two motivations occasionally overlap, but are clearly distinct. Participants seemed generally more driven by content than experience, though at times the two considerations seemed almost equal. Often uses of ambient and environmental sound were experience-driven, but were also somehow content-related. The most common content-driven use of sound came from content that directly produced sound, like film or audio recordings.

A notable exception to these two primary motivations is the category of interactive exhibition elements. Often intended to engage visitors while portraying content or concept, the interactive has the potential to produce a variety of sounds that are not directly content related and influence the environment (sometimes negatively). These types of exhibition elements were frequently discussed throughout the interviews, and were often given special consideration by practitioners.

### **Research Question 2: What are the factors that guide the use of sound?**

A number of factors guide these practitioners' use of sound in museum exhibits. These factors are often concrete issues that designers have faced or strategies that they have devised to manage associated challenges. Practitioners at all four case study museums were concerned with sound-bleed, containment, or control, and were aware of how architecture and the acoustic environment affects the use of sound in their exhibits. Many practitioners offered suggestions for mitigating these effects, including utilizing sound-proofing and sound-absorbing materials, directional speakers, or additional built-structures to contain and direct sound when needed.

Practitioners were also concerned with overwhelming visitors with cacophony, din, or loud, noisy environments. Many were explicitly concerned with setting volume levels and not overwhelming visitors. Strategies were presented for managing volume, including limiting audio sources, keeping volume levels appropriate for the number of visitors in a space, being able to adjust volume as needed, and utilizing headphones when audio sources don't necessarily need to be “open-air.”

Practitioners at three of the four case study museums showed express concern for the staff experience as well as the visitor experience. While this was not a concern for participants at all of the case study museums, concern for the staff experience was voiced more frequently than any other challenge. Many participants had experienced annoying sounds during their time in museums, and showed an awareness of the effects sound can have on staff members who experience it daily. While all practitioners seemed aware of the visitor's experience, the staff experience was also vehemently voiced as a challenge.

Participants also expressed one or more practical concerns, including budget allocations, hiring outside consultants, and equipment failure. These concerns did not come with particular suggestions or solutions for their management, other than that they require extra consideration. Finally, participants at half of the case study museums were concerned with making gallery spaces accessible to visitors with autism and autism-spectrum disorders. This is an interesting finding, as traditional accessibility literature regarding sound has focused on sight – a theme that did not appear throughout this particular study. While some mention of varying hearing abilities was cursorily mentioned when discussing subtitles, accessibility concerns were primarily for autism-spectrum visitors<sup>13</sup>.

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13 It's not completely clear why this is the case. As one participant mentioned, autism accessibility has been a popular topic of late, and the November/December 2012 edition of ASTC's *Dimensions* did discuss it at length. Its prevalence throughout the discussion (in comparison to other accessibility topics) could just be due to the current popularity of the topic within the field.

The exhibit designers participating in this study were all aware of the various challenges involved with using sound, and have devised a number of strategies for managing these challenges. While there is little in terms of organized evaluation specifically aimed at sound usage, these designers have learned what works and doesn't through a process of experimentation - accumulating experience of successful and effective applications of sound throughout their careers while modifying or abandoning those applications that proved ineffective.

Many of the museum professionals interviewed had limited knowledge about the specifics of acoustics and how sound works on a physical level. Many if not all of the case study museums have hired an external consultant or contractor to work on some aspect of exhibit audio, while some have dedicated staff members to develop audio-visual exhibit content. Regardless, it was generally understood that in order to achieve positive results, a certain amount of specialized knowledge is required when working with sound.

While formative and summative evaluations may be common practice for a museum's exhibits more generally, there seems to be no shared vocabulary or methodology for specifically evaluating the use of sound in exhibits. It does, however, seem as though there is a general understanding that effective audio in an exhibit “enhances” the visitor experience without otherwise “detracting” from it, though exactly *how* this is measured is unclear.

### **Implications**

The data and conclusions drawn throughout this study lead to a number of implications for the field. As sound and other multi-sensory experiences are utilized throughout museums, a number of considerations should be made. These considerations incorporate past literature and experience, current practice, and current understandings of the effects of sound on the visitor's experience. A number of concrete suggestions can be made from these implications,

including:

Utilization of a methodology like Forrest's *museum atmospherics* can help museum professionals shed some light on the elusive quantification of the “visitor experience,” and should be considered when evaluating exhibits that are heavily experiential, like those that utilize sound.

Evaluation and implementation of sound in exhibitions also needs to consider the staff experience as well as the visitor's experience. Staff experience was a primary concern for participants of this study, and needs to be considered when using sound in the future.

Practitioners need to be aware of the intended purpose of each sound, and how it relates to the content, topic, or theme of the exhibition. This will assist in prioritizing “open-air” versus headphone sound, and yield a more positive experience overall.

When implementing or evaluating sound in museum exhibitions, the entire sonic environment needs to be considered, and not just individual elements. Audio elements should not compete with one another and should be able to integrate into a cohesive sonic environment. Additionally, it should generally be asked whether the sounds of an exhibit enhances the visitor experience, or detracts from it.

These considerations, drawn from the experience and practices of exhibit designers, can greatly serve to enhance the utilization of sound in museum exhibitions. By these lessons to heart when using sound in exhibitions, museum practitioners can greatly enhance the experience of their visitors and staff, while creating immersive, engaging learning experience for all.

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## Appendix A: Interview Guide

## INTERVIEW GUIDE

*Audio Elements: Best Practices of Using Sound in Museum Exhibits*

## VERBAL CONSENT

I am asking you to participate in a research study that is part of my Master's Thesis work at the University of Washington. **The purpose of this research is to describe the ways in which exhibit designers and museum professionals approach the use of sound in museum.** Your participation is voluntary. Refusal to participate will involve no penalty or loss of benefits, and you may discontinue participation at any time. As a reminder, the identity of your museum will be revealed in the final results of this study. This interview will be recorded, and I may quote you in my final paper. **I will give you the opportunity to review any direct quotes before publication.** If you have any questions now or in the future, you may contact me or my advisor using the contact information I have provided above and will leave with you. Do you have any questions? Do you agree to participate in this interview?

## INTERVIEW QUESTIONS

*The goal of this interview is to establish an understanding of attitudes of museum professionals towards the use of sound in museum exhibits, and establish an understanding of what “effective” uses of audio elements involves. For the purpose of this study, “audio elements” are defined as sounds intentionally used in a museum exhibit.*

**Foundational** – “I'd like to start off by asking you some basic questions about [Exhibit] and your relation to it”

1. (How) Did you participate in designing the form/content of [Exhibit]?
  1. Who (primarily) worked on the audio elements used in [Exhibit]?
  2. Off the top of your head, could you describe some of the audio elements used in [Exhibit]?
  3. Do you have any favorite audio elements in (The Museum) [Exhibit]?
    1. Least favorite?

**Planning** - “I'm also interested in the planning process behind the exhibit.”

4. Can you describe how the audio elements used in [Exhibit] were chosen?
5. Where in the design process was the idea to use sound in [Exhibit] first introduced?
  1. Do you think this is typical for other exhibits?

**Management** - “I'm curious to know about the different properties of sound that may have been considered during the design process, and how those properties might be managed during the life of the exhibit. I'm going to start by asking you about certain sound properties and we can go from there.”

6. Are there any special ways in which the audio elements and these sound properties are managed? - (For example, were any special considerations made to manage “bleeding” of audio elements between one another?)
7. In the designing of [Exhibit] were any special considerations made for:
  1. Volume of individual elements and “sound bleeding” between elements?
  2. Reverberation/Echo? Surface reflection or absorption?
  3. Directionality or localization?
  4. Is there anything else that I may have missed?
8. Were any considerations given to changing audio formats and technologies, or parts

that may go out of production and become difficult to find if they break?

**Diving Deeper** - “Now I'd like to transition into talking a bit more in depth about the exhibit and its use of sound.”

9. What would you say is the purpose of the use of sound in [*Exhibit*] was? What were you/they trying to accomplish? (i.e. why sound? why here?)
  1. How does this relate to the purpose (or big picture idea) of the exhibit as a whole?
10. Was there a particular way visitors were intended to feel in relation to the sound used in [*Exhibit*]?
11. How do you think the audio elements of [*Exhibit*] work together as a whole?
  1. How/How not? Why/Why not?
12. Out of the audio elements in this exhibit, which do you think are the most effective?
  1. How are you defining effectiveness?
  2. Are there any audio elements that are particularly ineffective, in your opinion?
13. If you were given the opportunity to change or redesign any aspect of [*Exhibit*] in relation to its use of sound, what would you change? (How/Why?)

**General** - “I'd like to end with some questions about using sound in museum exhibitions more generally.”

14. On a scale of 1-10, how difficult do you think it is to use sound in an exhibit?
15. When would you say that using sound in an exhibit is a “bad idea”?
16. When would you choose an audio or audiovisual design element in an exhibit over a purely visual one?
17. What would you say are some of the biggest challenges to using sound in an exhibit?
18. Is there an exhibit you can think of in which sound was used particularly well, or in an appealing way?
  1. What is it about that exhibit that makes you feel that way?

**Closing remarks**

19. Well those are all the questions I've got, do you have anything else you'd like to add or anything you'd like to speak to regarding this topic?

“Thank you very much for your participation. I greatly appreciate you taking the time to talk with me, it's been extremely helpful with my research. If you need, you can contact me with the information I've provided for you.”

## Appendix B: Motivations for Using Sound Coding Rubric

Theme/Term	Individual Interview Code	Times Mentioned
Experience	1A, 2A, 2B, 3B, 4A, 4B	17
Content Related	1A, 1B, 2A, 3A, 3B, 4A, 4B	14
Environment	1A, 2A, 2B, 3A, 3B	10
Mood/Tone	2B, 3A, 3B, 4A, 4B	10
Voice	1A, 2B, 3B	8
Music/Songs	2A, 3B, 4A	6
Interactives	2B, 3A, 3B, 4A, 4B	5
Oral Histories	2A, 3B, 4A, 4B	5
Authenticity/Representation	1A, 2B, 3B	4
Sound from Content	2A, 4A, 4B	4
Emotion	2A, 3B, 4A	3
Orientation	4A	3
Storytelling	1B, 3B, 4A	3
Storytelling	1B, 2B, 4A	3
Animate	2B, 4B	2
Coherence	3A, 3B	2
Context	2A, 2B	2
Create Energy	3B	2
Engagement	3B, 4A	2
Immersion	1B, 4A	2
Language	2B, 4A	2
Other Senses	2A, 3B	2
Set the Scene/Stage	2A, 3B	2
Silence	3A, 4B	2
Audio Tour	3B	1
Communal	3B	1
Evocative	4B	1
Fun	3B	1
Narrative	3A	1
Nature	3B	1
Reach More People	1B	1

## Appendix C: Influencing Factors Coding Rubrics

## Challenges of Using Sound

Theme/Term	Individual Interview Code	Times Mentioned
Staff Complaints	1A, 1B, 2A, 2B, 4A, 4B	9
Sound Bleed	1A, 2A, 2B, 3A, 3B, 4A, 4B	8
Architecture	3A, 3B, 2A, 2B	6
Discomfort	3A, 3B, 4A, 4B	6
Can't Afford X	1A, 3B, 4A	5
Control	1A, 3B, 4A	5
Separation	1B, 2A, 3B, 4A	5
Reflective Surfaces	2A, 2B, 3B	5
Competition	1A, 3B	4
Volume Levels	2A, 3B, 4A, 4B	4
Small Budget	1A, 3B	3
Hire a Consultant	1A, 3A, 3B	3
Specialized Knowledge	1A, 1B, 3A	3
Audio Quality	1B, 2B, 4B	3
Looping Audio	1B, 4A, 4B	3
Open Space	2A, 3A, 4A	3
Resonant Sound	2B, 3A, 4A	3
Too Loud	3B, 4A, 4B	3
Too Much Noise	3B, 4A, 4B	3
Too many headphones	1A, 3A	2
Too Expensive to Repair	1B	2
Dwell Times	1B, 3B	2
Tall/High Ceilings	2A, 4A	2
Bad Interactive Sound	2A, 2B	2
Visitor Noise	2A, 4A	2
Overwhelm Visitors	3A, 3B	2
Din/Cacophony	3B, 4B	2
Fatigue	3B, 4B	2
Distraction	4A	2
Inconsistent	1A	1

Visitor Complaints	1A	1
Equipment Failure	1B	1
Operational Sound	2B	1
Proximity	3A	1
Integration of Elements	3B	1

## Guiding Principles, Practices, Strategies

Theme/Term	Individual Interview Code	Times Mentioned
Separation/Structures	1A, 2A, 3A, 3B	11
Avoid Noise, Etc.	1B, 2A, 3A, 3B, 4A, 4B	10
Headphones	1A, 2A, 3A, 3B	10
Interactives	2A, 2B, 3A, 4A, 4B	9
Engender Feelings	1B, 2A, 3A, 3B, 4A	7
Control/Containment	1A, 2A, 2B, 3A, 4A, 4B	7
Environmental/Natural Sounds	1A, 1B, 2A, 3B, 4B	7
Content Related	1A, 2A, 3A, 4A, 4B	7
Appropriateness	1A, 1B, 2A, 3A, 3B, 4A	7
Ambient Sound	1A, 2A, 2B, 4A, 4B	6
Video Interactives	1B, 4A, 4B	6
Repetition/Loops	1B, 4A	6
Volume Control	1B, 2A, 2B, 3B, 4A, 4B	6
Absorbant Surfaces	2A, 2B, 3A, 4A, 4B	6
Aware of Acoustic Environment	2A, 2B, 3A, 4A	6
Placement/Directionality	1A, 2A, 2B, 4A	5
Limit Ambient Audio Sources	3A, 3B	5
Multitrack Mix	1A, 3A, 4A	4
Visitor Experience/Engagement	1A, 3B, 4A, 4B	4
Budget	3A, 3B	3
Practical Museum Operations	1A, 2B, 4B	3
Sound Associated with Artifact	1B, 4A, 4B	3
Architecture	2A, 2B, 3B	3
Visitor Choice	1B, 4A	3
General Sound (PA)	1A, 4A	2
Support Goals	2B, 3A	2

Distance	3A, 3B	2
Integration	3A, 3B	2
Direct the Visitor	3A, 3B	2
Subtitles	1B, 3B	2
Audio Length	1B, 4A	2
What Visitors Want	1A	1
Silence	2B	1
Sound Quality	2B	1

### Understanding Effectiveness

Theme/Term	Individual Interview Code	Times Mentioned
Experience Enhancing	2A, 3B, 4A, 4B	4
Use Evaluation	1A, 3B	2
Doesn't Detract from Experience	2A, 4B	2
Reactions/Feelings	3B	2
Poor Quality	1B	1
Looping Audio	1B	1
Formative Evaluation/Testing	1B	1
Ambient Sound	1B	1
Creates an Experience	2A	1
Fits Exhibition Flow	2B	1
Follows Museum Goals	2B	1
Most Popular Exhibit Might Not Be Most Effective	2B	1
Experimentation	3A	1
Sets Tone Effectively	3B	1
Immersion	4A	1