

TOWARD NEW NARRATIVE CONSTRUCTIONS
AND INTERACTIVITY IN NATURAL
HISTORY APPLICATIONS

by

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DEDICATION

This thesis is dedicated to the innovators that inspired me to push my own limits and to the many people that supported me along the way.

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ABSTRACT

The natural history film genre has long played a critical role in the understanding of science and natural history for its audience. The demands of a ratings-based industry that calls for familiar story structure and minimal scientific depth compromise this position of authority. Time constraints and the adherence to passive spectator narratives further inhibits the transmission of factual information. Interactive media formats present opportunities to reconsider the narrative construction and expand natural history films beyond traditional forms. In this paper, I explore how employing innovations of interactive documentaries, video games, and informal learning environments in the design of an interactive natural history application can remove the current limitations associated with traditional wildlife film and promote deeper scientific understanding.

INTRODUCTION

The natural history film genre has long played a critical role in the understanding of science and natural history for its audience. In particular, the “blue chip” category - natural history films with high production value, dramatic wildlife sequences, and typically large budgets - has established itself as an authority on wildlife and their natural histories. In 2015, the BBC Natural History Unit reported reaching over 300 million people worldwide with its programming (BBC, 2015). During the premiere of the network's landmark series *Planet Earth* (2006), roughly 64 million viewers tuned in for each of the eleven episodes (Discovery Communications, 2010). Dingwall and Aldridge (2006) observed that networks like Discovery and Animal Planet have both the potential to reach large audiences (approximately 80% of US households) and the programming that “may be expected to have impact” on those audiences. They concluded that the natural history genre plays a central role in the public’s perception of biological and environmental issues. They go on to demonstrate, however, that the pressures of appealing to a large, general audience through dramatic narrative and visual spectacle in blue chip films discourage the transmission of scientific information. In the United States, the controversy around issues like evolution, climate change, and genetic modification places additional pressures on television producers to limit scientific language in natural history film production.

Producers often cite this problem of balancing education and entertainment in natural history production as one of the greatest challenges in program development. In an interview with *The Guardian* (Brown, 2014), the former head of BBC’s natural history

unit, Wendy Darke, claims that the network's recent shift toward exploring new storytelling techniques, like the storylines and dramatizations found in *Hidden Kingdoms* (2014), which documents the lives of small animals through fictitious adventure stories and special effects, marks an attempt to appeal to an audience indifferent to facts and figures. Darke goes on to explain that in natural history films dealing with single locations or species, "frequency corrodes value: it's not associated with story" and so the challenge becomes "maintaining a sense of variety and pace in one place."

In his book, *Houston We Have a Narrative, Why Science Needs Story*, Randy Olson (2015) echoes Darke's reasoning:

People can listen to a few facts, but not many. After a while their narrative need kicks in. You can give a lecture that is pure information with no narrative structure, and a nontechnical audience might be able to endure a half-hour or so before walking out, but that same audience will listen to hours and hours of good stories. You could show them a *Breaking Bad* marathon, and they would have no trouble sitting through lots of episodes. Such is the power of narrative (37).

Successful wildlife film producers understand that avoiding repetition and creating dramatic storylines is perhaps the only way to engage viewers in the often monotonous lives of animals. Audiences have little patience for the typical or mundane. Instead, they crave the unique and unexpected. It is the rare or momentous events of an animal's life that drive natural history storytelling: birth, death, the great migrations, the bloody hunts, and the extraordinary escapes. In short, wildlife films have adopted both the sensational methods and the familiar narrative structure of their competition: the family melodrama, sitcom, and action-adventure stories. In addition, blue chip films often focus on the largest and greatest on earth, the never before seen, and the alien worlds to capture the attention of their audience.

Some productions use the talent and influence of popular presenters such as Neil DeGrasse Tyson and David Attenborough to cover deeper scientific concepts. Even in these production, however, the goal, above everything else, is to attract and entertain a broad, dynamic audience by maintaining mass appeal. This is not to say that wildlife films do not or are not capable of educating their viewers. After all, films cannot inform a detached or absent audience. Instead, I argue that as a consequence of the medium, outlet, and passive viewer experience associated with the traditional natural history genre, producers are pressured to conform to narrative and visual constructions that limit the potential for the presentation of factual information. This limitation is evident in the absence of wildlife films that document the natural history of their subjects beyond the vignettes noted above as well as the reliance on sensational narratives and anthropomorphized subjects. If the goal is to communicate in-depth, scientific information about the natural history of wildlife, it is necessary to reconsider both narrative structure and viewer experience.

Interactive media formats present opportunities to expand natural history films beyond forms traditionally limited by linear storytelling, passive spectator narrative, time constraints and medium. In this paper, I explore how applying elements of game design and interactive learning environments to natural history can promote a greater transmission of factual information and alternative narrative constructions. I then examine how employing these techniques in the development of an interactive application detailing the natural history of bison removes limitations associated with the wildlife film genre and offers unique user experiences.

TOWARD NEW NARRATIVE CONSTRUCTIONS

Storytelling is central to every human culture. For over ten thousand years, humans have made sense of the world around them by organizing sensory information into recognizable patterns: stories that can be shared with others who will find meaning in them. We use stories to teach, to entertain, advertise and craft our own identities. Stories are universal, yet the methods of communicating them readily change with new media. Technology often drives the evolution of narrative format. The advent of periodicals and novels, photography, and motion picture cameras each affected the way we tell and experience stories, influencing both the way we interact with a narrative, and how we construct that narrative.

In order to create coherent narratives, television, like previous media formats, frequently relies on linear, sequential storytelling to a passively engaged audience. In the 1950s, television gave rise to new storytelling modes such as sitcoms and live event coverage, and built on earlier forms such as serial dramas. Derek Bousé (Wildlife Films, 2000) explains that although wildlife films are in a genre with distinct styles and conventions, they are essentially variations on the themes used throughout other television programs:

The idea is to present audiences with something recognizable, for which they already have conceptual categories; to be consistent with their previous viewing experiences, to fulfill not thwart their expectations, and to do all this by employing already familiar conventions of realism, not by trying to reproduce reality itself (2).

Bousé argues that wildlife films are essentially products of their environment, one in which spectacle and dramatic storylines win out in a competitive, ratings-based market. He goes on to explore how wildlife films reconstruct reality in order to conform to the conventions of television and viewer expectations, arguing that if a particular story is plausible, the audience will forgive inaccuracy. Bousé's central argument in *Wildlife Films* is critical to our understanding of how natural history films treat reality. His focus, however, is solely on the conflicts that arise in the genre by conforming to television standards. Bousé neglects to address the limitations the medium itself imposes.

Both narrative structure and time constraints in wildlife films necessarily conform to guidelines and pressures set by the industry. Yet the outlets for most wildlife films - the half-hour episode, the hour-long one-off, the feature film - impose narrative formats and time limitations independent of industry regulations or a competitive market. These conditions create an environment that is resistant to the non-linear, often elaborate story structures necessary to thoroughly educate viewers about science and natural history subjects. After all, in order to accurately explain many scientific concepts like natural selection, physiology, or predator-prey relationships, educators often turn to repetition and tangential explanations, avenues avoided by natural history producers. This avoidance of in-depth natural history has led to a routine in the industry. Producers constantly recycle familiar storylines while increasing spectacle. In an interview with BBC News (2015) promoting the highly anticipated, future release of Silverback Films' "Our Planet," Executive Producer Alastair Fothergill sums up the aspirations of blue chip film producers: "Our Planet is going to raise the bar for natural history landmarks. We

will reveal the most amazing sights on Earth and show them in ways they have never been seen before” (1).

This mantra is familiar. Fothergill, who has produced or directed some of the most successful blue chip films of the last decade - *Planet Earth* (2006), *The Blue Planet: Seas of Life* (2000), *Frozen Planet* (2011) - often emphasizes the importance of pursuing the sensational: "People often talk about technology, and I can understand why because they are crucial, and natural history is about revelation, it's about showing things that people haven't seen before" (Coates, 2013).

The central roles of spectacular visuals and familiar storylines in blue chip film have proved successful in gaining wide viewership but are problematic if the goal is to inform viewers on the deeper aspects of natural history. This issue becomes critical when we recognize that blue chip films are a dominant and authoritative source of information about natural history for the general public.

BLUE CHIP, SCIENTIFIC AUTHORITY, AND THE PUBLIC'S UNDERSTANDING OF NATURAL HISTORY

The role of informal modes of science and natural history education has been the subject of increased study in the last decade. Dingwall and Aldridge, for example, argue that the differences in understanding of scientific issues between experts and the public go beyond the presence, or lack of, a formal education. Non-traditional education, learning that occurs outside of schools and universities, is not bound to environments unavailable to segments of society. Much of the general public relies on informal and often self-guided educational pursuits. The accessibility of mass media (newspaper, radio, TV, Internet) and science museums, therefore, plays a vital role in the public's perception of scientific innovation and their understanding of natural history.

Dingwall and Aldridge note the difficulty in understanding all sources of science and natural history knowledge for the general public but argue that, based on audience numbers and the recognition of narrators such as David Attenborough as authority figures, wildlife programming is a significant source of the public's understanding of natural history. This is particularly true for individuals who have finished their formal educations and have minimal contact with wildlife in the natural world. It is possible, in fact, that much of the public's perceptions and expectations regarding wildlife are influenced more by media than by personal experience.

This position of wildlife film as a principal source of information about the natural world is unsettling when considering the informational depth of many blue chip programs. Programs such as *The Hunt* (2015), BBC's 7-part series documenting the

relationships between predators and their prey, rarely provide factual information beyond what is necessary to explain the spectacular behavior being witnessed. Even these explanations, however, often remain superficial. In one sequence in *The Hunt*, we learn that a certain species of octopus has the ability to travel on land between tide pools to prey on unsuspecting crabs, yet we are never led to understand how such behavior would evolve or even what species of octopus it is. Another sequence shows the familiar relationship between a cheetah and its prey, the wildebeest. We learn that cheetahs are the fast land animals on earth, that they can only maintain their incredible speed for short amounts of time, and that scientists are only now understanding how they achieve such speeds. The scene is visually stunning, captured at eye level with the cheetah on a stabilized, high-speed camera system that moves with the action. It is a sequence that showcases the innovative camera technology and relentless ambition of cinematographers to push the visual bar higher. Yet it is a purely emotional sequence. As viewers, we are left with a sense of awe by the grace and agility of the cheetah, conflicted between rooting for it and the baby wildebeest. The majority of viewers will already know that the cheetah is the fastest land animal on earth and we never discover what scientists have learned about a cheetah's physiology that allows such speed.

The Hunt does precisely what its creators endeavored to do: depict the life or death struggle that plays out in animals' lives in ways that have never been seen before and will fascinate audiences until the bar is raised again. This formula has proven effective time and time again in gaining large audiences that may be expected to end the series with a greater appreciation for the beauty of wildlife and the challenges faced

within the animal kingdom. Where do viewers turn, however, when this appreciation inspires the pursuit of additional information? The constructions of wildlife films and the constraints of the medium inhibit scientific inquiry beyond the superficial. Viewers may rely on academics to satisfy curiosity but find the lack of visual spectacle or the overwhelming amount of unfiltered information undesirable.

Bousé's focus on the narrative construction of wildlife films neglects to address the potential for new media. He may be forgiven since, in 2000, the Internet was still relatively young, primarily functioning as a new mechanism of delivery for older media forms: music, movies, text, and radio. Nearly two decades later, however, the Internet is revealing new narrative constructions grounded in a system that is truly interactive and allows the concurrent use of multiple media formats to tell non-linear stories. Frank Rose (2011, 2) uses the term "deep media" to describe the web's potential for taking stories beyond what previous narrative formats permit and blur the line between author and audience. With interactive technologies, producers have the tools to build immersive narrative experiences that encourage passive viewers to become active participants capable of modifying and contributing to storylines. These stories can be crafted in detail impossible to communicate in a single film and are capable of allowing viewers to move into alternate and expanded storylines along the way.

Interactive technologies present new opportunities for wildlife film producers to explore narrative techniques not bound by time constraints or linear story construction. In addition, producers may incorporate both the visual and dramatic devices of blue chip film into interactive systems that then offer informational depth to users who seek to

learn more about the specifics of an animal's natural history. Yet, as Rose explains, we are at the crossroads of inventing the immersion genre and must answer new questions about how we construct narratives in a system where the lines between not just fiction and fact, but between author and audience are blurred.

INTERACTIVE STORYTELLING AND THE QUEST FOR ADAPTIVE NARRATIVE

Narrative intelligence (Blair and Meyer, 1997) refers to the way we make sense of experiences in the world by organizing data into narrative accounts. As authors, film producers make assumptions about the narrative intelligence of audiences to structure stories in a way that is coherent, entertaining, and moving. Educators use the narrative intelligence of students to design curricula that both illustrate and motivate in relation to past experiences and knowledge. In everyday conversation and behavior, we unconsciously draw upon our own narrative intelligence to make decisions or ask questions. Only recently has narrative intelligence been incorporated into computer systems, creating adaptive programs capable of not only responding to user input but developing storylines based on that input and assumptions made about that user's narrative intelligence. The demand for immersive experiences has put gaming at the forefront of intelligent narrative systems, but the everyday presence of powerful mobile devices and computers in our lives is driving experimentation with adaptive narrative in education, entertainment, and advertising. The interactive documentary (i-doc) genre is a product of this experimentation yet is still in its infancy. The question now is, as Rose states: "What if the audience runs away with the story? And how do we handle the blur—not just between fiction and fact, but between author and audience, entertainment and advertising, story and game?" (8-9).

Emerging Trends in I-Docs

The definition of what makes a documentary interactive is a topic of considerable academic debate. Gaudenzi and Aston (2014) broadly define i-doc as "any project that starts with an intention to document the 'real' and that uses digital interactive technology to realize this intention" (1-2). Gaudenzi's concept of i-doc encompasses any digital platform that allows some sort of interactivity (i.e. the web, DVD, mobile devices, gallery installations, museum exhibits, etc.). She identifies i-docs based on the interactive logic involved, not the apparatus used, and proposes four modes: conversational, hypertext, participative, and experiential. To summarize Gaudenzi, conversational i-docs are pieces in which participants 'converse' with the computer system involved. She places video game inspired i-docs that use 3D worlds to immerse viewers in this category. The hypertext i-doc uses the internet-based concept of hyperlinking to give users an exploratory role, often through a video database of some sort. The participative mode relies on web-based conversations between authors and user communities to essentially crowdsource some piece of the i-doc, from research to realization. Finally, the experiential mode involves participants as a function of their immediate surroundings, often using a combination of GPS technology and responsive systems to generate place-based narratives.

Gaudenzi's broad interpretation of i-docs is justified given the fluid nature of the genre. A brief look at the filmography on doclab.org provides a glimpse of this variability. Data-driven and map-based narratives, virtual reality, algorithm-generated stories, and talking art exhibits are all evidence of the widespread experimentation taking

place. While some pieces fall conveniently into one of Gaudenzi's modes of interactive documentary, many, however, are hybrid variations or apply indistinct modes of interaction. For the purposes of this paper, I will avoid classifications as it is likely that the technologies employed in i-doc currently outpace categorization.

Narratives revealed through traditional, spectator-based formats can be powerful and moving, yet viewers have constantly pushed further, to interact with a story's formation. This drive inspired film lecturers to create narratives around silent films in the 1900s, the first computer game, *Spacewar!* (1962), and the recent surge in virtual reality systems. The term "interactive" is not a new one but should be understood in a modern context as virtually every media form requires some method of interaction from readers, viewers, players, or listeners, to create a meaningful experience. The term as it is used within i-docs assumes the user to co-create a given narrative by making decisions that define their experience. In other words, the traditional narrative form exists independently of its audience; the interactive narrative is constructed through user engagement. This is an important and relevant distinction considering the ongoing rise of immersive technologies, like Condition One's VR camera, in natural history film. Immersive films such as *In the Presence of Animals* (2016) and *American Bison* (2016) give viewers a sense of presence in the animals' environments by creating a 360° image, but afford no additional control over narrative structure or pace.

While VR opens new possibilities for interactive story design, it is often used as a novel delivery mechanism for traditional media. BBC's teaser for "Attenborough and the Giant Dinosaur" (BBC, 2016) exemplifies this use of 360° environments. In the four-

minute film, viewers are guided by Attenborough on a conveyor belt alongside the largest dinosaur ever discovered. Through a VR headset, users gain a sense of presence in relation to the dinosaur; they can compare Attenborough to the dinosaur and make assumptions about size or turn away from the action to listen to its footsteps in the darkness. Yet, viewers have control only over their perspective, incapable of determining, for instance, when to move under the dinosaur or which part of its anatomy to uncover. Interactive documentaries, in addition to the promise of greater immersion within a story, give a degree of authorial power to participants.

In 2008, Honkeytonk released *Journey to the End of Coal* (2008), an interactive and immersive web documentary that allows viewers to investigate how migrant coal miners risk their lives in China's forbidden mines. Users play the role of a journalist moving through a region west of Beijing and make choices about how to proceed with their research via links that appear on screen at certain times. *Journey to the End of Coal* relies on a pre-authored database of hundreds of photographs, sounds, and many hours of video. Users are then presented with choices such as walking to a town versus hitching rides. Each choice may move the story forward, in unexpected directions, or present roadblocks such as government officials blocking your investigation. The result is such that different users will likely have unique narrative experiences within the same text.

The process of discovery in *Journey to the End of Coal* relies on assumptions about the user's narrative intelligence. Most people who engage with the documentary will inherently understand the role they are to play: the role of a journalist. Some users will begin the journey already with an idea of the sensitive nature of human welfare in a

developing country, but others may realize this by performing certain actions within the narrative that lead to undesired ends. This process, and the rewards and lessons that result, are essential to immersing users in a storyline with complexity and depth that would be cumbersome in a traditional narrative format.

Making assumptions about narrative intelligence requires knowing your audience and crafting the story to fit their previous experiences. The pursuit of a broad audience in traditional natural history film often means many of these documentaries take a general approach to education in film, minimizing scientific depth to maximize appeal. Responsive systems allow for greater variety and depth in educational content, tapping into curiosity or spectacle as needed. Part of the success of *Journey to the End of Coal* is due to its use of game-influenced interactions such as “either, or” scenarios in which the user must choose the best options based on previous experiences within the game or how they would like to see the story unfold. Games are often credited as the first to implement user-influenced narratives from "choose your own adventure" stories to the complex, cinematic experiences offered by modern systems. Through a better understanding of its trends and mechanics, interactive documentary producers can inherit much from the gaming tradition.

Playing Games with Narrative Constructions

The Global Games Market is a rapidly changing, \$100 billion industry (Newzoo, 2016). Each year, the arrival of new technologies such as mobile gaming, virtual and augmented reality, and state-of-the-art consoles, change the gaming landscape as well as the user interface. The demand for both technological advancement and innovative, story-driven interaction constantly pushes the gaming industry to challenge current thinking regarding narrative formats.

Video games typically fall into one of two narrative formats: traditional, linear narrative and branching narrative. During linear narrative, users experience a sequence of events from beginning to end without altering how the story is constructed. Storylines are identical for each player. Branching narrative allows users to navigate a story that can be modified at various decision points throughout gameplay. Branching narrative first became popular in the Choose Your Own Adventures novels of the 80s and 90s in which readers had a degree of perceived authorship over the story that was unfolding. Modern videos games use elaborate branching narratives combined with autonomous, computer-controlled characters that respond to a player's actions. As storylines grow in complexity, users are presented with more choices and therefore, have greater perceived power over the story. Riedl and Young (2006) note the importance of control:

The degree of user engagement within an interactive narrative lies, to a great extent, with the user's perceived control over the character. The greater the users' sense of control over the character, the greater the sense of presence –that is, users perceive that they're part of the story world and free to pursue their own goals and desires (24).

This correlation between a user's influence over storyline and their immersion within that story is essential to successful game design. Increased control over a narrative, however, often compromises its overall coherence. Storylines depend on structured events that clearly lead into the next. Greater control over how these events unfold, and in what order they do so, increases the potential for inconsistent narrative or unintended endings.

Applying branching storylines to wildlife films presents similar challenges. Natural history applications require narrative coherence as well as educational frameworks that present users with information that is both relevant to the concepts at hand and presents opportunities for deeper learning experiences. This single feature of the web, the potential for virtually endless linking to supplemental information, separates it from all previous natural history mediums. As authors, we must understand, however, that this amount of control may lead users away from intended storylines and compromise their overall experience.

One method of preventing narrative systems from becoming infinitely large, producing redundancies, or leading users to unintended endings, is the use of an experience manager, a computer-based system that checks users' actions against acceptable consequences. For any given user interaction, an experience manager will either advance the story and present new information or intervene. This is called narrative mediation, a system in which an author creates an ideal narrative construction with specific points at which users can progress or alter their experience. These points are monitored by autonomous computer programs that can recognize, respond to, and

influence user decisions. Figure 1 represents the narrative construction where each node (A1) indicates authored content. Dotted lines represent user interactions (i.e. clicking, scrolling, etc.) that trigger the advancement or alteration of the story. At each user interaction, the experience manager checks whether previous conditions (i.e., past clicks or video views) have been satisfied and determines the best subsequent action.

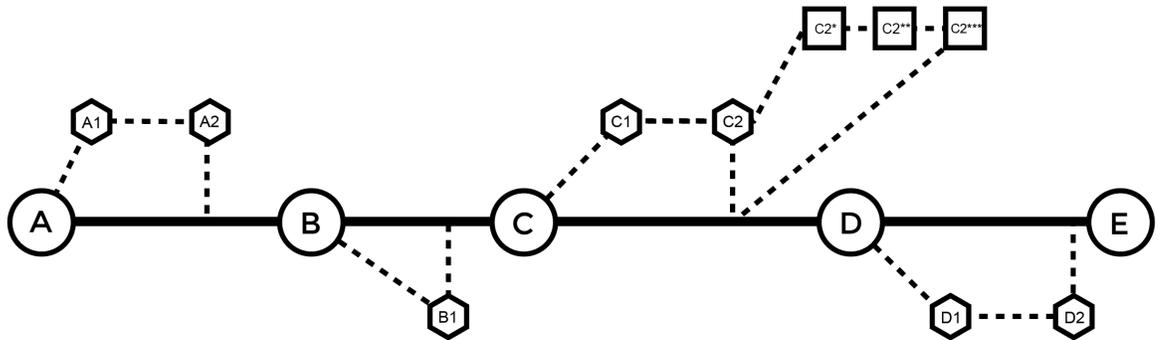


Figure 1: A basic narrative tree where circular and hexagonal nodes represent author-generated content. Dotted lines indicate that user interaction is necessary to access secondary (A1, A2) or tertiary (C1**) information.

By creating narrative maps to understand each possible user interaction, we can anticipate where natural history storylines become incoherent or educational content may be misunderstood or overlooked. The experience manager can then intervene by seamlessly changing the narrative or informational constructions without the user becoming aware of the inconsistency. This use of adaptive narrative allows participants to experience coherent, linear stories in an otherwise non-linear system.

Branching narratives, however, still require manual authorship. While game theorists have noted the potential for systems capable of generating storylines (i.e., Riedl and Bulitko, 2012), this is mostly a futuristic idea. Adaptive narratives in natural history applications are therefore currently limited to the producer's vision, their anticipation of the audience, and how individual users will interact with the system. An understanding of game design opens new possibilities for narrative construction. If the author's goal, however, is to more effectively communicate science and natural history concepts, an additional exploration of interactive interfaces designed for educational purposes is necessary.

Interactive Learning Environments

I have argued that implementing adaptive narrative systems in natural history communication gives users a degree of perceived authorship. This transformation from passive spectator to interactive participant encourages greater immersion within the narrative and promotes a more personalized learning experience. Users now have a role to play in revealing and interpreting narratives. While viewers intuitively understand the passive nature of traditional film formats, the participant's role within interactive media is not always clear. For an enjoyable, productive experience, the user must know when and how to progress the story, and when to become a spectator. The shift from filmmaker to interactive media producer means not only drawing on the mechanics of video games but being flexible and willing to experiment with both the means of communication and the

user interface. Experimentation of this sort has been taking place in informal learning environments around the world for nearly fifty years.

No longer simply archival repositories limited to enclosed animals and artifacts or silent dioramas, museums, zoos, and aquariums have evolved; developing new technologies and educational formats that engage visitors through interactive and personalized design. In these settings, exhibit designers often use interactive devices to introduce and explain scientific concepts. These devices are essentially virtual surrogates for the human authors and therefore rely on users to proceed through all necessary steps to reach the author's intended lessons. Sue Allen (2004) addresses the challenging nature of science museum exhibit design at San Francisco's Exploratorium:

On the exhibit floor there is no accountability, no curriculum, no teachers to enforce concentration, no experienced guide to interpret and give significance to the vast amounts of stimulus and information presented. Without restrictions, visitors have complete freedom to follow their interests and impulses as they move through a public space packed with exhibits all vying for attention. This quality of totally unrestricted choice in what to attend to has huge implications for learning in the museum setting (18).

Because of this user freedom, exhibit designers must create interfaces and stories in such a way that every step motivates users to continue. Audiences of traditional wildlife films understand that they are part of an experience that will reward their time investments with dramatic climaxes and rewarding endings. In an interactive environment, however, users have fewer previous experiences to draw on and therefore have no way of knowing if the reward will be worth the investment. Once again, this

conflict between control over a narrative and that narrative's coherence confirms the need for intermediate systems capable of managing user experiences.

While exhibit designers may employ computerized experience managers in teaching systems, they also rely on physical and graphic design, along with an understanding of user psychology, to create intuitive, compelling interfaces. An Ad Hoc Committee of the National Association of Research in Science Teaching (NARST) stated in 2003 that there are three “important characteristics of learning... First, learning is a personal process, second, it is contextualized, and third, it takes time.” (Falk, 2003). These requirements provide a better understanding of why traditional natural history formats may be unsuitable for educational undertakings. Time has already been noted as a limiting factor. A successful wildlife film, however, is deemed as such only if it has mass appeal. To expect members of a general audience to understand and connect with deeper natural history science without first providing personalized context is unrealistic. Stockmayer (2005) emphasizes the value of context: “Much of what people come to know about the world, including the world of science content and process, derives from real world experiences within a diversity of appropriate physical and social contexts, motivated by an intrinsic desire to learn.” In essence, Stockmayer is arguing that learning environments should tap into the user's narrative intelligence and reward a visitor's curiosity by providing conceptual challenges that can be solved by drawing upon past experience. Interactive devices can be built to provide individual experiences while maintaining the mass appeal. Given the physical nature of most exhibits, however, this appeal depends on the user's ability to intuitively understand both the device's purpose

and methods of interaction. Allen calls this "immediate apprehendability," though a more common term may simply be "user-friendly" or intuitive design.

Though they may not share the same terminology, achieving intuitive design is a goal shared by a multitude of disciplines including product manufacturing, website design, and city planning. One way to achieve intuitive understanding is through "user-centered" or "end-user" design. User-centered design focuses on creating objects that suggest one intended interaction over others. We instinctively know, for instance, that turning a knob clockwise will increase an amount of something, that buttons are for pushing, and flashing icons are a call for action. Donald Norman (1988) called these properties, "affordances," objects we know how to use just by looking at, with no instructions necessary. These affordances reduce the overall cognitive demand required by participants and give them the freedom to focus on conceptual problem solving. The idea of reducing the amount of work that users must dedicate to an application is key to understanding the success of not only exhibit design, but education, and natural history film. The audience wants to be pulled into the story, to be immersed, and the experience is everything.

Interactive device designers must also give thought to the physical nature of participation. Research on visitor learning in museums supports the constructivist idea that interactivity promotes engagement, understanding, and recall of exhibits (Schneider & Cheslock, 2003). Allen, however, found that while interactive exhibits were more successful than non-interactive ones, users only needed limited physical interaction and that a "more is better" approach did not increase user satisfaction. Allen argues that

successful exhibit design depends on establishing a balance between interactivity and coherence; suggesting that increased user control over a system can decrease comprehension of a concept (Allen, 2004).

As we employ interactive devices in natural history communication, we must recognize both the advantages and challenges of interface design. In educational undertakings, in particular, the user experience is vital to the efficient delivery of conceptual building blocks. Interactivity can aid in reducing the cognitive load necessary to grasp often complex theories in natural sciences. It can also complicate simple tasks and compromise intuitive design. If the goal is to provide users with an entertaining learning experience in the form of interactive narratives, it is essential to address the balances that must be maintained.

APPLYING INTERACTIVE STORYTELLING TECHNIQUES TO NATURAL HISTORY APPLICATIONS

My thesis project, *Wildlife Interactive: American Bison (Wild-I)*, is a prototype of an interactive, web-based application that details the evolution, cultural significance, and overall natural history of wildlife by immersing viewers in the world of bison. I have worked as a producer and cinematographer on a number of natural history film productions including *Florida's Forgotten Coast* (2015), *America the Wild* (2012-2014), and *Epic Yellowstone* (Est. release, 2019). My current involvement in these productions, along with past experiences in computer programming and a formal education in zoology, motivated me to explore how natural history education might be approached through interactive media applications.

Wild-I is an evolving approach to addressing the limitations of scientific depth in wildlife film by employing interactivity and responsive design alongside visual spectacle. The production of such an application is aided by drawing on the innovations of a diverse range of media formats. Natural history films, science museums, and gaming systems are sources of this inspiration. In the production of *Wild-I*, I developed a sense for how these technologies could enhance user immersion and encourage deeper scientific inquiry.

Narrative Mapping and Experience Management

The application of branching narratives and alternate storylines to natural history applications is an important aspect of creating individual user experiences. In video game design, branching narratives give users a degree of perceived authorship. Computer

controlled characters react to user actions and storylines progress accordingly. Programmed experience managers built into the gaming system monitor user actions and attempt to direct storylines in ideal directions by incentivizing or intervening when necessary. A similar use of branching narratives can be modified and implemented in natural history applications.

One goal of *Wild-I* is to offer detailed explanations of scientific concepts beyond what would be reasonable in a traditional film. At specific points, users are given the option of navigating through additional layers of information that more thoroughly explain the natural history of bison and present related scientific concepts. Like game designers, we can use narrative maps to represent interactive storylines and judge the coherence of a particular application. Figure 2 is a narrative map representing one section, "Behavior," within the *Wild-I* application. Circular nodes (1,2,3, etc.) represent informational content that exists independent of user actions. By scrolling from beginning to the end of the page with no additional interactions, a user would be part of a coherent, yet conceptually shallow narrative. Only by performing required actions (α) such as

clicking, hovering, or typing, can the user access secondary (A1, B1, B2) concepts or video sequences.

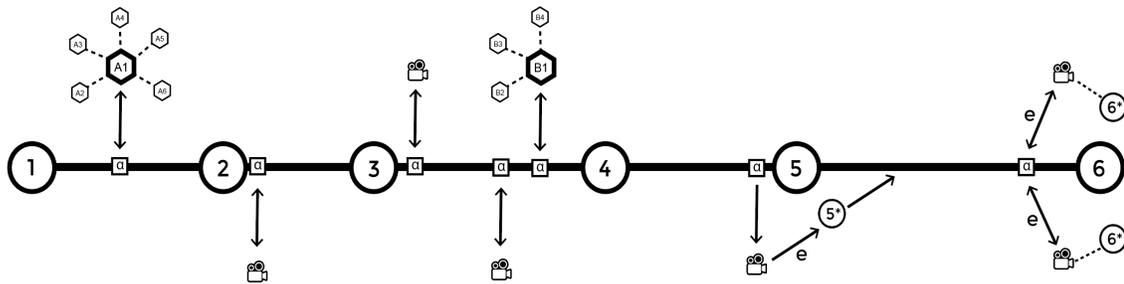


Figure 2: A narrative tree representing one chapter, *Behavior*, in the *Wild-I* application. Circular nodes represent authored content available without user action (α). Hexagonal nodes represent user-activated content. “e” represents conditions that must be met before proceeding to an element.

The purpose of branching concepts in *Wild-I* is to give users a level of narrative control. As the number of decision points in an application grows, however, the author must not only produce a larger amount of content but develop that content such that users have a coherent experience. An experience manager, built into the software of the application, monitors user input to ensure comprehension of important concepts and avoid redundant information. This is done by creating conditions that must be satisfied before the information is presented. Looking again at Figure 2, for each some actions, the experience manager checks that certain conditions (e) have been met and proceeds accordingly. The last point of action, for example, triggers one of two videos depending on whether the user clicks on the predator (wolf) or prey (bison). The experience

manager then dictates which video to play - (1) the wolves successfully hunt a bison or (2) the bison escapes - and the appropriate information to display when it is complete. This is conditional programming and is the foundation of experience management systems that identify and respond to user input.

The Importance of Experience

While offering deeper levels of information in *Wild-I* was an important part of its design, it still relies on making an emotional connection to participants. Like in blue-chip programs, much of that connection is dependent on providing powerful visuals supported by compelling editing and sound design. Each section in *Wild-I* depicts bison in a unique, and sometimes changeable, environment. Bison, humans, and other animals within the app move in subtle ways (i.e. breathing, moving fur, tail twitching). All of this helps to increase Wild-I users' sense of immersion.

Immersive visuals, however, are only part of establishing emotion connections. The editorial structure of traditional wildlife films builds tension and creates dramatic arcs as desired by the author. The active spectatorship of interactive media gives users a degree of editorial control. Dramatic climaxes can, therefore, be untimely or tension misplaced. As authors, though we may construct linear narratives with ideal arcs and conclusions, we relinquish much of this control to the interactive users. This aspect, perhaps more than any other, sets the experience of interactive media apart from that of traditional films.

I attempted to address this challenge in *Wild-I* in two ways: First, I incorporated short film pieces that emerge as part of the experience. While many of the individual animals in the application are animated, more traditional film pieces reveal the dramatic aspects of a bison's life when movement is key: mating rituals, play, and wallowing behavior. Second, an interactive soundtrack underscores much of the application. As the user scrolls through a page, the soundtrack, controlled by the experience manager, evolves in accordance with the new environment. New layers of the soundtrack are introduced when the user acts on interactive opportunities. When approaching points including video sequences, the soundtrack builds and seamlessly becomes the video's score.

While creating story arcs and building dramatic tension in interactive media is certainly challenging, experience management systems allow media producers to retain some authorship over a story's pace. Advanced experience management systems beyond what is implemented in *Wild-I* have the potential to react to user tendencies and generate unique, compelling narratives. As interactive media progresses, it may soon be necessary for programmers to work alongside producers and editors in natural history applications.

Interactive Features and the User Interface

Experience managers offer a means of maintaining emotional engagement between the user and the interface. The process of actively participating in interactive media, however, may break that connection. One way to encourage user immersion within an interactive narrative is through a user interface design that incorporates

discovery and surprise as part of the experience. Csikszentmihalyi and Hermanson (1995) argue that interaction at ideal museum exhibits is initially driven by curiosity and interest, then maintained via a “flow” state, where users become fully immersed in an exercise. For this to happen, exhibits require a level of challenge that matches the person’s skills and a distinct set of goals and rules.

In *Wild-I*, and I believe in any interactive application, it is necessary to achieve these flow states through a constant cycle of interaction, discovery, and reward. The Connected Worlds exhibit (nysci.org/connected-worlds/) at New York’s Hall of Science, for instance, exemplifies how flow states can be employed by rewarding children’s curiosity-driven interactions with appropriate responses. The exhibit’s combination of physical and digital interactions educates users about ecology and sustainability. The different resource demands of plants, for example, is communicated when users choose whether to plant a small or large tree in the digital world.

One example of these concepts in *Wild-I* is the Habitat chapter. In this section, users can first investigate how bison interact and adapt to their habitats during the summer months. As users traverse the page, they will eventually discover that they have the ability to change the seasons. As the temperature drops, the landscape transforms into a winter scene, and we see that the bison calves have grown into adolescents.

Interactivity not only gives users control over a system, but it also encourages exploration and experimentation. Once this is realized, it is the job of media designers to reward this participation to create flow states and maximize user immersion. That immersion can be interrupted, however, by users attempting to interact with unresponsive

elements. It is, therefore, also our job to understand which features users will interact with and create an intuitive design that encourages interactions with intended components and discourages it with others. In *Wild-I*, I incorporated what I believe are standardized interactive cues from game and web design. Flashing icons, for example, are calls to action. Where interaction may not be intuitive, such as clicking on a species to reveal more information, the experience manager can define these rules through visual prompts presented early in the application.

CONCLUSION

The educational limitations of wildlife film are evident in the lack of scientific depth in genre-defining series. Blue chip film producers are obligated by industry standards and the pursuit of mass appeal to recycle familiar dramatic narratives and minimize scientific discussions. Such constructions increase the universality and shelf-life of programs, but are problematic in a genre that is regarded as an authority on natural history science. I have argued that instead of reconsidering the narrative and informational structure of traditional film, media producers can benefit from exploring new media constructions. The interactive documentary genre, though still experimental in many ways, is pushing into new territories where the line between author and audience is blurred. One thing is clear: audiences want to be immersed so they feel as if they are truly a part of the story. Interactive media producers can draw on the mechanics of the video game industry and informal learning environments to create individualized experiences in natural history communication. The prospect for these technologies is exciting, but to use them, it is necessary to reconsider how we approach narrative constructions and develop emotional connections with viewers. Wild-I is a testament of the challenges ahead, but it is also an examination of the versatility and potential power of interactive applications.

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