CONSIDERATIONS FOR PRODUCING MEDIA FOR SCIENCE MUSEUM EXHIBITS: A VOLCANO VIDEO CASE STUDY

by

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Julia Elizabeth Sable

April 2013

DEDICATION

For Pele

Uahi Puna i ka oloka‘a pōhaku	Puna is smoky with hot rolling stones
Nā pe‘a ‘ia e ka Wahine	Persecuted by the Goddess
Nānahu ahi k aka papa o Oluea	The plain of Oluea is bitten with fire
Momoku ahi puna, hala i ‘āpua.	Puna is cut off by fire, even to ‘Apua.
A ihu e, a ihu la,	The flow is heading this way and that,
A hulihia la i kai,	Turning upside down toward the sea,
A hulihuli la i uka.	An upheaval toward the highlands.
A ua wāawa‘a	It is so desolate, uninhabitable
A ua noho ha‘aha‘a	Made low by the Goddess
A ua hele helele‘ihelele‘i.	Falling, falling, nothing but ashes.

(From a traditional Hawaiian chant)

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ABSTRACT

While science museums continue to expand their use of videos in exhibits, they are also seeking to add engaging content to their websites in the hope of reaching broader audiences. As a cost-effective way to do both, I propose developing a video for a museum website that can be easily adapted for use in an exhibit. The priorities and ideologies of science museums differ radically from those of science and nature television networks. This paper explores the needs of museums, identifying key contrasts with television, and shows how those needs are reflected in the content, form, and style of the two-part science video Living in Pele's Paradise. Through the story of the spectacular 1959-60 eruption of Kīlauea Volcano, the video shows how research and monitoring contribute to helping communities prepare for volcanic hazards. I highlight the characteristics that make the video appropriate for a science museum through comparisons with recent volcano documentaries for television. I also discuss the changes needed to adapt the web video for a museum exhibit.

INTRODUCTION

Science museums commonly include videos among their offerings, both in devoted theaters and installed as part of exhibits. Videos that are built into museum exhibits are distinct from the motion pictures shown in IMAX, Omnimax, fulldome planetariums, and 3D theaters in a number of ways. The theater videos have durations ranging from 20 minutes to over an hour, compared to just a few minutes for videos in exhibit halls. The theater films typically require a separate ticket purchase from exhibit hall admission, and people watch them while seated in a relatively comfortable and quiet environment, allowing them to give the movie their undivided attention. In contrast, the way most visitors encounter exhibit videos is simply to stumble upon them while wandering through a busy exhibit hall.

The exhibit spaces of twenty-first-century museums are full of screens. Some screens merely serve the roles of billboards or informational brochures, but many are integral components of exhibits. Exhibit videos may orient, provide instructions, introduce or illustrate a theme or concept, supplement or replace a text label, tell a story, or add visual excitement to attract visitors toward an exhibit (Serrell, "Watching" 50; Teixeira 2). Videos in a museum's exhibits deserve careful attention because they help shape the visitor experience and contribute to learning.

Videos on a museum's website may be even more important because they can influence people's perceptions of the museum before they ever set foot in the building. Hundreds of museums in the United States have reported that visits to their websites outnumber visits to the museums themselves by at least ten to one (Honeysett 149).

Potential visitors are increasingly likely to check a museum's website in advance of their visit (Marty 345).

Museums recognize the need to have informative websites, but they face challenges as technologies and audience interests continue to change rapidly. "Our constituencies are changing faster than we are," comments a report from the Smithsonian (*2030 Vision* 15). Thanks to the ubiquity of videos on the Internet, users expect to see videos and other digital media on all sorts of websites, including museum sites. Web videos can be valuable educational resources, as well as useful marketing tools (Ferren 83; Muller 45). The web is also an important vehicle for museums to reach out to larger audiences, including underserved populations that are less likely to visit museums due to socioeconomic and educational circumstances (Griffiths and King 17).

The Museum of Science, Boston (MOS), where I have worked for five years, recently overhauled its website and is trying to expand its web offerings. Its directors want to reach a larger and more diverse audience to advance the museum's mission "to play a leading role in transforming the nation's relationship with science and technology." The MOS website has pages about all its exhibits and programs, but like many other museums' pages, they are dominated by text and static images. Adding quality video content could enliven the website and make it more engaging.

MOS, like other science museums, is in a challenging position: it wishes to build its web presence but it also needs to keep people coming to its physical site. It does not want its website to be an exact mirror image of its exhibit spaces. Some museum professionals have expressed concern that if people can see all the exhibits on the web,

they will be less likely to visit the physical site (Thomas 3). An alternative could be to offer web content unrelated to the museum's on-site exhibits. The Exploratorium has over 100 webpages full of information, games, lesson plans, and activities to try at home. Denver Museum of Nature and Science offers *Science Bites*, a series of short videos featuring glimpses behind the scenes and conversations with museum curators and researchers. The videos are fascinating and well-produced but they do not reflect the topics of the exhibits at DMNS.

On the other hand, it could be advantageous to include videos and other content that relate directly to museum exhibits. Videos can get viewers excited about an exhibit and inspire them to check it out in person. Evidence disagrees with the professionals who feared that web attendance would depress physical attendance. Some museums report that letting people explore online versions of their exhibits actually helps drive attendance at the physical sites (Marty 339). The real exhibits have features that the websites cannot duplicate, such as encounters with authentic objects, hands-on experiments, conversations with museum staff, and social experiences to share with a group.

Videos and other web media can add new information to extend and enrich the experiences of a museum visit. Some museums have done this successfully, developing websites with videos and games to accompany exhibits. The website for the *What Does It Mean to Be Human?* exhibition at the Smithsonian's National Museum of Natural History is a beautiful example. The website has images and complete label copy for many of the exhibits. It also has many of the short videos that are on display in the exhibit, such as "Human Characteristics: Tools and Foods." It even has an interactive floor plan of the

exhibition. Yet the website is not just an imitation of the exhibit experience. It uses the strengths of web design to offer many different ways to peruse the content. One website user might be interested in the fossils on display; another might want to learn about human ancestors chronologically; another might prefer browsing videos and pictures. These and other paths of exploration would be difficult to follow in the exhibit space. The website also expands on the exhibition's content with links and videos about ongoing research in the museum's departments of anthropology and paleobiology. The physical exhibit and the website complement each other, each playing to its strengths. Another example is *Our Global Kitchen: Food, Nature, Culture* at the American Museum of Natural History in New York. In addition to an introductory video that doubles as an advertisement for the exhibit, this site offers several additional videos touching on the exhibit's subtopics.

Adequate money, time, and staff are critical to these websites' success (Howes 76). Many museums, including MOS, are not ready to set aside so many resources for content that has no presence within the walls of the museum. A cheaper approach could be to repurpose exhibit videos for the website, using the full videos or excerpts. The website for the *Whales Tohorā* traveling exhibition, developed by the Museum of New Zealand Te Papa Tongarewa, has examples of both. Website users can view the complete five-minute video "Search and Destroy," but only part of the video "Tinirau and the Whale." The videos on the website are small and low in quality compared to the large screens in the exhibition, which is currently on display at the American Museum of Natural History in Washington, DC. The shortened, shrunken versions of the videos on

the web might give potential visitors enough of a taste of the exhibit to lure them into visiting the museum, where they could see full, high-quality versions of the videos.

But this approach does not add to the exhibit experience, and it can feel like an afterthought, as it does on the website for Pacific Science Center's *Portal to Current Research*. Under the heading "Meet the Scientists!" are paragraphs introducing four researchers. Only one of them has a small video player next to his paragraph. The short video clip shows him on the deck of a ship talking about challenges of doing research at Earth's poles. The video has interesting cutaways of activities aboard the ship, but it lacks context and could leave the viewer confused.

This multi-platform approach has promise. Using the same video (or excerpts from the video, or even outtakes from shooting the video) for multiple purposes has the benefit of being more cost-effective than producing an entirely new video. But rather than starting with the exhibit video and trying to pull something web-worthy from it, I suggest the reverse: produce a video for a website and adapt parts of it for a museum exhibit. The result would be a well-produced online video that tells a complete story and expands on the exhibit's content. Viewers intrigued by the video might consider visiting the museum. Viewers who cannot visit the museum due to distance, cost, or other constraints could still get a satisfying online experience with enough context to make sense. The web audience would benefit from the availability of high-quality video content, rather than abridged or watered-down content. The museum would benefit from the chance to communicate more science to a larger audience.

Some people could watch the web video before visiting the museum, others could watch it in lieu of a visit, and still others could watch it *while* visiting the museum. All these uses of museum websites are well-documented (Marty 340). The exhibit could display a link to the web video so that curious visitors could view it on their mobile devices while standing in front of the exhibit. This method of delivering information "just in time" is an emerging trend in museums (Samis 21). Using an exhibit-related website appears to help people "make memories from a visit stronger and long lasting" (Franciolli, Paolini, and Rubegni 6).

I wanted to try this approach at MOS, but such a project did not fit the duties of my job at the museum. This thesis gave me a chance to pursue the project on my own. My goal was to produce a video that would be a useful addition to a website, but that would be easy to adapt for a museum exhibit. To accomplish this, I needed to keep the museum's needs in mind through every step in production.

Many producers of science and natural history media have strong grounding in the worlds of film and television world but less experience in the museum world. For this reason, I use science and nature television as a basis for comparison as I investigate what museums require in exhibit videos. Museums and television networks differ enough in their priorities and ideologies that a video produced for one of these worlds would not transition easily to the other. A television program would likely require dramatic, time-consuming changes to make it appropriate for a museum exhibit.

In this paper I examine the needs of a typical science museum, using examples from science and nature television for comparison. Then I apply my findings in

developing a web video that can be adapted to a hypothetical science museum exhibit with only minor changes. The two-part web video, *Living in Pele's Paradise*, explores the scientific and social impacts of volcanic eruptions in Hawai‘i through the story of the spectacular eruption of Kīlauea in 1959-1960. I extracted, reassembled, and tweaked segments from the two parts of the web video to make two corresponding exhibit videos.

NEEDS OF SCIENCE MUSEUMS

Obligations

Museums answer to many groups and have many requirements and expectations to meet. They have roles of public education, community engagement, and stewardship of the nation's cultural heritage (Manjarrez et al. 3). They get their revenue from a combination of sources: federal, state, and local governments; charitable donations from individuals, corporations, and foundations; admission and membership fees; food and museum store sales; building rentals for functions; and investments (Katz 6). Museums have to justify the support they get from governments by proving that they are fulfilling their public functions. Science and nature television networks like the Discovery Channel must answer to many stakeholders as well, but they do not depend so much on public funding. They earn most of their revenue from advertising.

Science museums are educational institutions but they are also much more. By providing learning experiences not available in most schools, museums complement formal education and also provide learning opportunities for adults, often called "lifelong learning" (NRC, *Learning* 28; Black, *Engaging* 125). Science museums in particular have a growing responsibility to support learning in schools. Experts in business, education, government, and industry agree on the urgent need to improve Americans' competence in science, technology, engineering, and mathematics (STEM) to keep the U.S. globally competitive (Rotherham 1). Government-supported STEM initiatives in museums are intended to develop free-choice educational experiences that fit national and state school standards as well as local school curricula (NRC, *Framework* 3). For example, the

Museum of Science, Boston, has a program called Engineering is Elementary that develops curricula for schools in the form of books, teacher guides, and activity kits.

As public institutions, museums must meet high standards of ethics, accuracy, and accountability to be recognized by the American Alliance of Museums (AAM). National-scale surveys show that the public lists museums among the most trusted sources of information (Griffiths and King 3). Museums maintain this trust by trying to minimize bias and avoid espousing a particular cultural agenda. They must also comply with regulations such as the Americans with Disabilities Act (Reich 12). Accommodations for individuals with disabilities can range from simple affordances such as ramps and automatic doors to wide-reaching initiatives for Universal Design, defined as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Center for Universal Design). Universally designed exhibits serve people with a wide range of physical and cognitive abilities.

Developing museum exhibits takes years and can cost millions of dollars, so exhibit designers build exhibits to last ten, twenty, or even thirty years in the case of major exhibitions. Museums often have a sense of being timeless, set apart from the trajectory of most of society. The Field Museum of Natural History's massive entrance hall, lined with marble columns and arches, feels almost frozen in time. But science museums also try to feature the latest technology. An ideal exhibit video would balance elements of past and present.

Audiences

Science museums' target audience is *everyone*: people of all ages, abilities, and backgrounds (Reich 15). Many factors require attention as museums work toward this ambitious goal. Museums try to address important, relevant, and sometimes controversial issues in their exhibits and programs, yet they must be careful not to offend. Their visitors come from around the world, so they must be sensitive to the perspectives of other cultures. Museums must be family-friendly and avoid displays that could frighten young children. Yet they must also offer experiences that appeal to adults. Not every exhibit has to appeal to everyone; science museums often have discovery spaces or children's areas for younger visitors. The Martin Children's Discovery Center in the Museum of the Rockies is an outstanding example.

School groups form a significant fraction of museums' admission sales. Major science museums have well-established links to schools, with special websites, field trip guides, and lesson plans for educators. Teachers and school administrators put pressure on museums to fit exhibits to the school curricula. Teachers cannot sacrifice a day of school and take their classes on an expensive trip to a museum unless they can justify the visit by working it into their lesson plans.

In addition to these educational expectations, museums must also provide plenty of entertainment to attract visitors. Studies of museum visitors, based on surveys or interviews of individuals or focus groups, reveal that "education" rarely tops people's lists of reasons for a museum visit. People visit science museums looking for a fun experience to enjoy with family or friends. With limited leisure time, people must choose

some activities over others. To a family deciding what to do this weekend, a science museum is just another option for amusement alongside sporting events, theme parks, music performances, and other attractions. So museums must compete with all these entertainment-focused venues for their customers (Black, *Engaging* 2; Smithsonian, *Visitation* 21).

Visitors arrive at science museums with their own agendas and expectations. If they purchase tickets for a planetarium show or an IMAX movie, they expect to sit down quietly for an hour and passively absorb an audiovisual experience. If they explore the exhibit halls, they expect a bounty of artifacts, displays, and interactive stations. They expect to be on their feet, exploring, moving, and interacting with their social group. The different expectations for theaters and exhibit spaces mean that videos designed for one area will not work well in the other.

People behave differently in exhibit halls than they do in other contexts (Hein 58). Most importantly, they are easily distracted, being constantly bombarded by stimuli from other exhibits, other visitors (both companions and strangers), and sensations ranging from ambient noise in the room to hunger pangs in their stomachs (Falk and Dierking, *Experience* 60). On average, visitors spend less than one minute at an exhibit (Hirumi, Savenye, and Allen 47). Some studies suggest that exhibits with videos hold visitors' attention longer than exhibits without videos, but the difference is slight. Serrell observed in her studies that visitors would watch a video for an average of 2 1/2 minutes, so "expecting visitors to stay at even a three minute video is asking a lot" ("Watching" 62).

Television networks have more tightly defined target audiences than museums do. They may overlap with the museum audience but they need not be so broad and inclusive. For example, programs on the National Geographic Channel target adults 25-54, with a slightly higher proportion of men than women, who are affluent and well-educated (Crain Communications). On PBS, different programs target different audiences; *Sid the Science Kid* and *Super Why!* target children ages 3 to 6, while *NOVA* and *POV* target adults ages 25-64 (SGPTV). Public television has to worry about some of the same sensitivities that museums do, and avoid being too offensive. Cable television has more freedom to design programs in whatever way will earn the highest ratings.

Measuring Success

To secure funding and achieve their missions, museums need to demonstrate that their exhibits are effective at engaging visitors and promoting learning (Lehn and Heath 3; Rockman, Bass, and Borse 23). Effectiveness is assessed through rigorous evaluation, often done by professional consulting firms (Pontin 119). Several companies listed by the American Evaluation Association specialize in museum exhibits and programs. Some museums have in-house staff who perform research and evaluation according to standards maintained by organizations such as the Joint Committee on Standards for Educational Evaluation (American Evaluation Association).

Common methods of exhibit evaluation include tracking and timing studies, behavioral observations, surveys, and exit interviews (Kunz Kollman 4). In tracking and timing studies, evaluators discreetly follow the progress of a selected visitor and note how much time the visitor spends at each exhibit component and the visitor's total time

in the exhibition overall. Behavioral observations are also unobtrusive and include noting things like whether a visitor reads labels, how the visitor interacts with exhibits, and whether the visitor engages with other people in these interactions. Surveys and exit interviews involve asking visitors questions about their experience. Questions are carefully worded to ensure that results provide measurable assessments of the exhibit's success at specific goals (Borun, Korn, and Adams 17).

Exhibits can be evaluated before, during, or after they have been designed and installed. Front-end evaluations occur very early in the design process and investigate visitors' awareness, interest, and understanding of target subjects (McLean 58). Formative evaluations analyze visitors' interactions with exhibit prototypes to identify areas for improvement. Formative evaluations are seldom conducted on videos (Serrell, "Watching" 51). Summative evaluations, the most common, are performed after the completed exhibit is on display. This type of evaluation typically assesses whether an exhibit achieved its educational goals, and the evaluation report is sent to funding agencies as evidence that the museum did its best to fulfill its promised deliverables (McLean 75). Videos in exhibits are evaluated through the same methods as other exhibit components, but Borland and Rockman note that "surprisingly little research exists on how museum visitors interact specifically with video installations in exhibits" (33).

Evaluations for videos in museum exhibits are generally more rigorous than evaluations for films in IMAX theaters, planetariums, or other separate ticketed venues in museums. The films in the theaters play for just a few months at a time, while the exhibit videos may remain on display for years. People can easily steer clear of the theaters if

they are concerned that a film might be too intense for their children. But everything in the exhibit hall is within view and within reach, so it all must be appropriate for the whole museum audience.

Evaluations for IMAX, planetarium, and other theater-based shows are similar to those for science and nature television shows. The films that are privately funded do not require evaluation and are commonly entertaining, narrative-heavy, and visually spectacular. They aim to entertain more than educate. Like BBC's *Planet Earth* television series, the film *To the Arctic* (MacGillivray Freeman, 2012) does communicate science and offers perspectives that may be new to viewers, and it can even inspire people to seek out more information after viewing. But it does not have to assess whether viewers learn new concepts or apply critical thinking skills as a result of watching. Science documentaries for television and film judge their success based on audience numbers, ratings, reviews, and awards.

Exceptions to this generalization are programs and films produced with public funding, such as PBS's *NOVA*, BBC/Discovery's *Frozen Planet*, or the IMAX film *Sea Monsters 3D: A Prehistoric Adventure* (e.g. Knight-Williams et al.; Bacharach, Grant, and Goodman). They may require professional evaluation. The evaluations use surveys or interviews similar to those described above for exhibits. The evaluators recruit participants that fit the demographic spread of the audience. Before and/or after viewing the program, the participants fill out questionnaires about their enjoyment, interest, and understanding of the program (Pontin 119).

Unlike evaluations for exhibits, the evaluations for television programs and films rarely ask actual content questions such as "What is the definition of a black hole?" or "Which of the following is closest to the number of bacteria in the average human body?" Instead, they rely solely on viewers' own perceptions of how much they learned. The evaluation for the *NOVA* series *Fabric of the Cosmos* asked participants to rate how much they agreed or disagreed with statements such as, "I feel more informed about physics and the cosmos because I watched," and "I have shared with others something I learned or heard about from this series" (Castori, Carroll, and Stokes 13). This sort of self-reporting is subject to error, and the evaluators recognize that. But for these programs, it is sufficient to show that people's awareness increased after viewing. The programs are not expected to support school curricula or provide professional development.

Evaluations are important deliverables for exhibits, television programs, and films produced with public funding. Exhibits, including their video components, are scrutinized with the greatest rigor. A video for an exhibit would ideally have all the following characteristics: it would be educational, entertaining, appropriate for all ages, non-offensive to all cultural backgrounds, easy to understand, universally designed, current yet evergreen, and less than three minutes long.

The obligations, audiences, and evaluation requirements museum exhibits are markedly different from those of shows for television and films for theaters. For a producer accustomed to working on science and nature television shows or films, making a video for a science museum would require keeping the needs of the museum in mind while carefully questioning conventions of content, form, ideology, and style.

A MUSEUM-COMPATIBLE VOLCANO VIDEO

Of the geological topics that focus on the Earth's interior, volcanoes are one of the most popular subjects for documentaries, followed by earthquakes and tsunamis. This makes sense because these three phenomena occur on human timescales and affect human populations. Most subsurface processes occur so slowly and over such vast distances that they are challenging to visualize or explain. Film and video are the ideal media for capturing the motion, sound, and spectacle of a volcanic eruption.

My video, *Living in Pele's Paradise*, explores people's experiences of living on an active volcano. It centers on the story of a spectacular and destructive eruption of Kīlauea, on the Big Island of Hawai'i, told through original film footage and recollections of Big Island residents. It follows the efforts of volcanologists who study the evidence that the eruption left behind and who monitor the volcano's current activity. It points out the main hazards of eruptions and shows how the social and scientific lessons from the past contribute to preparation for future eruptions. The video is split into two parts for more convenient viewing on the web. Part 1 is *From Beauty to Disaster: Story of an Eruption.* Part 2 is *Learning from the Past to Prepare for Future Eruptions*.

I tried to combine a compelling narrative, accurate science, and a useful message. To ensure that my video would be easy to adapt for a science museum exhibit, I used museums' needs as a guide when making decisions about content, form, and style. My video has some characteristics in common with television film documentaries about volcanoes from the last 25 years. It also differs from them in many ways.

Content

The throughline of *Living in Pele's Paradise* is: Although people cannot predict or prevent destructive eruptions, they can prepare with the aid of scientific research and monitoring. I sought to show how both scientists and non-scientists contribute to preparation for eruption hazards. Two of the volcano programs I studied communicate similar ideas. *America's Volcanoes: Sitting on a Powder Keg* (Discovery, 2005) and *Supervolcano: Yellowstone's Fury* (CBC, 2013) indicate that volcanoes can be dangerous but communities can deal with them if they make the effort to prepare. Several programs touch on examples of how societies coexist with, and even benefit from, volcanoes. These messages are valuable because they can encourage people to take proactive measures to minimize the impacts of a damaging eruption.

Unfortunately, the programs bury these messages in over-the-top, alarmist descriptions of worst-case scenarios that make it sound like no amount of preparation could save us. They fixate on the *worst* that a volcano could do without discussing what the volcano is *most likely* to do. This misrepresents the scientists' work and creates a sense of futility where there could be empowerment. "The awesome power of such an eruption—equivalent to the force of a thousand Hiroshima bombs every second—is impossible to defuse," says the narrator of *NOVA: Deadliest Volcanoes* (PBS, 2012) about Yellowstone. "All we can hope for is a warning."

The hope for a warning is another widespread theme in these television shows. Seven of the programs I studied highlight scientists' efforts to "predict" volcanic eruptions. The scientists themselves say nothing about prediction in these videos; they

talk about estimating the likelihood of eruptions. It is the narration that insists, "The importance of prediction science and these various devices is simple: saving lives" (*America's Volcanoes*).

It was important to me to be clear about the distinction between prediction and preparation in my video. My experience with volcano research and monitoring shows that the job of volcanologists is not to predict eruptions or prevent damage, but rather to understand and monitor past and current volcanic processes and share their findings to help communities prepare for eruptions. Yet in its segment about Mount St. Helens, *America's Volcanoes* asks, "Are we on the brink of another cataclysmic eruption? Or will leading-edge technology help prevent a repeat of the devastation nearly a quarter century ago?" This sentence is misleading and encourages a complacent attitude that "science will save us," rather than the reality that science can tell us what may happen, but it is up to the people and community leaders to make responsible decisions to safeguard lives and property. In my video I show how science can help, but I also show its limits.

I was careful to communicate my message without being preachy, and to support it with facts rather than opinions. A key reason that museums have earned such a high level of public trust is that they avoid endorsing opinions or prescribing actions (Griffiths and King 3). It is hard to find a news network, politician, or business expert that is not deploring some party's views or telling people what to do or how to think. Museums do not take sides on issues unless the scientific evidence is overwhelming. MOS does not have an official position on many controversial issues, such as whether plastics containing BPA are safe or whether drilling for shale gas is dangerous. But MOS does

officially uphold evolution, anthropogenic climate change, and the importance of vaccinations for individual and public health. These positions have vast supporting evidence and nearly complete consensus in the scientific community.

To remain reliable sources of information, museums use extreme care in choosing words and examples to convey scientific concepts. Exhibits do simplify information where needed to make ideas less intimidating and more understandable, but they do so while maintaining accuracy. I wrote my narration carefully to give a simple but accurate explanation of eruption processes. In cases where a detailed explanation would make the movie too long, I chose a brief, bare-bones explanation. For example, I devoted one sentence to plate tectonics and the Hawaiian hot spot. This achieved my purpose of comparing traditional cultural and modern scientific views of the origin of the Hawaiian Islands. A longer explanation would slow the pace and distract from the video's message. I prefer giving no details at all to giving a sloppy explanation.

Television shows often sacrifice rigorous science to keep the audience riveted. Of the numerous examples of imperfect science explanations in the volcano programs I examined, two inaccuracies stood out. One is a line from *America's Volcanoes* that says tectonic plates "float on top of the Earth's core." That is wrong, but it is a harmless mistake because it is unlikely to influence viewers' behavior in a detrimental way. The other is from *Yellowstone's Fury*. The first line coming out of a commercial break is, "At Yellowstone, it's not the animals you really need to be afraid of." It goes on to describe what you should "really" fear: a worst-case Yellowstone eruption. This statement verges on irresponsible. People are injured by bison, bears, or other wildlife every year in

Yellowstone, nearly always because the people get too close. Implying that the animals pose little danger could inspire someone to approach one and invite an attack. Getting too close to a bison is a far more likely cause of death than a super-eruption at Yellowstone, which has the same probability as a large asteroid colliding with Earth (USGS).

Compelling characters add to emotional impact and help maintain attention, so I sought out interesting and pleasant people to feature and tried to let the interviewees' personalities shine as they described their experiences. Akira Yamamoto is especially warm and lively and Gordon Morse is a great storyteller, so I featured them as much as I could. I also showed the scientists in action whenever possible because it gives insight into their methods and it is more dramatic than talking heads.

Studies of both classroom and informal learning show that people best connect to new ideas by way of familiar ones (Hein 156; Perry 109). I included features in my video that connect to visitors' prior experiences. Part 1 opens with classic views of Hawaiian landscapes and wildlife, similar to the postcards and calendars that tourists buy in Waikīkī. The slack key guitar music also fits people's preconceptions of Hawai‘i. Other references to familiar experiences include describing the traffic jam when tourists were flocking to the volcano to see the lava fountains, likening volcanologists to detectives, and comparing rising magma with opening a bottle of soda. When Part 2 introduces modern methods of volcano monitoring, it starts with cameras before moving on to seismometers and satellite receivers, which are not household items. It also mentions the webcams that the public can view live on the Hawaiian Volcano Observatory's website, because people who choose to watch my video on the web are likely to have experience

with webcams. When I posted the video on the web, I included links to the webcams to give viewers an easy way to engage further with the topic.

It may be useful for videos to refer to things in viewers' prior experience or knowledge, but that does not mean the videos have to agree with viewers' preconceptions. In fact, videos that directly address and refute viewers' likely misconceptions promote better learning outcomes (Muller 212). In addition, Beverly Serrell's meta-analysis of 45 exhibit videos at several American science centers indicates that "evolving visual and narrative surprises" attract and hold visitors' attention well ("Watching" 62). I applied these ideas in the first 30 seconds of Part 1 by inserting a surprise that challenges common preconceptions. Before the change, postcard-like scenes and gentle acoustic guitar music float by as the narrator says, "Hawai'i is a paradise." At 00:23, there is a hard cut to violent explosions of lava and the music changes to rapid Tahitian drumming. When people visit Hawai'i, they often think it would be an idyllic and relaxing place to live. My video adds the perspective that choosing to live in Hawai'i also means choosing to live with the risk of natural disasters, particularly on the Big Island. Another surprise in the video is the headline "THE VOLCANO ERUPTS AGAIN!" that appears abruptly at 09:22 along with a sudden change of music.

My video also tackles the misconceptions that (a) earthquakes trigger volcanic eruptions, (b) people can block lava flows by building large enough barriers, and (c) scientists can predict when an eruption will start or stop. In contrast, several television programs about volcanoes seem to reinforce misconceptions, especially the idea that a volcano can be "overdue" for an eruption. In *Everything You Need to Know: Volcanoes*

(Discovery, 2006), the narrator lists the dates of the three largest eruptions of Yellowstone, ending with, "And the last major eruption happened 640,000 years ago. That's about once every 700,000 years. If past eruptions are any indication of what's in store, it could blow any time now." This fallacy of extrapolating a cyclical pattern from just two or three examples is a pet peeve of geologists. In five of the programs I viewed, authoritative narrators' voices proclaim this baseless speculation as fact. In my job as a museum educator, I have answered enough visitors' anxious questions to suspect that people do believe the hype in these programs. I was determined to ensure that my video would not contribute to this problem.

Mode and Form

For *Living in Pele's Paradise*, I used the expository mode with an emphasis on narrative form guided by a combination of "voice-of-God" narration and interviews. I chose a widely used documentary form because a less familiar form might impede the average viewer's ability to engage with the video immediately. Sue Allen's research at the Exploratorium indicates that it is critical for exhibits to have what she calls "immediate apprehendability" (S20). In the case of an exhibit video, this would mean people should be able to get a sense of the video's purpose and structure the moment they approach it. Otherwise, their attention may be diverted toward adjusting to the unexpected format. The first few seconds of a visitor's interaction with an exhibit are crucial for deciding "whether a user continues or turns to any competing object of attention" (Hornecker and Stifter 141). Any confusion or frustration during that window can end the interaction prematurely. Research on learning suggests that a person's

working memory has a finite capacity, and burdening a person with too great a cognitive load can hinder comprehension and deplete attention (Black, *Engaging* 200; Muller 131).

I chose a straightforward story structure to make my video easily adaptable to an exhibit. Serrell notes that a linear structure and direct language help videos attract and hold attention (61). To make my story even clearer, I focused on a single eruption and covered it chronologically, rather than bouncing among several eruptions as other volcano programs do. I added dashes of science to the story of the 1959-1960 eruption in Part 1, but I avoided adding too much. In earlier cuts I wove the science and the story together in equal amounts, but I found that the longer scientific explanations caused the story to lose momentum.

In comparison, hour-long television shows such as *Volcano: Nature's Inferno* (National Geographic, 1997) and IMAX films such as *Ring of Fire* (MacGillivray Freeman, 1991) have time to explore multiple sites around the world. They commonly tell part of a story at one location, then segue to another spot and do the same, and after several more jumps they eventually come back around to complete the unfinished stories. This makes for an exciting whirlwind of world travel, but it also interrupts the narratives.

In my combination of narration and interviews, I gave more weight to the interviews in an effort to minimize bias. I am aware that no matter how carefully I interpret an interviewee's comments for my narration, I am processing that person's remarks through my own worldview. I let scientists explain things in their own words wherever possible. In contrast, the volcano shows I studied made narration dominant,

paraphrasing scientists' words liberally, and relegated the interview clips to a supplementary role.

I originally tried to craft my whole video completely from interviews, but I found that I had to add commentary to achieve the greatest clarity. As mentioned in Chapter 2, museums try to make their exhibits and programs accessible to the widest possible range of abilities. To benefit people with low vision or cognitive disabilities, Reich suggests that spoken words, whether in videos or in audio versions of text labels, should make sense when heard without visual accompaniment (124). This differs from the common practice in documentary filmmaking of building a story primarily through visual imagery and using dialogue or commentary as support (Rabiger 424).

Ideology

In *Watching Wildlife*, Cynthia Chris shows how television series use animals "as ciphers onto which any number of meanings with distinctive ideological ends can be projected" (116). Volcanoes can be used the same way. To appeal to science museums' all-inclusive audience, I had to be conscious of any cultural agendas or ideologies that my video might reinforce.

I chose a female narrator for three reasons. First, it helps balance the voices, because my interviews feature more men than women. Second, it is a change of pace from most television and film documentaries about volcanoes. Of the videos I studied, the only one with a female narrator is *Yellowstone's Fury* (2013), part of CBC's *Doc Zone* series. Ann-Marie MacDonald narrates all episodes of the series. The rest of the volcano documentaries have male voices. In the older programs, such as *Inside Hawaiian*

Volcanoes (Smithsonian, 1989), *Ring of Fire*, and *Volcano: Nature's Inferno*, the male voice is one of calm authority, intoning each sentence as unquestionable fact. In the later programs, such as *America's Volcanoes*, *Deadliest Volcanoes*, *How the Earth Was Made: Krakatoa* (History Channel, 2009), and *NOVA: Doomsday Volcanoes* (PBS, 2013), the male voice resembles the narration in trailers for Hollywood action and horror movies.

One program where the male narrator's voice especially stands out is *Doomsday Volcanoes*, which focuses on active volcanoes in southern Iceland. In an attractive computer-animated graphic, labels appear on a map as the narrator describes the volcanoes Laki, Hekla, and Katla. He refers to each of them as "she," but does not explain why these volcanoes would be assigned feminine identities. Christian myths associate Iceland's volcanoes with the devil's power, regarding Hekla as an entrance to Hell, which does not seem particularly feminine. Old Norse myths do not feminize the volcanoes either, generally treating the volcanoes not as characters but simply as parts of an active landscape. One Norse story that does seem to personify a volcano associates it with Hrungnir, a male giant who was killed by Thor (Bergström 189).

My interpretation is that the writers, being from English-speaking countries, thought the volcanoes' names sounded like women's names, so they chose to use the feminine pronoun to give the narration a little more drama. Describing Hekla, the narrator says, "Historically, she has erupted violently, without warning, belching vast amounts of ash." As for Katla, "She's currently rumbling, so volcanologists are most worried about her." Lines like these would sound odd if spoken by a female narrator.

Perhaps unintentionally, the show assigns the female gender to the violent, unpredictable volcano, consistent with Western cultural narratives that link the untamed wilderness to the fall of Eden precipitated by the fall of Eve (Merchant 88). Merchant describes recovery narratives where male agency leads progress toward civilization, turning the wilderness into a garden (183). In programs like *Doomsday Volcanoes*, the male narrator brings order to the chaos with his authoritative explanations.

The third reason I chose a female narrator was to underpin the symbolism of Pele, the goddess of Hawaiian volcanoes. This is one area where I deviate slightly science museums' usual custom of avoiding any association with religion. I do include some religious references in the web version of my video, but my video does not endorse a specific religion. I wanted to incorporate past and present local culture into the video to show a society that has been interwoven with the volcano from its earliest days. I had to include religion to represent the native people's perspective properly. For both ancient and many modern Hawaiians, religion and culture are inseparable (Nimmo 158). Consistent with the modern Hawaiian view, I portray Pele as more of a metaphor than a figure of worship.

One might argue that Christianity has a long tradition in Hawai‘i too, starting with missionary activities in the early 1800s (Vowell 29). I do include a reference to Christianity, but it is a subversive one. The word "paradise" in my title may sound like a place in the Bible, but if anyone rules this paradise, it is Pele, not God.

Other than that, I steered clear of Christian ideology because it sets up a conflict between man and volcano. The very first line of *Everything You Need to Know:*

Volcanoes is, "They are hell on earth." The title of *Volcano: Nature's Inferno* also seems to allude to the Christian Hell. Some of the programs depict this conflict as a nonviolent effort to dominate nature by understanding it and unlocking its mysteries. The scientists do this by observing and analyzing natural processes, or "interrogating" them as Merchant puts it in her explanation of Francis Bacon's proposed philosophy during the Enlightenment (75).

A similar theme is the quest to conquer nature by taming it and imposing rules on it, echoing Biblical sentiments that flourished during the Renaissance (Merchant 63). Several of the television shows attempt to constrain unpredictable volcanoes with categories, maps, and numbers. In their scheme, new technologies and scientific discoveries have little merit on their own, mainly serving as steps along the path toward a prime example of human supremacy over nature: predicting volcanic eruptions. In a section about a new method of detecting variations in rock density deep underground, *Deadliest Volcanoes* says, "It could revolutionize prediction by revealing the inner structure of the volcano," greatly exaggerating the technology's potential. Instead of suggesting that humans are progressing inevitably toward dominating nature, my video admits that true prediction is impossible and highlights the futility of human efforts to control lava flows.

Other television programs frame the man vs. volcano conflict as a battle. They compare eruptions to atomic bombs, illustrating the concept with archival footage of real nuclear blasts. *How the Earth Was Made: Krakatoa* compares magma to "liquid dynamite" and describes the volcano as "a time bomb waiting to explode." The humans

are armed for battle too: “Another weapon in the prediction arsenal is the new seismometer,” says *America’s Volcanoes: Sitting on a Powder Keg.* The very title of that program conjures thoughts about weapons of mass destruction.

To show eruptions’ impacts on people, the programs use clips from newscasts about past eruptions, especially the 1991 eruption of Pinatubo in the Philippines. The clips from the eruption’s aftermath look exactly like footage of victims of bombings, with emergency personnel carrying people on stretchers. These similarities to news coverage of violent conflicts may be the television shows’ method of helping viewers access new information by relating it to prior experiences. My video avoids military metaphors and focuses on living and coping with volcanic hazards.

Some shows ascribe human qualities to the volcanic adversary. They make the volcano sound sentient, even sinister, as if it is plotting to wreak destruction on unsuspecting humans. *Yellowstone’s Fury* makes the volcano wrathful with its title and makes it conniving with the line, “Yellowstone is up to something.” Three shows describe volcanoes as “killers.” It is certainly true that large eruptions can kill people, but the word “killer” evokes stories of violent crimes and horror movie monsters. Describing volcanoes in *America’s Volcanoes*, the narrator says, “They can torture you for days…. Get too close, and they will eat you alive.” Communicating the hazards of volcanic eruptions can encourage people to prepare for eruptions, but turning volcanoes into deranged killers is not productive. I avoided making Kīlauea Volcano into an action-movie bad guy.

The technique of anthropomorphizing selected objects to advance cultural agendas has been popular for hundreds of years (Evernden 53). Although my video describes the personality and moods of Pele, who symbolizes Hawaiian volcanoes, I do not give such characteristics to Kīlauea Volcano itself. Of the ten volcano films and television programs I studied, seven anthropomorphized the volcanoes and three did not. The seven that did were all produced after 2001, and the others were older. Perhaps these newer documentaries are infused with a post-9/11 American ideology. For over a decade, color-coded security advisories and 24-hour news networks have pressured citizens to remain in a perpetual state of alert. This cultivates an undercurrent of fear and paranoia that sometimes emerges in movies and television.

Terrorists surprise you and catch you unprepared. Volcanoes can do that too. Americans' fear of an amorphous yet imminent threat finds tangible form in the explosive volcano. *Everything You Need to Know: Volcanoes* says, "If you believe, like most Americans, that volcanoes are something you don't need to worry about, you'd be wrong." *America's Volcanoes* says, "Perched just above Seattle and Tacoma, Mount Rainier threatens the lives of one million residents every day it *doesn't* erupt… The potential for an eruption is a constant threat." My video's message acknowledges danger and advises preparedness without exaggerating the threat.

Some of the programs push the fearmongering to the point that they all but declare, "The End Is Nigh!" In addition to the reference in its title, *Doomsday Volcanoes* contains the phrases "a view of Armageddon" and "the end of the world." And *Supervolcano: Yellowstone's Fury* says, "An eruption like Yellowstone could trigger the

end of civilization as we know it." The program uses visual cues to create the impression that the supervolcano is building inexorably toward the ultimate catastrophe. The most recent of Yellowstone's last three major eruptions was not its largest. But two animated graphics in *Yellowstone's Fury* suggest otherwise. In one, cubes representing the total volume of erupted materials are arranged in order of increasing size from left to right. It would be easy to misinterpret the lineup as a timeline suggesting that eruptions have been getting larger. The three seconds that the graphic is on screen do not give the viewer enough time to study it and avoid confusion. The other graphic is an animated map. As the narrator cites the date each of Yellowstone's three known major eruptions, a cartoon ash plume appears for each date, in chronological order. The plumes are different sizes, and the one representing the most recent eruption is the largest by far—but that eruption was *not* the largest. Combined with the show's writing, these graphics seem to be engineered to inspire fear of an impending global catastrophe.

It makes sense for these programs to try to engage viewers' emotions. Emotional impact is vital for capturing and holding attention, and it also improves comprehension and retention of information (Mouw and Spock 47; Muller 63). People remember videos in more detail if the videos elicit strong emotions. The emotions do not have to be cheerful; Serrell notes that an especially engaging video in a past exhibit at the New York Hall of Science was a sad but inspiring story of a woman struggling with heart disease ("Watching" 52). For all the post-2001 volcano shows I studied, the primary emotion they seek to evoke is fear. Each show tries to one-up the previous one at scaring the audience. They add drama to stories by setting up conflicts and cliffhangers, sometimes

artificially imposing dramatic structure. The older programs aim to inspire awe rather than fear, and their overall emotional impact is weaker. Their appeal seems more intellectual and less visceral than that of the newer programs.

Partly to be museum-appropriate and partly to take a stand against the escalating alarmism of these programs, I kept fear and doomsday out of my video. I created other types of emotional impact through story, pacing, music, and surprises. The narrative of the 1959-1960 eruption in Part 1 has pauses to allow viewers to share the interviewees' awe of the towering lava fountains. Later in Part 1, when lava buries the town of Kapoho, the narrative takes longer pauses with plaintive music to let viewers sympathize with the residents who lost their homes and possessions. I also include moments of humor, such as Akira Yamamoto's laughter in Part 1 and Bruce's joke about "tephra down the knickers" in Part 2. But I do not manufacture false drama or stretch the scientific claims to provoke stronger emotions. My video is less emotionally intense than recent television programs, but it does a better job of providing a realistic understanding of scientists and the scientific process.

Style

Good production values and beautiful imagery are important for attracting and holding viewers' attention (Gammon, *Lessons* 1; Serrell, "Watching" 62). I made my video as beautiful and polished as my budget and skills allowed. I tried to shoot the interviews in beautiful locations such as the rim of Halemaʻumaʻu Crater at the summit of Kīlauea. In addition to the archival footage from 1959-1960, I acquired many impressive

video clips of Kīlauea's recent activity from the U.S. Geological Survey. I aimed for clean, attractive design in my graphics and animations.

The film and television documentaries about volcanoes are packed with gorgeous photography. The aerial shots of Hawai‘i and Yellowstone are especially stunning. The filmmakers went to great lengths to get the best possible shots. Before I shot my video in 2009, a Discovery Channel crew was in Hawai‘i Volcanoes National Park, shooting for *Kilauea: Mountain of Fire* (PBS Nature, 2009). They interviewed Matt Patrick, whom I feature in Part 2 of my video. Matt told me that the Discovery crew hiked with him across old lava flows toward the coast, over miles of extremely rough terrain, and insisted on staying out there past sunset to get shots with the right light. It was quite a challenge to hike back in the dark, but they shot some dazzling material. My experience with Dr. Patrick was very different; with no crew or heavy equipment, we covered ground quickly and made the hike without impinging on his work schedule.

Just as people learn better if new information builds on familiar ideas and experiences, people also learn better if the information is conveyed in a familiar style, such as the style of popular television shows (Roberts 131). Viewers will find it easier to focus if they feel comfortable and at ease (Black, *Engaging* 29). So I used common editing techniques such as covering the cuts in interviews with B-roll and using lower third graphics to indicate interviewees' names and affiliations. The text for names and labels is relatively large so that it will be readable if viewed on a smartphone. The interviewees gaze just to the side of the camera, rather than looking directly at the camera. I made my animations clear and colorful and got a little more adventurous in my

artwork for Pele. Using these customary elements can provide a bridge for viewers to cross into less formulaic fare.

Museums build exhibits to last for years to decades. They strive to be current but also aim for an impression of timelessness. I included the latest scientific findings in the movie, but I explained them in terms of fundamental principles to make the content evergreen, meaning it will remain relevant for years, even after new research is published.

I used a conventional editing style to ensure a good fit for a museum environment. If I had used trendy editing techniques in my video, it would look dated in a few years. In contrast, the styles of television programs about volcanoes draw on recent fiction films, music videos, and commercials. They use short shots cut together in quick succession. They add energy and visual impact with whip pans, crash zooms, wipes, flashes, and other editing tricks. They use sound strategically to build tension. For example, they use music that alternates between heavy syncopated percussion and ominous chromatic scales on strings, much like blockbuster action movies. They punctuate dramatic lines with orchestral stings. And they use lots of sound effects. Even the cuts between shots get their own sound effects such as swooping noises and cymbal strikes.

I did not have original natural sound for the 1959-1960 eruption, because it was filmed before sound equipment was very portable. I also could not get natural sound for the lava flows I recorded because the environment was so windy. I borrowed sounds of roaring lava fountains from the USGS film *Eruption of Kilauea 1959-1960* (1961), because the sounds are accurate for that style of eruption. I used Hawaiian slack key

guitar music throughout my video to provide a sense of place. Instead of building anxiety, the music sets a tone that fits the local culture. I wanted to leave the viewer with a better idea of what it is like to live on the Big Island of Hawai‘i.

Not surprisingly, explosions are everywhere in volcano documentaries. One of the fascinating things about volcanoes is that, along with meteorite impacts, they are only natural phenomena on Earth that spontaneously produce huge, fiery explosions. All other explosions in our experience derive from human technologies. Both natural and manmade explosions appear in most of the television programs. In many cases they are combined: one common technique is to show a video clip of a volcanic explosion while playing the sound of an ordnance explosion such as a bomb.

The programs splice footage from several different explosive eruptions together for more dramatic effect, frequently mixing in clips from dissimilar types of eruptions and even computer-generated explosions, while keeping the soundtrack uniform. Nearly every program shows at least one shot of incandescent Hawaiian lava while talking about an entirely different type of volcano. They never explicitly indicate that they are mixing and matching footage this way.

Derek Bousé writes about the practice of creating composite animals and events in wildlife films to support a fabricated narrative. A film might use shots of several different moose to represent a sequence of moments in the life of a single moose character, while using stylistic conventions and sound to maintain the illusion of continuity (32). The programs I studied make composite volcanoes instead of animals. They do it for the same reason: as Bousé puts it, they “depict nature close-up, speeded-

up, and set to music, with reality's most exciting moments highlighted, and its 'boring' bits cut out" (3).

My video does not concoct a composite volcano. All the clips I used come not only from the correct volcano, but also from the correct eruption—the 1959 fountaining eruption of Kīlauea Iki. I admit that there may be some mix-ups between different episodes of that eruption. The 1959 lava fountain started and stopped seventeen times and the filmmakers did not shoot every phase. The original footage does not contain enough information to identify every episode precisely, but I matched the chronology as closely as I could. This attention to accuracy is appropriate for a museum exhibit.

ADAPTING *LIVING IN PELE'S PARADISE* FOR A MUSEUM EXHIBIT

Throughout this essay I have mentioned issues to consider based on the needs of museums and on studies of attention, engagement, and learning in museum visitors, especially with regard to videos. A review of these considerations will be useful before I discuss the changes I made to optimize *Living in Pele's Paradise* for a hypothetical museum exhibit.

Needs and characteristics of science museums:

- Museums are trusted to be reliable, unbiased sources of information.
- They must meet strict ethical standards; they avoid endorsing specific ideologies or prescribing actions.
- They seek to appeal to the widest possible range of ages, abilities, nationalities, and backgrounds.
- As educational institutions, science museums must provide content that is compatible with school standards and curricula.
- They use rigorous evaluation to assess the effectiveness of their exhibits and programs.
- As leisure destinations, museums must also entertain or risk losing business to competing attractions.
- Science museums make their offerings current and relevant as possible.
- They design for longevity in their exhibits because the exhibits are expensive to produce.

- They make concepts understandable by simplifying information while maintaining accuracy.
- They do not overload visitors with too many new terms or concepts.
- Unlike people in theaters or watching television, people in museum exhibit halls are constantly on the move and surrounded by distractions.

Videos attract and hold attention and promote learning better if:

- They are less than three minutes long.
- They have good production values and beautiful photography.
- They have simple, linear story structure.
- They use clear, direct language.
- Their purpose and structure are immediately obvious.
- They contain visual and narrative surprises.
- They refer to things in viewers' previous knowledge or experience.
- They directly address viewers' misconceptions.

For the web video *Living in Pele's Paradise*, I ventured outside some common conventions for science museum exhibits to provide a broader cultural perspective about how people live with active volcanoes in Hawai‘i. For the exhibit videos, I adhered to museums' customs more strictly. Most of my changes were minor because I made the web version with museum adaptation in mind.

The titles of the exhibit videos match the subtitles of Parts 1 and 2 of the web video. They are *From Beauty to Disaster: Story of an Eruption* and *Learning from the*

Past to Prepare for Future Eruptions. Unlike the web video, the exhibit videos are not grouped together under the title *Living in Pele's Paradise* for reasons discussed below.

I made two exhibit videos because visitors enjoy having choices and the power to influence an exhibit, but too many options can be overwhelming (Gammon, *Lessons* 1). Two exhibit videos plus the option to watch a more in-depth version on the web is a manageable set of choices.

First, I shortened the videos. My observations at MOS and the visitor studies I surveyed agree on an important point: visitors rarely spend more than two minutes at a museum exhibit, whether or not it contains a video (Serrell, "Watching" 62). I made each of my videos 2 minutes, 8 seconds long. I cut about 20 minutes of material from the web video, and kept the parts that best match the museums' needs and educational objectives.

In case two minutes is still too long to hold a viewer's attention, I communicate each video's key points very simply in the first thirty seconds, and then explore those ideas in greater detail for the rest (Falk and Dierking, *Revisited* 121; Serrell, "Watching" 60). I made the videos appealing to a wide range of ages and educational backgrounds by including both basic concepts (lava flows can be dangerous) and more complex ones (rapid formation of bubbles in the magma drove the lava fountains). This method of "layering" content can provide shallower or deeper levels of engaging with the exhibit, depending on the user's preference (Hornecker and Stifter 141). Knowing that more visitors will watch the first video than the second (Bronnenkant 8), I included all the key concepts in the first one, without overlapping too much with the second.

I removed all mention of the Hawaiian goddess Pele for exhibit use. I did not want to risk creating the impression that the museum favored a certain religion. This is not to say that religion has no place in a science museum. Religions portrayed through anthropological or historical frameworks can fit well in science and natural history museums. The Museum of Science, Boston, will display fragments of the Dead Sea Scrolls starting May 19, 2013. Religious context will be an important part of that exhibition. But for my exhibit videos, I took out the mythology to reduce the risk of confusing viewers. I had to cut 80% of the material from the web video to shorten the videos, and Pele is not required to explain the science.

The exhibit videos have a higher proportion of spectacular lava fountain footage than the web video has. I packed the exhibit videos full of beautiful visuals to help attract and hold visitors' attention. Each video opens with an especially dramatic shot, because the first few seconds of a video are critical for determining whether a visitor will stay for the rest of the video (Hornecker and Stifter 141). I also included exciting shots throughout the video, because in a busy exhibit hall, many visitors are likely to walk past the video while it is in the middle of playback. I wanted the videos to look intriguing no matter what point they were in the story.

I kept a linear narrative structure, which was easy to do because I designed the web video that way. I made the language even more clear and direct than in the web video.

I removed some unfamiliar terms, such as the name Halema‘uma‘u Crater. The exhibit videos are very short, and research shows that excessive density of concepts can

hurt comprehension and retention. In my job developing live presentations at MOS I follow a guideline of including no more than three new terms in a 20-minute presentation. I kept the term “tephra” because it is so central to the volcanologists’ research methods.

I retained references to familiar experiences such as opening a bottle of soda to help visitors connect with the newer content.

I covered current research and technology and emphasized the goal of helping communities prepare for future eruptions, because museums try to cover current and relevant information.

I gave the exhibit videos as much emotional impact as I could. I kept humorous moments like Bruce’s “tephra down the knickers” line. I provided a pause for contemplation around the sad destruction of the town of Kapoho. The emphasis on helping communities prepare appeals to people’s desire for security and safety.

To benefit users with low vision or other disabilities, I used relatively large font sizes for labels on the interviews and animations. I also removed the music to make the spoken words stand out as clearly as possible. My experience at MOS suggests that the music would not be audible in a noisy museum exhibit hall anyway.

Finally, I propose a possible plan for deployment and evaluation of the video in a museum exhibit. The videos’ success would depend greatly on their physical setting in the exhibit hall. The screen that displays the videos would be part of a group of exhibit components; it would not be engaging by itself. When computer-based exhibits were new in the 1980s, visitors responded enthusiastically (Jones-Garmil 44; Wanning 56). But in

the 2010s, videos are so commonplace that they attract little attention on their own. I have watched hundreds of visitors walk past stand-alone video kiosks at MOS without noticing the screens at all. My exhibit videos would go well with artifacts or interactive devices such as a microscope for viewing rock samples from the 1959 Kīlauea Iki eruption, a car or other object encased in lava from the 1960 Kapoho eruption, an interactive model of Kīlauea Volcano's summit and rift zones, or a historical display with archival photos. It would be important to arrange the objects and labels so that their relationship to the videos would be obvious.

Ideally, the display screen would be large to attract more attention and allow more visitors to watch simultaneously (Teixeira 3). The screen should be positioned to be visible from a range of heights. A large graphic panel above the screen would show the title: "Would You Want to Live on an Active Volcano?" Users would select and control the videos with buttons on a control panel. The interface would be as simple and intuitive as possible.

In the interest of universal design, the control panel would be positioned for easy access from a wheelchair, would have large buttons distinguished by different shapes and colors. The buttons would also be labeled in text and Braille. The videos would be captioned, and any text on the home screen would have a corresponding audio recording. Ideally, audio description tracks would be available for the videos.

Providing seating would greatly enhance the videos' appeal, especially if the screen and seats were set aside from the high-traffic areas of the exhibit hall. Directed speakers would make the video's sound easy to hear from the seating area, but would not

project beyond that space. Ambient sound around the exhibit would be minimized (Serrell, "Watching" 60).

A label with orienting information would help visitors recognize quickly whether the topic interests them. The information should include "who it is for, how long it is, and how it's structured" (Serrell, "Watching" 63). The label could also include a link to the web video. An alternative would be to show the web video link at the end of each exhibit video, possibly above the credits. The link would need to be displayed long enough for viewers to jot it down or take a picture of the screen.

An ideal evaluation plan for the exhibit would include both formative and summative stages. The formative evaluation would involve observing visitors using a prototype version of the video exhibit. The prototype would look as finished as possible, so visitors would treat it like any other screen-based exhibit. Observations could include noting visitors' behaviors and timing their interactions. The computer that runs the exhibit could be programmed to log visitors' button presses and track how frequently each video is watched. Evaluators would also survey visitors about their experiences with the exhibit, focusing on ease of use and whether visitors found the exhibit engaging. The formative evaluation would identify areas that need improvement, and after appropriate revisions, the final exhibit would be installed.

The summative evaluation would be conducted much like the formative evaluation, with tracking and timing studies and visitor surveys, but the survey questions would assess educational outcomes as well as ease of use. A report of the results would be submitted to the agencies that funded the exhibit.

CONCLUSION

Technologies and visitor expectations continue to evolve, and museums' use of video continues to grow (Falk and Dierking, *Revisited* 118). Museums across the world are experimenting with innovative ways to crosslink their physical offerings, such as artifacts and hands-on activities, with web offerings, including content for mobile devices (Bearman and Trant 3; Carper Long and King 43). The growing prevalence of Internet-connected smartphone and tablets, especially among typical museum-going demographics, is opening up new possibilities for expanding the exhibit experience (Black, *Transforming* 37; Kelly 3). Both in the exhibit hall and on the web, people seek out interactive experiences that encourage nonlinear exploration and discovery. They expect reliable information that is organized and presented at a level appropriate for them, and they enjoy chances to socialize with like-minded peers.

Because the use of video is expanding in so many formats and screen sizes, an important trend among museums is to make videos and other digital media easily adaptable for multiple platforms (Gubbins, Rosenthal, and Molla 7). In the 2000s-2010s, informal science education institutions have experimented with cross-platform media experiences to extend their exhibits' educational impact over a longer time than just the duration of the visit (NRC, *Learning* 48). At the simple end, this could involve creating a website that echoes and expands on the themes of the exhibit.

At the complex end, designers could build a whole alternate reality game with opportunities for participation through video and web media, social networks, mobile applications, and real-life experiences such as museum visits. This sophisticated way of

developing a story through many synchronous threads with extensive user participation is called transmedia storytelling. It started primarily as a marketing tool for big-budget films and video games, and has since emerged as a practice in independent projects (Gubbins, Rosenthal, and Molla 6). Full-scale transmedia campaigns are ambitious and may be too expensive for most museum exhibits, but elements of these cross-platform projects have exciting potential.

In my cross-platform project, I took an approach of developing an in-depth video for the web first, and then repurposing parts of that video to make short videos for a science museum exhibit. To make my web video easily adaptable to a museum exhibit, I had to consider museums' needs from the very beginning of the project. I found it helpful to compare the priorities of museums with those of television networks. The worlds of television and museums are different enough that a single video will not fit well in both settings, but a carefully designed video could cross from one world to the other with relatively small changes.

This project has allowed me to combine my knowledge of volcanology, filmmaking, and museum education to make a multi-use video that interweaves scientific and social perspectives on volcanic eruptions. *Living in Pele's Paradise* is a flexibly designed video that represents a possible cost-effective strategy for museums to enhance their on-site and online media offerings at the same time.

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