CHILDREN AND CONSERVATION AT ZOOS:

WHAT PART DO SIGNS PLAY?

by

Sarah Haenke

A Thesis
Submitted in partial fulfillment
of the requirements for the degree
Master of Environmental Studies
The Evergreen State College
December 2016

This Thesis for the Master of Environmental Studies Degree

by

Sarah Haenke

has been approved for

The Evergreen State College

by

_____

Kathleen M. Saul MA, MES
Member of the Faculty

_____

Dec. 12, 2016

ABSTRACT

Children and Conservation at Zoos: What Part do Signs Play?
Sarah Haenke

This thesis examines the impact that signs have on children at zoos. Specifically, I used surveys and observations to determine if children read, understood, or otherwise interacted with signs at the Oregon Zoo. My research team and I surveyed and observed 115 children between the ages of four and 13 about their knowledge about conservation and sign usage. Six hundred and twelve children were observed separate from the survey process to examine peer and familial interactions that occur at signs. I found that the majority of children do not understand the concept of conservation, despite many of the children surveyed visiting multiple zoos prior to the survey. Also, only approximately 10% of children observed examined zoo signs and the average time spent was under 15 seconds. This presents an interesting conundrum due to the potential for education about conservation and the volume of visitors that zoos present. Encouraging parental interactions at signs may lead to an increase in conservation awareness in young children. Effective zoo signs encourage interaction, contain a small amount of text with a concise message, are colorful, easily visible, and not in the path of foot traffic.

Table of Contents

List of Figures ..... ***V***
Acknowledgements ..... **VI**
Introduction **1**
Literature Review **4**
Informal Learning *4*
Why Focus on Children? *7*
How Children Learn *10*
Zoos and Conservation *12*
How Zoos Educate Visitors *17*
Focusing on Signs *19*
Methods **22**
Study Site Selection *23*
Sign Specifications *27*
Surveys *32*
Results **37**
Child Participant Demographics *37*
Answers to Questions about Child's Beliefs about Protecting Animals and the Environment *40*
Child Self-Reported and Observed Sign Data *44*
Predators of the Serengeti *45*
Polar Bear *47*
Condors of the Columbia *54*
Observational Data of Interactions *57*
Discussion **62**
Thesis Question Results *62*
Study Sign Attractiveness *64*
Additional Results *67*
Recommendations and Final Thoughts *69*
Bibliography **71**
Appendices **76**
Appendix A: Sign Specifications *76*
Appendix B: Surveys *87*
Appendix C: Child Observation Sheet *92*

List of Figures

Figure	Title	Page Number
Figure 1	An Interpretive sign that Exemplifies the 3-30-3 Rule…….	20
Figure 2	A Visual Representation of the Different Locations of Signs……..	30
Figure 3	Two Signs that Together Include Every Variable in this Thesis……..	34
Figure 4	Sign Posted on Tables Used to Attract Children……..	36
Figure 5	Photograph of Label used in this Study…….....	36
Figure 6	The Ages of All Study Participants……..	39
Figure 7	The Ethnicity of All Study Participants……	40
Figure 8	Study Question “Do you Think Animals Need our Help?”……..	43
Figure 9	Study Question “Is This Important?”…….....	44
Figure 10	Survey Question “How Can you Help?” Before and After……..	45
Figure 11	Predators of the Serengeti Study Signs and Location……...	47
Figure 12	Polar Bear Study Signs and Location……...	49
Figure 13	Condors of the Columbia Study Signs and Location……...	56
Figure 14	Eagle Canyon Study Signs and Location…….	60
Figure 15	African Rainforest Study Signs and Location……..	60
Figure 16	Amazon Flooded Forest Study Sign and Location…….....	61
Figure 17	Interactions at Signs Based on Age and Gender……...	62
Figure 18	All Study Signs with Their Sign Numbers…….....	66

Acknowledgements

I would first like to thank my thesis reader Kathleen Saul for her continuous support and genuine enthusiasm. I have never met an educator so willing to help as Kathleen. Even before she was my reader, her support, patience, knowledge, and caring nature has lead me to success time and time again. Her door is always open and I could not have asked for anyone better to mentor me during my thesis.

I would like to acknowledge Grant Spickelmier, Education Curator at the Oregon Zoo, for allowing me the honor of working with such a wonderful organization. His timely responses and flexibility were greatly appreciated.

I am eternally grateful for my two friends, and research assistants, Kennedy Krossen and Quynnessa Kauffman for their tireless work during the hundred degree weather, endless amounts of support and thoughtful discussions. Without their participation and input, my surveys and observations would not have been successfully completed.

I would also like to thank my mother, Judy Haenke, and brother, Daniel Wood, for providing me with encouragement at every hurdle during these last two years and especially during the process of writing this thesis. I would not be where I am now if I did not have these two in my life.

I owe my deepest gratitude to my wife, Victoria. I have always known that I can accomplish whatever I set my mind to as long as she is with me. She assisted me with every step, from data collection to proofreading and beyond. With her encouragement I started my graduate career and with her patience, understanding, and gentle prodding when necessary, I have proudly finished it.

Thank you.

Sarah Haenke

Introduction

Imagine spending an afternoon with your child at the zoo. You visit the elephants, listen to a keeper talk about the tigers, and watch the caracals. Did you learn anything? According to recent research, yes, you have increased your knowledge of the animals, or ecosystems, represented at the zoo, you have a higher likelihood of reporting positive beliefs about conservation and you may even change certain behaviors to help animals thrive (Olukole & Gbadebo, 2008) (Haydon, 2014) (Taylor E. W., 2006). But what about your child? Unfortunately, your child has rarely been studied in scientific research. Research that focuses on children usually examines parent-child relationship and communications instead of the learning of the children. This work is especially important for zoos where millions of children visit annually.

Moss et. al., Jensen, and Randall have conducted on the effects that zoo animals and personnel have on adult visitor's beliefs about conservation (Moss, Jensen, & Gusset, 2014) (Jensen, 2014) (Randall, 2012). However, little research has been completed on the importance that zoo signs play in changing these beliefs. Signs play a unique role in a zoo environment. Depending on the season or even the time of day, an animal may be off exhibit or asleep. Keeper talks suffer from similar issues of not always being available. Most talks occur only in specific areas at scheduled, intermittent times. Visitors can spend an entire visit without speaking or listening to a talk by a zoo keeper. Signs, on the other hand, always available to visitors. Zoo signs can inform visitors about a wide variety of topics, from animal husbandry to conservation actions. An effective sign can get the message across in under a minute, while an ineffective sign may not get the message across at all (U.S. Forest Service Department of Argiculture, 2015). However, unlike talking with keepers, if a visitor doesn't understand the message of a sign, they

cannot ask questions or engage in conversation. People who cannot read a sign may just walk away.

For my thesis, I examined how well children could read and understand zoo signs. I chose to specifically focus on young children because children are rarely studied in zoo literature (Jensen, 2014). Children can also help us evaluate if signs are overly complex. If a child is able to read and comprehend a zoo sign then English as a Second Language (ESL) and adult visitors should be able to comprehend it as well (Freeman, Feeney, & Moravcik, 2011). For the purpose of this thesis I am defining children being between the ages of seven and twelve. Most seven year olds are able to read and write which was necessary for my methods to be successful. The upper limit of twelve is due most zoos categorizing adults as 13 or older so I am keeping in the limits of what a zoo classifies as a child. The Oregon Zoo was chosen due to its proximity to The Evergreen State College, its popularity (Oregon Zoo, 2015) and the work the zoo continues to do for both children (Shaping Outcomes, 2014) and conservation (Oregon Zoo, 2015).

My previous work found that sign about conservation in zoos have an average of a 10th grade reading level (Haenke, 2015), which may prove difficult for young children. Additionally, Zoos are known as centers of conservation and education (Jensen, 2014) (Taylor E. W., 2006) and I wanted to examine how much information about conservation was understood by the visiting children. I wanted to see if there was some connection between signs and knowledge of conservation. My research questions for this thesis are;

1) Are children, ages seven through twelve, reading the sign at the Oregon Zoo?
2) Do these children understand what they are reading?
3) Do these signs help create positive conservation beliefs in these children?

The next chapter of this thesis will comprise a literature review. The literature review will focus on the current scientific literature and provide background for the significance of this topic as well as the work already completed. The first topic within that section is informal learning and its importance in modern society. Informal learning occurs outside of formal learning environments, such as schools, and can be as important in conveying ideas and information as formal learning environments. Studies have examined how well informal learning occurs within zoos, parks, and museums, with both adults and children. The thesis then shifts to examining the current literature on children are learning. Several studies delve into how children learn within an informal learning environment and how children can help other children, as well as adults, gain understanding of new and complex ideas. These studies are a small portion of the literature available and this thesis presents several arguments on why children are an important population that needs research. The literature review veers slightly, to discuss how effective zoos are at educating their visitors and the methods they use to communicate their unique messages. Finally, the literature review will end with background information about signs in zoos, their purposes, uses, and possible influence in altering the beliefs of visitors.

The Methods chapter begins with a complete walkthrough of Oregon Zoo to identify study signs and study signs based on multiple criteria. Six separate sites were chosen. These sites were diverse in their size, amount of signage, shape and size. From these study sites, 2-3 study signs were selected based on multiple criteria. The second section outlines how the children were recruited and how the two surveys, an entrance survey and an exit survey, were administered.

Over a hundred children participated in the survey. About 40% of these children engaged with the study signs, spending about 14 seconds on average. The Results chapter goes into detail about each of these interactions. This chapter then explains a second set of methods focusing on

the interactions that occurred at the study signs. These methods yielded over 600 observations. The Discussion chapter explains how the lack of interaction at the study signs is significant and recommends ways to improve involvement.

Literature Review

The purpose of this chapter is to delve into the current scientific literature on topics that relate to this thesis. This chapter begins with a section on informal learning: its definition, challenges, and benefits. The next section explains the lack of research on children in this field and why focusing research on children is beneficial to multiple groups. Next, this chapter also examines how children learn. The fourth section introduces zoos and explains the ways in which they aid in conservation. This is followed by a brief explanation of how zoos can interact and educate visitors. The chapter ends with an explanation of how effective signs are created, which leads into the Methods chapter.

Informal Learning

Not all learning occurs within a classroom or other formal setting. Any experience that creates a sensory-rich and meaningful experience can lead to learning (James & Bixler, 2008). This unsystematic and unorganized type of learning, known as either informal or non-formal learning, accounts for the majority of a person's lifetime knowledge (Sevdalis & Skoumios, 2014). Experiences that are the base of informal learning are wide and variable, often non-verbal, social, emotive, aesthetical and/or motivational (Rodari, 2009). Informal learning caters to the individual's personality, what they find interesting or moving, and focuses on the present time and location (Taylor E. W., 2006). Crafting this type of highly emotive learning, however, can be difficult.

The complexities of informal learning present many unique challenges. According to Taylor, (2006), the act of active participation in learning can be one of the most difficult challenges to overcome in informal learning. This results from the voluntary nature of informal

learning. Distractions can also cause a person to disengage from learning (Taylor E. W., 2006). An adult listens to a lecture about conserving polar bears at the zoo, for example. He listens and analyzes the zoo keeper‘s speech. About halfway through the talk, he becomes disinterested and disengages with the keeper and instead thinks about something else. The keeper shows a graphic of current polar bear populations which catches his attention again, causing him to engage in learning. However, the polar bears enter their enclosure which cause his children to excitedly point and talk which distracts him from keeper’s lecture. This is an example of a single male who has his own interests and prior knowledge.

The varied assortment of the learners is a key characteristic of informal learning and presents another challenge. Learners have different levels of prior knowledge, experiences, skills and ages. Young learners can present unique problems due to their smaller size and less developed physical ability and motor skills (Taylor E. W., 2006). Going back to the example of the polar bear lecture, the adult male listened with his three children. The youngest, a four year old, needed to be held by her father to see the keeper but doesn’t have the vocabulary to understand a majority of the lecture so she disengages herself and instead plays with a toy. The middle child can understand most of the vocabulary but he is shorter than the surrounding adults and can’t see any of the learning aids. He becomes discouraged and jumps, trying to see but ultimately wiggles in closer, in an attempt to see the learning aids, losing much of the lecture in the process. The oldest is intensely interested in polar bears and the conservation. She actively listens to the keeper and is only briefly distracted by the entrance of the polar bears. The differences between these four learners will dictate how engaged they are in the keeper’s lecture and how much learning occurs. Even with its difficulties as described above, informal learning can enhance overall knowledge as well as learning that occurs in formal settings (Rodari, 2009).

Formal and informal learning are best described as two ends of the same spectrum. Neither is better at dispensing knowledge, both will allow a for learning the same information at the same rate (Kanhadilok & Watts, 2014), but they do have key differences. At the extreme end of the formal learning spectrum, instructors inform a mostly uniform group of learners with no to little feedback from the learners to the instructor (Taylor E. W., 2006). An example of this may be some primary education classrooms, where students are of similar age, abilities, prior knowledge, and skills are taught from a curricula where deviation by the students is limited. This is in contrast to informal learning where instructors act more as facilitators guiding student learning with heavy involvement from the learner. This type of heavy involvement by the students has been shown to lead to an increase in student learning, curiosity, attention, and willingness to observe, discuss, and question more than in formal environments (Randall, 2012) (Baur, 2011) (Stanford, 2014) (Haydon, 2014) (Monk, 2013). Despite the differences between formal and informal learning, most instructors agree that the two have a complementary, rather than incompatible, relationship. Formal science curricula, for example, benefit greatly when students have gained prior knowledge though informal learning avenues (Sevdalis & Skoumios, 2014), such as zoos or aquariums.

Museums such as zoos and aquariums, which are often referred to as living museums, utilize informal learning to educate visitors. Although rarely studied in the United States, studies in Europe have shown positive associations between informal learning in museums and increased learning in visitors (Taylor E. W., 2006). Given the topics raised in scientific museums (conservation, resource depletion, habitat loss and biodiversity, ect) the flexible structure of informal learning helps visitors learn about complex concepts (Xanthoudaki, 2013). When exposed to environmental programs, such as those found in museums, a person's

environmentally responsible awareness and behavior increases (Randall, 2012) (Skibins, Powell, & Hallo, 2013) (Stanford, 2014) (Swanagan, 2000).

However, studies have also shown this to be difficult. As previously mentioned, visitors come to museums with their own experiences and level of knowledge (Leinhardt, 2014) (James & Bixler, 2008). If a person has a low level of knowledge or had negative experiences with scientific endeavors in the past, then attempting to teach them about science in an informal learning environment may be difficult. This can overcome by instilling confidence in the learner (Rodari, 2009) or by presenting the information in an easily obtainable manner with concepts and information dispersed throughout an exhibit or museum (Jant, Haden, Uttal, & Babcock, 2014) as opposed to a single deposit of highly technical knowledge.

However, most experiences in science exhibits are static (Monk, 2013), meaning that the learner must seek out and interpret the information for themselves. Due to differences in learner preferences and interest, different types of engagement are needed for a successful learning experience. (Schreiber, 2013) (James & Bixler, 2008). But what is the best way to help visitors become engaged? This thesis proposes that catering exhibits towards children greatly benefits the potential learning that occurs within an exhibit.

Why Focus on Children?

This thesis focuses on how well children engage with, and comprehend, signs posted throughout a zoo. Most published literature on zoos and learning within zoos features studies that focus on adults as research subject and some exclude children entirely (Jensen, 2014). For example, in her study on exhibit label effectiveness in UK zoos, for example, Martin separates her study population into three groups: lone adults, two adults, and families (Martin 2012).

Children are completely excluded in Skibins et.al's study on charismatic megafauna's influence in conservation behaviors in Australian safaris and zoos where the average age of the study group was 38 (Skibins, Powell, & Hallo, 2013). And Kanhadilok and Watts' paper on adult play-learning examine how children can assist adult learning. While children were not excluded from this research they were not the focus but treated more as a variable (Kanhadilok & Watts, 2014).

As previously mentioned, an exhibit that excites and engages children will be more accessible to a wider breadth of adults. Writing for children means creating signs that contain simpler language, with shorter sentences, fewer abstract ideas and with a single main theme or idea (Ho, 2000). Given these limitations it would be expected that signs designed for children would be overly simplistic and unable to tackle difficult concepts, however, this is not the case. Children's literature has the ability to raise complex or sensitive subjects. Educators frequently use children's stories to teach students about culture, myths, and legends from other cultures and it can ease students into sensitive topics, such as slavery, war, and poverty (Freeman, Feeney, & Moravcik, 2011). One of the best examples is the collection of short stories known as *Aesop's Fables*. These stories rarely reach more than a page in length and contain simple, colorful language and many editions contain bright full-paged pictures. The morals in these fables such as 'greed destroys the source of good' from the story "The Goose Who Laid the Golden Egg" and 'be satisfied with what you have' from "The Dog and His Reflection" are written as much for children as they are for adults (Aesop, 1999).

Focusing on children may also create more effective exhibits for adults as well. Since children have a smaller vocabulary than adults they are frequently used to test for sign effectiveness for ESL visitors in museums (Freeman, Feeney, & Moravcik, 2011) (Aggett-Cox,

2013). Children may become conduits to improved learning within family groups. A school-aged child, for example, may learn about how palm oil can endanger the lives of gorillas. She rushes home after school and explains sustainable palm oil to her older sibling and parents. Her parents, avid gorilla enthusiasts, only buy sustainably processed palm oil and encourage others in their peer group (siblings, cousins, friends, colleagues, ect) to do the same. Adults can also gain knowledge by guiding children through exhibits, asking them questions, telling stories, helping them form connections, and expanding upon the information in sign (Kanhadilok & Watts, 2014).

Children account for a majority of zoo visitors. One survey found that 74% of visitors to a European zoo ranged between newborn and 15 years of age (Olukole & Gbadebo, 2008); another survey found that 51% of groups that visit zoos include children (Faulk, Heimlich,, & Foutz, 2009). In addition, within the last ten years, 12 million school aged children visited Association of Zoos and Aquarium (AZA) accredited zoos on field trips (Randall, 2012). For many children, specifically those living in urban areas, field trips or other visits to a zoo will be the only time they interact with animals other than pets (Stanford, 2014).

These trips can be a great chance for informal learning to take place. To take full advantage of the small amount of time children spend at the zoo, both during the single visit and during their pre-adult lives, we must understand that children and adults do not learn or act in the same ways in an informal setting, such as a zoo. Children rely on signs, learning aids, parents, guardians, facilitators and peers to help learn (Whitehouse, et al., 2014) (Kristensen & Nielsen, 2011). Adults usually come to the zoo with a larger prior knowledge base than children. They also have an improved vocabulary, which makes signs and keeper talks more comprehensible, and more resources at their disposal. If, for example, an adult wanted to learn more about

rainforest deforestation they would be able to download information, spend time at a library doing research, or otherwise use their time and privileges as adults to acquire additional knowledge. This is not true of children who, for the most part, do not have the same resources at their disposal.

How Children Learn?

A child's specific experiences, interests and prior knowledge play a pivotal role in determining what a child learns in an informal learning setting (James & Bixler, 2008). Some of the most powerful learning experiences occur when a child interact with his/her peers. For example, child A (Jamie) starts work on a puzzle designed for him to move the elephants around in their enclosures using gates. As Jamie starts to work on the puzzle, a second child (Sam) approaches and observes Jamie. Sam then joins Jamie and the two of them start a dialogue about the puzzle and move the pieces around in an attempt to complete it. While working together, they chat about their own previous experiences with elephants, about puzzles similar to the one they are completing, and asking about their work with the puzzle (Why did you move the blue one there?).

Interactions between children have been shown to increase the learning of all of the children involved. Students tend to be more engaged when they observe their peers interacting with objects or learning (James & Bixler, 2008). By asking questions, specifically why, how, and what questions, exchanging ideas, experience and solutions, both children can learn from each other (Dooley & Welch, 2014) (Jant, Haden, Uttal, & Babcock, 2014) (Turner & Krechevsky, 2003). James and Bixler's study found that child to child interactions occur more frequently than child to adult interactions. They also reported that children were unaware of adults when actively

engaged in an informal learning environment with other children. Children engage more frequently with peers they already know, such as classmates or family members, than children they do not know (James & Bixler, 2008). Since most children visit zoos and aquariums on school trips or with their families, the increase in child to child interaction can boost engagement and lead to memorable learning moments within these museums. Although children engage with each other more than they engage with adults, the effect that adults, especially parents, have on their children's learning is significant.

In fact, parental interactions significantly influence what a child learns in an informal learning environment (Nadelson, 2013). A 2014 study by Dooley and Welch examined children's interactions with their parents inside a children's museum. They specifically compared the knowledge gained by children who interacted frequently with their parents, or other caregivers, and those who did not. They found that after two weeks children who frequently interacted with their parents retained significantly more information than the children who did not. (Dooley & Welch, 2014). Parents usually provide their children with a feeling of security and familiarity which can encourages children to be more outgoing and seek out information more freely (James & Bixler, 2008). Although the interactions between parents and their children are unique and depend on the family structure, children usually begin the interactions by asking questions, for company or for physical assistance. These child-led interactions then lead to an increase in communication between parents and children (Dooley & Welch, 2014). Parents also offer their own perspective, knowledge, and experiences to their children which can greatly increases children's learning (Jant, Haden, Uttal, & Babcock, 2014).

Zoos and Conservation

Most museums specialize in a single topic. An art museum, for example, usually features a few styles of art, painting, ceramics, and pottery, and visitors to the museum tend to be people who like those types of art. Zoos, on the other hand, attract a much broader audience due to their diverse appeal (Olukole & Gbadebo, 2008). Most zoos contain animals from different parts of the world, including tiny insects and fish as well as traditional charismatic megafauna. Many even exhibit unique plant life. Zoos may contain areas specifically catering to children, spanning multiple outdoor acres where running and excitement are the norm. Zoos easily accommodate hundreds to thousands of visitors at a time, from families with young children to a single adult researching animal behavior.

Worldwide, over 1,700 million people visit just the World Association of Zoos and Aquariums (WAZA) accredited zoos and aquariums yearly with United States making up 175 million of this figure (Braverman, 2011). The total number of visitors to zoos can be considered higher than this figure because not all zoos and aquariums have been accredited by the WAZA. Zoos contribute over $350 million to conservation project yearly (Fa, Gusset, Flesness, & Conde, 2014). This money goes to a multitude of different projects worldwide. The National Pollinator Garden Network, for example, educates the public about the decline of pollinators and helps fund schoolyard and community pollination gardens (National Pollinator Garden Network, 2015). Another example is FrogWatch USA. This group uses volunteers in the community to count frogs which helps researchers track population data (Association of Zoos & Aquariums, 2016). These projects are costly endeavors for zoos because they are not publicly funded and the money a zoo makes needs to be budgeted between the needs of the zoo (salaries, cleanliness, and upkeep), the needs of the animals (food, veterinary care, enrichment activities), the needs of the

visitors (facilities, water, space), and various other expenditures (breeding programs, advertising, addition or expansion) (Junhold & Oberwemmer, 2011).

The emphasis of zoos has changed within the last few decades. Previously, recreation, education and research were the focus of zoos but this has shifted to conservation. WAZA accredited zoos, for example, rank conservation and educating visitors about conservations to be some of their most vital roles (Smith, Broad, & Weiler, 2008). The change of focus can

> …be attributed to many factors, including the rise of the animal rise movement and some factions of the animal welfare movement, the ensuing public debate about the moral justification of zoos and the publication of the World Zoo Conservation Strategy (IUDZG/CBSG,1993), which called for zoos to become centres (sic) of conservation. . . (Smith, Broad, & Weiler, 2008, p. 544).

While all zoos are obligated to protect biodiversity it is a legal requirement in some countries (Fa, Gusset, Flesness, & Conde, 2014). The Zoo Licensing Act of 1981 covers the legality of licensing a zoo in the UK. In 2003 this act required that zoos had to indicate how they would be implementing a limited set of conservation measures in their zoo before they were given licensure. Conservation measures include educating the public, practicing good animal husbandry, breeding and, when appropriate, reintroducing animals into their native habitat (Legislation.gov.uk, 1981). In the United States, licensing of zoos falls under two broad acts, the Endangered Species Act and the Animal Welfare Act, neither of which require zoos to practice any forms of conservation (Grech, 2004) (Department pf the Interior U.S. Fish and Wildlife Service, 1973) (United States Department of Agriculture, 2013). However, the AZA, which is a voluntary organization, does require its members to keep an up to date record of their conservational measures, goals and outcomes (Association of Zoos & Aquariums, 2017).

In addition to conservation measures, zoos can provide many benefits both to the general public and to the scientific community. They offer a multitude of resources for researchers who can use zoos to conduct research. This research may be translated into peer-reviewed journal articles, books, technical reports, presentations (Pereboom, Leus, & Van Elsacker, 2011). One example of a peer-reviewed journal article derived in this way examined the genetics of six iguanas that are critically endangered. The authors had been given access to the San Diego Zoo for breeding purposes, but the lizards may have been related. The researchers examined the genetic variation of the six lizards to prevent inbreeding of the iguanas (Mitchell, et al., 2011). Research departments in zoos may also offer PhD grants, or internships for graduates or undergraduates (Pereboom, Leus, & Van Elsacker, 2011).

Animals provide entertainment for, and emotional connections with, visitors. This connection can lead to an increase in interest about conservation and even behavior change to help the animals (Olukole & Gbadebo, 2008) and ecosystems (Taylor E. W., 2006). Zoos offer context for scientific learning to occur (Haydon, 2014). For example, a visitor watches a polar bear play with an enrichment tool, such as a ball, and enjoys watching them. A nearby sign explains the effect that the shrinking ice caps has on the survival of polar bears and the visitor, who has formed a connection with the bear, decides to carpool to work to help decrease the carbon dioxide emissions.

Through zoos the public can become engaged in, and excited about, wildlife conservation and science (Jensen, 2014). Of note, an interesting study conducted by Kuhn et al. in Germany examined how well a television program succeeded in recruiting volunteers to assist scientists in monitoring butterflies. The television program, Adventure Butterfly, ran for three years from 2005-2007. The researchers found that that Adventure Butterfly attracted a high

number of volunteers. All of the volunteers had pervious knowledge about butterflies and their taxonomy. Younger viewers and people with minimal knowledge were not interested in this program and did not volunteer. Engagement, love and knowledge of butterflies were key to the success of Adventure Butterfly (Kuhn, et al., 2008).

Decreases in biodiversity and habitat loss remain a cause for concern. With the present impacts of climate change, both on ecosystems and their inhabitants, and very serious implications of future implications, zoos play a leading role in helping conserve exotic, rare, or endangered animals. This urgency to preserve species and ecosystems has dramatically increased over the years (Cohn, 1992) (MacDonald & Hofer, 2011). Conservation may be the solution to species loss and habitat degradation with education being essential for long term survival of many species (Jensen, 2014).

Educating the public about conservation has been a major goal for zoos for over 30 years. Most zoos also strive to educate their visitors about how their behaviors can help increase conservation efforts. Zoos frequently encourage their visitors to donate to the zoo, or a non-profit organization, examine and limit their consumption (of fuel, non-sustainable foodstuffs and other products), be active politically, by voting, writing to legislators and/or signing petitions, activities that further goals set by leaders in conservation (Swanagan, 2000). Due to their large audiences zoos can quickly educate hundreds of people although many of these visitors will not make changes that the zoo suggests (Jensen, 2014) (Whitehouse, et al., 2014). Many zoos attempt to make the behavioral change easier to understand and follow through on by having donation centers in the zoo, handing out seafood watch cards, or encouraging recycling within the zoo grounds.

While not all of these efforts show success after the zoo visit is over, studies have found that zoo education has had positive results. Visitors tend to increase their knowledge about conservation after a zoo visit regardless of the amount of prior knowledge they had (Street, Jenkins, & Frasier, 2012). One study examined visitor attitudes from 30 different zoos and aquariums in over 19 countries. Moss, Jensen and Gusset compared conservation knowledge in "before" and "after" surveys distributed to 6,000 visitors across the different zoos and aquariums. They found a 5.3% increase in visitor's knowledge of biodiversity and an 8.3% increase in the visitor's understanding of how to protect an ecosystem. This change was similar for all zoos and aquariums surveyed (Moss, Jensen, & Gusset, 2014). A similar study found that 18% of visitors became more concerned with species extinction after a single visit to a zoo (Jensen, 2014).

Researchers see zoo personnel as experts at educating their visitors about conservation. People can become educated about conservation in many places, but studies have found that messages about conservation at the zoo have the largest impact (Swanagan, 2000). Also, most zoos ally themselves with other organization to help provide resources for conservation efforts (MacDonald & Hofer, 2011). Focusing on these achievements works well to educate adult visitors about conservation effectively (Smith, Broad, & Weiler, 2008). The majority of signs concerning conservation target adults; children don't have the proper knowledge to comprehend the conservation-related signage. Zoo personnel simply assume that children know more about conservation than they actually do (Kristensen & Nielsen, 2011).

In my own research, I sampled signs from eleven zoos and aquarium in Washington, Idaho, Oregon and California. Ultimately, I found that the average reading level, using the Flesch-Kincaid reading level, for all of the sites was 10th grade, the level of a 16 year old

teenager. Although reading levels ranged from 2nd grade to post PhD studies, the majority of reading levels fell between 6th and 11th grade (Haenke, 2015). This not only means that young children would not be able to understand most of the conservation related signs (which was the basis of my study), about 13.6% of adults would not be able to comprehend these signs (United States Census Bureau, 2014). As just discussed, researchers believe there should be an effort to educate kids about conservation in zoos (Korpen, Bisanz, Bisanz, & Lynch, 1998) (Stanford, 2014).

How Zoos Educate Visitors

Zoo interact with visitors in three ways: through engagement with animals, communication with keepers, and by written documents, specifically signs. In some museums, exhibits offers a video that plays educational material. While these can be effective ways to offer information to a lot of visitors at one time, a study completed by Nadelson found that location of the video was very important. If the video gets played in an out of the way area visitors may not notice and may walk by. If it is placed near the entrance, many visitors with children will be dragged pass by the children's excitement to see the animals (Nadelson, 2013). The most popular places for videos tend to be those with a high animal density, such as a reptile house, though these places may be too cramped for visitors to feel comfortable enough to watch the entire video (Balmford, 2000). Nadelson did not specify the length of his video, but in Leinhardt (2014) found that a 59 second video attracted visitor attention for a few seconds, on average (Leinhardt, 2014).

Regardless of how the message gets across, increasing visitor's learning and engagement needs to be a museum's top priority (Nadelson, 2013). Studies, such as ones by Nadelson and

Street, Jenkins and Frasier, have found that visitors also crave more information than what zoos provided. These visitors left zoos feeling as if they had an incomplete understanding of conservation. A wide variety of visitors wanted a more information about conservation due to its importance to them personally (Street, Jenkins, & Frasier, 2012).

Gap in the Literature

Current research focuses on the effect that animals and keepers have on visitor engagement and learning (Fa, Gusset, Flesness, & Conde, 2014) (Taylor, Sickler, Bicknell, & Fraser, 2009) and, because of this, this thesis focuses on learning achieved through signs. Given the prevalence of signs there needs to be more focused study into their effects on visitors. Signs and other public displays educate zoo visitors (Whitehouse, et al., 2014) about animals, survival issues that the animals may be facing, and how best to assist them (Tunnicliffe & Scheersoi, 2012).

However, messages about conservation are often static and adults spend the least amount of time at these signs when compared to other sign topics (Kristensen & Nielsen, 2011). Street, Jenkins, and Frasier have found that signs that remain positive and encouraging show the most promise. By remaining upbeat -explaining the how much carbon is saved by walking verses driving- rather than negative -many species become extinct each year- visitors engage with the sign for a longer duration. Encouraging behavior change enforces the messages already in the sign. It may also give new visitors ideas on which behaviors to change and how powerful small changes are in the long term (Street, Jenkins, & Frasier, 2012).

Creation of effective signs may be difficult. When visitors examine a sign, they first give their own evaluation of the sign and then, depending on their knowledge and interests and the

specifics of the sign, they will examine the sign in more detail, question it, tell a story relating to the information in the sign, or connect it to their current knowledge (Leinhardt, 2014). This process equates to engagement with the material and learning.

Focusing on Signs

Most signs in zoos, aquariums or other museums follow the 3-30-3 rule. Figure 1 shows an example of a sign abiding by the 3-30-3 rule. This guideline states that successful signs have three types of messages: The first is a short title that can be read within three seconds to capture the attention of a passerby.

Figure 1: An interpretive sign that exemplifies the 3-30-3 rule (U.S. Forest Service Department of Agriculture, 2015 pg. 7)

1. If the visitor finds the title interesting, a successful sign will have several smaller, and more detailed subheadings, which describe the specifics of the sign to entice the visitor to continue reading the sign. These should be able to be read within 30 seconds.
2. The rest of the sign should be separated organized underneath the subheadings. This content is the most complexed and detailed and makes up the majority of the sign. This should take a maximum of three minutes to read.

This guideline has been shown by the Center for Design and Interpretation Rock Mountain Region of the U.S. Forest Service to produce the most viewership (U.S. Forest Service Department of Argiculture, 2015).

Too much information in signs or other guides overwhelms parents, while too little not used due to perceived lack of information (Nadelson, 2013). Good signs should be large enough to be read from four feet away (Martin, 2012). They should be large, colorful, have graphics and have a good location. In contrast, ineffective signs have little to no meaningful information, contain small or hard to read text, and placed haphazardly within the exhibit (Aggett-Cox, 2013). Signs do not equal dialogue. The message should be brief, informative, with simple language and a low reading level (Aggett-Cox, 2013). This will ensure that visitors of all ages and education levels can read and understand the signs.

Nadelson (2013) examined parent's use of printed material as resources in a science museum to promote learning and understanding throughout the museum. Museum staff created guides and handed them out at the entrance. The study found that parents used the guides much less than was expected and parents explained that they have little to no value. These guides contained approximately a page of basic information covering all of the museum's exhibits. Visitors cited this lack of information for their disinterest (Nadelson, 2013). Capturing a visitor's interest is key, because visitors come museum (or zoo) because they want to be there. Because of the informal atmosphere, visitors will only read signs that interest them based on their own individual preferences. They will stay as long as the reading material is interesting (unless they are distracted) (Arcand & Watzke, 2010).

A study conducted in Liverpool examined how people learn in an outdoor informal setting. This study set signs concerning astronomy around a library, and interviewed the visitors as they walked through the exhibit. The authors found that visitors examined signs from 2-3 seconds to 2-3 minutes with an average of 30 seconds. Other studies have found similar results for the average amount of time observing a sign: 60 seconds (Whitehouse, et al., 2014) and 90 seconds (Kristensen & Nielsen, 2011). The amount of time spent reading signs was longer for larger groups and visitors stopped at the most colorful and attractive signs most frequently. This study also examined family participation in informal learning. Family groups, as compared to lone adults or groups containing only teenagers or adults, spent the most time examining the exhibit, with the children asking the majority of the questions and leading conversations (Arcand & Watzke, 2010). This finding reinforces that children and adults work off each other to improved learning together.

Taylor et. al surveyed visitors at three zoos and two aquariums to determine what visitors felt was important, or of interest, to include on an animal exhibit label. The most common items on these labels, scientific name, gestation period, and location were found to be the least engaging facts to visitors. Odd facts about the animal rated number one among visitors while conservation status of the animal ranked a very close third (Taylor, Sickler, Bicknell, & Fraser, 2009), suggesting that a majority of visitors are interesting in learning about conservation and more information would be welcomed. A final case study conducted by Martin examined zoo visitor interactions with signs at three different exhibits within a single zoo. The author spent 90 minutes examining visitors as they observed the animal label within an exhibit. She found that about 20% of visitors read the sign and did so for an average of 2-5 seconds. Martin

recommended that further valuable information might be obtained by visitors who observed more signs for a longer period of time, as described in the Methods section.

Methods

The methods chapter begins with an examination of the Oregon Zoo and its approach to educating children of diverse socioeconomic backgrounds. The methods used for this research fall into three distinct categories. The first occurred before the actual study took place. The goal of this first section was to determine areas that were diverse in the amount of signage, the amount of animals presented, and the size of the overall exhibit. After a thorough walkthrough of the Oregon Zoo, seven different study sites were chosen for best matching the criteria. One of these sites featured only one animal, one featured only a single sign, while the others varied in signage, animal density, and the size of the overall exhibit. After the sites were chosen, every sign was measured in multiple ways (specifics will be detailed in the methods section of this paper) and several signs were chosen to be used as study signs.

The second part of the methods included recruiting and interviewing children before and after they experienced the study site. Data was collected for an entire day at each site and, due to the age of the children. There were two people, myself and a research assistant, who were interviewed the children to, enable quick turnaround and only a brief pause from the visitor's enjoyment of the zoo.

The third section was done by a third research assistant. She observed the children who participated in the study as they interacted with the study signs. The research assistant recorded behaviors, such as the length of time the child interacted with the sign, the type of interaction, and any discussion that occurred. These results were combined with the responses to questions concerning the signs in the exit interview to determine how effective these signs are. The specifics of these methods are fully outlined in the methods section of this paper.

Study Site Selection

The Oregon Zoo, located at 4001 Southwest Canyon road in Portland Oregon, was chosen for this thesis due to its closeness to myself and the university, its abundance of animals, the passion for conservation and the specialized zoo programs for youth. Nearly 1.6 million people visit the Oregon Zoo yearly making it one of the Pacific Northwest's most popular zoos. The zoo cares for over 2,000 animals and 1,000 unique species of plants with 59 of them endangered or threatened species (Oregon Zoo, 2015). The Oregon Zoo has multiple certifications notably including the AZA, ISIS (International Species Information Systems), and WAZA. These non-profit organizations compile and share information and animal husbandry and engage in conservation programs. The Oregon Zoo's conservation efforts are focused on caterpillars, turtles, butterflies, elephants and the California condor (Oregon Zoo, 2015). The zoo also has a strong focus in education, especially the education of children. In addition to summer camps and internships, the zoo has two unique programs that focus on youth. The first is the Urban Nature Overnight program. This program provides children ages 8-11 with an overnight zoo experience. This trip includes educational programs and there is no charge so children in families of lower socioeconomic classes can participate. The second is aimed at teenagers. The Zoo Animal Presenter program is a two year long internship. Classes run from January to June on communication and animal husbandry and student then present this information to their neighbors. Not only does this give teenagers work experience and knowledge, it also promotes educational outreach to those who might not visit a zoo (Shaping Outcomes, 2014). There are other ways that zoos can educate visitors.

An investigative walkthrough of the Oregon Zoo was completed in January 2016. The walkthrough aimed to find be good study sites for this experiment. The site needed to meet

several parameters to be considered a good study site. First, a site needed to have an obvious beginning and end with only one or two exits. With only myself and two research assistants available to monitor sites, areas that contained more than two exits could not have been used due to the possibility of a study subject leaving without completing the exit survey. Second, study sites needed to have sufficient room at the exit(s) for a researcher to conduct surveys. There had to be space for the researcher, the child, the child's family, and the equipment necessary for the study. A third important criteria was the size of the study site. The area needed to be spacious enough to allow researchers to move through the exhibit without feeling observed. Overly large areas also suffered from having multiple exits or contained long stretches of paths without signage which wasn't conducive to this experiment. Finally, that the study sites needed to be located in areas in different sections of the zoo. This allowed me to examine the change in conservation knowledge not just within one study site but between various sites throughout the zoo.

The study sites chosen for this research are described below.

- Eagle Canyon:

This site consists of a small linear area with a single pathway that doubles back on itself towards the exit. It contains a covered bridge, a full size replica of an eagles nest for children to play in and a covered viewing area to observe the bald eagles. This site contains nine signs located along the pathway, around the eagle nest replica and inside the covered observatory. Eagle Canyon is located in the Great Northwest area of the zoo and was chosen for this research due to its small size, the abundance of signs, and because it had enough space for researchers without restricting flow for the zoo visitors.

- Condors:

Condors of the Columbia is located in the Great Northwest area. This study site consists of a single raised pathway adjacent to the family farm. There are eight signs and two covered observational areas with ample room for research set-up on either end of the study site. This site held special significance for species conservation due to the great recovery of the California Condors; the signs on display explain that recovery. I felt it was important to examine the effect the signs in this specific area have on the study participants.

- Polar Bear:

The polar bear exhibit is a long enclosed exhibit that curves around a large polar bear enclosure. There are two exits, one connecting to the Central Plaza in the Pacific Shores section and another that loops around and connects to the Sun Bear exhibit. This second exit contains multiple side paths that might confuse study participants, so for the purpose of this study the exhibit ended after the final polar bear viewing area. There are seven signs in this study site.

- Amazon Flooded Forest:

The Amazon Flooded Forest is a short straight outdoor site with multiple enclosures on one side containing large snakes, lizards and fish, sakis and turtles. This study site contains nine signs and a small play area located away from main walkway.

- Predators of the Serengeti:

The Predators of the Serengeti, located in the Africa area, is the largest of the selected study sites. It is an enclosed circular area with animal enclosures on both sides of the walkway, housing cheetahs, African wild dogs, lions, and caracals. A small room inside the enclosure that holds several small animals and some African artifacts. There are two exits located close

together so that both survey researchers can be within speaking distance of each other. There are 39 signs located throughout the study site.

- Indoor African Rainforest:

This area is in the Rainforest Plaza of the Africa area of the Oregon zoo. This study site includes an indoor exhibit and an outdoor enclosure. The animals in the outdoor enclosure, birds including ducks and flamingos, are separated from the visiting public by a wooden fence. The indoor enclosure featured animals, from a small toad and gecko to the larger crocodile and Nile monitor, remains hot and humid, with animals on either side. This exhibit includes 14 signs.

There were two specific areas that were considered but, in the end, were not chosen as study sites. The first was the new Elephant Lands which opened winter of 2015 however, it was too large to study. The second area, the Aviary located in the Africa area of the zoo, consisted of a small enclosed area with a single sign. During the investigative walkthrough, the sign was formatted to resemble a book, with birds in the aviary appearing on a separate page. The unique structure and placement of this sign resulted in the site being chosen as a study site. However, after a sample survey that occurred in March 2016, the zoo replaced the sign with a simple sign with bird names, both common and scientific, and a picture of the bird. Since this was drastically different from the original sign the study site was eliminated.

Sign Specifications

After a study site was selected, I took multiple pictures of every sign in the study site. Several sign specifications, including sign location, size and height, reading level, text percentage and visual impression, were also noted.

Sign Location

Whether or not a sign is observed and engages visitors depends, even to the smallest degree, on location (Aggett-Cox, 2013). In this study, sign location was determined based on the sign's relation to the animal's enclosure, if the person viewing was standing directly in front of the enclosure. Please see figure 2 for a visual representation of sign location.

- On:

Signs located on the glass of the animals' viewing area. Several enclosures did not have a glass separation between the visitor and the animal. In these cases, a sign was considered to be 'on' if it fell between the viewer and the exhibit.

- Near:

Signs that could be viewed easily by a visitor in front of an enclosure without rotating their head 90° or more. Most of these signs were placed next to the viewing area within a few inches to a foot of the front of the enclosure.

- Adjacent:

Signs that were on adjoining walls (or other physical barrier such as a post) to the viewing area.

- Across:

Signs that lie on the wall opposite of the viewing area for the animal.

- Away:

Signs that could not be seen while standing at a viewing area. Most of these signs did not discuss information about the animals, but about the ecosystem or environment that the animals inhabited.

- Inside:

There was only a single sign in the Oregon zoo that qualified as inside of the exhibit and that was the Aviary sign. The Aviary exhibit allowed visitors to roam the same area as the birds without barriers. Due to this special exhibit layout inside signs were accessible to both visitors and animals.

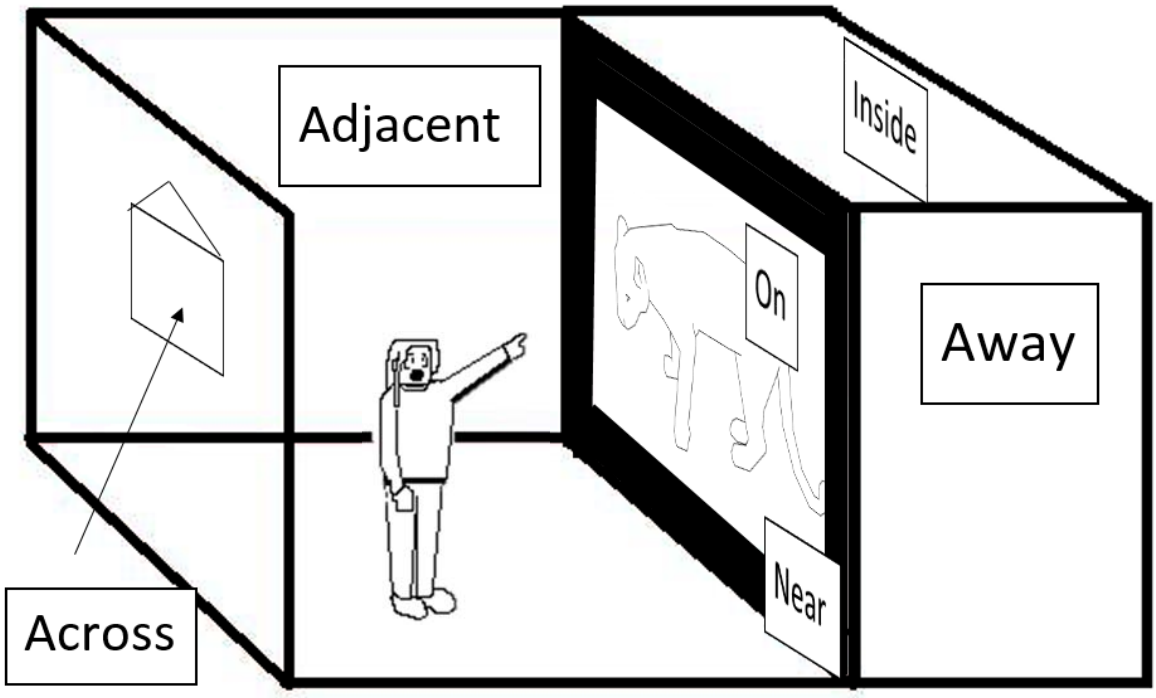


Figure 2: A visual representation of the different location of signs

Sign Size and Height

The length and width of every sign was measured to the nearest 0.5 centimeter. For signs with an unusual shape, containing a curved side or with protrusions (such as a ruler) for example, the longest horizontal or vertical straight line was measured. The sign height, from the bottom of the sign to the ground, was also measured. Potential error in these measurements. Many of these signs were situated on dirt, making it difficult to ascertain the ground level. Because of this, the sign height was only measured to the nearest centimeter.

Reading Level

I transcribed the content of every sign included in this study. These transcriptions were sent through a word and syllable counter (Text Statistics Projects, 2016) which counted the number of sentences per sign, words per sentence, average syllable per word, and calculated the Flesch-Kincaid grade reading level. The U.S. Department of Defense uses this scale due to its effectiveness and popularity as a readability scale. The Flesch-Kincaid Grade Readability Formula remains the basis for determing readability for government issued technical manuals as well as books used in schools for education (DuBay, 2004). This scale allowed me to convert the text of the signs into distinct categories of difficulty, and compare those against the age of study participants. I manually calculated two signs, the first and last of the study signs using the Flesch-Kincaid Grade Level Readability Formula [Reading Age = (0.39 x average sentence length) + (11.8 x average number of syllable per word) – 15.59] (Paz, Liu, Fongwa, Morales, & Hays, 2009) to validate the online counter.

Percentage of Text

A photographic image of every sign was loaded onto Adobe Fireworks CS6. Using this software, researchers placed a 10 by 10 graph on top of the image so that 100 equal squares were spread across the picture. This allowed the percentage of text per sign to be calculated by counting the number of squares with text and dividing by 100. A square was considered to have text in it if it contained more than three letters or if the text covered one-fourth or more of the square. In many cases, the signs were not square and alteration of the graph was necessary to cover the image thoroughly and accurately. The Fireworks software is able to manipulate the graph to cover the image even if the photograph is skewed or at an angle, so that every square would contain the correct percentage of the image. A few signs had very abnormal shapes, a wave for example, and the graph was not able to be manipulated to this shape. For these cases, the graph conformed to the image as close as possible, the shape was often a rectangle, and then the percentage of text was calculated by taking the number of squares that had text and dividing by the number of squares that contained part of the sign.

Visual Impression

This section proved to be the most challenging to define. Aggett-Cox (2013) found that signs with more pictures, colors and designs, engage visitors more than bland signs (Aggett-Cox, 2013). Still, which characteristics of an attractive sign make it engaging? The following rubric was developed after the walkthrough. A sign was deemed more engaging if it contained:

- Photographic Images;
- Charts/Infographics/Maps;
- Artistic Depictions;

- Varied Text Size/Font/Colors;
- Interesting Shape of Sign;
- Color:

Most of the coloration on a sign was made from photographic images, charts, or artistic depictions. Color, in this section, refers to a single color that was separate from the other variables. In most cases, one color would be the background of the sign with words and images pasted on top of it.

- Layers:

Each separate structure that made the sign further from the wall it was attached to. For example, one sign featured a picture of an eagle (1st layer) with a ruler attached in front of the wingspan (2nd layer) to show the size and encourage visitors to measure their own wingspan.

- Texture/Material:

Each separate textural element that was used in the creation of the sign. For example, a plastic picture of a caracal (1st material) with a wooden from around it (2nd material) and a piece of caracal fur attached to it (3rd material).

Figure 3 shows two signs reflecting a number of these variables.

Figure 3: Two signs that together include every variable that was included in this study.

Surveys

The research surveys were accepted by the Evergreen State College Human Subjects Review Board and the Oregon Zoo board. The main questions on the entrance survey included:

- How old are you?
- What is your gender?
- Have you been to a zoo or aquarium before?
- Who are you visiting the zoo with today?
- What are you excited about seeing at the zoo today?
- Do you think that animals need our help?
- Is this important? Why?
- Can you do anything to help?

The exit survey included the following:

- What does the word “Conservation” mean to you?
- How can you help animals or the places they live?
- Referencing a study sign:
    - Do you remember looking at this sign?
    - About how long did you look at this sign?
    - Why were you interested in this sign?
    - Did you read this sign?
    - Do you remember what this sign was about?

These surveys, as well as the Informed Consent Form, are included in appendix B.

One survey was completed before the child entered the exhibit and one after. The two surveys were created by referencing similar surveys in the published research (Arcandt and Watzke 2010) (Haden, Babcock, and Uttal 2014) (Olukole and Gbadobo 2008) (James and Bixler 2008) (Jenson 2014) (Whitehouse et.al 2014) (Marino et al. 2010).

During the research children had to initiate the interaction, however if a child appeared interested in the study we would reach out to them with a simple greeting (See Figure 4). If a child expressed interest, the research was explained to both guardian and child. If both agreed to participate, the child was given an entrance survey to fill out and the guardian filled out a consent form. After signing the consent form the guardian was offered a copy, although most declined.

Each child filled out an entrance survey. Researchers encouraged honest answers, reassuring the child that “there are no right or wrong answers”. Sometimes a child would ask for assistance, or a guardian would ask to write for the child for various reasons. In these cases we considered it appropriate for the guardian to assist the child as long as the input came from the child. Researchers recorded if the guardian wrote without consulting the child, or wrote something different than the child responded. Many parents wrote for their child if the child was slow at writing or embarrassed because he/she did not know how to spell a word correctly.

After the child finished the entrance survey they were given a label for identification for the observer and the exit survey researcher. This label consisted of a letter written on a small rectangular wooden tag in either blue or red as shown in Figure 5. This tag was worn around the neck with a piece of bright green yarn. This letter-color combination was also written in four places, the consent form, the entrance survey, the observation sheet, and the exit survey. This better facilitated matching the documents later. The time was also written on the entrance survey at the approximate time the child finished the entrance survey was also noted. The entrance survey usually took between 2 to 5 minutes, although one child took 10 minutes to complete it.

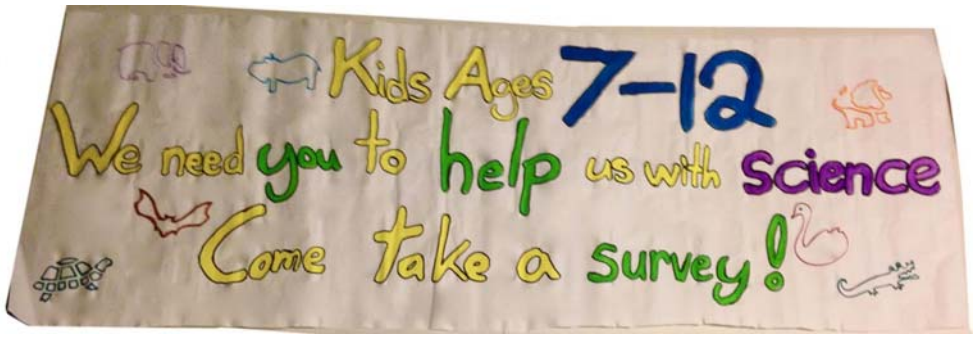


Figure 4: Sign posted on tables used to attract children.

Figure 5: Photograph of Label used in this Study

An observer watched the children as they interacted with the signs, paying close attention to how long they interacted with it and with whom. If a child did not look at a sign, they were considered to have passed it. Between 1 and 5 seconds was considered a glance. Anything longer was written down specifically. The observer also wrote down anecdotal observations that might be pertinent to the research. She also recorded the label code (red or blue) and approximate time the child arrived at the signs to help match the observations to the child's surveys response.

When a child reached the exit table a researcher took their tag. Their label code and the approximate time were written on the survey before it was handed to the child to fill out. Again, if a child or guardian requested, the guardian could fill out the exit survey for the child. During the second section of the exit survey, the child was briefly shown a picture of the signs in the exhibit. The writing on these pictures had been blurred so a child filling out the survey couldn't read them to obtain answers and instead needed to use their own memory of the sign in the exhibit. Exit surveys took a wider range of time to finish than entrance surveys, depending on how much the child wanted to write or draw and how much they remembered about a sign. In order to help establish the child's credibility in filling out surveys, we combined all three sets of data, comparing the observational and exit survey data.

The research occurred on August 17-19. The first day was spent at the Predators of the Serengeti exhibit, with single table stationed in the middle of loop. Three researchers administered both entrance and exit surveys. A fourth researcher completed observations as previously explained. The second day spent was at the Polar Bear exhibit, with two tables stationed one at either end of the exhibit. One researcher sat at each table and a third alternated between the tables, assisting whichever table had the most need at the time. Again, the fourth researcher spent the day observing. The third day was spent at the Condors of the Columbia exhibit. The table setup was the same as the Polar Bear exhibit. Approximately 4-5 hours was spent at each exhibit.

At the end of each day the four sets of data (the consent form, the entrance survey, the exit survey and the observations) combined into groups by child. The researchers read and discussed answers in order to:

- Gain a better understanding of any problems that were occurring in the process
- To see if there were any cursory relationships between what was written and what was observed.
- To ensure that the questions were getting desirable results.

After the third day, we concluded that we were not obtaining new answers to our questions. The surveys were originally planned to continue for three additional days at three alternate sites, but, considering the lack of variety in the answers, it didn't seem like the best use of the time. Also, there seemed to be an interesting development occurring that couldn't be captured on the survey: parent and child interaction and child to child interaction. Observational data had captured this information both at the signs and during the different surveys but the surveys themselves did not.

New methods were discussed between the researchers and it was decided that focusing on child's interactions with their guardians and other children would give more compelling information than what was already collected.

Because the surveys were on a volunteer basis, we were missing out on children who either were not interested in completing a survey or, mostly the case, had guardians who didn't allow their child to participate. It was decided that the researchers would observe a child as they wandered throughout the exhibit and mark if they: looked at the sign and for how long, had any interactions around the sign with an emphasis on who was initiating the interaction. The gender of child and guardian was also recorded (as shown in appendix C). Once a child had exited the exhibit area, the next child (or children if they were in a family group) was observed. I used an N of 100. This occurred on August 21st with about 5-6 hours of observation.

Results

The Results chapter is comprised of four sections. I begin with a detailed look into the demographics of my study participants, including age, gender, ethnicity, group composition, and previous zoo visits. The next section focuses on the children's answer to the questions about their beliefs and general level of knowledge. I coded the answers for each question using identical codes when possible. Some questions required a unique set of codes and this information is provided in more detail in the respective section. The third section is the longest and most in-depth. I examined each child's answers to the sign related questions and compared this information with the observational data. The final section is focused on the collected observational data on interactions between children and the adults and peers in their group.

Child Participant Demographics

One hundred fifteen child participants included their age on the entrance survey forms. The age range of these children was four and 14 years with 85% of children falling into the 7-12 year age range. Figure 6 displays the age range of participants in the study. The numbers in the pie wedges represent the ages of the children. Children

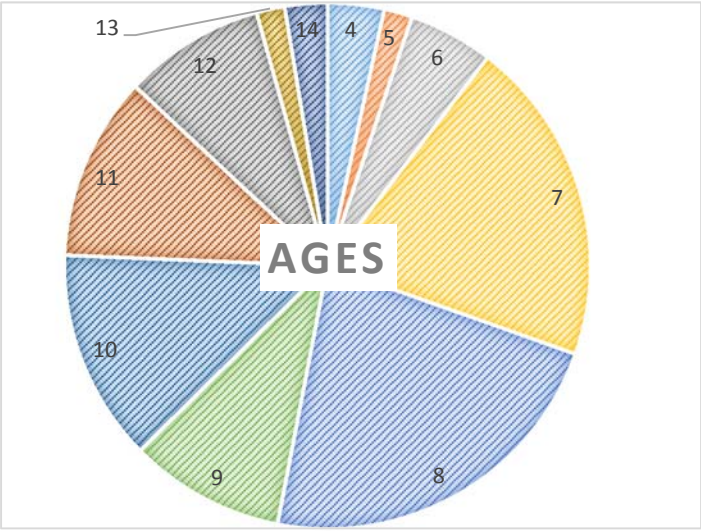


Figure 6: The Ages of All Study Participants

younger than 7 were allowed to participate in the survey as long as they were able to read and write down their answers.

The majority of children were female -61% female verses 49% male- with two children not disclosing their gender. The question of ethnicity was the only question that I asked parents to answer for their children and it was located on the consent agreement (See Figure 7). Twenty children, making up 18% of the study group, had undisclosed ethnicities. Parents reported most of the children, 75 individuals or 67%, as Caucasian. Only 17 children were reported as being another ethnicity with seven children listed as Hispanic/Caucasian, two Asian, two Hispanic, and two Islander. Only one child fell into the other ethnicities categories: Black, Native American, Hispanic/Native American/Caucasian, and Native American/Asian/Caucasian.

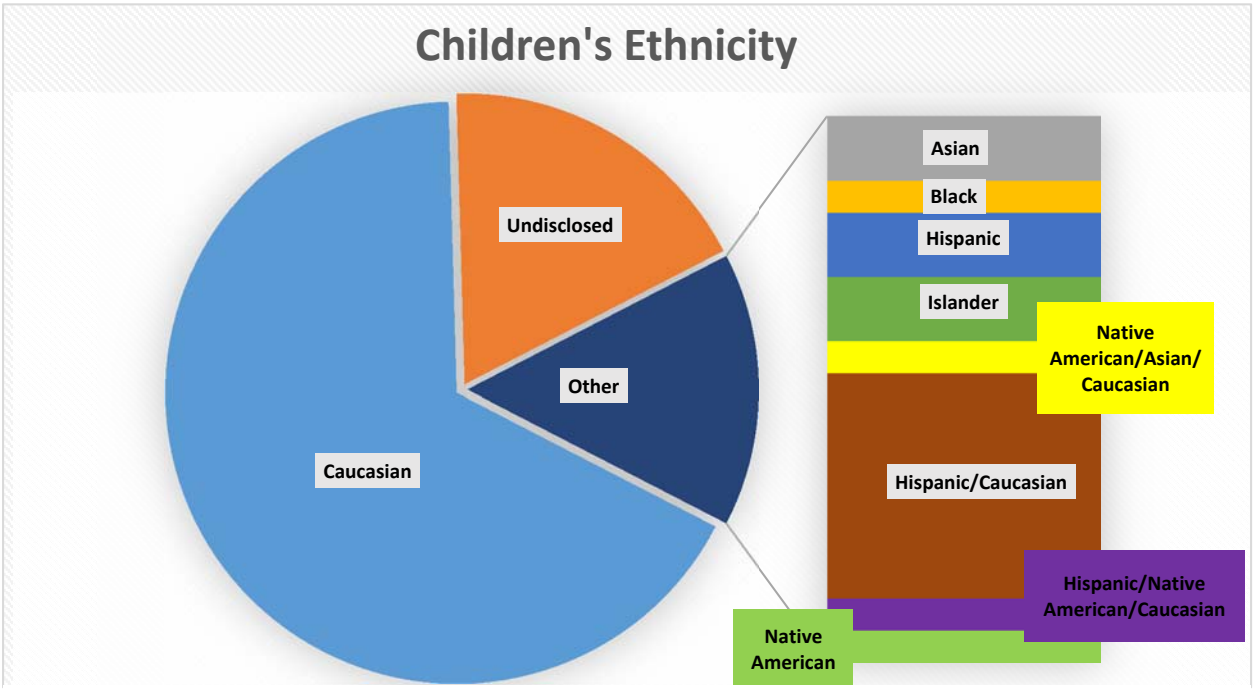


Figure 7: The Ethnicity of All Study Participants

All but nine of the children had previous experiences with an aquarium or zoo with 41 children visiting the Oregon Zoo on a previous occasion. Other popular zoos and aquariums were

the Newport Aquarium, (nine children), San Diego Zoo, (10 children), Woodland Park Zoo, (9), Seaside Aquarium, (6), and the Seattle Aquarium, (7). Most children had visited zoos in nearby states, including Washington, Idaho and California, but a few had been to zoos on the east coast, Alaska, and Canada. Thirty three children had visited one previous zoo or aquarium. Specifically, 20 children reported to have visited two, 16 reported to have visited three, five children visited 4 zoos previously and one child had visited six zoo previous to my study.

I analyzed the composition of the group with which the children came to the zoo, as reported by the children on their entrance survey. I separated all possible relations into two groups, guardians (mothers, fathers, aunts, uncles, grandparents) and peers (older and younger siblings, cousins, and friends). When comparing parents specifically, 39 children had both their mother and father present with them at the zoo. Five children were alone with their mothers at the zoo while 33 had their mothers in groups with others (but those other did not include their father). Only two children were at the zoo alone with their fathers and 16 children reported a father (but not mother) as part of a group. Aunts and/or uncles were present in 23 groups and served as the primary guardian for ten children. Nineteen groups included grandparents and for eight children those grandparents acted as them. When looking at the children's peers, I examined how many children were in groups that contained older and younger siblings, cousins and friends. Nine groups that contained both an older and younger sibling while 37 contained a younger sibling and 17 had an older one. Twenty-six groups contained cousins and the same number contained friends of the survey participants.

Answers to Questions about Child's Beliefs about Protecting Animals and the Environment

This section analyses the answers to four sets of questions that appeared on both the entrance and the exit survey forms. These questions were not sign-related; a large box on the form permitted the child to either write or draw a picture in response to each question. I coded the first two questions in the same manner. Both sets started with a question that child could answer either "Yes", "No", or "I don't know". A follow-up question allowed the child to express their specific thoughts and I coded responses to those questions. The following list explains the codes that I used for these questions, the first line is the name of the code followed by a dash which separates it from its abbreviation (which is used in graphs later in this section). Following the second dash is a quote given by a study participant that exemplifies the code. The codes used for the first two question sets included:

"Do you think that animals need our help?" and "Do you think this is important?"

- I Don't Know - IDK
- Conservation Status – CS – "Some of them are endangered and need our help"
- Habitat loss/Destruction – HL – "Polar bear's ice is melting"
- Poor Health – PH – "They can die of sickness"
- Restricted Access to Food – RAF - "They need help with food"
- Need Help General – NHG – "Some can't help themselves"
- Connectedness to the Environment – CE – "Because I love them"
- Nonsense in Context – NC – "You good"
- Other – Other – Viewpoints in the minority so it is difficult into a category – "Zoos are not good for animals because they don't run around as much as they are used to"

The first question set asked the children to answer the question “Do you think that animals need our help?” Ninety children stated that they agreed with this statement while four disagreed and 19 answered “I don’t know”. The children were asked to explain their answers, which are plotted on Figure 8. The most common answer to this question, with 35 children, was the “I don’t know”. Twenty-three children answered with the “conservation status”. Seventeen responded with “habitat loss or destructions” and 11 with “poor health”. The other response categories came up less frequently by under ten children each.

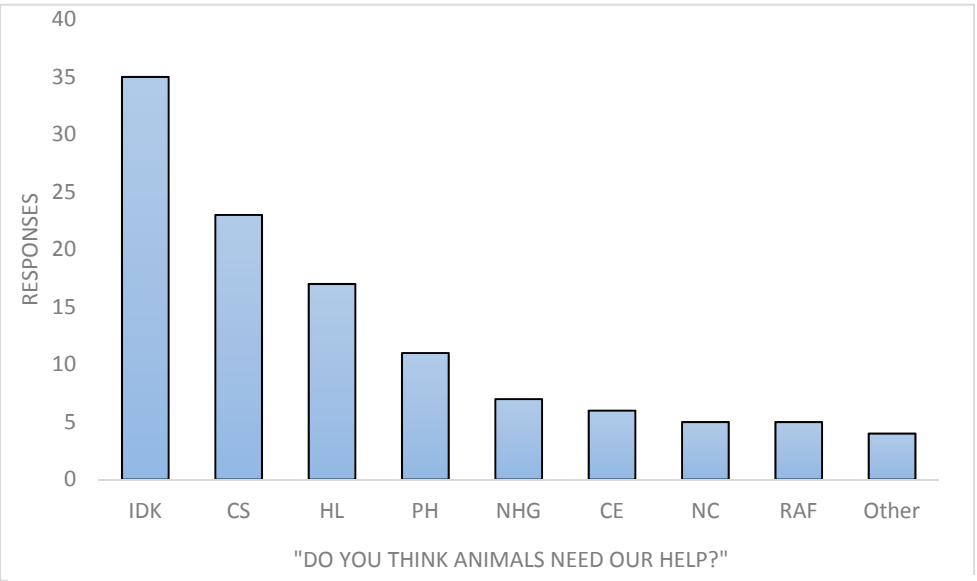


Figure 8: Study Question "Do you Think Animals Need our Help?"

The next question set asked children if they believed in the importance of help animals. The answers are shown in figure 9. Most children answered “Yes”, with only one child disagreeing with the statement. The rest of the children, a total of 33, answered “I Don’t Know”. This amount of “I Don’t Know” statement is almost twice as high as the first question which I feel indicates some child didn’t understand the question. The next part of this question set,

asking for an explanation, supports this hypothesis “I Don’t Know” appeared in 41 of the children’s responses. This is twice as much as the next highest answer, “Need Help General”. “Conservation Status”, “Habitat Loss/Destruction”, and “Connectedness to the Environment” received 15, 14, and 11 responses respectively. Figure 7 shows a visual representation of these answers.

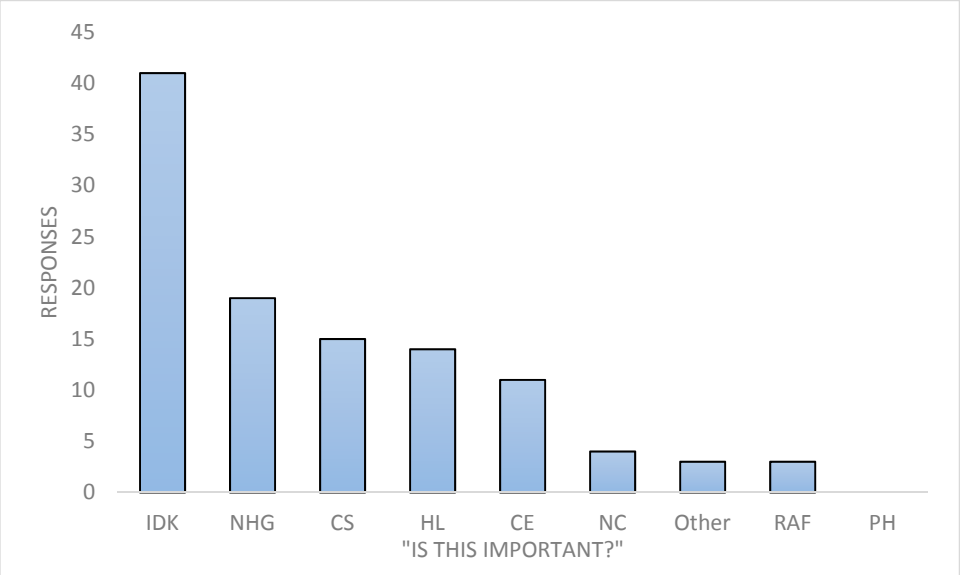


Figure 9: Study Question "Is This Important?"

One question appeared on both surveys to determine if a change in belief occurred between the two surveys. In the entrance survey this question was posed as “Can you do anything to help?” and on the exit survey it was “How can you help animals or the places they live?” At first these were coded using the following codes:

- I Don’t Know – IDK
- Stop Littering – SL – “Don’t trash the places they live”
- Donate Money – DM – “[Put] change in machines for animals”
- Non Descriptive Answer – NDA “Yes”
- No Hunting – NH – Don’t hunt endangered creatures”
- Nonsense in Context – NC – “25 years or 100 years”
- Give Food – GF – “Feed them”
- Restore Habitats- RH – “Clean up dirty places”
- Raise Awareness/Political Actions – RA – “Tell other people how great animals are”
- Being Environmentally Conscious – EC – “Reduce greenhouse gases”

- Other – Other – Viewpoints in the minority so it is difficult into a category – “Hunt coyotes”
- Improving Zoo Animals’ Standard of Living – ZSL – “Buy supplies for all the animals to play with”

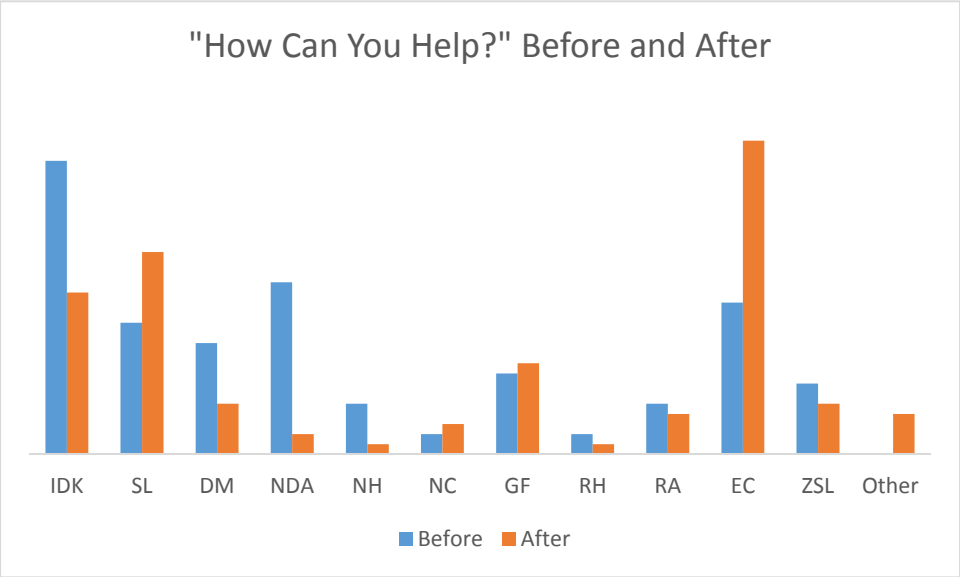


Figure 10: Survey Question "How can you Help?" Before and After

As you can see from the Figure 10 the amount of “I Don’t Know” and “Non Descriptive Answers”, declined between the entrance and exit survey. “Being Environmentally Conscious” ideas also increased in the exit survey. Twenty-five children who answered “I Don’t Know” in the entrance survey question gave a definite answer in the exit survey. Twenty-eight children gave a definite answer in the entrance survey but gave a different definite answer in the exit survey, such as changing from “Give Food” to “Donate Money” Code. Some of these changes did seem to be influenced by the signs. The Condors of the Columbia exhibit featured a sign that explained that adults fed litter to their offspring which could be lethal. This sign was viewed frequently and children did change their answer to “Stop Littering”. Another example occurred during the Polar Bear exhibit where one child changed his answer from “Maybe” to “Save the polar bears from the melting ice blocks” which is the specific content a study sign in that exhibit. The majority of children, 39, did not change the type of answer in some cases writing “I’ve already answered that question” in the exit survey. There were also ten

children who changed their answer from a definite answer in the beginning to an "I Don't Know" in the exit survey.

The following codes were used for the question "What does conservation mean to you?"

- IDK – I don't know
- C- Conversation – "To talk to someone about something"
- D – Definition – "It means to conserve"
- NDA – Non Descriptive Answers – "Doing something"
- CR – Conserving Resources – "To save energy"
- RH – Restoring Habitat – "To preserve parts of our world for animals"
- HA – Helping Animals – "Saving Animals"
- Other - Other – Viewpoints in the minority so it is difficult into a category - "Conservative"
-

An overwhelming majority of the children's responses, 65% or 66 children was "I don't know". "Definitions" was the next highest with twelve responses, "Non Descriptive Answers" with eight, "Conversation" with five, "Other" with four, "Conserving Resources" with three and "Restoring Habitats only received a single response. Many children were observed to have a problem recognizing the word Conservation and even many of the parents appeared to struggle. In one case, a child asked their parent what that word, conservation, was. The parent replied that the word was conversation. A researcher did correct the parent to ensure the child knew the correct word. This misunderstanding did not seem to be an isolate incident as parents seemed unable to assist their children with this question.

Child Self-Reported and Observed Sign Data

A comparison of self-reported data and observational data revealed that child self-reported data may not be as accurate as first hoped. Many children reported observing and spending "Two minutes" at a sign. However, observations included a good number of the children passed by all of the study signs. I decided to look at the answers of the children who

were observed to interact with the signs. I also wanted to look at the reliability of the self-reporting by comparing the number of children that said they looked at sign and the number of children actually observed to interact with signs.

Predators of the Serengeti

Sign 1

Sign 2

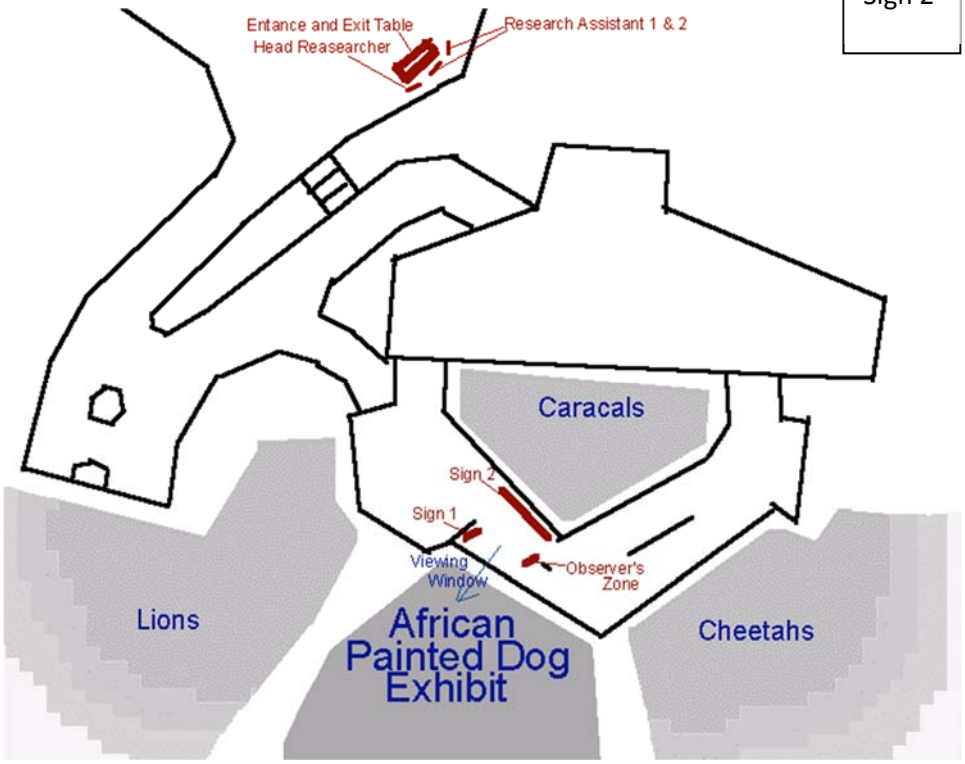


Figure 11: Predators of the Serengeti Study Signs and Location

Out of the 32 completed surveys only 6 children, all Caucasian, were observed interacting with signs. Figure 11 contains the locations of the signs, the research tables, and the observer area.

Child 1: This seven year old male reported that he did not observe either sign, although he did report that he spent "very little time" at the first sign. He also reported that he read all of it, although he didn't remember what it was about. The observer indicated he spent eight seconds at Sign 1. At this sign, he had a conversation with his mother:

Child: *Pointing at the sign* "This is a hyena"
Parent: *Reading sign* "No, that's an African Painted Dog."
Child: "It's the same thing"
Parent: "No, they're different."

Child 2: This seven year old female reported that she saw the second sign only and reports that she spent an "average amount of time" at this sign. She was interested in this sign because "It teaches you not to kill animals and help them". She could correctly remember what the sign was about. The observer reported that she merely gazed at the sign while walking through the exhibit. Child 2 indicated on her entrance survey that she had been to a zoo or aquarium previously but did not indicate which one. There is a possibility that she examined this Sign on a prior occasion.

Child 3: This five year old male reported only seeing the first sign. He spent "very little time" at this sign because the sign had images that "looked like dogs". The observer reported that he passed this sign and instead spent three seconds at the second sign before being distracted by an interactive phone. His mother was observed shooing him through the exhibit.

Child 4: This seven year old male reported seeing neither sign. The observer saw him touching the second sign for about four seconds.

Child 5 and 6: Child 5 was a four year old male and Child 6 was his six year old sister. Child 5 reported to seeing neither sign. Child 6 reported to only seeing the second sign. She spent a "little amount of time" at this sign. She did not read it because "the words were too small" yet she correctly remembered the content of the sign. The observer saw Child 5 spending 1:02 with his father reading the sign to him. Child 6 joined Child 5 for about half of this time.

Polar Bear

Sign 3

Sign 5

Sign 4

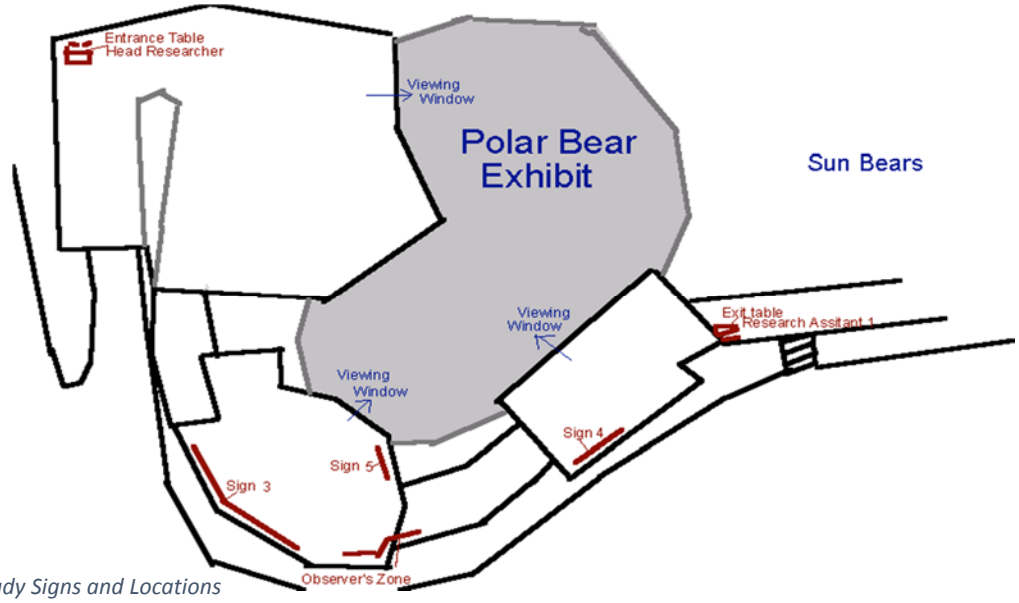


Figure 12: Polar Bear Study Signs and Locations

This exhibit proved more difficult to observe. The three study signs in this exhibit were spread apart: Signs 3 and 5 were in the same enclosure whereas Sign 4 was around a slight corner as shown in Figure 12. The fourth sign attracted a lot of attention, making it even more difficult to observe the children. Out of 36 completed surveys for this exhibit 20 children interacted with at least one sign.

Child 7: This twelve year old Caucasian female reported that she spent "an average amount" of time at the third sign, "a very long time" at the fourth and "little time" at the fifth sign. She was interested in these signs because she was "curious". She reported reading all of the fourth sign and some of the other two. Still, child 7 couldn't remember what the third sign was about, but correctly recalled the content of the other two signs were about. The observer reported that she passed the third sign, and glanced at the fifth sign. She spent 43 seconds at the fourth sign measuring both herself and her father.

Child 8: This eight year old Caucasian male reported spending "little time" on sign 3, "an average amount" at Sign 4 and passing the fifth sign. He was not interested in the third sign and although he reported reading some of the sign he couldn't recall its content. He was interested in the fourth sign "because I like to see how tall I am" but he didn't read it. He also couldn't correctly recall what it was about. He spent 15 seconds at the fourth sign and passed the other two. The observer noted that he seemed nervous of her.

Child 9: Child 9, a twelve year old Caucasian male, reported seeing only the fourth sign. He spent "an average amount" with this sign and was interested in it due to "the different sizes." He read some of it and correctly recalled the sign's contents. He actually spent nine seconds at the fourth sign and passed the other two. The observer also noted an interaction between Child 9

and a younger female child (either a sister or a cousin). The younger child was interested in the third but he told her “You can’t read”.

Child 10: This child was a six year old Caucasian male. He reported spending “an average amount” of time at the third sign (reading all of it), “a long time” at the second sign (reading some of it), and “an average amount” at the final sign (reading none of it). He was interested in the third sign because he wanted to “learn about the environment” although he couldn’t specifically recall the sign’s contents. He was interested in measuring himself at the fourth sign and he correctly recalled the content of the sign. Sign 5 was interesting to him because of the globe, but he “didn’t have time” to read it. In contrast to the child’s self-reported behavior, the observer reported that he passed the third sign and touched the globe at the fourth sign as he passed. He spent six seconds at the fifth sign.

Child 11: Child 11 was a nine year old Caucasian male. He reported spending “very little time” at the fourth sign, “little time” at the fifth sign and passing the third sign. He was not interested in any sign although he could not articulate why, and he did not read either of the signs he saw. He actually passed both signs 3 and 4 and spent 10 seconds at the fifth sign.

Child 12: This eleven year old Caucasian female reported spending “little time” at signs 3 and 4, and “an average amount” at sign 5. She was interested in the third sign because it moved and did not read it because she was “turning them the same way”. Child 12 was observed to spend 53 seconds at this sign turning all of the numbers to the front and straightening out the signs. She recalled that the sign was about “helping the environment” but didn’t list anything specific. She was interested in the fourth sign “because it showed how tall the type of bear was” and correctly recalled the contents of this sign. Child 12 reported that she didn’t know why she

was interested in the fifth sign and only read some. She incorrectly recalled what the sign was about ("it showed where the polar bears live"). She actually passed the second sign and spent 6 seconds at the third.

Child 13 and 14: Child 13 was an eleven year old Caucasian male and child 14 was his eight year old Caucasian sister who both reported seeing all three of the signs. Child 13 reported spending "an average amount" at the third sign because his "mom was reading it" and read all of it. He recalled the basics of the sign, but couldn't recall anything specific. He reported spending "an average amount" at the fourth sign, reading some of it, and but incorrectly recalled the content "conservation". (I found it interesting that he wrote conservation specifically. In his exit survey, he reported that to him conservation meant "save") He reported spending "very little time" at the fifth sign because his "family was leaving". Child 14 spent "little time" at the third sign because she "wanted to see the answer", she read some of it and reported the sign was "about cars". The content of one of the signs focused on driving less by using other modes of transportation. Interestingly, only she and one other child, Child 23, could recall anything specific about that sign. She reported spending "an average amount" at the fourth sign, reading all of it and could correctly recall its contents. Child 14 reported spending "very little time" at the last sign because she "wasn't interested". The observer recorded that Child 13 and 14 read the third sign together. Child 13 spent 10 seconds at sign 4 and walked by sign 5 while briefly touching the globe. Child 14 spent 19 seconds at the fourth sign and passed sign 5.

Child 15: This seven year old Caucasian female reported seeing all three signs. She spent "very little time" at the third sign, did not read it and couldn't articulate why. She spent "a very long time" at sign 4 "because it has my favorite animal. I was interested in how tall I am". She read all of it and could correctly identify the sign's content. Child 15 spent "very little time" at

the fifth sign but she did not read it. She was interested in it because “it has part of a globe”. She was observed interacting with sign 4 for 19 seconds and passed the other two signs.

Child 16: Child 16 was a ten year old Caucasian female. She reported that she saw and interacted with signs 3 and 4. She spent “very little time” at sign 3 and did not read it. She spent more time at the fourth sign, “an average amount,” and read some of it. Child 16 reported not remembering what she had read. She reported not seeing the fifth sign at all. The observer reported that she passed signs 3 and 4 and spent 41 seconds at the fifth sign.

Child 17: This child was an eleven year old Caucasian female. She reported spending time at each sign, “little time” at the third sign, “an average amount” at the fourth sign, and “little time” at the fifth sign. The third sign interested Child 17 because “it said 10 things *you* can do”, but she didn’t read it because she was distracted by the polar bears. She reported to have read all of sign 4 and correctly recalled the sign’s content. “The graphic of the visual of the globe” drew her to the fifth sign and, although she reported to have only read some of the sign, she correctly recalled the content was about “the decrease of ice in the pole”. Her answers on her exit survey showed that she did seem to pick up some knowledge (Can you help question – “I don’t know” verses “reduce greenhouse gases”). She actually passed by the third sign, spent fourteen seconds at the fourth sign, and nine seconds at the fifth.

Child 18: Child 18 was a nine year old Caucasian male who reported observing each sign. At the third sign, he reported spending “an average amount” and reading the whole sign although he incorrectly recalled the sign’s content. He reported spending “an average amount” at the fourth sign but did not read or recall the sign’s content. He reported spending “very little time” at the fifth sign but couldn’t recall the sign’s content. The observer reported that child 18

spent 58 second at the third sign and seven seconds at the fifth sign. His mother went through the signs with him.

Child 19: This child was a seven year old Asian/Caucasian male distinctive in that he had not visited a zoo before. He reported observing the third and fourth signs, spending “very little time” at the third and “an average amount” at the fourth. He was drawn to the signs “because I like to learn”. Although he reported that he read some of both signs, he couldn’t recall the content of either sign. He actually spent 27 seconds at the third sign with his father. Due to the crowds the observer was not able to see his interactions with the fourth sign, but he did pass the fifth sign.

Child 20: This eight year old Caucasian male reported that he observed all three signs. He reported spending “very little time” at each sign but cited his love of animals as to why he was interested in them. He did not read the third sign. The child reported reading all of sign 4 and correctly recalled the content. He read some of the fifth sign and recalled the sign was about “the ice … shrinking”. The observer reported that Child 20 passed the third sign and spent 33 seconds at the fifth sign, touching the globe multiple times. He also spent time at the fourth sign, but due to the crowded area, no specific time was recorded.

Child 21: Child 21 was an eight year old Caucasian female who reported observing all three signs. She spent “little time” at the third sign and reported reading some of the sign although she could not remember the content of the sign. She spent “an average amount” at the fourth sign, read all of it, and correctly recalled the content of the sign. Child 21 reported that she spent “very little time” at the fifth sign and did not read it. The observer reported that she spent eight seconds at the fourth sign and passed the third and fifth sign.

Child 22: This ten year old female of undisclosed ethnicity reported observing only the fifth sign. She wrote that she spent “very little time” there but did not read it. The observer reported that she passed the third sign and spent 8 seconds at sign 4 and 5.

Child 23: Child 23 was nine year old male of undisclosed ethnicity who reported observing only the third and fifth sign. He spent “very little time” at the third sign and reported reading some of the content. He specifically recalled that the sign’s content included information about how to “recycle”. He reported spending “an average amount” at the fifth sign but incorrectly wrote that the sign’s content was about “where they (polar bears) live”. The observer reported that Child 23 passed signs 3 and 4 and spent 21 seconds at sign 5.

Child 24: This eleven year old black male reported interacting with signs 4 and 5. He reported that he was interested in the fourth sign because he wanted “to see how big the bears were and try to estimate how much they eat”. He reported reading all of the sign although he incorrectly recalled the sign’s content. Child 24 reported spending “very little time” at the fifth sign but did not read it because he wasn’t interested in it. The observer reported that he passed signs 3 and 4 and spent 33 seconds at the fifth sign.

Child 25: Child 25, an eight year old Caucasian female, reported spending “very little time” at signs 4 and 5. She correctly recalled the content of sign 4 although she reported that she did not read it. She did not read sign 5 because she wasn’t interested in it although she could not articulate the specific reason. She actually passed the third and fourth sign and spent 4 seconds at the fifth sign.

Child 26: This child was a twelve year old Caucasian male. He reported seeing signs 4 and 5 although he did not specify a time for either sign. He reported reading some of the fourth sign and was able to correctly recall the content. He was interested in the fifth sign because “it

shows where polar bears live" and correctly recalled that the content was "…what's happening to their home". The observer reported that he passed signs 3 and 4 and he stood next to sign 5 for eleven seconds.

Condors of the Columbia

Sign 6

Sign 7

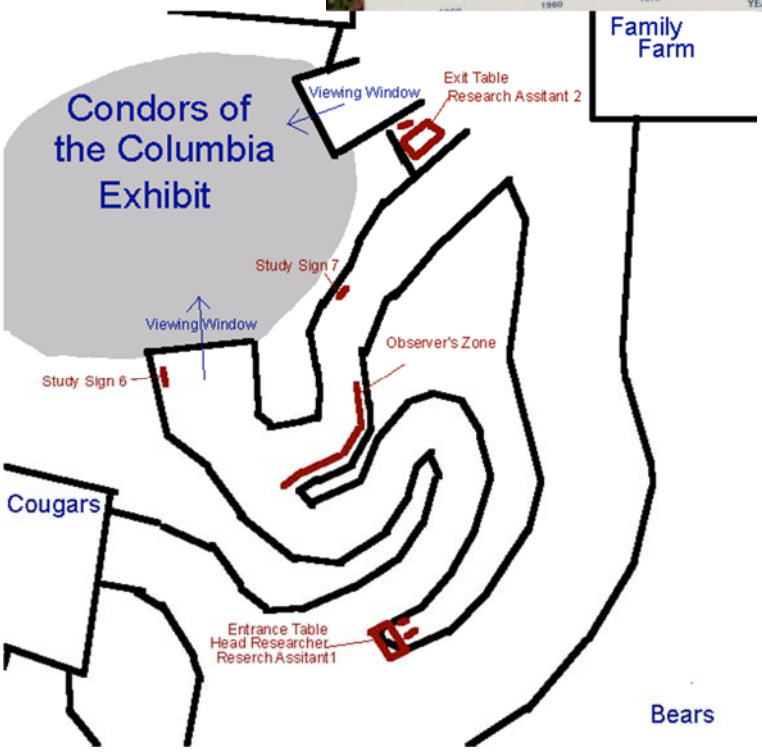


Figure 13: Condors of the Columbia Study Signs and Location

Out of the 31 children that completed the survey 14 were observed to have interacted with the study signs. Due to the smaller area of the exhibit the observer easily observed both signs simultaneously as shown in Figure 13.

Child 27: This child, a seven year old Caucasian female, reported seeing both study signs but spent “very little time” and read neither of them. Despite recording not reading sign 6, she correctly described the content of the sign as “they feed their babies garbage if they found it”. The observer noted that the child asked “What are these mom?” and touched and discussed sign 6 for 31 seconds. She also looked at a sign neighboring the seventh sign, but did not interact with the seventh sign.

Child 28: This child is a seven year old Caucasian female who reported that she didn’t see either sign. The observer reported that the child’s guardian talked with the child about both signs.

Child 29: Child 29 is a seven year old Caucasian child with an undisclosed gender. They reported seeing both signs but spending minimal time at each, “very little time”, while reading some of the sixth sign and none of the seventh one. They were unable to recall the content of the seventh sign. The observer reported that they spent 15 seconds at the sixth sign and 30 seconds at the seventh.

Child 30 and 31: Both Child 30, a nine year old Islander female and Child 31, her seven year old Islander sister, reported seeing neither sign although the observer reported that these children both passed sign 6 but glanced at the seventh sign.

Child 32, 33, and 34: These siblings, a twelve year old Caucasian female (Child 32), a ten year old Caucasian female (Child 33), and a nine year old Caucasian male (Child 34) reported

seeing the sixth sign but not the seventh sign. Child 32 reported that she spent "an average amount" at sign 6 and did not read the sign. Child 33 also reported not reading this sign although she reported spending only "very little time". Child 32 reported reading all of the sixth sign and recalled the contents were about "trash". These children spent 30 seconds at sign 6 with their mother, although Child 32 was on her phone during this time. This group stopped at sign 7 for 23 seconds but it seemed to the observer that they were reading the adjacent sign.

Child 35: Child 35 was an eight year old Caucasian male who reported seeing the sixth sign and spending "an average amount" of time with it. He reported reading all of the sign and correctly recalled the sign "showed that condors pick up trash but trash can kill chicks". The observer reported that he passed both signs, but returned and walked through the exhibit twice. He eventually spent 15 seconds at the sixth sign.

Child 36: This ten year old male of undisclosed ethnicity reported spending "little time" at the sixth sign and not seeing the seventh sign. He did not read this sign, however, because "I didn't want to read". He actually spent 27 seconds at the sixth sign and passed the seventh sign.

Child 37: Child 37, an eight year old Hispanic and Caucasian male, reported that he did not see either sign. The observed reported that he glanced at the sixth sign and passed the seventh.

Child 38: This eleven year old Caucasian female reported seeing only the sixth sign. She spent "very little time" at this sign "because it had garbage in it" but did not read it "because I wanted to look at the animals". The observer reported that the guardian spent time with the child talking about the signs.

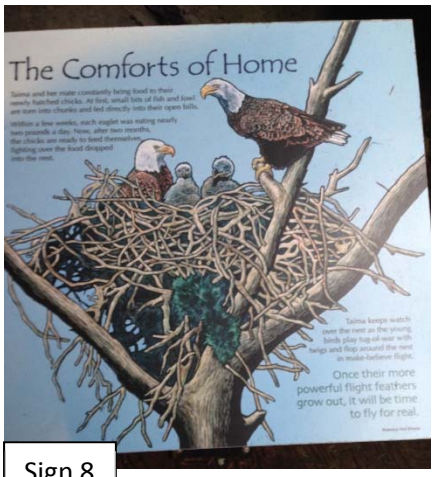
Child 39: Child 39 was a seven year old Caucasian female who reported that she did not see either sign. The observer reported that she passed the sixth sign and glanced at the seventh sign.

Child 40: The final child was an eight year old Caucasian female who reported only seeing the sixth sign. She spent "very little time" at the sign because "my dad told me to look at it". She reported to have read some of the sign, but could not recall the sign's content. The observer reported that the child talked with the parents about the sign for 39 seconds. She recorded that the parents, mother and father, were instructive. The child did pass the seventh sign.

To summarize, only 40 out of the 99 children observed the study signs and spent on average 14 seconds at these signs. Children interacted with, and spent more time at, the study signs when their guardians spent time at the signs with them. However, these children had similar amount of recall as children who did not have parental interactions at the study signs. It's also worth noting that there was not a lot of racial diversity in this group of children; only 5 of these study participants are not Caucasian.

Observational Data of Interactions

For this section, the signs were analyzed separately to determine how many children passed, glanced, or interacted at a specific sign. The interactions were combined and analyzed.



Sign 8

Sign 9

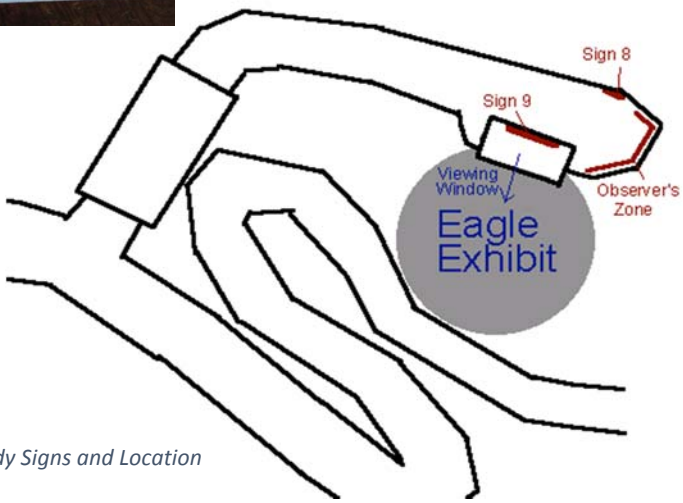
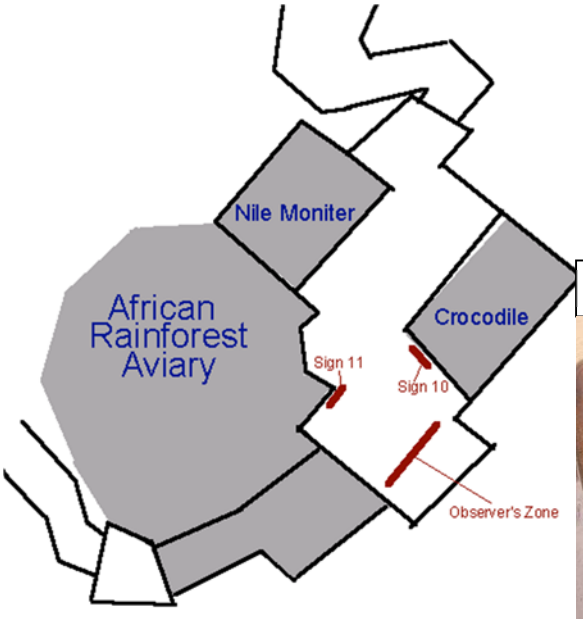


Figure 14: Eagle Canyon Study Signs and Location



Sign 10

Sign 11

Figure 15: African Rainforest Study Signs and Location

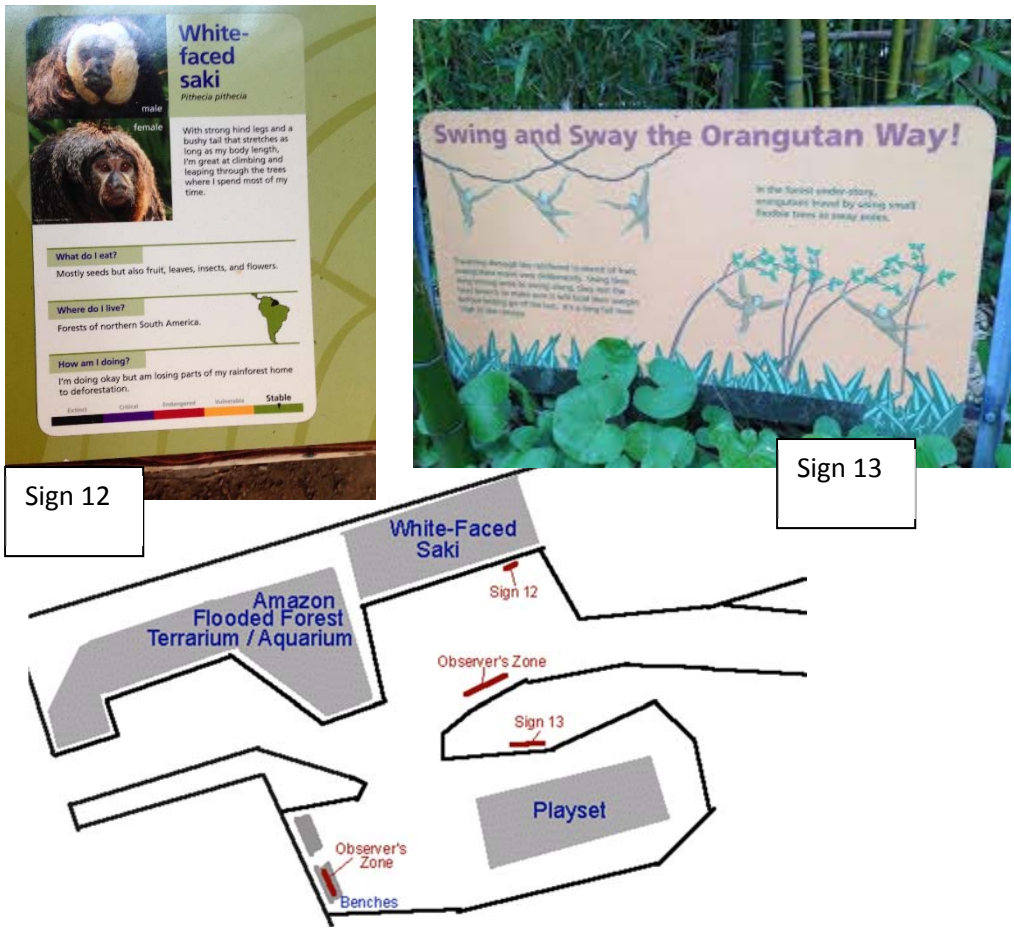


Figure 16: Amazon Flooded Forest Study Signs and Location

A majority of children passed signs without looking at them. The composting sign in the Rainforest area, Sign 10 in Figure 15, received glances from only six children. The gecko sign, Sign 11 of the same figure, in the Rainforest area received more attention, with glances from eleven children and a single child spending 5.6 seconds interacting with the sign. The two signs in the Amazon Flooded Forest, the orangutan and saki signs, received similar attention. The saki sign, Sign 12 in Figure 16, attracted glances from 36 children and five children spent more time interacting with the sign, an average of 11 seconds. The orangutan, Sign 13, sign was unusual, due to its placement within the exhibit, and no one interacted with it. It only received glances from two children; 68 children skipped the area entirely. The final area, Eagle Canyon, contained two study signs as shown in Figure 14. Sign 8, the eagle nest sign, received nine glances. Two

children spent more time with these signs, one spending 15 seconds and the other spending 7. The last sign was the most attractive to children. The ruler sign, Sign 9, received 29 glances with 30 children spending more time interacting with this sign, an average time of 18 seconds.

Out of the 612 children observed during this segment of the study, 68 interacted at the study signs. These interactions were coded into four categories and counted. The first code, 'interacted with sign' was applied to any interaction where one person encouraged interaction with the sign. Another, 'moved away from sign' applied when one person either physical removed the other, or called their attention away from the sign. 'Attempted interaction but was ignored' was used when one person interacted with a sign and encouraged another to join in the interaction but was denied. Results were coded 'no engagement' when the people neared the sign but did not engage with it. This occurred mainly with the Eagle Canyon eagle nest sign where children would climb on the sign to reach the rocks above it.

Female guardians instigated the majority of interactions that occurred at these signs, as represented in the graph by 'FG' (Please see Figure 17). The graph shows the four codes of interactions: interaction is 'interacted with sign', attempted is 'attempted interaction but was ignored', and movement is 'moved away from

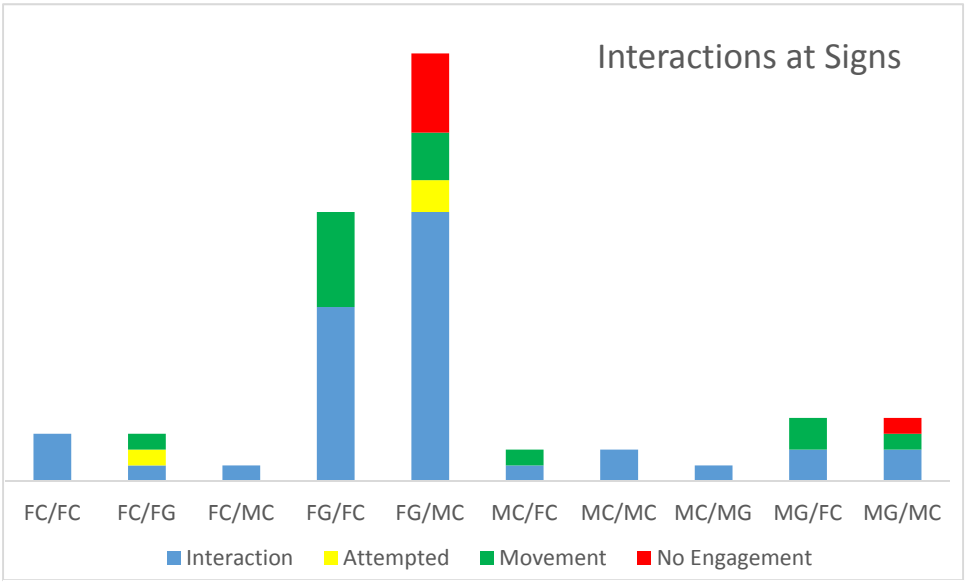


Figure 17: Interactions at Sign based on Age and Gender

sign'. This graph also shows who interacted with whom based on code order with the first being the initiator. Child to child interactions (FC, female child, and MC, male child) were usually positive in nature and encouraged interaction with the signs. Some children were observed to read the sign and pass on the knowledge they obtained, such as the physical differences between the genders of the sakis, to their peers. All groups 'interacted with sign' but only two groups, the FC/FG and FG/MC, attempted interaction but was ignored' sign.

Discussion

Now that that you have finished reading my results I can move on to discussing my findings. But first, let me remind you what my original thesis questions were: 1. Are children, ages seven through twelve, reading the signs at the Oregon Zoo? 2. Are they understanding what they are reading? 3. Do these signs help create positive conservation beliefs in children? For each of these questions the answer is a resounding no.

Thesis Question Results

To begin with children within my chosen age group are not reading zoo signs. Out of the 99 children that completely filled out both surveys, less than half of them saw a study sign within the study sites. In the second experiment, only 38 children spent more than 5 seconds looking at the study signs. Even then, the average reading time was only 14 seconds. Though I focused on a few signs, my researchers and I observed children, both included and excluded in my thesis, walk pass sign in a similar fashion to my findings. While there are some exhibits that contained items, such as a mock jeep and a telephone, which captured many children's interest these are the minority and most signs are ignored. Because of the general apathy most children have for the signs I feel that I can generalize my findings throughout all of the zoo's signs.

My second question focuses on children that have read the signs to see if they have gained or retained any content related knowledge. I only included children that were observed interacting with the signs. There were children that had visited the Oregon Zoo on previous occasions, about 45% of children surveyed, and I questioned whether these children could have remembered the signs from a previous visit even though they were observed to have passed the signs during the study. Further analysis showed that this was not the case. The answers that

children gave to my exit survey showed two main things: children did not remember the content or they remembered it incorrectly. In the instances where a child could correctly recall a sign's content I saw two main trends. Either the content of the sign was simple, for example listing off five different types of bears and their heights, or the child had incomplete recall. This was usually the case for the more complex but interactive signs. The best example of this was the second study sign at the polar bear exhibit. The sign's content focused on the melting ice caps due to climate change with anthropogenic causes as an aside. Of the few children that could recall this sign's content, they could remember that it was about "melting ice caps" but nothing more.

The findings for my final question, concerning children's knowledge of conservation, is somewhat surprising. My previous research had led me to the assumption that the answers to my first two questions would be negative so my findings seem to coincide with what I had previously hypothesized. Even so, I expected that children would have some understanding of conservation. However, my results show that not only do children not know what conservation means, but it seems that parents don't either. Considering that approximately half of the children surveyed had visited the Oregon Zoo on a previous occasion, and the majority had visited two or more other zoos, it is upsetting to see that children do not have even a simple understanding of conservation. I see these results as a sign that a greater effort needs to be placed on encouraging children to learn about conservation and related topics. This is important and the need obviously is not being met.

Study Sign Attractiveness

Not every study sign received the same amount of attention. In this section I explain which signs were the most popular and give my explanation of what made a sign attractive or not. These explanations are based on survey answers and observational data. Figure 18 shows all study signs with their sign number for reference.

Sign 1

Sign 2

Sign 3

Sign 4

Sign 5

Sign 6

Sign 7

Sign 8

Sign 9

Sign 10

Sign 11

Sign 12

Sign 13

Figure 18: All Study Signs with Their Sign Numbers

Sign 1 received very little interaction which did cause some confusion as other signs that were similar in color and text, such as Sign 12, attracted more children. Many children did not go to look at the African wild dogs because the animals were not active in their exhibit. The sign's location, next to the African wild dog viewing area, may have been the reason why Sign 1 was not as attractive. Sign 2 also attracted little attention. This sign was large in size however the multiple paragraphs were written in small, dense text.

Sign 3 proved moderately attractive. It was short, concise and interactive and many children and adults were observed flipping the signs around. However, many visitors walked by this sign due to its location. The polar bear observation area across from it drew many visitors away from Sign 3. The Zoo Teen cart, a mobile interactive cart that often contains furs or other items related to the exhibit's animals, was often located across from this sign which further attracted visitors away from it.

Sign 4 attracted the most attention. This sign's bright colors and short and concise text proved to be interactive and engaging. Visitors of multiple age groups were observed measuring themselves or taking pictures of friends or family.

Sign 5 was unpopular due to its large sections of dense and complicated text. Many children wrote that they were disappointed that the globe would not spin, indicating that the sign would have been more popular had it been interactive. Observational data showed similar results: children would approach Sign 5 and touch the globe before leaving without spending more time with the sign.

Sign 6 proved to be very attractive to children. The location, inside of a viewing area, was usually uncrowded. Sign 6 contained identifiable trash which was effective at engaging

children and the text contained simple and concise wording. The sign proved difficult to read from a distance due to its small size.

Sign 7 was unattractive to children due to several factors. The complex text is written in a small font and it may have been intimidating to visitors due to the complexity of the graph. Sign 7's location on a walkway may have pressured visitors to continue walking so they did not impede foot traffic.

Sign 8 did not attract a lot of attention from children. It is located next to a replica eagle nest for children to play in, which guardians often took picture of, which may have caused the sign to be overlooked. Often children would play in the nest and then run off to see the eagles without looking at the sign. Some guardians were seen reading this sign to children but this sign was mostly used as a ledge to climb up the rocks it was posted on.

Sign 9 received a lot of attention from children and adults. The interactive nature of this sign provided the opportunity for children and adults to measure their 'wingspan' and take photographs. Sign 9 is also concise and very visual and was located in the viewing area for the eagles. Some children didn't enter the observation deck because they thought that the deck was for official use only, however this was a minority.

Signs 10 and 11 did not receive much attention due in part to the exhibit. The Indoor African Rainforest exhibit is one of the smaller exhibits and becomes cramped with a group of visitors. It is also hot and humid which can become uncomfortable which caused several groups to bypass it. The signs themselves are very small. Sign 10 is also dark and contains one dense block of text. Its specific location, on the corner of a decorative outcropping, makes reading the

sign awkward and puts the visitor in the flow of foot traffic. Sign 11's position is much more open than Sign 10 and the sign itself is more simplistic and concise.

Sign 12 was attractive to children due to its location in the exhibit and its design. Sign 12 is located below the glass viewing area on the saki exhibit which allowed it to be viewed by anyone observing the animals. This sign also has multiple small groups of text and graphics. Many children examined this sign and talked about the differences between the male and female saki.

Sign 13 received the least amount of attention mainly due to its location: on a forked path away from the main exhibit and tucked away behind some bamboo. The area itself only contained jungle bars for children to play on and many people bypassed the area completely. Sign 13 blended into the background with muted colors and small dense text.

To summarize, popular signs were located in areas next to viewing areas and not in the paths of foot traffic. They were colorful, concise and contained a small amount of text. These signs also encouraged interaction and engaged the visitors. These criteria all proved to be critical determinants in a sign's attractiveness.

Additional Results

This thesis led to some noteworthy findings aside from the ones that I was specifically testing for. First, I found that there are specific types of sign that attract more attention both from children and adults. As previously stated, these were signs that encouraged interaction. When I first began this thesis I chose my study signs based on their differences in what I believed would make a sign more accessible to children, reading level, amount of colors, location and size, to name a few (this is outlined in my methods chapter). However, whether or not the sign was

interactive was not a variable that I had taken into account. So, while I can say that interactive signs are more attractive, I will have to complete further research to determine which types of interactive signs are the most effective.

Child self-reported data is not reliable. The difference between what a child said they did and what they were observed doing was so severe that most of the answers were in question. I don't feel that this was done intentionally. I feel that our child participants felt pressured to answer the questions positively possibly due to the presence of friends and family, although I can't be sure because that is beyond this thesis' scope. Due to the inaccuracy with child self-reported data I highly recommend observing children when during surveys.

Another interesting finding is that female adults initiate the majority of interactions with the children in their group. Our surveys did find that there were more adult females than adult males within groups of participants, however, there was only an approximate 2:1 female to male ratio. I found that the amount of interactions initiated by adult females was much higher than this ratio at nearly 4x as many interactions. This is obviously significant but outside the scope of this paper. I have gathered cursory information about the amount of female initiated interactions, but more research is needed to make a real world recommendation.

While children have interests all their own, I found that it is the parents who dictate what a child will interact with and for how long. This control took many guises, from physically pulling children who were interested in our survey tables away and around a corner, to pushing a clearly uninterested child to complete the survey (I want to note that a survey was not done with a child who had not given his or her consent). This parental control could be both positive and helpful, adults holding children to better see the animal, reading signs to very young children,

explaining ideas and words and connecting it to the child's life. During one entrance survey a mother reminded a child that she had donated her birthday money to an animal rescue to help her answer one of the questions. The child had previously not thought of donation as a way to assist animals but, with her mother's help, she was able to connect the two ideas. However, our group also observed many negative examples of parental control. In one scenario, four children started the entrance survey with their mother/aunt giving permission. She became upset at the time the survey was taking and, although the children were excited about completing the survey, the guardian hurried them through the exhibit and told them "no, just give back the tags and let's go." Another example of this occurred when a young female wanted to start the survey and a researcher overheard the following:

Child: "I want to do the survey"
Adult: "No, let's go."
Child: "But I like science."
Adult: "No, you don't like science."

It is clear that a parent's influence on a child is immediate and more powerful than any other single factor found during the entire survey.

Recommendations and Final Thoughts

I recommend further study. Specifically, the participants in the study were mostly Caucasian, so studies that included zoos with a more diverse population would be valuable. Also, observing the children during the first study was difficult because if more than one child was at a sign the single observing researcher could not fully concentrate on either child. Additional researchers would also have been beneficial in order to more closely observe the children, which matches recommendations made in Nadelson's study on parental engagement with children at a science center (Nadelson 2013).

Overall, zoos have an amazing opportunity to reach out to children and educated them about conservation, habitat restoration, and sustainability but this message isn't being transmitted to them as well as it should. I have found that the children's guardians play a crucial role in encouraging learning. Signs have potential but, as they are now, are not optimized to encourage interactions between the adults and children and the signs. With an emphasis on interaction and short, simple messages, signs could prove to be an invaluable asset in education.

Bibliography

Aesop. (1999). *The Classic Treasury of Aesop's Fables.* Philadelphia: Running Press.

Aggett-Cox, G. (2013). Where do I Begin? Starting an Education Department from Scratch. *IZE Journal*, 5-8.

Arcand, K., & Watzke, M. (2010). Bringing the universe to the street. A preliminary look at informal learning implications for a large-scale non-traditional science outreach project. *International School for Advanced Studies*, 1-13.

Association of Zoos & Aquariums. (2016, November 2). *FrogWatch USA*. Retrieved from Animals & Conservation: https://www.aza.org/frogwatch

Association of Zoos & Aquariums. (2017). *The Accreditation Questionnaire (application)* . Retrieved from Association of Zoos & Aquariums: https://www.aza.org/assets/2332/accreditation_questionnaire_application.doc

Balmford, A. (2000). Separating Fact from Artifact in Analyses of Zoo Visitor Preferences. *Conservation Biology*, 1193-1195.

Baur, B. (2011). Basel Zoo and its Native Biodiveristy Between the Enclousures: A New Stragety of Cooperation with Academic Institutions. *Interational Zoo Yearbook*, 48-54.

Braverman, I. (2011). Looking at Zoos. *Cultural Studies*, 809-842.

Cohn, J. (1992). Decisions at the Zoo. *BioScience* , 654-659.

Department pf the Interior U.S. Fish and Wildlife Service. (1973). *Endangered Species Act of 1973.* Washinton D.C.

Dooley, C. M., & Welch, M. M. (2014). Nature of Interactions Among Young Children and Adult Caregivers in a Children's Museum. *Early Childhood Educ J*, 125-132.

DuBay, W. H. (2004). *The Principles of Readability.* Costa Mesa: Impact Information.

Fa, J., Gusset, M., Flesness, N., & Conde, D. (2014). Zoos Have Yet to Unveil Their Full Conservation Potential. *Animal Conservation*, 97-100.

Faulk, J., H. J., & Foutz, S. (2009). *Free-Choice Learning and the Environment.* Lanham: AltaMira Press.

Freeman, N., Feeney, S., & Moravcik, E. (2011). Enjoy a Good Story; Why We Use Children's Literature When Teaching Adults. *Early Childhood Educ J*, 1-5.

Grech, K. (2004). *Overview of the Laws Affecting Zoos.* Retrieved from Animal Legal & Historical Center: https://www.animallaw.info/article/overview-laws-affecting-zoos

Haenke, S. (2015, August 26). Exposing Sustainability and Conservation to Children. Olympia, Washington.

Haydon, R. (2014). Defining and Articulating the Quality of Learning Zoos. *IZE Journal*, 53-55.

Ho, L. (2000). Children's Literature in Adult Education. *Children's Literature in Education*, 259-271.

James, J. J., & Bixler, R. D. (2008). Children's Role in Meaning Making Through Their Participation in an Enviornmental Education Program. *The Journal of Enviornmental Education*, 44-59.

Jant, E., Haden, C., Uttal, D., & Babcock, E. (2014). Conversation and Object Manipulation Influence Children's Learning in a Museum. *Child Development*, 2029-2045.

Jensen, E. (2014). Evaluating Children's Conservation Biology Learning at the Zoo. *Conservation Biology*, 1004-1011.

Junhold, J., & Oberwemmer, F. (2011). How are Animal Keeping and Conservation Philosophy of Zoos Affected by Climate Change. *International Zoo Yearbook*, 99-107.

Kanhadilok, P., & Watts, M. (2014). Adult play-learning: Observing informal family education at a science museum. *Studies in the Education of Adults*, 23-41.

Korpen, C., Bisanz, G., Bisanz, J., & Lynch, M. (1998). *Chart: A Tool for Surveying Young Children's Opportunties to Learn About Science Outside of School.* Ottawa: Canadian Social Science and Humanities Research Council.

Kristensen, J. L., & Nielsen, K. (2011). Exploring Soci-linguistic Context of Children's Learning About Great Ape Conseration in a Zoo. *IZE Journal*, 10-15.

Kuhn, E., Feldmann, R., Harpke, A., Hirneisen, N., Musche, M., Leopold, P., & Settele, J. (2008). Getting the Public Involved in Butterfly Conservation: Lessons Learned From a New Monitoring Scheme in Germany. *Isreal Journal of Ecology & Evolution*, 89-103.

Legislation.gov.uk. (1981, July 27). *Zoo Licensing Act of 1981.* Retrieved from The National Archives: http://www.legislation.gov.uk/ukpga/1981/37#commentary-c1021662

Leinhardt, G. (2014). Museums, Conservations, and Learning. *Revista Colombiana de Psicología,* 13-33.

MacDonald, A., & Hofer, H. (2011). Editorial: Research in Zoos. *International Zoo Yearbook*, 1-6.

Martin, R. (2012). A Study of Public Education in Zoos with Emphasis on Exhibit Labels. *IZE Journal*, 55-60.

Mitchell, A. A., Lau, J., Chemnick, L. G., Thompson, E. A., Alberts, A. C., Ryder, O. A., & Gerber, G. P. (2011). Using microsatellite diversity in wild Anegada iguanas (Cyclura pinguis) to establish relatedness in a captive breeding group of critically endangered species. *Conservation Genetics*, 771-781.

Monk, D. F. (2013). John Dewey and Adult Learning in Museums. *Adult Learning*, 63-71.

Moss, A., Jensen, E., & Gusset, M. (2014). Zoo Visits Boost Biodiversity Literacy. *Nature*, 186.

Nadelson, L. S. (2013). Who Is Watching and Who Is Playing: Parental Engagement with Children at a Hands-On Science Center. *The Journal of Educational Research*, 478-484.

National Pollinator Garden Network. (2015, June 3). *National Pollinator Garden Network Luanches Million Pollinator Garden Challenge.* Retrieved from National Pollinator Garden Network: http://millionpollinatorgardens.org/wp-content/uploads/2015/06/NPGN_PressRelease_06032015.pdf

Olukole, T. O., & Gbadebo, O. S. (2008). Patterns of Visits and Impacts of Zoo Animals on Visitors. *Anatolia: An International Journal of Tourism and Hospitality Research*, 237-249.

Oregon Zoo. (2015, October 2). *About.* Retrieved from Oregon Zoo: http://www.oregonzoo.org/about

Oregon Zoo. (2015, November 10). *Conserve.* Retrieved from Oregon Zoo: http://www.oregonzoo.org/conserve

Paz, S., Liu, H., Fongwa, M., Morales, L., & Hays, R. (2009). Readability Estimates for Commonly Used Health-Related Quality of Life Surveys. *Quality of Life Research* , 889-900.

Pereboom, J., Leus, K., & Van Elsacker, L. (2011). Pro Natura et Scientia: zoo research at the Royal Zoological Society of Antwerp. *International Zoo Yearbook*, 38-47.

Randall, T. (2012). Assessment of Change in Conservation Attitudes Through Zoo and Aquarium Education. *IZE Journal*, 13-17.

Rodari, P. (2009). Learning science in informal enviornments: people, places and pursuits. A review by the US National Science Council. *Journal of Science Communication*, 1-5.

Schreiber, J. (2013). Informal Enviornments. *The Journal of Educational Research*, 421-422.

Sevdalis, C., & Skoumios, M. (2014). Non-formal and Informal Science Learning: Teacher's Conceptions. *The International Journal of Science and Society*, 13-25.

Shaping Outcomes. (2014). Oregon Zoo's ZAP & UNO Expansion. *Shaping Outcomes Cases*, 1-9.

Skibins, J., Powell, R., & Hallo, J. (2013). Charisma and Conservation: Charismatic Megafauna's Influence on Safari and Zoo Tourist's Pro-Conservation Behaviors. *Biodivers Conserv* , 959-982.

Smith, L., Broad, S., & Weiler, B. (2008). A Closer Examination of the Impact of Zoo Visits on Visitor Behaviour. *Journal of Sustainable Tourism*, 544-562.

Stanford, A. (2014). Can I Touch It?: Zoo Program Impacts. *IZE Journal*, 64-67.

Street, B., Jenkins, J., & Frasier, J. (2012). Research on Visitor Receptiveness to Conservation Messaging and its Impact on Exhibit Design. *IZE Journal*, 60-63.

Swanagan, J. (2000). Factors Influencing Zoo Visitor Conservation Attitudes and Behaviors. *The Journal of Enviornmental Education*, 26-31.

Taylor, A., Sickler, J., Bicknell, J., & Fraser, J. (2009). What Information Do Zoo & Aquarium Visitors Want on Animal Identification Labels? *Journal of Interpretation Research*, 7-19.

Taylor, E. W. (2006). Making Meaning of Local Nonformal Education: Pracitioner's Perspective. *Adult Education Quarterly*, 291-307.

Text Statistics Projects. (2016, January 29). *Readability-Score*. Retrieved from Readability-Score: https://readability-score.com/

Tunnicliffe, S. D., & Scheersoi, A. (2012). Voices in Zoos and Aquariums . *IZE Journal*, 23-26.

Turner, T., & Krechevsky, M. (2003). Who are the Teachers? Who are the Learners? *Educational Leadership*, 40-43.

U.S. Forest Service Department of Argiculture. (2015, December 6). *Outdoor Interpretive Signs.* Retrieved from Lews and Clark Trail Heritage Foundation: http://lewisandclark.org/grants/docs/NFS_Interpretive_Sign_Design_Steps.pdf

United States Census Bureau. (2014). *Selection Social Characteristics in the United States 2010-2014 American Community Survey* . Retrieved from American FactFinder: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_DP02&prodType=table

United States Department of Agriculture. (2013). *Animal Welfare Act and Animal Welfare Regulations.*

Whitehouse, J., Waller, B. C., Wallace, E., Schel, A., Peirce, K., Mtichell, H., . . . Slocombe, K. (2014). Evaluation of Public Engagement Activities to Promote Science in a Zoo Enviornment. *Plos One*, 1-14.

Xanthoudaki, M. (2013). Reflecting on the role of informal learning and visitor experience in science museums. *Journal of Science Communication*, 1-2.

Appendices

Appendix A: Sign specifications for signs at study sites at the Oregon Zoo. Highlighted sign numbers indicate a selected sign.

Location	Indoor African/ bird					
Sign #	1	2	3	4	5	
Location	Near	Near	Near	Near	Across	
Size cm	22*12.5	58,34.5	23,12.5	58.5,34	122,150.5	
Height cm	129	88	111	120	0	
Reading Level	6.6	6.8	2	5.3	10.8	
Percentage of Text	52	31	24	26	17	
Percentage of Text	52	28	22	24	15	
Photographic Images	1	0	0	0	6	
Charts/infographics	0	0	0	0	1	
Artistic Depictions	0	1	1	1	0	
Varied Text Size/Font	3	2	2	3	4	
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	1	0	0	0	2	
Layers	1	2	1	1	1	
Texture/Material	1	1	1	1	1	
Location	Indoor African/ bird					
Sign #	6	7	8	9	10	
Location	On	On	On	On	On	
Size cm	61,12.5	61,13	185,10	61,13	61, 13	
Height cm	106	106	106	106	106	
Reading Level	3.8	7.5	7.3	6.4	4.8	
Percentage of Text	20	23	28	28	47	
Percentage of Text	18	21	25	25	43	
Photographic Images	2	1	1	1	1	
Charts/infographics	0	0	0	0	0	
Artistic Depictions	0	0	0	0	0	
Varied Text Size/Font	2	2	2	3	2	
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	1	1	1	0	1	
Layers	1	1	1	1	1	
Texture/Material	1	1	1	1	1	

Location	Indoor African/ bird					
Sign #	11	12	13	14		
Location	Near	Near	Near	Near		
Size cm	23,12.5	58,34	23.5,12.5	58.5,34		
Height cm	126	85	113	105		
Reading Level	16.3	6.9	6.6	6.5		
Percentage of Text	12	35	32	23		
Percentage of Text	11	32	29	21		
Photographic Images	1	0	0	1		
Charts/infographics	0	0	0	1		
Artistic Depictions	0	1	1	0		
Varied Text Size/Font	3	3	3	2		
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular		
Colors	1	1	0	0		
Layers	1	1	1	1		
Texture/Material	1	1	1	1		
Location	Aviary					
Sign #	1	2	3	4	5	
Location	Inside	Inside	Inside	Inside	Inside	
Size cm	26,21.5	26,21.5	26,21.5	26,21.5	26,21.5	
Height cm	81	81	81	81	81	
Reading Level	7.3	6.5	7	6.1	7.8	
Percentage of Text	44	50	34	44	33	
Percentage of Text	40	45	31	40	30	
Photographic Images	1	1	2	1	1	
Charts/infographics	1	1	1	1	1	
Artistic Depictions	1	1	0	1	1	
Varied Text Size/Font	5	5	5	5	5	
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	0	0	0	0	0	
Layers	1	1	1	1	1	
Texture/Material	1	1	1	1	1	

Location	Aviary					
Sign #	6	7	8	9		
Location	Inside	Inside	Inside	Inside		
Size cm	26,21.5	26,21.5	26,21.5	26,21.5		
Height cm	81	81	81	81		
Reading Level	7	10.2	7.4	6		
Percentage of Text	34	32	33	29		
Percentage of Text	31	29	30	26		
Photographic Images	1	1	2	2		
Charts/infographics	1	1	1	1		
Artistic Depictions	1	1	0	0		
Varied Text Size/Font	5	5	5	5		
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular		
Colors	0	0	0	0		
Layers	1	1	1	1		
Texture/Material	1	1	1	1		
Location	Predators of the Serengti					
Sign #	1	2	3	4	5	
Location	Away	Near	Near	Near	Across	
Size cm	34,44	32.5,52	62,16	87,63	66.5,64	
Height cm	110	132	110	109	97	
Reading Level	2.3	11.8	7.1	7.2	6.5	
Percentage of Text	30	36	50	32	22	
Percentage of Text	27	33	45	29	20	
Photographic Images	0	1	1	2	2	
Charts/infographics	0	0	0	0	0	
Artistic Depictions	1	0	0	0	0	
Varied Text Size/Font	2	6	6	5	4	
Shape of Sign	Slanted Rectangluar	Rectangular	Rectangular	Unusual	Unusual	
Colors	0	1	1	1	0	
Layers	1	1	2	4	4	
Texture/Material	1	1	1	2	2	

Location	Predators of the Serengti					
Sign #	6	7	8	9	10	
Location	Across	Adjacent	Adjacent	Near	Near	
Size cm	108,102	124,77	75, 37	104,60	86,59	
Height cm	78	90	80	91	104	
Reading Level	4.1	8.5	7.1	8.8	6.4	
Percentage of Text	40	17	22	35	30	
Percentage of Text	36	15	20	32	27	
Photographic Images	5	1	2	2	1	
Charts/infographics	0	1	0	0	0	
Artistic Depictions	0	0	0	6	0	
Varied Text Size/Font	7	4	4	9	5	
Shape of Sign	Unusual	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	1	1	0	2	1	
Layers	4	3	4	3	3	
Texture/Material	2	3	3	3	2	
Location	Predators of the Serengeti					
Sign #	11	12	13	14	15	
Location	Adjacent	Adjacent	Across	Adjacent	Near	
Size cm	68.5,67	40,60	48,86	58.5,51.5	51,20	
Height cm	89	109	148	111	88	
Reading Level	5.9	5.9	2.5	5	8.2	
Percentage of Text	21	36	29	29	29	
Percentage of Text	19	33	26	26	26	
Photographic Images	4	1	1	1	1	
Charts/infographics	0	0	0	0	0	
Artistic Depictions	0	0	0	0	0	
Varied Text Size/Font	4	3	3	2	3	
Shape of Sign	Unusual	Rectangular	Unusual	Rectangular	Rectangular	
Colors	1	3	1	1	2	
Layers	5	3	4	3	1	
Texture/Material	2	2	3	2	1	

Location	Predators of the Serengeti					
Sign #	16	17	18	19	20	
Location	Near	Near	Near	Adjacent	Away	
Size cm	51,20.5	51,21	51,20	37.5,60	80,50.5	
Height cm	88	88	88	98	110	
Reading Level	17	8.8	10.1	4.8	4.4	
Percentage of Text	13	29	24	17	40	
Percentage of Text	12	26	22	15	36	
Photographic Images	1	1	1	1	1	
Charts/infographics	0	0	0	0	2	
Artistic Depictions	0	0	0	0	0	
Varied Text Size/Font	2	5	3	2	4	
Shape of Sign	Rectangular	Rectangular	Rectangular	Unusual	Unusual	
Colors	1	2	2	2	1	
Layers	1	1	1	4	4	
Texture/Material	1	1	1	2	2	
Location	Predators of the Serengeti					
Sign #	21	22	23	24	25	
Location	Away	Away	On	On	Away	
Size cm	247,147	55,58	59,31	35,53	69,70.5	
Height cm	65	97	64	116	90	
Reading Level	11.5	5.2	9.2	9.5	9	
Percentage of Text	41	40	26	31	29	
Percentage of Text	37	36	24	28	26	
Photographic Images	14	1	1	1	1	
Charts/infographics	0	0	0	0	0	
Artistic Depictions	0	0	0	0	1	
Varied Text Size/Font	5	3	3	2	5	
Shape of Sign	Unusual	Slanted Rectangular	Rectangular	Rectangular	Unusual	
Colors	1	2	2	0	1	
Layers	5	2	3	1	4	
Texture/Material	3	2	2	1	2	

Location	Predators of the Serengeti					
Sign #	26	27	28	29	30	
Location	Away	Away	On	On	Away	
Size cm	276,164	51,70	27.5,43.5	33.5,71	36.5,114.5	
Height cm	86	90	168	107	46	
Reading Level	9	6.9	3.7	3.4	7.9	
Percentage of Text	44	25	48	33	23	
Percentage of Text	40					
Photographic Images	12	1	0	0	1	
Charts/infographics	0	0	0	0	2	
Artistic Depictions	1	0	0	1	0	
Varied Text Size/Font	6	3	3	2	2	
Shape of Sign	Unusual	Slanted Rectangular	Rectangular	Slanted Rectangular	Slanted Rectangular	
Colors	1	1	1	1	1	
Layers	4	2	1	1	2	
Texture/Material	4	2	1	1	1	
Location	Predators of the Serengeti					
Sign #	31	32	33	34	35	
Location	Away	Away	Adjacent	Away	Near	
Size cm	211,120.5	74,72	69,47	114,66.5	65, 20.5	
Height cm	83	91	112	103	73	
Reading Level	9.6	1.6	7.6	5.1	5.5	
Percentage of Text	36	16	18	14	33	
Percentage of Text						
Photographic Images	10	1	0	0	1	
Charts/infographics	0	0	0	0	0	
Artistic Depictions	0	0	1	1	0	
Varied Text Size/Font	2	2	3	2	2	
Shape of Sign	Unusual	Rectangular	Slanted Rectangular	Rectangular	Rectangular	
Colors	1	0	2	2	1	
Layers	4	2	3	3	2	
Texture/Material	4	2	2	2	1	

Location	Predators of the Serengeti					
Sign #	36	37	38	39		
Location	Near	Near	Across	Away		
Size cm	70,20	33.5, 97	51,57.5	26,24.5		
Height cm	63	100	109	124		
Reading Level	8.4	7.3	7.6	3.2		
Percentage of Text	29	24	22	52		
Percentage of Text						
Photographic Images	1	1	1	0		
Charts/infographics	0	0	0	0		
Artistic Depictions	0	0	0	0		
Varied Text Size/Font	2	2	2	2		
Shape of Sign	Rectangular	Slanted Rectangular	Slanted Rectangular	Rectangular		
Colors	1	1	1	1		
Layers	3	2	4	1		
Texture/Material	2	1	3	1		
Location	Amazon Flooded Forest					
Sign #	1	2	3	4	5	
Location	Adjacent	Nearly	Near	Near	Near	
Size cm	66,33	66,33	66, 67.5	66,33	20,30	
Height cm	140	135	99	136	56	
Reading Level	5.2	6.7	6.1	7.9	8.5	
Percentage of Text	36	35	44	25	21	
Percentage of Text						
Photographic Images	2	2	3	2	3	
Charts/infographics	4	4	6	0	2	
Artistic Depictions	0	0	0	0	0	
Varied Text Size/Font	3	3	3	3	3	
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	2	2	2	1	2	
Layers	2	2	2	2	2	
Texture/Material	1	1	1	1	1	

Location	Amazon Flooded Forest					
Sign #	6	7	8	9		
Location	Near	Away	Away	Away		
Size cm	20,30	90.5,51	62.5,91	70,126		
Height cm	61	73	80	44		
Reading Level	4.8	4.8	6.7	7.8		
Percentage of Text	27	26	22	17		
Percentage of Text						
Photographic Images	1	0	5	3		
Charts/infographics	2	0	0	2		
Artistic Depictions	0	1	1	1		
Varied Text Size/Font	3	2	3	3		
Shape of Sign	Rectangular	Rectangular	Unusual	Unusual		
Colors	2	0	0	0		
Layers	1	1	2	3		
Texture/Material	1	1	1	1		
Location	Polar Bear Exhibit					
Sign #	1	2	3	4	5	
Location	Away	Away	Adjacent	Across	Away	
Size cm	45.5,92	950,107	327,104	152,45.5	86.5,115	
Height cm	96	94	81	82	92	
Reading Level	11	6.7	7.3	4.4	8	
Percentage of Text	18	12	23	32	31	
Percentage of Text						
Photographic Images	0	0	6	0	7	
Charts/infographics	0	0	4	0	0	
Artistic Depictions	2	5	0	7	0	
Varied Text Size/Font	2	6	6	4	5	
Shape of Sign	Rectangular	Unusual	Unusual	Rectangular	Rectangular	
Colors	1	1	1	2	2	
Layers	2	2	4	1	1	
Texture/Material	2	3	3	2	1	

Location	Polar Bear Exhibit[1]					
Sign #	6	7	8	9	10	
Location	Away	Away	Away	Away	Away	
Size cm	274, 302	38, 62	38,62	38, 62	38,62	
Height cm	0	~90	~90	~90	~90	
Reading Level	3	5.1	3.9	3.4	6.7	
Percentage of Text	9	21	26	17	32	
Percentage of Text						
Photographic Images	0	0	0	0	0	
Charts/infographics	1	0	0	0	0	
Artistic Depictions	4	1	1	1	1	
Varied Text Size/Font	2	3	3	3	3	
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	1	2	2	2	2	
Layers	1	2	2	2	2	
Texture/Material	1	2	2	2	2	
Location	Polar Bear Exhibit					
Sign #	11	12	13	14	15	16
Location	Away	Away	Away	Away	Away	Away
Size cm	38, 62	38,62	38, 62	38,62	38, 62	38,62
Height cm	~90	~90	~90	~90	~90	~90
Reading Level	4	4.3	5.1	3.2	3.1	3
Percentage of Text	20	30	19	20	29	27
Percentage of Text						
Photographic Images	0	0	0	0	0	0
Charts/infographics	0	0	0	0	0	0
Artistic Depictions	1	1	1	1	1	1
Varied Text Size/Font	3	3	3	3	3	3
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular
Colors	2	2	2	2	2	2
Layers	2	2	2	2	2	2
Texture/Material	2	2	2	2	2	2

[1] Polar bear sign 7-16 together make up one large sign. Statistics included here to show their similarities.

Location	Condors					
Sign #	1	2	3	4	5	
Location	Away	Adjacent	Adjacent	Adjacent	On	
Size cm	106.5,55.5	96.5,92	25,60	86,91.5	107,55	
Height cm	93	86	118	87	93	
Reading Level	5.8	5	3.1	6.6	7.3	
Percentage of Text	22	22	26	37	24	
Percentage of Text						
Photographic Images	1	2	1	9	3	
Charts/infographics	0	0	0	0	1	
Artistic Depictions	1	0	0	0	0	
Varied Text Size/Font	5	5	3	5	7	
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	0	1	0	1	1	
Layers	1	2	2	2	1	
Texture/Material	1	5	many	2	1	
Location	Condors					
Sign #	6	7	8			
Location	On	Adjacent	Adjacent			
Size cm	60.5,55.5	87,61	87,61			
Height cm	93	117	119			
Reading Level	9.2	4.3	7.2			
Percentage of Text	27	22	29			
Percentage of Text						
Photographic Images	1	0	2			
Charts/infographics	1	0	0			
Artistic Depictions	0	1	0			
Varied Text Size/Font	4	5	6			
Shape of Sign	Rectangular	Rectangular	Rectangular			
Colors	1	0	1			
Layers	1	1	1			
Texture/Material	1	1	1			

Location	Eagle Canyon					
Sign #	1	2	3	4	5	
Location	Away	Away	Away	Away	Away	
Size cm	76,30	76,30	76,45.5	61,60.5	61,60.5	
Height cm	108	108	51	65	78	
Reading Level	5.7	7.7	8	4.8	6.4	
Percentage of Text	38	24	32	23	17	
Percentage of Text						
Photographic Images	1	1	3	0	0	
Charts/infographics	0	0	0	0	0	
Artistic Depictions	2	2	1	1	1	
Varied Text Size/Font	3	4	4	4	3	
Shape of Sign	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular	
Colors	0	0	0	0	0	
Layers	1	1	2	1	1	
Texture/Material	1	1	1	1	1	
Location	Eagle Canyon					
Sign #	6	7	8	9		
Location	Away	Away	Adjacent	Across		
Size cm	61,60.5	61,60.5	56, 35.5	213, 122		
Height cm	67	78	136	49		
Reading Level	6.1	10.6	12.2	5.1		
Percentage of Text	23	16	16	26		
Percentage of Text						
Photographic Images	0	2	0	3		
Charts/infographics	0	1	0	1		
Artistic Depictions	1	2	1	1		
Varied Text Size/Font	3	4	2	3		
Shape of Sign	Rectangular	Unusual	Rectangular	Unusual		
Colors	0	0	1	0		
Layers	1	2	1	3		
Texture/Material	1	3	1	1		

Appendix B: Informed consent agreement, entrance survey and exit survey form used for the surveys at the Oregon Zoo.

Informed Consent Agreement

"Zoo Conservation and Children"

I, _____, hereby agree to have my child serve as a subject in the thesis project titled "Zoo Conservation and Children." It has been explained to me that its purpose is to gather information about children's knowledge of conservation and their experience in a zoo exhibit. The research activities my child will participate in are two short questionnaires. My child will also be observed as they engage with the exhibit.

I have been informed that the information my child provides will only be used for a thesis and presentation by Sarah Haenke for a Masters of Environmental Studies at The Evergreen State College. I also understand that my child's responses may be reported in the thesis and presentation, and my child's identity will be kept confidential and no identifying information about my child will be included.

I understand that the risks to my child are minimal, and would likely be nothing more than a short time commitment. I agree for my child to be interviewed. I understand that the questionnaires will be destroyed when the project is finished.

There will be no compensation of any kind available for my child's participation. I have been told that my child can skip any question or stop the interview and withdraw his or her full participation from the study at any time without penalty. If my child or I have any questions about this project or my participation in it, I can email Sarah Haenke at Sarah.Haenke@gmail.com. Likewise, the person to contact if I experience problems as a result of my participation in this project is John McLain, IRB administrator at The Evergreen State College, Library 2211, Olympia, WA 98505; Phone 360.867.6045.

I understand that my participation in this project is completely voluntary, and that my choice of whether to participate in this project will not jeopardize my relationship with The Evergreen State College. I am free to withdraw at any point before or during the interview. I have read and agree to the foregoing.

Signature_____ Date_____

What is your child's ethnicity?

- ☐ Prefer not to say
- ☐ Hispanic/Latino
- ☐ Black/African American
- ☐ Asian
- ☐ White/Caucasian
- ☐ Other _____

1) **How old are you?**

3) **Have you been to a zoo or aquarium before?**

☐ Yes
☐ No

2) **What is your gender?**

If yes, which ones?

4) **Who are you visiting the zoo with today?**

Mother _____ Older Sibling_____ Cousin _____
Father _____ Younger Sibling _____ Friend _____
Grandparent _____ Aunt or Uncle _____ Other _____

5) **What are you excited about seeing at the zoo today?**

6) **Do you think that animals need our help?**

☐ Yes ☐ No ☐ I don't know

7) **Can you please explain?**

8) **Is this important? Why?**

9) **Can you do anything to help?**

Exit Survey Area: Rainforest Child #: Time:

1) **What does the word "Conservation" mean to you?**

2) **How can you help animals or the places they live?**

Please look at the picture of a sign labeled number 1.

3) **Do you remember looking at this sign?**

☐ Yes, please fill out the questions below ☐ No

3a) **About how long did you look at this sign?**

1	2	3	4	5
Very little time		An average amount		A really long time

3b) **Why were you interested in this sign?**

3c) **Did you read this sign?**

☐ Yes, I read all of it ☐ Yes, I read some of it.

☐ No, I didn't read it. **Can you please list why you didn't read it?**

3d) **Do you remember what this sign was about?**

Exit Survey Area: Rainforest 2 Child #: Time:

Please look at the picture of a sign labeled number 2.

3) **Do you remember looking at this sign?**

☐ Yes, please fill out the questions below ☐ No

3a) **About how long did you look at this sign?**

1	2	3	4	5
Very little time		An average amount		A really long time

3b) **Why were you interested in this sign?**

3c) **Did you read this sign?**

☐ Yes, I read all of it ☐ Yes, I read some of it.

☐ No, I didn't read it. **Can you please list why you didn't read it?**

3d) **Do you remember what this sign was about?**

Exit Survey Area: Rainforest 3 Child #: Time:

Please look at the picture of a sign labeled number 3.

3) **Do you remember looking at this sign?**

☐ Yes, please fill out the questions below ☐ No

3a) **About how long did you look at this sign?**

1	2	3	4	5
Very little time		An average amount		A really long time

3b) **Why were you interested in this sign?**

3c) **Did you read this sign?**

☐ Yes, I read all of it ☐ Yes, I read some of it.

☐ No, I didn't read it. **Can you please list why you didn't read it?**

3d) **Do you remember what this sign was about?**

Appendix C: Child Observation Sheet.

#	Child	P	G	Time (s)	Interaction					Remarks
1	M F				N/a	MG FG	← →	MC FC	Other	
2	M F				N/a	MG FG	← →	MC FC	Other	
3	M F				N/a	MG FG	← →	MC FC	Other	
4	M F				N/a	MG FG	← →	MC FC	Other	
5	M F				N/a	MG FG	← →	MC FC	Other	
6	M F				N/a	MG FG	← →	MC FC	Other	
7	M F				N/a	MG FG	← →	MC FC	Other	
8	M F				N/a	MG FG	← →	MC FC	Other	
9	M F				N/a	MG FG	← →	MC FC	Other	
10	M F				N/a	MG FG	← →	MC FC	Other	
11	M F				N/a	MG FG	← →	MC FC	Other	
12	M F				N/a	MG FG	← →	MC FC	Other	
13	M F				N/a	MG FG	← →	MC FC	Other	
14	M F				N/a	MG FG	← →	MC FC	Other	
15	M F				N/a	MG FG	← →	MC FC	Other	
16	M F				N/a	MG FG	← →	MC FC	Other	
17	M F				N/a	MG FG	← →	MC FC	Other	
18	M F				N/a	MG FG	← →	MC FC	Other	
19	M F				N/a	MG FG	← →	MC FC	Other	
20	M F				N/a	MG FG	← →	MC FC	Other	
21	M F				N/a	MG FG	← →	MC FC	Other	
22	M F				N/a	MG FG	← →	MC FC	Other	
23	M F				N/a	MG FG	← →	MC FC	Other	
24	M F				N/a	MG FG	← →	MC FC	Other	
25	M F				N/a	MG FG	← →	MC FC	Other	
26	M F				N/a	MG FG	← →	MC FC	Other	
27	M F				N/a	MG FG	← →	MC FC	Other	
28	M F				N/a	MG FG	← →	MC FC	Other	
29	M F				N/a	MG FG	← →	MC FC	Other	
30	M F				N/a	MG FG	← →	MC FC	Other	