Investigating the Influence of Zoo Exhibit Design on Visitor Empathy for Wildlife

Thesis

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By

Emily R. Grover
Graduate Program in Environment and Natural Resources

The Ohio State University

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Thesis Committee

Dr. Kristi Lekies, Advisor
Dr. Alia Dietsch
Dr. Emily Buck
Abstract

Zoos and aquaria are constantly expanding upon their animal habitats and creating new visitor experiences. In addition to traditional interpretive signage, some institutions are incorporating innovative features such as videos and interactive elements into their exhibits. While there has been some research on how these new exhibit elements might impact visitor learning, what remains to be researched is how different elements of exhibit design influence the emotional connections made between visitors and animals during a zoo visit.

This study sought to investigate 1) zoo visitors’ empathy for charismatic and non-charismatic animals, 2) what types of exhibit elements visitors interact with, and 3) whether specific exhibit design elements can be used to influence visitor empathy for the two types of animals. It was hypothesized that these exhibit elements can influence visitor empathy for animals, and specifically, those elements with more “layers” or technological features such as videos or interactive elements will be more influential. It was also predicted that zoo visitors will have high levels of empathy for wildlife, especially for charismatic species. It was expected that there would be gender and age differences in empathy for wildlife as well.

To test these hypotheses, participants were recruited at the Columbus Zoo and Aquarium to complete a survey measuring their empathy for a charismatic and non-charismatic
species, represented by a polar bear and jellyfish, and their perception of each exhibit element’s contribution to their empathy for those two species. The data were analyzed using correlations, $t$-tests, ANOVAs, and regression analysis. Results from data analysis suggest that zoo visitors express high levels of empathy for wildlife and slightly higher empathy for charismatic species. They also suggest that different exhibit elements do influence visitor empathy for both charismatic and non-charismatic species, and visitors perceive the elements of theming and animal habitat to be most influential in promoting empathy for wildlife. The findings of this study provide valuable implications for promoting visitor empathy for wildlife as well as improving zoo exhibit design.
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Vita

2010……………………………………….High School Diploma, Brecksville-Broadview Hts. High School, Broadview Heights, OH

2014……………………………………….BS in Psychology, The College of Wooster

2015-present…………………………Graduate Teaching Assistant, School of Environment and Natural Resources, The Ohio State University

2016-present…………………………Evaluation Team, Columbus Zoo and Aquarium

Publications


Fields of Study

Major Field: Environment and Natural Resources
# Table of Contents

Abstract .................................................................................................................................................. ii  
Acknowledgments .................................................................................................................................. iv  
Vita .......................................................................................................................................................... v  
List of Tables ......................................................................................................................................... ix  
List of Figures ........................................................................................................................................ x  
Chapter 1. Introduction .......................................................................................................................... 1  
  Background ........................................................................................................................................ 1  
    Conservation Messaging in Zoo Exhibits ......................................................................................... 2  
    Role of Zoos in Promoting Pro-Conservation Attitudes .............................................................. 3  
    Role of Zoos in Promoting Empathy ............................................................................................ 4  
    Evolution of Zoo Exhibit Design .................................................................................................. 4  
  Significance of the Study .................................................................................................................... 6  
  Research Questions ............................................................................................................................ 8  
Chapter 2. Review of Literature ............................................................................................................ 10  
  Technology in the Environmental Education Field ........................................................................ 10  
    Technology in Environmental Education Programming ............................................................ 11  
    Split Opinions on Technology ........................................................................................................ 12  
  Technology and Connection to Nature ............................................................................................ 13  
  Zoo Exhibit Design: Exhibit Elements and Evolution of Design .................................................. 15  
    Theming/Props ............................................................................................................................... 17  
    Animal Habitat .............................................................................................................................. 18  
    Signage ......................................................................................................................................... 20  
    Videos ......................................................................................................................................... 21  
    Interactive Elements ...................................................................................................................... 22  
  Visitor Interaction with Zoo Exhibits ............................................................................................... 24  

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empathy Toward Animals</td>
<td>26</td>
</tr>
<tr>
<td>Early Research on Empathy Toward Nature</td>
<td>26</td>
</tr>
<tr>
<td>Later Research on Empathy Toward Animals</td>
<td>27</td>
</tr>
<tr>
<td>Empathy with Charismatic and Non-Charismatic Animals</td>
<td>27</td>
</tr>
<tr>
<td>Attitudes Toward Wildlife</td>
<td>29</td>
</tr>
<tr>
<td>Current Research on Empathy Toward Animals</td>
<td>30</td>
</tr>
<tr>
<td>Empathy: Role of Zoos in Promoting Empathy Within Visitors</td>
<td>32</td>
</tr>
<tr>
<td>Framing</td>
<td>33</td>
</tr>
<tr>
<td>Storytelling</td>
<td>33</td>
</tr>
<tr>
<td>Summary and Hypotheses</td>
<td>34</td>
</tr>
<tr>
<td>Chapter 3. Methodology</td>
<td>37</td>
</tr>
<tr>
<td>Research Questions</td>
<td>37</td>
</tr>
<tr>
<td>Study Design</td>
<td>37</td>
</tr>
<tr>
<td>Participants</td>
<td>38</td>
</tr>
<tr>
<td>Measurement and Instrument</td>
<td>39</td>
</tr>
<tr>
<td>Conservation Caring</td>
<td>40</td>
</tr>
<tr>
<td>Data Collection</td>
<td>42</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>45</td>
</tr>
<tr>
<td>Chapter 4. Results</td>
<td>46</td>
</tr>
<tr>
<td>Research Question 1</td>
<td>47</td>
</tr>
<tr>
<td>Research Question 2</td>
<td>48</td>
</tr>
<tr>
<td>Research Question 3</td>
<td>49</td>
</tr>
<tr>
<td>Visitor Empathy for Jellyfish</td>
<td>49</td>
</tr>
<tr>
<td>Visitor Empathy for Polar Bears</td>
<td>51</td>
</tr>
<tr>
<td>Chapter 5. Discussion</td>
<td>54</td>
</tr>
<tr>
<td>Summary of Problem and Study Summary</td>
<td>54</td>
</tr>
<tr>
<td>Summary and Discussion of Findings</td>
<td>55</td>
</tr>
<tr>
<td>Research Question 1</td>
<td>55</td>
</tr>
<tr>
<td>Research Question 2</td>
<td>56</td>
</tr>
<tr>
<td>Research Question 3</td>
<td>58</td>
</tr>
<tr>
<td>Visitor Empathy for Jellyfish</td>
<td>59</td>
</tr>
<tr>
<td>Visitor Empathy for Polar Bears</td>
<td>60</td>
</tr>
</tbody>
</table>
List of Tables

Table 1. Pearson's Correlations for Polar Bear (PB) Variables ......................................................... 84  
Table 2. Pearson's Correlations for Jellyfish (J) Variables ................................................................. 85  
Table 3. Pearson's Correlations for Demographic Variables and Typical Visitor Interaction with Signage, Videos, and Interactive Elements ........................................................................... 86  
Table 4. Summary of Multiple Linear Regression Analysis for Signage, Video, Interactive Elements, Theming/Props, and Animal Habitat Contribution to Empathy for Jellyfish predicting Visitor Empathy for Jellyfish ................................................................................................. 87  
Table 5. Summary of Hierarchical Regression Analysis for Variables Predicting Visitor Empathy for Jellyfish ............................................................................................................................. 88  
Table 6. Summary of Multiple Linear Regression Analysis for Signage, Video, Interactive Elements, Theming/Props, and Animal Habitat Contribution to Empathy for Polar Bears predicting Visitor Empathy for Polar Bears ................................................................................................ 89  
Table 7. Summary of Hierarchical Regression Analysis for Variables Predicting Visitor Empathy for Polar Bears .................................................................................................................. 90
List of Figures

Figure 1. Research Questions. ........................................................................................................... 8
Chapter 1. Introduction

Background

When considering what a trip to the zoo or aquarium can offer, the experience could be viewed as an opportunity to have up-close encounters with wild animals that one may otherwise not be able to see, or perhaps it is a chance to spend time with family and friends. Regardless of the multitude of reasons that visitors find value in their experiences at the zoo or aquarium, these institutions offer visitors one opportunity unlike that at any other informal education center: a learning experience that fosters connections between people and wildlife. Although a zoo visit comprises only a fraction of an individual’s lifelong learning experiences, it has the potential to create a powerful, lasting impact through educational programs, interactions with zoo staff, and even design of the animal habitats and interpretive content. While mere exposure to the wild animals might suffice to inspire wonder and awe within visitors, the way in which conservation messages and individual animal stories are portrayed through interpretation and various elements of exhibit design can also be highly influential (Davey, 2006; Ross & Gillespie, 2009; Yocco, Bruskotter, Wilson, & Heimlich, 2015) although the depth of this influence has yet to be fully discovered. By better understanding how all of these elements work together to create an engaging and inspiring exhibit, zoos and aquaria can encourage not only care, concern, and admiration for specific zoo animals but also for their counterparts
in the wild.

Conservation Messaging in Zoo Exhibits

The function of zoos and aquaria has evolved over the years from a primarily scientific study and research focus to an emphasis on recreation and leisure. While visitors continue to seek out these institutions as recreation destinations, more recently, their role has been tailored to ensuring the survival of threatened and endangered species for generations to come (Ballantyne, Packer, Hughes, & Dierking, 2007; Hutchins & Smith, 2003). Some research has found that when compared to the general public, zoo and aquarium visitors have demonstrated greater alarm and concern about global warming, which suggests that these institutions can be influential venues for inspiring engagement about global warming (Kelly et al., 2014) as well as other issues such as conservation (Boyle & Mott, 2000; Mallinson, 2003; Perdue, Stoinski, & Maple, 2012). Thus, through the discovery that they can be vital centers for promoting wildlife conservation, zoos have taken a more active role in promoting conservation learning among visitors.

Zoos can accomplish these efforts to promote conservation learning in a variety of ways; most notably through conservation messaging in the interpretation and content of zoo exhibits. Research has shown that visitors to zoos and aquaria are receptive to conservation messages in exhibit content and learn new information from this content, although their interest might be influenced by their previous visits and personal involvement with conservation issues. There is also evidence that visitors retain the information communicated in these messages and even maintain levels of concern about conservation long after their visit (Yalowitz, 2004). Other factors that influence visitors’ conservation learning at zoos include availability and accessibility of the information and
presentation of content in a captivating manner. The research suggests that a relatively small proportion of visitors read informational signs at exhibits, which further indicates that new, engaging methods of presenting conservation information – including those that promote social interaction among groups of visitors – could benefit visitor learning (Blud, 1990; Clayton, Fraser, & Saunders, 2009; Ross & Gillespie, 2009).

Role of Zoos in Promoting Pro-Conservation Attitudes

By effectively communicating conservation messages through exhibits, zoos and aquaria seek to promote pro-conservation attitudes within visitors. The way that conservation message content is framed can have a profound impact on visitors’ adoption of pro-conservation attitudes such that those messages that align with personal beliefs or concerns tend to be most effective in conveying messages. For example, most zoo visitors hold a high level of biospheric concern, or concern for all living things, and research shows that using biospheric-framed messages in exhibit content is most effective for motivating environmental concern and environmentally responsible behaviors, and perhaps pro-conservation attitudes as well (Yocco et al., 2015). Exhibit design and interpretive signage also have the potential to enhance visitor understanding of the animals and conservation-related information so that attitudes about those animals are positively impacted. Additionally, exhibit design has the ability to increase the odds of willingness to change future behaviors that benefit conservation (Pearson, Dorrian, & Litchfield, 2013). Visitors have been shown to become more conservation-focused after visiting exhibits with technology features linked to conservation issues (Davey, 2006). This finding is important in that it presents an opportunity to tie conservation education into interactive exhibits, to further cultivate support for conservation initiatives.
Therefore, maximizing visitor knowledge through improvements to signage displays and
general design of the exhibit can have a meaningful impact on visitor pro-conservation
attitudes.

Role of Zoos in Promoting Empathy
Zoos and aquaria have a responsibility to promote both pro-conservation attitudes and
feelings of empathy toward wildlife and conservation of species. Since empathy
encompasses deeper emotions entwined within the connections between people and
wildlife, it can be perceived as a pathway to achieve pro-conservation attitudes by
nurturing an understanding of and care for a species. Recently, there has been an
emphasis on investigating the topic of empathy in relation to how zoos and aquaria can
play a role in fostering the emotional connections that could underlie pro-conservation
attitudes. Although it is still a developing investigation in the field, a number of studies
have suggested that zoos might help facilitate connections between humans and wildlife
that incite a desire to care for animals at the zoo, translating this into a broader concern
for the species as a whole and the habitat in which those animals live (Hacker & Miller,

Evolution of Zoo Exhibit Design
Early zoo exhibit designs began as concrete enclosures with dry or water-filled moats that
did not have many naturalistic qualities. Exhibits have since transformed to become more
naturalistic habitats that typically include some type of interpretive signage or species
identification (Shettel-Neuber, 1988). More recently, zoo exhibit designs have employed
a greater amount of interpretive signage that includes interactive components, such as
things to touch, spin, lift, or compare, or questions that prompt discussion in order to
engage visitors, as well as audiovisual media to increase visitor learning. This increase in
the utilization of technology-based interpretation spans such visitor attractions as nature
centers and theme parks in addition to zoos and aquaria (Hutchins & Smith, 2003;
Kleiman, Thompson, & Baer, 2010; Leask, Fyall, & Barron, 2014). The widespread
adoption of personal mobile technologies has also created new opportunities for visitors
to use their own technology for personalized interpretive experiences. These personalized
experiences can further facilitate the means by which attractions can cater their
experiential offerings to different segments of visitors (Leask et al., 2014; Yocco, Danter,
Heimlich, Dunckel, & Myers, 2011).

While there has been some concern over whether introducing more elaborate exhibit
design elements would deviate too far from the naturalistic-feel of the animal habitats, the
overall response from visitors has been positive, suggesting that the inclusion of
technology or interactive elements in zoo exhibits could be a beneficial practice (Clay,
Perdue, Gaalema, Dolins, & Bloomsmith, 2011; Perdue, Clay, Gaalema, Maple, &
remains to be researched is how effective all of these different elements of exhibit design
are in crafting an exhibit that promotes not only visitor learning and pro-conservation
attitudes but also empathy for wildlife. This study examined the elements of
theming/props, animal habitat, signage, video, and interactive elements in relation to
what extent they foster empathy within visitors for conservation of wildlife.

It has been shown that visitors to zoos and aquaria have embraced new and interactive
exhibit designs (Carter, Webber, & Sherwen, 2015; Perdue, Clay, et al., 2012; Tofield et
al., 2003; Webber, Carter, Smith, & Vetere, 2016), but there is still much to determine
about what kinds of specific elements of exhibit design best engage visitors and to what extent they aid in connecting audiences with wildlife. While there has been some research in the area of incorporating newer technological elements and interactive features into zoo and aquarium exhibits, specifically how they might influence visitor learning (Andersen, 2003; Davey, 2006; Yocco et al., 2011; Yocco et al., 2015), there remains a lack of knowledge as to how these elements might be used to enhance zoo visitor experiences and influence visitors to become more empathetic toward conservation of wildlife. The purpose of this study was to address this gap in the literature with the overall objective to understand the influence of different exhibit design elements on visitor empathy for conservation of wildlife.

Significance of the Study

As zoo and aquarium exhibits evolve and become more elaborate, it will be important to understand the impact of exhibit design, and specifically individual elements of exhibit design, on creating emotional connections between visitors and wildlife and on sharing conservation stories that encourage care and concern for these animals. Since informal learning institutions such as zoos are becoming more demanding of interactive and engaging experiences, these types of cutting-edge exhibits could be at the forefront of future exhibit design. It will also be vital to know whether the addition of technological features such as videos, touchscreens, or kiosks to exhibits not only enhances the visitor experience but also promotes empathy for wildlife within visitors. Although visitors will be exposed to the same exhibits at an informal education institution such as a zoo, what they retain from their experience will vary from person to person, and they will each interpret conservation information in different ways (Ballantyne, Packer, Hughes, &
Dierking, 2007). The challenge for zoos and aquaria and their future exhibits is to create experiences that will allow each visitor to integrate their current knowledge with the new knowledge they receive. Ultimately, effective wildlife and nature interpretation thrives on the ability to connect both emotionally and intellectually with visitors (Ballantyne et al., 2007), and understanding exhibit design can ultimately help better cater to recipients of informal environmental education.

The results of this study offer improved knowledge on communicating conservation messages and build upon existing foundations for future exhibit design at zoos and aquaria. The findings also provide insight into whether the inclusion of exhibit elements other than static signage adds merit to already established methods of communicating conservation messages and animal stories to audiences. The study provides benefits to the environmental education and visitor studies fields of zoos, aquaria, and perhaps more generally to informal environmental education centers. Since zoo exhibits are continually evolving to include more interactive and technological features in their exhibits, findings from this study have the potential to benefit design departments at zoos and aquaria as well as the environmental education field at large. In summary, addressing this gap in the literature provides benefits that include:

- Improved knowledge on communicating conservation messages
- Future directions for exhibit design at zoos and aquaria, as well as other informal environmental education centers
- Insight into whether the inclusion of interactive or technology-related exhibit elements in these fields adds merit to already established methods of communicating environmental and conservation messages to audiences
A better understanding of the connection between exhibit design and promoting visitor empathy for wildlife

Bridging of the exhibit design and environmental education fields in order to increase learning and inspire connections to wildlife and nature

Research Questions

This study sought to understand how we might be able to successfully foster empathy for conservation of wildlife through exhibits at zoos and aquariums, and in doing so, addressed the following research questions:

1) What levels of empathy for wildlife do zoo visitors express?

2) What different elements of exhibit design do visitors interact with at zoos and aquaria?

3) Do these different elements of exhibit design influence visitor empathy? If so, which are most influential in promoting visitor empathy?

Figure 1. Research Questions.

Based on previous research indicating that zoo visitors have been shown to express biospheric concern (Yocco et al., 2015) and concern about conservation (Davey, 2006; Pearson et al., 2013; Yalowitz, 2004), it was expected that zoo visitors will also have high levels of empathy for wildlife, suggesting a greater care for and understanding of
species. It was also hypothesized that exhibit design elements with more “layers” or technological features such as push-buttons, videos, touchscreens, or kiosks would be more influential in promoting visitor empathy than more traditional elements such as theming/props or signage alone because they can connect visitors to specific species conservation stories in a more engaging way (Clay et al., 2011; Davey, 2006; Perdue, Clay, et al., 2012; Shettel-Neuber, 1988; Tofield et al., 2003; Webber et al., 2016; Weiler & Smith, 2009).
Chapter 2. Review of Literature

The purpose of this chapter is to review current literature related to the topics of technology and empathy in the environmental education field, as well as exhibit design at zoos and aquaria. Since there are not many studies exclusively focusing on how exhibit design influences visitor empathy, this review will concentrate on how technology contributes to visitor learning and exhibit design at zoos and aquaria. It will also focus on how these institutions are promoting empathy within their visitors. Information will be presented on technology in the environmental education field, technology and connection to nature, zoo exhibit design, visitor interaction with zoo exhibits, empathy toward animals, and the role of zoos in promoting empathy within visitors. A summary concludes the chapter.

Technology in the Environmental Education Field

In order to understand the role of technology in zoo exhibits and its influence on visitor learning and empathy, it is necessary to examine how technology has been implemented more generally in the environmental education field. Previous research has explored the role of technology in the environmental education field, which at its roots, was a field more focused on naturalistic study. Once appearing to be technophobic and exhibiting historical resistance to incorporating technology (Bowers, 2000), the environmental education field has been increasingly inclusive of technology in programming (Peffer,
Bodzin, & Smith, 2013). Examining informal environmental educators’ use of instructional or learning technology, Peffer et al. (2013) found that there is a willingness of environmental educators to incorporate it into educational programs through the use of personal digital assistants (PDAs), simulations, online discussions, and instruments called probeware that collect data from the physical world, although few actually integrate it into their instructional venues to enhance cognition. A combination of educational opportunity, support, and practicing technology integration appears to influence the decision to use learning technology in programs, and educators cited professional development support as something they felt would better prepare them to incorporate technology into the field (Heimlich, 2003; Peffer et al., 2013). Much of the technology surge in the environmental education field has been a result of advances in types of technology available, for example, tools to measure water quality. To remain socially relevant in our modern world, environmental education has adapted to this technological change, combining access to the natural world with access to the tools of formal education (Anderson et al., 2015; Crawford, Holder, & O’Connor, 2016; Heimlich, 2003).

Technology in Environmental Education Programming

Multiple studies investigate the role of technology in environmental education, and specifically, how it has been incorporated into programming (Barnett, Vaughn, Strauss, & Cotter, 2011; Chavez, 2009; Chen, Kao, & Sheu, 2003; Harmon & Gleason, 2009; Moreno, Smith, & Agnello, 2015). Some of the different types of technology that have been integrated into programming include cell phones, personal digital assistants (PDAs), remotely operated vehicles (ROVs), global positioning systems (GPS), cameras, and
geographic information system (GIS) software. Overall, the literature suggests that technology better enables children to interact with and learn from the outdoors through programs administered via cell phones and PDAs (Chen et al., 2003), remotely operated vehicles, or ROVs (Harmon & Gleason, 2009), GPS devices and cameras (Chavez, 2009), as well as GIS software (Barnett et al., 2011). Benefits associated with using technology of this kind in outdoor informal education settings include increased education, excitement, and engagement (Harmon & Gleason, 2009), in addition to greater self-efficacy toward science and sense of environmental stewardship (Barnett et al., 2011).

Split Opinions on Technology
There exists some concern over whether technology could impair connection to the natural world. While many educators recognize the potential of technology to augment learning, reduce negative experiences, and build emotional ties to the environment, others feel it would reduce emotional connections to the environment (Leydon & Turner, 2013; Peffer et al., 2013). This split over the integration of technology in environmental education covers two different philosophies: one which claims that the integration of digital technologies would negatively affect the beneficial influence of nature, and another claiming that the use of technologies can be an appropriate way to educate youth through a more readily connected means (Kacoroski, 2015). Although there are mixed beliefs about technology integration in environmental education, with children, it is important to consider alternative possibilities to present the information through a means with which children better connect. Environmental education researchers share widespread agreement on the need for additional research on social media, information
technologies, and specifically, using technology in accomplishing environmental education, regardless of whether they fear digital technology disconnecting people from nature or welcome opportunities for greater engagement (Ardoin, Clark, & Kelsey, 2013; Kacoroski, 2015; Peffer et al., 2013; Thomas & Munge, 2015).

Some research has been conducted on the effects of technological nature, or the technologies that mediate, augment, or simulate the natural world through such enhancements as videos and live webcams of nature, robot animals, and immersive virtual environments (Kahn, Severson, & Ruckert, 2009). This topic addresses how actual nature is being replaced with technological nature, creating the growing concern for “generational amnesia,” which occurs when humans gradually adapt to the loss of actual nature and increase of technological nature, lowering the baseline across generations for what counts as a full measure of the human relationship with nature and of the human experience. Although interacting with technological nature can provide some, although not all, of the benefits of interacting with actual nature, this will be important for environmental educators to consider when thinking about implementing technology into programming and exhibits (Kahn et al., 2009).

Technology and Connection to Nature

As just discussed, researchers and educators are divided over the implementation of technology in the environmental education field. While there is support for technology integration to engage audiences in learning experiences without distracting from nature, there is also concern over whether technology will jeopardize deeper connections to the environment (Kacoroski, 2015). There have been an increasing number of studies, however, supporting the role of technology in stimulating environmental interest and
learning in youth (Barnett et al., 2011; Harmon & Gleason, 2009). This suggests that many of the benefits of utilizing technology outweigh the possibilities of losing connections to the natural world, and may, in fact, reinforce those connections. Some studies more generally support the use of technology in various ways to increase student or visitor engagement at informal environmental education institutions. For example, as the technologically sophisticated and always connected traveler becomes the latest trend in tourism, researchers are exploring how mobile technologies assist tourists throughout their trips through smartphone applications and games (Chung, Han, & Joun, 2015; Nunes & Mayer, 2014). These mobile devices can enhance tourist or visitor experiences by promoting different levels of engagement and interaction, and even sustainable behavior (Kirn, 2012; Klasky, 2014). Some game-like applications for cell phones are connected to interpretation that includes environmental and cultural heritage as well as the importance and types of environmentally responsible behavior in these areas. With these applications, tourists develop greater sensitivity and commitment to the environment while also learning about the location (Nunes & Mayer, 2014). Another way technology is used to improve visitor experiences is in zoo settings, where visitors can download a zoo-specific application onto their smartphone or tablet. The use of this type of application has been studied in the context of communicating environmental messages to visitors and framing these messages using visitors’ varying levels of environmental concern. Visitors tend to have higher levels of biospheric concern, or concern for all living beings, and agree more with statements or messages that are framed by biospheric concern (Yocco et al., 2015). This is important in relation to the potential power of environmental communication and framing strategies in
informal environmental education settings to facilitate learning about central environmental issues. The study by Yocco et al. (2015) suggests that zoos consider technological devices such as smartphone applications to communicate targeted environmental concern-framed messages to their visitors. For instance, the smartphone application could be personalized to reflect different types of environmental concern, with the same content, only delivered through a different frame. Touch-screen kiosks could also be used onsite, which administer a brief environmental concern scale that is summarized by the computer and used to display on-screen messages tailored to these results (Yocco et al., 2015). These examples suggest that smartphone applications and games can be used to both communicate environmental messages (Yocco et al., 2015) and present educational materials (Nunes & Mayer, 2014), fostering a connection to nature. Similar to how technology might influence connection to nature, the present study explored the influence of technology in zoo and aquarium exhibits on connection to wildlife, and whether those exhibits with technology might foster greater care or concern for wildlife than those without technology.

Zoo Exhibit Design: Exhibit Elements and Evolution of Design

Just as environmental education programs have evolved with the addition of technology, zoo exhibit design has changed to improve animal welfare and engage visitors to become conscious of conservation efforts. First generation zoo exhibit designs began as concrete enclosures with dry or water-filled moats that did not have many naturalistic qualities. Second generation exhibits responded to animal welfare concerns by housing animals in larger enclosures, and third generation exhibits made the first attempt to mimic the animal’s natural habitat and include some type of interpretive signage or species
identification (Carter et al., 2015; Shettel-Neuber, 1988). In contemporary zoos, immersive exhibits are becoming more prevalent, seeking to create naturalistic exhibits that promote a sense of being immersed in the animal’s natural habitat through such features as free-range enclosures, themed precincts, up-close visibility or animal encounters, and even recreational experiences (Carter et al., 2015). Exhibit designs have also begun to implement a greater amount of interpretive signage that includes interactive components, such as things to touch, spin, lift, or compare, or questions that prompt discussion in order to engage visitors (Serrell, 1988), as well as audiovisual media to increase visitor learning. Although slow to appear across zoos out of concern for interference with these more naturalistic habitats, animatronics (animated robots) and technology-based elements such as interactive computer stations and videos have also been added to zoos in the U.S. to improve animal welfare and simultaneously enhance visitor experiences (Carter et al., 2015; Hutchins & Smith, 2003; Kleiman et al., 2010). Beyond zoos and aquaria, this increase in the utilization of technology-based interpretation spans such visitor attractions as nature centers and theme parks (Hutchins & Smith, 2003; Kleiman et al., 2010; Leask et al., 2014). The widespread adoption of personal mobile technologies has also created new opportunities for visitors to use their own technology for personalized interpretive experiences. Some museums have also adopted the use of wireless technologies and electronic guidebooks to enhance these experiences (National Research Council (U.S.), 1996). These personalized experiences can further be used to benefit institutions by catering to different segments of visitors (Leask et al., 2014; Yocco et al., 2011). As museums and informal environmental education institutions continue to seek innovative and persuasive techniques for engaging
interpretation, they expand educators’ horizons for connecting with audiences.

The literature suggests that although some concern existed over the possibility of more elaborate exhibit design elements detracting from the naturalistic-feel of the animal habitats, visitors have responded to this introduction of new exhibit elements positively overall, supporting the inclusion of technology or interactive elements in zoo exhibits as a beneficial practice (Clay et al., 2011; Perdue, Clay, et al., 2012; Shettel-Neuber, 1988; Tofield et al., 2003; Webber et al., 2016). Research has even shown that adding multiple “layers” of interpretation or exhibit elements can enhance visitor learning outcomes and their overall zoo experience (Weiler & Smith, 2009). Visitor evaluations also demonstrate that they enjoy and learn from these amenities, but the interactive exhibits are expensive to produce and maintain, as was found in the study by Shettel-Neuber (1988). Whether all of these different elements of exhibit design are actually effective in creating an exhibit that promotes empathy for wildlife, and to what extent, remains to be researched. Thus, it was the purpose of this study to examine the elements of theming/props, animal habitat, signage, videos, and interactive elements in relation to what extent they foster empathy within visitors for conservation of wildlife.

Theming/Props

One exhibit design element that was examined in the present study is the theming and props within an exhibit. With the development of immersive exhibits in modern zoos, theming and props can play a role in the creation of the visitor experience. Immersive exhibits often place visitors where the animals are, letting them become part of the animals’ habitat and immersing them in the story of that animal through various details throughout the exhibit (Carliner, 2001). Immersion can serve as a storytelling technique,
placing visitors in the environment of the animals to suggest to them that they are entering the animal’s natural habitat and sharing the same space with those animals (Carter et al., 2015). For example, at the Columbus Zoo and Aquarium’s African themed Heart of Africa exhibit, animals such as lions, giraffes, and cheetahs are exhibited amid structures created to imitate African village “huts” and “local” signs scattered along the pathway through this region. There is also a mock “base-camp” alongside the vervet monkey habitat filled with various props that resemble objects one might find in an African base camp (maps, journals, binoculars) to create the feeling that visitors are walking through a base camp in an actual African village. The theme of journeying through an African village and props that add details to this storyline immerse visitors in the African savannah to help them imagine what it might be like to live amongst the animals that reside there. The theming and props of a region in the zoo may function to play a vital role in communicating the connections between animal species and human impact on the environments they share with those species (Carter et al., 2015). The present study investigated the contribution of an exhibit’s theming and props to visitor empathy for wildlife. For the purpose of this study, theming included any structures that help describe the subject or overall character-giving concept of a region or exhibit, while props included the objects set in a region or exhibit that support the theme (“Glossary - ZooLex,” n.d.).

Animal Habitat

Another exhibit design element that was explored in this study is animal habitat, the type of environment in which an organism or group of organisms lives or occurs (“Glossary - ZooLex,” n.d.). As zoos continue to evolve, they are encouraging more positive visitor
perceptions of animal welfare by commonly designing animal enclosures to replicate the animal’s natural habitat, thus creating more “naturalistic” habitats (Carter et al., 2015). By designing naturalistic habitats, zoos are able to portray the animals as if they are living in their natural environment, and convey to visitors what life might be like for those animals in the wild. Showing visitors what the animals’ wild habitats might look like can also pose an opportunity to communicate messages of conservation, namely, how habitat conservation is critical to ensure the future of the species’ counterparts in the wild (Hutchins & Smith, 2003). Studies have found that zoo visitors prefer naturalistic animal enclosures, perceiving them to be the best type of habitat to provide the necessary environmental resources to fulfill the biological needs of the animals and ensure their welfare (Ballantyne & Packer, 2016; Fàbregas, Guillén-Salazar, & Garcés-Narro, 2012; Fernandez, Tamborski, Pickens, & Timberlake, 2009). Naturalistic exhibits that provide retreats for the animals allow the animals to have some control over stressful situations, as in the case of large crowds of visitors, thus improving their welfare as well (Fernandez et al., 2009). Animal visibility has also been shown to impact visitors’ sense of connectedness with the animals, such that designing exhibits so that animals are visible within their habitats has the potential to encourage affective connections to form between visitors and animals (Luebke & Matiasek, 2013). Since animal habitat and visibility creates an opportunity to promote emotional connections between visitors and wildlife, the present study examined the contribution of animal habitat on a similar level, to determine its impact on visitor empathy for wildlife in comparison to the other exhibit design elements. In this study, animal habitat included any natural or man-made features of an animal’s enclosure, such as vegetation, rockwork, or climbing structures.
Signage

Exhibit signage is the third design element that was investigated in this study. Interpretive signs have been implemented in many different contexts, perhaps most notably in park systems, national landmark sites, and museums. In a hiking trail context, interpretive signage has been found to shape the experience of hikers by telling stories about the environment around the trails, providing reassurance for the hikers’ experiences, and serving as cues for internal reflection on nature and their personal experiences (Lekies & Whitworth, 2011). Interpretive signage in zoo exhibits provides similar stories and cues for reflection and can include a variety of different types of information, for example, scientific information about the animals on display, conservation information about the animals, their habitat, or the environment in general, and content used to help connect visitors with the animals such as anecdotes about the animals, questions for visitors to reflect upon, or photos of the animals. One study explored how important zoo and aquarium visitors considered each type of information to be included on interpretive signage (Ballantyne & Packer, 2016). The researchers found that visitors perceived scientific information to be the most important type of information to include on interpretive signage, including the animal’s name, species, and genus, as well as geographical location and range, and behavior. Visitors also found conservation information to be important to include, and content that included stories, questions and photos to be less important than the other two types of information (Ballantyne & Packer, 2016). These findings suggest the importance of visitors’ information preferences and expectations when considering interpretive signage design, without compromising an engaging delivery of the information.
Bitgood (2000) offered some guidelines to designing effective interpretive signage or labels, emphasizing that interpretive signage should aim to complement rather than compete with the animals or other three-dimensional objects in the exhibit. He suggested that designers focus on capturing visitors’ attention and motivate their interest by simplifying text in order to help them focus on the content and ensure that the interpretive message is communicated. If the text is too complicated for the visitor to follow, it will increase mental effort and decrease their limited mental capacity or “power supply” of attention, consequently lowering the chances of successful message communication (Bitgood, 2000). Some studies have found that although visitors perceive signage to be important, most do not actually read the panels of information, suggesting there may be mixed opinions and research on the benefits and usage of signage (Derwin & Piper, 1988; Perdue, Clay, et al., 2012; Serrell, 1988). In the present study, interpretive signage in zoo exhibits was examined in reference to its contribution to visitor empathy for wildlife. The exhibit design element of signage included any displays of interpretive content through text or graphics.

Videos

Videos are another exhibit design element that was investigated in the present study. Research on the influence of videos on zoo visitors appears sparse. One study supports the addition of videos to exhibits as an educational tool to positively influence visitor knowledge and behavior and increase stay time at the exhibit (Perdue, Stoinski, et al., 2012), while other studies suggest that visitors will only watch exhibit videos under certain conditions or will skip them entirely, thus portraying videos as an inconsistent source of information (Bennett, 2009; Carliner, 2001). While videos can provide such
benefits as communicating stories in a captivating manner and appealing to the emotions of visitors, they can also be a source of frustration in terms of upkeep for staff and noise for visitors (Carliner, 2001). Since videos are a more modern addition to zoo exhibits, their influence on visitor empathy was assessed. For the purpose of the present study, the exhibit design element of video included only screens that show a film or clip or a camera feed of an exhibit, without the presence of any interactive components to the video.

Interactive Elements
As with videos, interactive elements are among the newest features being incorporated into zoos and aquaria, and can be considered the most expansive of the design elements featured in the present study. Because they are among the latest additions, the literature about the impact of interactive features on the visitor experience is still expanding (Webber, 2015). The category of interactive features often encompasses both those that include technology elements and those that do not. Regardless of the technology aspect, they offer a more hands-on, sensory experience for visitors to engage with interpretive content in an exhibit than informational panels or signage (Carliner, 2001). For example, a type of interactive feature without technology could be a touch table on which objects are placed for visitors to touch, move, and examine them, engaging senses other than sight (Lindemann-Matthies & Kamer, 2006). A study that explored the visitor experience of visitors who interacted with touch tables at a zoo exhibit and those who only read interpretive panels found those who interacted with the touch tables were more drawn to the animal in the exhibit and reported learning something about the biology or conservation of the animal more frequently than those who only read the panels (Lindemann-Matthies & Kamer, 2006). Related to the influence of interactive elements
on visitor learning, research has found that interactive elements can significantly improve visitor information recall (Derwin & Piper, 1988).

A different type of “touch table” incorporates technology by functioning as more of a touchscreen, or a screen that visitors can interact with by touching it. In a study similar to the one conducted by Lindemann-Matthies and Kamer (2006), researchers examined visitor experience and use of an interactive 3D multi-touch table at a museum compared to a guided tour with printed maps (Zaharias, Michael, & Chrysanthou, 2013). Results indicated that visitors who interacted with the 3D multi-touch table reported having a more enjoyable visitor experience compared to those who only completed a guided tour with printed maps, and the visitors who engaged with the touch table also expressed greater intentions to return to the museum (Zaharias et al., 2013). In relation to promoting a more enjoyable visitor experience, another study found that exhibit activities that contain technology enhancements are more likely to attract the attention of visitors and engage them, especially if the technology is newer or not traditionally found in exhibits, such as touchscreen manipulations of words or photos, touch screen quizzes, or digital voice recording and playback (Yocco et al., 2011). Visitors also typically spend longer periods of time using interactive components compared to reading interpretive panels (Rogers, 2010). At the Melbourne Zoo, a “Zoopermarket” interactive supermarket-themed display includes shelves of consumer products, barcode scanners, and interactive touchscreens that visitors can use to scan the products and find out more about the manufacturer’s response to issues of palm oil production (Webber et al., 2016). Visitors have the option to contact those manufacturers who have unfavorable responses, enabling them to take action. The display is intended to help visitors understand this important
conservation issue by engaging them through interactive technology, impacting their sense of personal connection to orangutans, and offering them an opportunity to reflect on how their consumer choices could impact orangutans in the wild (Webber et al., 2016).

The literature suggests that age is one factor that influences usage of interactive elements, with some studies asserting that interactive elements are more attractive to children and young adults, while older visitors prefer to read panels of information over using the interactive elements (Derwin & Piper, 1988; Webber, 2015; Webber et al., 2016). Other studies claim that it is common for adults and children to utilize interactive elements together, sometimes with adults assisting their children in interacting with the technology (Yocco et al., 2011). For the purpose of this study and to simplify this category of exhibit design element, the interactive elements included only those features that have technology elements such as push-buttons, kiosks, and touchscreens (identified as more than a video due to the interactive nature of the visitor touching and interacting with the screen).

Visitor Interaction with Zoo Exhibits
As zoo exhibits change, the way in which visitors perceive and interact with exhibits evolves as well. Describing the “visitor experience” itself may prove to be a challenge, since there can be various ways to define “experience,” but ultimately the visitor experience encompasses a combination of what an institution provides and what a visitor brings to the experience (Packer & Ballantyne, 2016). The visitor experience can be a personal and subjective experience that is sensitive to the affordances of external or staged activities, settings, or events created by the institution. The design of these
activities, settings, and events can be tailored to elicit particular types of experiences (Packer & Ballantyne, 2016). Although not all visitor experiences may be extraordinary or transformative, by giving visitors the tools and resources to construct their own meaning and therefore their own story, exhibit design and interpretation allows visitors to craft memorable experiences.

There are a number of reasons that one might make a trip to the zoo, and it has been found that visitors have different motivations for visiting informal education institutions. There may also be seasonal changes to those motivations, meaning their motivations to visit change depending on the season or even on their personal involvement with conservation issues and previous visits (Rowe & Nickels, 2011; Yalowitz, 2004). In addition, research indicates that while visitors have been shown to prioritize the entertainment aspects of their zoo visit, they also consider conservation education an important aspect to their visit, suggesting these two motivations can fluctuate among visitors (Ballantyne & Packer, 2016). Just as visitor motivations to visit the zoo can vary, their motivations to interact with zoo exhibits can also differ, especially depending on visitor age or type of exhibit element such as signage or interactive features (Webber et al., 2016; Yocco et al., 2011). Studies have found that some adults may shy away from using interactive features because they believe those components are meant only for children, or oppositely, they may use these technology-mediated elements to assist their children in interacting with the exhibit features and to encourage conversation about the topic of the exhibit (Andersen, 2003; Blud, 1990; Kisiel, Rowe, Vartabedian, & Kopczak, 2012; Yocco et al., 2011). In general, younger visitors have been shown to prefer more interactive elements in exhibits, such as touch screens, since they are more accustomed to
using this kind of technology on a general basis and have likely grown up using it (Ting, Lim, & Sharji, 2013).

Research has also shown that visitors interact with signage differently depending on whether they have children with them and how much they socialize with other members of their group. Visitors with children or those who spend more of their time interacting with others in their group might not be as engaged with signage in an exhibit, whereas those without children or those visiting the zoo solo might have a better opportunity to engage with the signage (Ross & Gillespie, 2009). Other studies have examined the benefits of using different elements within zoo exhibits and zoos themselves to promote visitor interaction with the exhibits and encourage conservation learning among visitors. These elements include the use of interactive features in exhibits to deliver conservation messages and smartphone applications with targeted environmentally concerned framed messages to onsite visitors (Davey, 2006; Yocco et al., 2015).

Empathy Toward Animals

Early Research on Empathy Toward Nature

Now that the evolution of technology in the environmental education field has been reviewed, it is important to also investigate how empathy literature has evolved. The environmental field has only begun to see the development of empathy research that seeks to explore how one might be able to foster connections between people and nature or people and wildlife to encourage conservation-minded attitudes and behaviors. The appearance of empathy research related to nature and childhood in this field dates back to 1996, examining the need for children to love and connect with the natural world in order to care for it and conserve its resources, and emphasizing the importance of developing
this empathy during childhood (Sobel, 1996). More recent empathy research began emerging a few years ago, focusing more broadly on dispositional empathy with nature, which describes the sharing and understanding of the emotional experience – particularly distress – of the natural world (Tam, 2013). This research suggests that empathy has the ability to motivate efforts to protect nature and that personal factors may account for individual differences in the dispositional tendency to engage in empathy with nature.

**Later Research on Empathy Toward Animals**

Research on the singular connections between humans and animals then began to examine how animals can provide a bridge to developing caring relationships with the natural world in general (Myers Jr. & Saunders, 2002). Studies that specifically investigated this relationship in a zoo setting found that zoo visits provide opportunities to experience shared identity between humans and nonhuman animals, which may, in turn, increase visitors’ concern for the wellbeing of the animals, especially if those animals have more human-like traits (Allen et al., 2002). During their zoo visit, visitors might attempt to put themselves in the place of the animals or make behavioral or conceptual connections between themselves and the animals, which contributes to empathy. The idea that species with more human-like traits are more likely to promote visitor experiences of shared identity with zoo animals is based in the concept of charismatic species, which will be discussed next, along with non-charismatic species.

**Empathy with Charismatic and Non-Charismatic Animals**

In the conservation biology field, charismatic animals are those species that draw public attention and interest, helping raise conservation awareness and action by appealing to visitors’ emotional affinity for that species (Skibins, Powell, & Hallo, 2013). This is not a
set definition, however, as charisma can be defined subjectively through marketing and culture (Ducarme, Luque, & Courchamp, 2013). There is more of an argument as to what constitutes a “non-charismatic” species, since this definition can also change based on culture or other varying characteristics such as food, predation, and degree of threat (Ducarme et al., 2013). Some animals might be deemed non-charismatic simply because they do not express emotions or behaviors with which humans can identify or understand or because they do not display mammal-like features (Seattle Aquarium, 2015). The literature suggests that charismatic megafauna often comprise large vertebrates of conservation concern, including large mammals such as bears, big cats, great apes, and elephants, as well as large birds, while less charismatic or non-charismatic species usually encompass smaller-bodied organisms or invertebrates such as plants, corals, shellfish, insects, worms, reptiles, echinoderms, and algae (Ducarme et al., 2013; Skibins et al., 2013; Théberge & Nocera, 2014). Studies have shown that species of conservation concern, typically larger charismatic megafauna such as mammals, also tend to reflect greater popularity with zoo visitors (Moss & Esson, 2010), in part because it tends to be easier to generate support, interest, and funding for these types of animals than it is for non-charismatic species such as reptiles or insects (Skibins, Dunstan, & Pahlow, 2017). While featuring charismatic megafauna in conservation efforts as species with which the public can identify may provide advantages for motivating the public to protect species more familiar to them, it has also raised concern that this could divert attention from more endangered but lesser-known or less appealing species, putting them at risk of being forgotten (Ducarme et al., 2013; Sommer, 2008).
As mentioned above in the article by Allen et al. (2002), when zoo visitors experience a shared identity with certain animals by making behavioral, conceptual, or emotional connections to the animals, they are developing empathy for that species. Hence, empathy toward animals tends to develop in much the same way humans develop empathy toward other humans (Seattle Aquarium, 2015). Supporting the influence of experiencing a shared identity between humans and nonhuman species, other studies have found that a species’ conservation status and relatability (to humans) have been shown to positively influence the public’s emotional connection to that species (Skibins, Dunstan, & Pahlow, 2017; Skibins et al., 2013). The studies suggest that these two characteristics can be used proactively in zoo exhibit interpretation to cater to a greater array of overlooked species beyond charismatic megafauna to address conservation concerns and potentially support positive attitudes toward these often discounted species.

Attitudes Toward Wildlife

Although empathy research in zoos appears to be a more recent phenomenon, it seems as though one study dates back to the appearance of empathy research in the environmental field in 1996. That particular study focused on people’s attitudes toward zoo animals and found that the general public might have less favorable perceptions of zoo animals than zoo visitors, who tend to perceive zoo animals as more happy, well-kept, less bored, and more attractive to look at (Reade & Waran, 1996). It was also found that people aged 20-39, and females in particular, respond to zoo animals with more compassion and empathy. Related to these findings, a more recent study investigated tolerance for wildlife in general in the context of communicating about species to effectively ensure their survival in the wild. This research suggested that tolerance, or passive acceptance of
wildlife, can be enhanced by emphasizing the benefits that people can derive from a species rather than the risks associated with the species (Bruskotter & Wilson, 2014). Similar research describes how both cognitive and affective factors can impact people’s decisions about how to act with respect to wolf conservation, indicating that in general, people’s emotional reactions to a species can impact their beliefs about a species (Slagle, Bruskotter, & Wilson, 2012). These cognitive and affective or emotional factors to empathy will be reviewed subsequently.

**Current Research on Empathy Toward Animals**

Empathy is now emerging as a construct that involves three separate components that are interrelated: affective (the ability to “experience” or sense perceived emotions of another), cognitive (the ability to understand the experiences of another by imagining yourself in their place), and empathic concern (the ability to act on feelings of compassion to relieve another’s suffering) (Seattle Aquarium, 2015). Recently, there has been some evidence that empathic concern for wildlife has increased (George, Slagle, Wilson, Moeller, & Bruskotter, 2016), and thus the public is becoming more empathic toward wildlife, such that people seem more willing to question conservation practices perceived to be morally problematic (Nelson, Bruskotter, Vucetich, & Chapron, 2016). Explanations for this increase include: increased exposure and attention given to animals, and sometimes the poor treatment of them, may contribute to higher empathy and positive attitudes toward animals, and direct experiences with animals can affect attitudes toward that animal (George et al., 2016; Skibins et al., 2013). In the field of animal welfare, there is a strong correlation between attitudes toward animals and general empathic concern for them, suggesting that attitudes can serve as a general indicator of
concern for the welfare of a species (George et al., 2016). While there may be a correlation between attitudes and empathy toward wildlife, there remains a distinction between the two constructs. Zoos are now delving into determining how to help visitors develop deeper emotional connections to wildlife that might be more inherent than the attitudes they express toward wildlife. Therefore, Skibins and Powell (2013) created the Conservation Caring scale, based on the concept of Conservation Caring (Rabb & Saunders, 2005), to measure people’s emotional connection to a species with the aim of exemplifying expressions of concern beyond simple attitudes. The Conservation Caring scale includes items that contain both cognitive and affective domains and through empirical support and validation has been found to be a useful measure and predictor of positive attitudes and empathy toward wildlife (Skibins et al., 2017; Skibins & Powell, 2013; Skibins et al., 2013; Verbos, Brownlee, & Skibins, 2015). Since Conservation Caring encompasses cognitive and affective components, it aligns more closely with empathy than knowledge or attitudes, in an expression of individuals’ care and concern for a species (Skibins et al., 2017). In empathizing with a species, an individual identifies the emotions and cognitions of an animal as parallel to his or her own, reaching beyond an individual experience to truly understand the perspective of another (Seattle Aquarium, 2015; Skibins et al., 2013). In an attempt to explore how visitors’ emotional connectivity to a species might influence conservation behavioral intent, Skibins and Powell (2013) used the Conservation Caring scale to discover that zoos play a vital role in fostering connections between people and wildlife and motivating pro-conservation behaviors. To put their findings into practice, they suggested that zoos and aquaria may be able to encourage greater levels of Conservation Caring.
through targeted interpretation, viewing experiences, and exhibit design that is focused on certain species and strengthening emotional connections with that species.

Empathy: Role of Zoos in Promoting Empathy Within Visitors

As zoos and aquaria continue to focus their efforts on promoting conservation of species, they must also inspire both pro-conservation attitudes and empathy toward wildlife within their visitors. Since empathy involves ingrained emotions based within the connections between people and wildlife, it can be perceived as a route to attain pro-conservation attitudes by cultivating care or concern for a species. Recently, the literature has focused on exploring empathy in terms of how zoos and aquaria can encourage the emotional connections that could underlie pro-conservation attitudes. Although this investigation in the field is still emerging, various studies have suggested that zoos specifically might assist the creation of connections between humans and wildlife that provoke caring emotions for animals at the zoo, transforming this into a broader concern for the species as a whole as well as its habitat (Clayton et al., 2009; Hayward & Rothenberg, 2004; Myers Jr. & Saunders, 2002).

The Seattle Aquarium has compiled some of the best practices for developing empathy within visitors. In their suggestions, they include: considering how we frame messages and conversations about animals, physically modelling empathetic behaviors, increasing visitors’ knowledge of animals’ needs or behaviors and comparing the animals’ experiences to our own, providing experiences for direct interaction with animals, providing opportunities to practice care for an animal, and activating visitors’ imaginations to better understand the perspective of an animal (Seattle Aquarium, 2015).

For the purposes of this study, empathy was defined as: “a stimulated emotional state that
relies on the ability to perceive, understand and care about the experiences or perspectives of another person or animal” (Seattle Aquarium, 2015). Two of the best practices for developing empathy within visitors that will be most relevant to the present study will now be reviewed: framing and activating imagination (storytelling).

Framing
One relevant practice zoos and aquaria can use to develop empathy within visitors is framing. Narrative language can impact the communication of stories about species in such a way as to encourage empathy. For example, framing conversations between zoo staff and visitors or exhibit interpretation such as signage about certain species as subjective others with unique needs, stories, and purposes can portray the species as easier to identify with (Seattle Aquarium, 2015). Focusing on the individual stories or personalities of animals can likewise provide opportunities for visitors to reflect on how these compare and contrast to their own individual experiences and personalities.

Storytelling
Another relevant practice for developing empathy within zoo visitors is activating imagination through storytelling. Similar to framing, storytelling encourages visitors to take the perspective of another by communicating the individual experiences of animals to elicit empathic responses (Seattle Aquarium, 2015). Telling stories of the animals from their perspective can also increase connections to those animals and their environment, especially children’s connections. The exhibit element of videos can apply the practice of storytelling to impact visitors as well. For example, a video at the Seattle Aquarium displayed the individual stories of crabs on the beach and their responses to both destructive and non-empathetic behaviors, creating an effective story to elicit empathy.
from visitors by describing the story through the crab’s perspective (Seattle Aquarium, 2015). This example of using video to tell the story of a specific species and the previous practice of framing, which can be applied in interpretive signage, suggest that some exhibit elements such as videos and signage are indeed capable of reflecting the “best practices” for developing empathy within zoo and aquarium visitors.

Summary and Hypotheses

Based upon the literature, it seems as though technology is increasingly making its way into the environmental education field for people of all ages. Different types of technology have been incorporated into environmental education programming over the years (Barnett et al., 2011; Chavez, 2009; Chen et al., 2003; Harmon & Gleason, 2009), although there still appear to be split opinions over its integration and arguments over whether it reinforces or reduces emotional connections to the environment (Kacoroski, 2015; Peffer et al., 2013). What is agreed upon is the need for further research to determine whether it is more beneficial or harmful to connecting with the environment.

Technology features have been shown to enhance visitor experiences in zoo settings (Nunes & Mayer, 2014; Yocco et al., 2015), and technology-based interpretation has been increasing in usage across various informal environmental education institutions and visitor attractions (Hutchins & Smith, 2003; Kleiman et al., 2010; Leask et al., 2014). Zoo exhibits have also evolved over time to include more naturalistic enclosures for the animals and interactive or technological features in their interpretation (Shettel-Neuber, 1988). What remains to be fully determined is whether some exhibit design elements are more effective or influential than others in promoting visitor learning and connection to wildlife. Studies show that visitor interactions with zoo exhibit features vary depending
on visitor age, motivation for interacting with the exhibit, type of exhibit feature, and size of visitor group (Rowe & Nickels, 2011; Webber et al., 2016; Yalowitz, 2004; Yocco et al., 2011).

Empathy research in the environmental education and zoo research fields has just been developing over the past two decades, examining more broadly people’s connections to the natural world (Sobel, 1996; Tam, 2013) and also the opportunities that zoos and aquaria provide for fostering empathy within their visitors and creating connections between visitors and wildlife (Clayton et al., 2009; Myers Jr. & Saunders, 2002). Since research in this topic still seems to be growing, there remains much to discover in terms of the role of empathy in connecting visitors to both specific species and wildlife as a whole. A related gap in the literature concerns how exactly empathy can be best promoted during a zoo visit and what kinds of exhibit features might aid in this process. For example, there does not appear to be much research yet on how exhibit signage compares to videos in influencing visitor empathy. It was the purpose of this study to address this gap in the literature and further investigate the ties between the emergence of technology features in the environmental education and zoo fields and the ongoing focus on fostering visitor empathy for conservation of wildlife.

From this review of relevant literature, the following relationships were expected: 1) exhibit design elements with more “layers” or technological features such as push-buttons, videos, touchscreens, or kiosks would be more influential in promoting visitor empathy than more traditional elements such as theming/props or signage alone because they can connect visitors to specific species conservation stories in a more engaging way (Carter et al., 2015; Clay et al., 2011; Davey, 2006; Perdue, Clay, et al., 2012; Webber et
al., 2016; Weiler & Smith, 2009; Yocco et al., 2015) and 2) zoo visitors would also have high levels of empathy for wildlife, suggesting a greater care for and understanding of species, since the literature suggests that zoo visitors express biospheric concern (Yocco et al., 2015) as well as concern about conservation (Davey, 2006; Pearson et al., 2013; Yalowitz, 2004).

Secondary hypotheses examined in the study included: a) visitors would connect with or have higher empathy for more charismatic species (such as polar bears) that have more human-like traits because they would identify more with them (Allen et al., 2002; Moss & Esson, 2010; Skibins et al., 2017) and b) younger visitors’ empathy for conservation of wildlife would be more influenced by technology features in exhibits than older visitors because they are more used to utilizing technology in their everyday lives (Derwin & Piper, 1988; Ting et al., 2013; Webber et al., 2016). In addition, women were expected to show more overall empathy for conservation of wildlife than men, indicated through higher overall ratings on the Conservation Caring scale, because past research has found that they respond to zoo animals with more empathy (Powell & Bullock, 2014; Reade & Waran, 1996).
Chapter 3. Methodology

This study was designed to investigate whether zoo exhibit design, and specifically five elements of exhibit design, influences visitor empathy for conservation of wildlife. The following chapter presents information on the study design, participants, measurement and instrument, data collection, and the data analysis plan.

Research Questions

The research questions that guided this study were as follows:

1) What levels of empathy for wildlife do zoo visitors express?

2) What different elements of exhibit design do visitors interact with at zoos and aquaria?

3) Do these different elements of exhibit design influence visitor empathy? If so, which are most influential in promoting visitor empathy?

Study Design

The design for this study was a one-time, descriptive survey distributed to a sample of Columbus Zoo and Aquarium guests. The survey was intended to address the overarching research question of whether certain zoo exhibit design elements influence visitor empathy for wildlife and which are most influential.
Participants

The participants in this study were adult visitors to the Columbus Zoo and Aquarium during August, September, and October of 2017. Data collection took place over five weekend days for about 2-3 hours each. A minimum of 125 individual responses was desired for the study, based on average daily fall zoo attendance. Sample response rate for the surveys was also calculated, based on a refusal tally kept during each data collection session. The overall survey response rate for data collection was 61%. A total of 120 surveys were obtained, one of which was not included in analysis due to lack of completion. Although eight participants did not complete the survey fully, they completed a majority of the questions, so their responses still counted toward the 119 completed surveys used in analysis.

Participants were 71% female and 29% male. Sixty-four percent of participants came to the zoo with children the day they filled out the survey. Participants’ ages were self-reported as follows: 20% aged 18-25, 28% aged 26-35, 25% aged 36-45, 18% aged 46-55, 4% aged 56-65, and 4% aged over 65. According to the Association of Zoos and Aquariums, zoo visitors are primarily women or mothers aged 25-35, and two-thirds of adults visit the zoo with a child ("Visitor Demographics," n.d.). These demographics suggest the sample for this study is representative of the zoo visitor population. Five participants did not identify their gender, age, or whether they came to the zoo with children, so the statistics reported above reflect the sample demographics of the participants that did complete these questions.
Measurement and Instrument

The research questions focused on the influence of zoo exhibit design on visitor empathy for conservation of wildlife, and therefore Visitor Empathy for Wildlife served as the dependent variable in this study. This dependent variable was further split into Visitor Empathy for Polar Bears and Visitor Empathy for Jellyfish, examining visitor empathy for both a charismatic and non-charismatic animal. The contribution of the five exhibit elements of interest in this study, Signage, Video, Interactive Elements, Theming/Props, and Animal Habitat, to visitor empathy were the main independent variables. Element Contribution to Empathy was a separate rating for each of the five exhibit elements and was also split into Element Contribution to Empathy for polar bears and for jellyfish. The exhibit elements were not meant to refer to a specific exhibit at the Columbus Zoo but rather were meant to represent a compilation of all examples of each element throughout the zoo. For example, when visitors considered the element of Signage while completing their survey, they were asked to consider all the examples of signage throughout the zoo (that they had seen or interacted with that day or in past visits), in a general sense. If the visitor was considering the element of Video, they were to consider the various examples of video used in exhibits throughout the zoo, again, in a more general sense of the element. This same thought pattern was followed for each of the exhibit elements.

Additional independent variables that were included in regression models for analysis were: Age, Gender, Group Make-up, Typical Visitor Interaction with Elements, Current Pet Ownership, Childhood Pet Ownership, Frequency of Visits to Zoos, Aquaria, and Similar Institutions, and Past Exposure to a Polar Bear or Jellyfish.
In the survey, visitors were asked to rate their empathy toward a charismatic animal and a non-charismatic animal, and then how each element influenced their empathy toward those animals. A polar bear was chosen as the charismatic animal, and a jellyfish was chosen as the non-charismatic animal. Specific animals were chosen to represent charismatic and non-charismatic animals, but just as the exhibit elements used in this study were meant to represent the general category of each element, the polar bear and jellyfish were meant to represent the general categories of charismatic and non-charismatic animals, respectively. The literature suggests that charismatic megafauna typically include large vertebrates that are often of conservation concern, such as large mammals including bears, big cats, great apes, and elephants, as well as large birds, whereas the less charismatic or non-charismatic species are usually smaller-bodied or invertebrates such as plants, corals, shellfish, insects, worms, reptiles, echinoderms, and algae (Ducarme, Luque, & Courchamp, 2013; Skibins, Powell, & Hallo, 2013; Théberge & Nocera, 2014).

Conservation Caring
The variable of baseline Visitor Empathy toward these animals was measured through a 9-item portion of the Conservation Caring scale, a scale found to be both reliable and valid (Skibins & Powell, 2013). Reliabilities were calculated for each of the two modified scales measuring Visitor Empathy for Polar Bears ($\alpha = 0.90$) and Visitor Empathy for Jellyfish ($\alpha = 0.94$), revealing high internal consistency for both scales. When completing the scale, visitors rated their agreement with the statements on a 7-point Likert scale (ranging from 1 as “Strongly Disagree” to 7 as “Completely Agree”), according to their empathy toward either the polar bear or the fish. The scale was condensed from a 9-point
Likert scale to a 7-point Likert scale to create a more simplified yet reliable scale for visitors (Wakita, Ueshima, & Noguchi, 2012). Some items were adapted for the purposes of this study or simplified for the zoo visitor demographic. Items in this scale include: “I am concerned about the well-being of this animal,” “This species has as much right to exist as any human being,” “Ensuring this species’ survival is my highest priority,” “The extinction of this species will drastically lower my emotional sense of well-being,” “I need to learn everything I can about this species,” “I would object if I learned of the mistreatment of this animal,” “I will alter my lifestyle to help protect this species,” “My connection to this animal has increased my connection to the species as a whole,” and “Wildlife protection should be a high priority within our society.”

In order to assess Element Contribution to Empathy, zoo visitors’ perceptions of how much each exhibit element contributes to their general empathy for charismatic and non-charismatic animals (represented in this study by a polar bear and a jellyfish), a Likert-type scale was created. Visitors were asked to rate how much each exhibit design element in general contributes to their empathy for either polar bears or jellyfish on a 7-point scale (ranging from 1 as “Does not contribute at all” to 7 as “Contributes a great deal”). A question about zoo visitors’ typical interaction with signage, videos, and interactive elements was also included. To assess the variable of Typical Visitor Interaction with Elements, visitors were asked to rate on a 5-point Likert-type scale (ranging from 1 as “Never interact with” to 5 as “Always interact with”) whether or how often they interacted with signage, videos, and interactive elements. The two exhibit elements of theming/props and animal habitat were excluded from this question, since visitors are constantly exposed to theming/props and animal habitat during their zoo visit. Their
exposure to and interaction with signage, videos, and interactive elements, however, offers more variability. In answering this question, visitors were asked to consider their general interactions with or exposure to each of the three exhibit elements over the course of all their Columbus Zoo visits and across all exhibits at the zoo.

Additionally, eight extra questions were included in the survey. Zoo visitors were asked to identify their gender, age, whether they have seen a polar bear or jellyfish at a zoo, aquarium, or in their natural habitats, whether they had any childhood pets, whether they currently have any pets, whether they came to the zoo with any children that day, and how often they typically visit zoos, aquaria, nature centers, or wildlife parks such as The Wilds. The questions about past exposure to polar bears and jellyfish were added to the survey based on studies that have suggested direct experiences and increased exposure or attention to animals can affect attitudes and empathy toward those animals (George et al., 2016; Skibins et al., 2013). The questions about pet ownership were included in the survey based on studies that have demonstrated the influence of pet ownership on empathy for animals (Daly & Morton, 2006; Hergovich, Monshi, Semmler, & Ziegelmayer, 2002). The variables of Current Pet Ownership, Childhood Pet Ownership, and Past Exposure to a Polar Bear or Jellyfish were examined in data analysis to determine whether they were contributing factors to visitors’ baseline empathy for charismatic and non-charismatic animals. Appendix B provides a copy of the survey.

Data Collection

This study was approved by The Ohio State University Institutional Review Board in June of 2017, and participants were recruited during the end of summer 2017 using the “continual ask” method of sampling at the Columbus Zoo and Aquarium, located in
Columbus, Ohio. This recruitment method involves continually asking any visitors who walk by if they would be willing to participate. Visitors were told that the researchers would like to gather some information about their feelings toward the different elements that make up a zoo exhibit and asked whether they would be willing to complete a survey that takes about 5-10 minutes. A more central location near Conservation Lake in the zoo was chosen to capture visitor thoughts and opinions during the middle of their zoo experience, rather than at the end of their visit, when they are more likely to be tired or focused on leaving the zoo.

Five display boards with examples of the five exhibit design elements were set up for visitors to reference while they filled out the survey. Images of the actual display boards used in data collection can be found in Appendix C. Each board exhibited photos of one of the five elements so that there was one board for examples of signage, one for examples of video, and so on. Each element board had photos composed of various examples of the element found in exhibits throughout the zoo. For example, the “Signage” board had photos of different signs found in exhibits around the zoo, and the “Theming/Props” board had photos of different exhibit themes and props from exhibits throughout the zoo. The inclusion of photo boards in this study was modeled after previous studies that have used photos as supplementary references with questionnaire or interview methods (Fyhri, Jacobsen, & Tømmervik, 2009; Harper, 2002; Yocco et al., 2011). The present study draws inspiration from the methods used by Yocco et al., 2011. In that study, when zoo visitors were presented with 18 photos of different interactive exhibit activities located throughout the zoo, 88% of visitors recognized at least one activity from their visit, and 54% of them reported engaging with one or more of the
activities pictured. Forms of engagement with the activities included doing the activity, reading and asking questions based on the signage at the activities, and discussing the activities with others (Yocco et al., 2011). The present study offered visitors photos of exhibit elements in a similar manner, so visitors could better recognize what each element consisted of.

Tables were also set up for children to work on coloring sheets while the adults completed their survey. Visitors were instructed to examine the display boards to familiarize themselves with each exhibit element, and then they were handed a clipboard with a survey to complete on their own, with the researchers nearby to answer any questions they had. Participants gave their consent to complete the survey and were free to leave any of the questions blank. For most visitors, the survey took about 5-6 minutes to complete, but for a few it took up to 10 minutes. All survey responses were anonymous and kept confidential.

In the survey, participants were provided with a definition of empathy as it was used in the study. They then completed the Conservation Caring scale to assess their baseline empathy toward polar bears, a charismatic animal. Participants repeated the baseline empathy assessment, only this time for a jellyfish, a non-charismatic animal. Next, they were asked to rate their perception of how much each exhibit design element contributes to their empathy for polar bears, and complete the same rating scale for jellyfish. Then, they completed a question about their typical interaction with signs, videos, and interactive elements. Finally, participants identified how often they typically visit zoos, aquaria, or similar institutions, whether they had any childhood pets, whether they currently have any pets, whether they have seen a polar bear or jellyfish at a zoo,
aquarium, or in its natural habitat, whether they came to the zoo with any children that day, and finally their age and gender. After data collection was complete, responses were compiled for analysis.

Data Analysis

Data from the surveys were entered into IBM SPSS Version 24 software for analysis. Descriptive statistics, Pearson correlations, and multiple linear and hierarchical regression models were used to analyze the data. To determine the levels of empathy that zoo visitors express (Research Question 1), averages were calculated from the nine items used to measure Visitor Empathy for Wildlife on the survey, for each type of animal: polar bears and jellyfish. To determine the level of visitor interaction with signage, videos, and interactive elements (Research Question 2), averages were calculated from the Typical Interaction with Elements ratings on the survey, resulting in separate averages for signage, videos, and interactive elements. Additional correlations, independent samples t-tests, and one-way ANOVA tests were used to examine the variables of Age and Gender in relation to these three elements. To determine whether the five exhibit elements influence Visitor Empathy for Wildlife and which are most influential (Research Question 3), individual ratings for the Element Contribution to Empathy (i.e. for each element) were entered into a multiple linear regression predicting Visitor Empathy for Wildlife. There were two separate regressions: one for polar bears and one for jellyfish. Two hierarchical regressions further analyzed the influence of the elements on visitor empathy for polar bears and jellyfish, in relation to some of the extra demographic and predictor variables. Extra analyses were also performed to broaden analysis of the survey data.
Chapter 4. Results

This chapter presents the findings for each research question in the study.

The study examined 10 overall variables: Visitor Empathy for Wildlife, Element Contribution to Empathy, Typical Visitor Interaction with Elements, Current Pet Ownership, Childhood Pet Ownership, Frequency of Visits to Zoos, Aquaria, and Similar Institutions, Past Exposure to a Polar Bear or Jellyfish, Age, Gender, and Group Make-up. Three variables had separate ratings for each type of animal, polar bears and jellyfish: Visitor Empathy for Wildlife, Element Contribution to Empathy, and Past Exposure to a Polar Bear or Jellyfish.

Visitor Empathy was separated into a rating for Visitor Empathy for Polar Bears and Visitor Empathy for Jellyfish. Past Exposure was similarly separated into a rating for Past Exposure to a Polar Bear and Past Exposure to a Jellyfish. Element Contribution to Empathy was split between separate ratings for each of the five exhibit elements of interest in the study, as well as for each type of animal. For example, Signage Contribution to Empathy had separate ratings for polar bears and jellyfish, Video Contribution to Empathy had separate ratings for polar bears and jellyfish, etc. The single scale rating for each exhibit element’s contribution to empathy for each type of animal served as its own variable. Visitor Empathy for Polar Bears and Visitor Empathy for Jellyfish were computed as averages of the total ratings for all items of each scale.
Gender was coded in the data as 0 for Female and 1 for Male. Group Make-up was coded according to the question, “Did you come to the zoo with any children today?” with 0 indicating a “No” response and 1 indicating “Yes.”

Table 1 presents a series of Pearson correlations with the Polar Bear variables, and Table 2 presents the Pearson correlations with the Jellyfish variables. The correlations revealed significant relationships between some of the variables for both types of animals, which can be found in the respective tables. Most of the significant relationships for the polar bear variables were moderate to strong positive correlations. For the jellyfish variables, most were also moderate to strong positive correlations, but overall, they were generally stronger than those for the polar bear variables.

Research Question 1
What levels of empathy for wildlife do zoo visitors express?

Modified questions from the Conservation Caring scale were used to measure both Visitor Empathy for Polar Bears and Visitor Empathy for Jellyfish. Visitors rated their agreement with the scale items from 1 (Strongly Disagree) to 7 (Completely Agree). To determine what levels of empathy visitors express for the two types of animals, the mean, median, and standard deviation were calculated for these variables. The descriptive statistics suggest that visitors to the Columbus Zoo and Aquarium express slightly higher empathy for polar bears ($M = 5.79, Mdn = 5.89, SD = 0.97$) than for jellyfish ($M = 5.24, Mdn = 5.39, SD = 1.27$). Visitor Empathy for Polar Bears was also found to be significantly related to Visitor Empathy for Jellyfish, such that visitors who expressed higher levels of empathy for polar bears also tended to express higher levels of empathy for jellyfish, $r = 0.78, p < .05$. 
Pearson correlations indicated that Gender was significantly related to Visitor Empathy for Polar Bears ($r = -0.23, p < .05$) and Visitor Empathy for Jellyfish ($r = -0.23, p < .05$). An independent samples $t$-test further suggested significant differences in empathy for polar bears between males and females, $t(112) = 2.55, p < .05$. Females ($M = 5.92, SD = 0.86$) expressed higher empathy than males ($M = 5.42, SD = 1.14$) for polar bears. A similar $t$-test revealed significant differences in empathy for jellyfish between males and females, $t(111) = 2.46, p < .05$. Females ($M = 5.41, SD = 1.26$) also expressed higher empathy than males ($M = 4.76, SD = 1.27$) for jellyfish. A one-way between-subjects ANOVA test suggested there were no significant differences in Visitor Empathy for Polar Bears between age groups, $F(5, 108) = 1.10, p = 0.36$. Another one-way ANOVA also revealed no significant differences in Visitor Empathy for Jellyfish between different age groups, $F(5, 107) = 0.48, p = 0.79$.

Research Question 2
What different elements of exhibit design do visitors interact with at zoos and aquaria? It was assumed that zoo visitors are automatically always exposed to the exhibit elements of Animal Habitat and Theming/Props; thus, this research question focused on visitors’ interaction with Signage, Videos, and Interactive Elements. Visitors rated their typical interaction with these elements on a scale from 1 (Never Interact With) to 5 (Always Interact With). To assess visitors’ levels of interaction with these three exhibit elements, the mean and standard deviation were calculated for each element. The data suggest that zoo visitors typically interact most with interpretive signage ($M = 4.08, SD = 0.86$) at exhibits, then equally with videos ($M = 3.79, SD = 0.89$) and interactive elements ($M = 3.79, SD = 1.08$).
Table 3 presents a series of correlation coefficients for the demographic variables of Age, Group Make-up, and Gender and the variables of Typical Visitor Interaction with Signage, Videos, and Interactive Elements. Correlations revealed that Gender was significantly \( p < .05 \) related to Typical Visitor Interaction with Videos. An independent samples \( t \)-test further identified differences in Typical Interaction with Videos between males and females, \( t(111) = 2.07, p < .05 \), such that females \( (M = 3.89, SD = 0.90) \) typically interact with videos in exhibits more often than males \( (M = 3.52, SD = 0.80) \). Group Make-up was also found to be significantly \( p < .05 \) related to Typical Visitor Interaction with Interactive Elements. An independent samples \( t \)-test revealed visitors who come to the zoo with children \( (M = 4.06, SD = 0.96) \) typically engage with interactive elements more often than those who do not come with children \( (M = 3.34, SD = 1.18) \), \( t(111) = -3.50, p < .05 \). Age was not significantly related to Typical Visitor Interaction with Signage, Videos, or Interactive Elements.

Research Question 3
Do these different elements of exhibit design influence visitor empathy? If so, which are most influential to promoting visitor empathy?

Overall, regressions revealed that visitors’ perception of how much each exhibit element contributes to their empathy for either polar bears or jellyfish influences their empathy for these two types of animals.

Visitor Empathy for Jellyfish
To assess how strongly Signage Contribution to Empathy, Video Contribution to Empathy, Interactive Elements Contribution to Empathy, Animal Habitat Contribution to Empathy, and Theming/Props Contribution to Empathy each predict Visitor Empathy for
Jellyfish, as well as how strongly the model of these five variables predicts Visitor Empathy for Jellyfish, a multiple linear regression revealed that the model of all variables together significantly predicted Visitor Empathy for Jellyfish, $R^2 = 0.38$, $F(5,108) = 13.24$, $p < .05$. As seen in Table 4, Animal Habitat Contribution to Empathy as an individual predictor variable significantly predicted Visitor Empathy for Jellyfish, such that visitors who perceived a greater contribution of Animal Habitat to their empathy for jellyfish also reported higher empathy for jellyfish.

To assess how much predictive power Signage Contribution to Empathy, Video Contribution to Empathy, Interactive Elements Contribution to Empathy, Animal Habitat Contribution to Empathy, and Theming/Props Contribution to Empathy add to predict Visitor Empathy for Jellyfish after all demographic variables are controlled for, a hierarchical regression was used. In this regression, the demographic variables refer to Age, Gender, Group Make-up, and all other relevant visitor variables such as Typical Visitor Interaction with Elements. Holding the demographic variables constant, the regression revealed that Signage, Video, Interactive Elements, Animal Habitat, and Theming/Props Contribution to Empathy for Jellyfish together uniquely explain 24% of the variance in Visitor Empathy for Jellyfish, $R^2 = 0.43$, $F(5,92) = 7.67$, $\Delta R^2 = 0.24$, $p < .05$. This suggests that all the Element Contribution to Empathy for Jellyfish variables still matter as predictors of Visitor Empathy for Jellyfish, even after other demographic variables are considered. Table 5 presents the hierarchical regression predicting Visitor Empathy for Jellyfish in more detail. In the second model of the hierarchical regression, the set of Element Contribution to Empathy for Jellyfish variables that was added to the existing model of demographic predictor variables, Theming/Props Contribution to
Empathy for Jellyfish as an individual predictor variable significantly predicted Visitor Empathy for Jellyfish. Visitors who perceived a greater contribution of Theming/Props to their empathy for jellyfish also reported higher empathy for jellyfish. This variable was significant after the demographic variables were controlled for. Although Animal Habitat Contribution to Empathy for Jellyfish was a significant predictor of Visitor Empathy for Jellyfish in the multiple linear regression model of the five Element Contribution to Empathy for Jellyfish variables in Table 4, it was no longer a significant predictor of empathy when added to the model of control variables \(p = 0.127\) in Table 5’s hierarchical regression. If significance were to be considered at the \(p < .10\) level, then Animal Habitat could be considered close to significant as a predictor for empathy.

Visitor Empathy for Polar Bears

To assess how strongly Signage Contribution to Empathy, Video Contribution to Empathy, Interactive Elements Contribution to Empathy, Animal Habitat Contribution to Empathy, and Theming/Props Contribution to Empathy each predict Visitor Empathy for Polar Bears, as well as how strongly the model of these five variables predicts Visitor Empathy for Polar Bears, a multiple linear regression revealed that the model of all variables together significantly predicted Visitor Empathy for Polar Bears, \(R^2=0.33, F(5,110) = 10.90, p < .05\). As seen in Table 6, Theming/Props Contribution to Empathy as an individual predictor variable significantly predicted Visitor Empathy for Polar Bears, such that visitors who perceived a greater contribution of Theming/Props to their empathy for polar bears also reported higher empathy for polar bears.

To assess how much predictive power Signage Contribution to Empathy, Video Contribution to Empathy, Interactive Elements Contribution to Empathy, Animal Habitat
Contribution to Empathy, and Theming/Props Contribution to Empathy add to predict Visitor Empathy for Polar Bears after all demographic variables are controlled for, a hierarchical regression was used. In this regression, the demographic variables refer to Age, Gender, Group Make-up, and all other relevant visitor variables such as Typical Visitor Interaction with Elements. Holding the demographic variables constant, the regression revealed that Signage, Video, Interactive Elements, Animal Habitat, and Theming/Props Contribution to Empathy for Polar Bears together uniquely explain 23% of the variance in Visitor Empathy for Polar Bears, $R^2 = 0.49$, $F(5,94) = 8.51$, $\Delta R^2 = 0.23$, $p < .05$. This suggests that the Element Contribution to Empathy for Polar Bears variables still matter as predictors of Visitor Empathy for Polar Bears, even after other demographic variables are considered. Table 7 presents the hierarchical regression predicting Visitor Empathy for Polar Bears in more detail. In the second model of the hierarchical regression, the set of Element Contribution to Empathy for Polar Bears variables that was added to the existing model of demographic predictor variables, Typical Visitor Interaction with Interactive Elements as an individual predictor variable significantly predicted Visitor Empathy for Polar Bears, such that visitors who typically interacted more with interactive exhibit elements reported lower empathy for polar bears. Past Exposure to a Polar Bear and Theming/Props Contribution to Empathy for Polar Bears as individual predictor variables also significantly predicted Visitor Empathy for Polar Bears, such that visitors who had seen a polar bear at a zoo, aquarium, or in its natural habitat, or visitors who perceived a greater contribution of exhibit theming/props to their empathy for polar bears, also reported higher empathy for polar bears. These three variables of Typical Visitor Interaction with Interactive Elements, Past Exposure to
a Polar Bear, and Theming/Props Contribution to Empathy for Polar Bears were significant after the demographic variables were controlled for.

Since many of the five Element Contribution to Empathy variables for both jellyfish and polar bears were highly correlated, some additional tests were done to assess any possibility of multicollinearity between the variables. Variance Inflation Factors (VIF) for the variables were analyzed, but none of the statistics suggested problematic multicollinearity. VIF were slightly higher for the jellyfish Element Contribution to Element variables compared to those for the polar bear variables, however, these statistics were still below what would be of concern, such as a VIF in the range of 5-10. Additional regressions were run combining all five Element Contribution to Empathy variables into one Element Contribution to Empathy variable for each type of animal, but no variables in the regression showed changes in significance, magnitude, or sign from the original regressions run with the five elements as separate variables (Bowerman & O'Connell, 1990). After running these extra tests, it was decided that the original regressions with the five variables kept separate would remain as they were, with the added caveat of a small sample size. Due to this smaller amount of data, results should be interpreted accordingly. Also, supporting the purpose of this research question, it was important to identify the separate impacts of the exhibit elements on visitor empathy for wildlife, and thus the original regression was deemed appropriate for this reason as well. If any of the variables were to be combined or kept out of the regression, it would not be possible to accurately show their influence on visitor empathy.
Chapter 5. Discussion

This chapter presents a summary of the study describing the problem, methodology, and results. A discussion for each research question follows. The chapter concludes with a discussion of limitations, implications, and future research.

Summary of Problem and Study Summary

Zoos and aquaria are continually improving their animal habitats and creating new experiences for their visitors. In addition to traditional interpretive signage, some institutions are incorporating innovative features such as videos and interactive elements into their exhibits. While there has been some research on how these new exhibit elements might impact visitor learning, to date, little research has been done on how different elements of exhibit design influence the emotional connections made between visitors and animals during a zoo visit. This study sought to investigate zoo visitors’ empathy for different types of animals, whether specific exhibit design elements can be used to influence visitor empathy for these animals, and which elements are most influential.

This study was grounded in the theory that various elements of a zoo exhibit can encourage visitor learning and understanding of wildlife through communication of conservation messages or animal stories, and therefore these exhibit elements can similarly be used to promote visitor empathy for wildlife. It was hypothesized that these
exhibit elements can influence visitor empathy for the animals. Specifically, those elements with more “layers” or technological features such as videos or interactive elements would be more influential in promoting visitor empathy for wildlife than more traditional elements such as interpretive signage or theming/props. It was also predicted that since zoo visitors have been shown to express concern for conservation, they would have high levels of empathy for wildlife, especially for charismatic species. It was expected that there would be gender and age differences in empathy for wildlife as well. To address the research questions, a survey was designed to measure zoo visitor empathy for both a charismatic and non-charismatic species and visitor perception of each exhibit element’s contribution to their empathy for wildlife. A random sample of 195 visitors to the Columbus Zoo and Aquarium were approached in fall of 2017 to complete the survey. Out of this sample, 120 visitors agreed to fill out the survey and all but one of the surveys had a majority of questions complete to be used in data analysis.

Summary and Discussion of Findings

This section summarizes the findings presented in Chapter Four. The summary follows the order of research questions outlined in Chapter One.

Research Question 1

What levels of empathy for wildlife do zoo visitors express?

The survey data suggest that zoo visitors to the Columbus Zoo and Aquarium express high levels of empathy for both polar bears and jellyfish, although they express slightly higher empathy for polar bears than for jellyfish. This finding supports the main hypothesis that zoo visitors would have high levels of empathy for wildlife. It also supports the secondary hypothesis that visitors will connect more or have higher empathy
for more charismatic species that have human-like traits because they will identify with them (Allen et al., 2002; Moss & Esson, 2010; Skibins et al., 2017, 2013). Empathy for polar bears and empathy for jellyfish was found to be related such that visitors who expressed higher empathy for polar bears also expressed higher empathy for jellyfish. Females also expressed higher empathy than males for both polar bears and jellyfish, supporting the secondary hypothesis that women would show more overall empathy for conservation of wildlife than men. The finding that females expressed higher empathy than men for both types of animals is consistent with the work of Powell and Bullock (2014) and Reade and Waran (1996), which found females respond to zoo animals with more compassion and empathy. Age was not significantly related to either empathy for polar bears or jellyfish. Although Reade and Waran (1996) found that people aged 20-39 respond to zoo animals with more empathy, the present study cannot support this finding.

Research Question 2
What different elements of exhibit design do visitors interact with at zoos and aquaria?
This study examined the five exhibit elements of Signage, Videos, Interactive Elements, Animal Habitat, and Theming/Props. Assuming zoo visitors are automatically always exposed to the exhibit elements of Animal Habitat and Theming/Props, the survey only asked visitors about their interaction with Signage, Videos, and Interactive Elements. Survey data revealed that zoo visitors typically interact most with interpretive signage, then equally with videos and interactive elements. Unlike Yocco et al. (2011), who found that exhibit activities that contain technology enhancements are more likely to attract and engage visitors, especially if the technology is newer or not usually found in exhibits, the present study found that visitors typically reported interacting with signage over videos or
interactive elements. Perhaps this finding of more interaction with signage than videos or interactive elements is a result of more exposure to signage than the other two elements. Videos and interactive elements are still a relatively new addition to zoo exhibits, and thus, visitors may not have had as many occasions to interact with these features. This finding also contrasts with research that has suggested most visitors do not actually read panels of interpretive signage even though they perceive it to be important (Derwin & Piper, 1988; Perdue, Clay, et al., 2012; Serrell, 1988).

The results of the present study support research by Bennett (2009) and Carliner (2001), in which videos are portrayed as an inconsistent source of information. These studies suggest visitors will only watch exhibit videos under certain conditions or will skip them entirely. This explanation could certainly apply to the present study’s findings about visitor interaction with signage, videos, and interactive elements, since it was found that visitors will typically interact with signage more than videos or interactive elements.

Females reported interacting more often with videos than males, and visitors who came to the zoo with children typically engage with interactives more often than those who do not bring children. It is possible that females appear to interact more with videos than males because many tend to visit the zoo with children, and thus, they may jointly interact with the videos alongside their children. Likewise, perhaps adults find that using the interactive exhibit elements to engage their children can be an opportunity to teach them about the content of the exhibit or the animal. Yocco et al. (2011), Blud (1990), and Kisiel et al. (2012) found similar results, in which it was common for adults and children to utilize interactive exhibit elements together, sometimes with adults assisting their
children in interacting with the technology and encouraging conversation about the topic of the exhibit.

There was no evidence to support the secondary hypothesis that younger visitors’ empathy for conservation of wildlife will be more influenced by technology features in exhibits than older visitors because they are more used to utilizing technology in their daily lives (Derwin & Piper, 1988; Ting et al., 2013; Webber et al., 2016); age was not significantly related to typical visitor interaction with any of the three elements. This finding conflicts with studies that have found age is one factor that influences usage of interactive elements, suggesting interactive elements are more attractive to children and young adults, while older visitors prefer to read panels of information over using the interactive elements (Derwin & Piper, 1988; Webber, 2015; Webber et al., 2016).

Research Question 3
Do these different elements of exhibit design influence visitor empathy? If so, which are most influential to promoting visitor empathy?

The results of the current study indicated that overall, elements of zoo exhibit design do appear to influence visitor empathy for wildlife, and this finding extends to both charismatic and non-charismatic species. In this study, these species were represented by a polar bear and jellyfish. Although exhibit elements were found to be influential, it was not in the manner hypothesized. It was predicted that elements with more “layers” or technological features such as videos or interactive elements will be more influential in promoting visitor empathy for wildlife than more traditional elements such as interpretive signage or theming/props; however, the results indicate that visitors perceive theming/props and animal habitat as the most influential in promoting empathy for both
polar bears and jellyfish. Although research suggests that elements such as videos and signage can encourage empathy through framing and storytelling (Seattle Aquarium, 2015), the present study found that elements such as theming and animal habitat are perhaps more foundational to developing empathy for wildlife. Using framing to tell the story of a specific species through interpretive signage or videos might have a unique influence on empathy, separate from the effects of theming and animal habitat. Since the elements of signage, videos, and interactive elements are auxiliary to the animal’s habitat and the theming of the exhibit or region, the finding could reflect visitors’ focus on the overall impression of an exhibit more than on the supplementary informational and interactive features. The findings specific to each type of animal will be discussed in more detail below.

Visitor Empathy for Jellyfish

Zoo visitors perceived animal habitat as the exhibit element that contributes most to their empathy for jellyfish, representing a non-charismatic species. This result was evident from the regression predicting visitor empathy for jellyfish, in which animal habitat was the strongest predictor among all five exhibit elements. Perhaps visitors perceived this element as contributing most because to them, it is important that the habitat of jellyfish reflects their natural habitat in the wild. Not only can an animal’s habitat convey to visitors what their actual habitat might look like but it also poses an opportunity to communicate messages of habitat conservation to ensure the species’ future (Hutchins & Smith, 2003). If a habitat provides ample animal visibility, it increases the chances that visitors will create affective connections with the animal. The finding that visitors perceive animal habitat as most important suggests in order to connect with a non-
charismatic species such as a jellyfish, they might expect to see a naturalistic habitat for the jellyfish that reflects their home in the wild, without sacrificing visibility among other potential species in an aquarium-like setting.

Holding the demographic and other relevant visitor variables constant, the five exhibit elements’ contribution to empathy still mattered as predictors of empathy for jellyfish, suggesting different parts of zoo exhibits should be considered as unique components that influence empathy for wildlife. Another variable that appeared to influence visitor empathy for jellyfish was visitors’ perception of how much theming and props contribute to their empathy for jellyfish. Visitors’ perception of the contribution of theming/props to their empathy may have been influential to encouraging their care and concern for jellyfish because research suggests exhibits that are immersive often transport visitors to the animals’ natural habitat, immersing them in the story of that animal through various details within the exhibit and suggesting they are sharing the same space as the animal (Carliner, 2001). Theming can thus influence the connections between visitors and animals, and perhaps enlighten visitors to the impact humans have on those shared environments with the species.

Visitor Empathy for Polar Bears
Zoo visitors perceived exhibit theming/props as the element that contributes most to their empathy for polar bears, representing a charismatic species. This result was evident from the regression predicting visitor empathy for polar bears, in which theming/props was the strongest predictor among all five exhibit elements. It is possible that visitors perceived this element as contributing most because to them, it is important that the exhibit of a polar bear reflects the conservation story of that animal, transporting them into that
shared space and into the story of the polar bear. As mentioned in the discussion on jellyfish, theming and props can encourage connections between visitors and animals through the details these elements provide, which make the immersive experience complete. The finding that visitors perceive exhibit theming and props as most important suggests in order to connect with a charismatic species such as a polar bear, they might expect to be absorbed in the conservation story of the polar bear, supported by the design of a theme and selection of props with an attention to detail. When this is accomplished to best illustrate a visitor’s journey with the animal, there is a better chance that the visitor will feel an emotional connection to the animal.

Holding the demographic and other relevant visitor variables constant, the five exhibit elements’ contribution to empathy still mattered as predictors of empathy for polar bears, further emphasizing the consideration of various aspects of a zoo exhibit as influential in creating feelings of empathy for wildlife. Other variables that influenced visitor empathy for polar bears in this regression include having seen a polar bear at a zoo, aquarium, or in its natural habitat in the past, visitors’ typical interaction with interactive elements in an exhibit, and exhibit theming/props, reflected in visitors’ perception of how much theming contributes to their empathy for polar bears. Past exposure to a polar bear at a zoo, aquarium, or in its natural habitat may have influenced visitor empathy for polar bears because they could have been more familiar with this species, and perhaps they even had preexisting connections to specific polar bears at the zoo. Memories from these past interactions and feelings during those experiences could have contributed to their empathy.
Although Seattle Aquarium’s (2015) research on “best practices” for encouraging empathy within visitors to zoos and aquaria suggests that technological elements can be used to present compelling animal conservation stories, the present study found that visitors’ typical interaction with interactive exhibit elements may have influenced their empathy for polar bears in the opposite way. Analyses suggested that the more visitors typically interacted with interactive elements, the lower their empathy for polar bears. This result does, however, appear to support the main finding that theming/props and animal habitat are the most influential elements in promoting visitor empathy, since those two elements lack any technological elements. Perhaps visitors tend not to engage with the interactive elements because those elements somehow detract from the exhibit, the animal of interest, or their experience of developing empathy for that animal. As mentioned previously in this discussion, visitor perception of the contribution of theming and props to their empathy for polar bears may have influenced their empathy because they could have pictured being immersed in an arctic region or exhibit that reflects the polar bears’ natural habitat. These feelings of immersion might further shape the affective connections they form with polar bears.

Limitations
There were several limitations to this study. First, the study was limited to visitors at the Columbus Zoo and Aquarium, a facility that charges admission and requires time to visit. Thus, the experiences of adults may be different at other zoos and aquariums and are not reflective of the population as a whole. The sample of participants also contained more females than males, and therefore may not be reflective of the general adult population. As described in Chapter 4, the small sample of participants remains a limitation to the
study, and with many of the variables found to be highly correlated, results should be interpreted appropriately. Second, since data was collected from visitors to the Columbus Zoo and Aquarium, the sample could have been automatically more prone to care about wildlife, influencing their responses. Third, participants were asked to perceive the contribution of the five exhibit elements to their empathy for wildlife and self-reported their thoughts and feelings on the measures used in the surveys, so actual thoughts and feelings were not measured. There is a possibility that some visitors were more likely to participate in the study because they may have been naturally drawn to the display boards. Their survey responses for the exhibit element of signage could have reflected social desirability with this inclination toward the display boards as well.

Although considered an initial limitation to the study, weather conditions did not seem to influence attendance to the zoo on data collection days. Generally, data was collected on days when weather conditions were favorable, although it will still be considered a limitation because it was not something that could be controlled in this study. Another limitation was that the results indicate that visitors perceive theming/props and animal habitat as the exhibit elements that contribute most to their empathy for jellyfish and polar bears, but the study does not provide evidence to suggest why or how these elements contribute to visitor empathy, or what makes those two elements more influential than the others. Unintentional ordering effects could be an additional limitation to the study, since visitors were asked on the survey to rate their baseline empathy for polar bears first, then jellyfish second. This order was repeated for visitors’ rating of the five element contributions to empathy for both species. Presentation of the survey questions relating to each species should be randomized in future studies.
Lastly, a polar bear was used as an example of a charismatic species, and visitors could have been influenced by their familiarity with specific polar bears at the Columbus Zoo and Aquarium. It is possible that seeing the zoo’s polar bears on the same day visitors completed their surveys could have affected survey responses. Alternatively, the zoo does not have any jellyfish in its collection, which also could have influenced visitors’ familiarity with this species. Despite these limitations, this study provides valuable information about zoo visitors’ empathy for different types of animals and the contribution of exhibit elements to their empathy for those animals and perhaps conservation of their counterparts in the wild.

Implications
The results of this study conclude that visitors to the Columbus Zoo and Aquarium have high levels of empathy for wildlife, especially for charismatic species, and that exhibit design elements appear to influence visitor empathy for both charismatic and non-charismatic species. Data analysis revealed some unexpected findings, including visitors perceive exhibit theming/props and animal habitat as contributing most out of the five elements to their empathy for wildlife.

Promoting Empathy for Wildlife
Exhibit design appears to be influential to visitor empathy for wildlife. Based on this study, zoos and aquaria can focus on continuing to improve animal habitats, as well as designing the theming and selecting the props for a region or exhibit in a detailed way, to evoke empathy for the animals. The present study suggests that zoo visitors place importance on animal habitats and the well-being of the animals that reside in them, providing implications for the timely topic of animal welfare across zoos. As exhibits are
continuously becoming more naturalistic to reflect the animal’s home in the wild, this study provides evidence that the design and appearance of habitats is also increasingly important to zoo visitors. While much of the research surrounding how zoos and aquaria can promote empathy within visitors focuses on using the interactive exhibit elements like signage, videos, and touchscreens, kiosks, or push-buttons to promote empathy, the present study suggests examining the elements of theming/props and animal habitat in more depth. There is potential for these foundational exhibit elements to encourage empathy within visitors as well.

Institutions such as zoos and aquaria should continue designing exhibits that bring visitors into the natural habitats and conservation stories of the animals if they are to continue promoting empathetic connections between visitors, animals, and their wild counterparts. This also has implications for visitor experiences at zoos and aquaria. Since zoo visitors were found to identify the theming and props of an exhibit as important, these institutions should focus on creating immersive experiences for their visitors so more people will likely visit, spending time learning about and connecting with different species.

The current study found that zoo visitors express high levels of empathy for both polar bears and jellyfish, but they express slightly higher empathy for polar bears, a charismatic species. Numerous efforts to promote empathy for wildlife within zoo visitors tend to focus on charismatic, recognizable species (Ducarme et al., 2013; Moss & Esson, 2010; Skibins et al., 2017; Sommer, 2008). Since there has been evidence presented from past research and the present study suggesting visitors typically convey higher empathy for charismatic species, zoos and aquaria should begin shifting their focus to the non-
charismatic species that are often overlooked. Broadening these initiatives to encompass empathy for all types of wildlife will ensure all species are given an equal opportunity to thrive in the wild through conservation efforts.

Zoo visitors in this study reported feelings of empathy toward two species. If zoos and aquaria continue to encourage empathy for wildlife, visitors can translate those feelings into actions that support conservation. Actions such as researching more information about a species or donating to a conservation organization, as well as bringing friends and family to the zoo to so they may form their own feelings of empathy, inspire efficacy to contribute to a larger cause. Empathy may be an essential starting point, but ultimately, it will be the actions resulting from those feelings that will empower conservation efforts.

The constructs of care, concern, and empathy should also be more fully explored in future studies to contribute to the growing collection of empathy literature, especially in relation to empathy for wildlife. Although these terms are all related, more research should be done to understand their specific meanings, usage, and the differences between them.

Improving Zoo Exhibit Design

The results of this study provide implications for exhibit design at zoos and aquaria across the globe as well. Since zoo visitors typically interact most with interpretive signage, or are exposed to this exhibit element the most, zoos and aquaria can use these findings to concentrate their informational or conservation messaging efforts on this avenue of communication, at least until videos and interactive elements become more commonly incorporated into exhibits. Although the data suggest visitors typically interact most with signage, they could be exposed to more interactive elements or videos at other zoos or aquaria, increasing their interaction with these elements and changing the
outcome of this finding. Visitors who come to the zoo with children show higher levels of typical interaction with interactive elements. This finding can be used to facilitate social interaction between adults and children. As adults engage with their children, perhaps helping them use the interactive features in an exhibit, they can simultaneously teach them about exhibit content and better connect them with the animals. Within this interaction lies an opportunity to instill empathy for wildlife at an early age.

Implications for Future Research

The current study allows for numerous opportunities to expand upon the findings and explore new avenues for research on zoo exhibits in general. Visitors perceived theming/props and animal habitat as most influential in promoting empathy but the present study is limited in its ability to provide insight into why or how these elements might be vital in encouraging empathy for wildlife. Future studies should more specifically address these impacts by exploring what it is about animal habitat and theming/props that influences empathy. Subsequent studies can also investigate what it is about signage, videos, and interactive elements that might make them less effective at influencing empathy and how these can be improved to do so. Although past research has suggested that those elements could be influential in promoting empathy, the present study found no such evidence. Further study will need to be done to determine whether this finding is due to location, exposure to and prevalence of exhibit elements, or a different explanation.

It would benefit future studies to add additional survey questions to better understand the influence of other factors on visitor empathy for wildlife. For example, one question on the present survey asks whether visitors have seen a polar bear and jellyfish at a zoo,
aquarium, or in their natural habitats. Future studies can modify this question so that visitors are able to specify where they have seen each species. Further questions can examine whether visitors donate to conservation organizations or are zoo members. Replicating the study with an experimental design would lend new insight into the influence of exhibit design on visitor empathy by investigating the effects of each element on visitor empathy in a specific exhibit setting, instead of relying on visitor perception of each element’s contribution to empathy. This study should also be repeated with different examples of charismatic and non-charismatic animals to see whether there are differences in results. A polar bear and jellyfish are only two of numerous examples that could be used to represent each type of species. A study using a different population of participants instead of zoo visitors would provide a representation of the population at large rather than just the zoo visitor population. This would allow community members who might not typically visit the zoo to participate and possibly inform an investigation of whether or to what extent using zoo visitors changes the findings. Examining a younger population, such as teenagers, would also be of interest when considering replication of the study, to better understand any generational differences in empathy toward wildlife or perception of the exhibit elements’ contribution to their empathy.

Conclusion

The focus of this study was to explore zoo visitors’ levels of empathy for wildlife, and in particular, a charismatic and non-charismatic species, as well as examine how different elements of exhibit design might influence visitor empathy for these two types of animals. With continuous changes in exhibit design across zoos and aquaria, and public
perception of zoos an ever-pressing issue, promoting empathy for wildlife both in zoos and in the wild has become a relevant mission. Findings from the present study revealed that zoo visitors already have high levels of empathy for both charismatic and non-charismatic species, although they express somewhat higher empathy for charismatic species, and that elements of exhibit design do have the potential to influence visitor empathy for wildlife. Contrary to hypothesis, zoo visitors perceived exhibit theming and props and animal habitat to contribute most to their empathy for wildlife. It appears zoo visitors may have conflicting perceptions with the future direction of exhibit design, suggesting that more technological features in exhibits may not actually enhance visitors’ experiences or encourage them to feel empathetic toward wildlife. Based on findings from the present study, it may suffice for zoological institutions to focus their exhibit improvements on creating expansive and natural habitats for the animals, as well as a theme with props authentic to each species’ home in the wild. These findings have the potential to benefit future exhibit design plans for zoos and aquaria, as well as the museum and visitor studies fields at large. Zoos and aquaria should be encouraged to continue promoting empathy for wildlife within their visitors and inspiring visitors to become involved in their important efforts to conserve the diversity of life on our planet.
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Appendix A. Tables
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ECE: “Element Contribution to Empathy”

Table 1. Pearson’s Correlations for Polar Bear (PB) Variables

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<td>-.025</td>
<td>-.119</td>
<td>-.123</td>
<td>-.093</td>
<td>-.008</td>
<td>-.009</td>
<td>-.036</td>
<td>-.013</td>
<td>.075</td>
<td>.020</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.073</td>
<td>-.090</td>
<td>-.051</td>
<td>.146</td>
<td>.154</td>
<td>.104</td>
<td>-.022</td>
<td>.061</td>
<td>.315**</td>
<td>.046</td>
<td>.009</td>
<td>.089</td>
<td>-.004</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.049</td>
<td>-.016</td>
<td>-.049</td>
<td>.035</td>
<td>.069</td>
<td>.210</td>
<td>.134</td>
<td>-.019</td>
<td>.025</td>
<td>-.107</td>
<td>.174</td>
<td>.076</td>
<td>.149</td>
<td>.071</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>-.227*</td>
<td>-.219*</td>
<td>-.176</td>
<td>-.224*</td>
<td>-.247**</td>
<td>-.274**</td>
<td>-.140</td>
<td>-.192*</td>
<td>-.148</td>
<td>-.085</td>
<td>.100</td>
<td>.105</td>
<td>-.060</td>
<td>-.086</td>
<td>-.153</td>
<td>1</td>
</tr>
</tbody>
</table>

p-value: *<0.05 (2-tailed), **<0.01 (2-tailed)
ECE: “Element Contribution to Empathy”

Table 2. Pearson's Correlations for Jellyfish (J) Variables
1. Typical Visitor Interaction: Signage 1

2. Typical Visitor Interaction: Videos .426** 1

3. Typical Visitor Interaction: Interactive Elements .092 .508** 1

4. Group -.022 .061 .315** 1

5. Age .134 -.019 .025 .071 1

6. Gender -.140 -.192* -.148 -.086 -.153 1

p-value: *<0.05 (2-tailed), **<0.01 (2-tailed)

Table 3. Pearson's Correlations for Demographic Variables and Typical Visitor Interaction with Signage, Videos, and Interactive Elements
<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE\ B$</th>
<th>$Beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signage Contribution to Empathy for Jellyfish</td>
<td>0.23</td>
<td>0.14</td>
<td>0.22</td>
</tr>
<tr>
<td>Video Contribution to Empathy for Jellyfish</td>
<td>0.14</td>
<td>0.17</td>
<td>0.13</td>
</tr>
<tr>
<td>Interactive Elements Contribution to Empathy for Jellyfish</td>
<td>-0.27</td>
<td>0.14</td>
<td>-0.27</td>
</tr>
<tr>
<td>Theming/Props Contribution to Empathy for Jellyfish</td>
<td>0.27</td>
<td>0.14</td>
<td>0.27</td>
</tr>
<tr>
<td>Animal Habitat Contribution to Empathy for Jellyfish</td>
<td>0.32</td>
<td>0.13</td>
<td>0.30**</td>
</tr>
</tbody>
</table>

$R^2$ 0.38
$F$ 13.24**

p-value: *<0.05, **<0.01

Table 4. Summary of Multiple Linear Regression Analysis for Signage, Video, Interactive Elements, Theming/Props, and Animal Habitat Contribution to Empathy for Jellyfish predicting Visitor Empathy for Jellyfish
<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th></th>
<th></th>
<th>Model 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>Beta</td>
<td>B</td>
<td>SE B</td>
<td>Beta</td>
</tr>
<tr>
<td>Typical Visitor Interaction: Signage</td>
<td>0.13</td>
<td>0.15</td>
<td>0.09</td>
<td>-0.14</td>
<td>0.15</td>
<td>-0.10</td>
</tr>
<tr>
<td>Typical Visitor Interaction: Videos</td>
<td>0.53</td>
<td>0.18</td>
<td>0.37**</td>
<td>0.19</td>
<td>0.18</td>
<td>0.13</td>
</tr>
<tr>
<td>Typical Visitor Interaction: Interactive</td>
<td>-0.22</td>
<td>0.13</td>
<td>-0.20</td>
<td>-0.16</td>
<td>0.15</td>
<td>-0.14</td>
</tr>
<tr>
<td></td>
<td>Elements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoo Visit Frequency</td>
<td>0.001</td>
<td>0.15</td>
<td>0.001</td>
<td>0.046</td>
<td>0.13</td>
<td>0.029</td>
</tr>
<tr>
<td>Childhood Pet Ownership</td>
<td>-0.11</td>
<td>0.55</td>
<td>-0.021</td>
<td>0.033</td>
<td>0.48</td>
<td>0.006</td>
</tr>
<tr>
<td>Current Pet Ownership</td>
<td>0.045</td>
<td>0.33</td>
<td>0.015</td>
<td>-0.22</td>
<td>0.29</td>
<td>-0.071</td>
</tr>
<tr>
<td>Group Make-up</td>
<td>0.32</td>
<td>0.26</td>
<td>0.12</td>
<td>0.29</td>
<td>0.23</td>
<td>0.11</td>
</tr>
<tr>
<td>Age</td>
<td>0.03</td>
<td>0.095</td>
<td>0.031</td>
<td>0.055</td>
<td>0.083</td>
<td>0.056</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.46</td>
<td>0.26</td>
<td>-0.17</td>
<td>-0.20</td>
<td>0.23</td>
<td>-0.075</td>
</tr>
<tr>
<td>Past Exposure to a Jellyfish</td>
<td>-0.27</td>
<td>0.32</td>
<td>-0.077</td>
<td>-0.063</td>
<td>0.29</td>
<td>-0.018</td>
</tr>
<tr>
<td>Signage Contribution to Empathy for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video Contribution to Empathy for Jellyfish</td>
<td>0.23</td>
<td>0.25</td>
<td>0.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interactive Elements Contribution to</td>
<td>-0.29</td>
<td>0.19</td>
<td>-0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theming/Props Contribution to Empathy for</td>
<td>0.33</td>
<td>0.16</td>
<td>0.32*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Habitat Contribution to Empathy for</td>
<td>0.22</td>
<td>0.15</td>
<td>0.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.20</td>
<td></td>
<td></td>
<td>0.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta R^2$</td>
<td></td>
<td></td>
<td></td>
<td>0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F$ for change in $R^2$</td>
<td>2.36*</td>
<td></td>
<td></td>
<td>7.67**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p-value: *<0.05, **<0.01

Table 5. Summary of Hierarchical Regression Analysis for Variables Predicting Visitor Empathy for Jellyfish
<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>Beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signage Contribution to Empathy for Polar Bears</td>
<td>0.12</td>
<td>0.10</td>
<td>0.13</td>
</tr>
<tr>
<td>Video Contribution to Empathy for Polar Bears</td>
<td>0.16</td>
<td>0.11</td>
<td>0.18</td>
</tr>
<tr>
<td>Interactive Elements Contribution to Empathy for Polar Bears</td>
<td>-0.02</td>
<td>0.11</td>
<td>-0.02</td>
</tr>
<tr>
<td>Theming/Props Contribution to Empathy for Polar Bears</td>
<td>0.28</td>
<td>0.10</td>
<td>0.31**</td>
</tr>
<tr>
<td>Animal Habitat Contribution to Empathy for Polar Bears</td>
<td>0.10</td>
<td>0.11</td>
<td>0.10</td>
</tr>
</tbody>
</table>

\[ R^2 \quad 0.33 \]

\[ F \quad 10.90** \]

p-value: *<0.05, **<0.01

Table 6. Summary of Multiple Linear Regression Analysis for Signage, Video, Interactive Elements, Theming/Props, and Animal Habitat Contribution to Empathy for Polar Bears predicting Visitor Empathy for Polar Bears
### Table 7. Summary of Hierarchical Regression Analysis for Variables Predicting Visitor Empathy for Polar Bears

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$B$</td>
<td>$SE\ B$</td>
<td>Beta</td>
<td>$B$</td>
</tr>
<tr>
<td>Typical Visitor Interaction: Signage</td>
<td>0.19</td>
<td>0.12</td>
<td>0.17</td>
<td>0.024</td>
</tr>
<tr>
<td>Typical Visitor Interaction: Videos</td>
<td>0.26</td>
<td>0.14</td>
<td>0.23</td>
<td>0.002</td>
</tr>
<tr>
<td>Typical Visitor Interaction: Interactive Elements</td>
<td>-0.16</td>
<td>0.098</td>
<td>-0.018</td>
<td>-0.27</td>
</tr>
<tr>
<td>Zoo Visit Frequency</td>
<td>-0.066</td>
<td>0.11</td>
<td>-0.053</td>
<td>0.046</td>
</tr>
<tr>
<td>Childhood Pet Ownership</td>
<td>-0.55</td>
<td>0.40</td>
<td>-0.15</td>
<td>-0.47</td>
</tr>
<tr>
<td>Current Pet Ownership</td>
<td>0.36</td>
<td>0.25</td>
<td>0.15</td>
<td>0.22</td>
</tr>
<tr>
<td>Group Make-up</td>
<td>-0.028</td>
<td>0.19</td>
<td>-0.014</td>
<td>-0.26</td>
</tr>
<tr>
<td>Age</td>
<td>0.044</td>
<td>0.070</td>
<td>0.058</td>
<td>0.021</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.37</td>
<td>0.19</td>
<td>-0.174</td>
<td>-0.13</td>
</tr>
<tr>
<td>Past Exposure to a Polar Bear</td>
<td>2.37</td>
<td>0.71</td>
<td>0.33**</td>
<td>2.01</td>
</tr>
<tr>
<td>Signage Contribution to Empathy for Polar Bears</td>
<td>-0.004</td>
<td>0.14</td>
<td>-0.004</td>
<td></td>
</tr>
<tr>
<td>Video Contribution to Empathy for Polar Bears</td>
<td>0.15</td>
<td>0.12</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Interactive Elements Contribution to Empathy for Polar Bears</td>
<td>0.082</td>
<td>0.12</td>
<td>0.092</td>
<td></td>
</tr>
<tr>
<td>Theming/Props Contribution to Empathy for Polar Bears</td>
<td>0.41</td>
<td>0.12</td>
<td>0.46**</td>
<td></td>
</tr>
<tr>
<td>Animal Habitat Contribution to Empathy for Polar Bears</td>
<td>0.066</td>
<td>0.11</td>
<td>0.066</td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.26</td>
<td></td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>$\Delta R^2$</td>
<td></td>
<td></td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>$F$ for change in $R^2$</td>
<td>3.46**</td>
<td></td>
<td>8.51**</td>
<td></td>
</tr>
</tbody>
</table>

p-value: *<0.05, **<0.01
Appendix B. Zoo Visitor Survey

**DIRECTIONS:** Please answer the following questions, but **do not** put your name on this survey. Please feel free to skip any question you are uncomfortable answering. You may discontinue the survey at any time.

<table>
<thead>
<tr>
<th>Individual Concern and Care for Wildlife</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following questions will ask about your concern and care toward two types of animals. <strong>Please note:</strong> The use of “polar bears” and “jellyfish” does NOT refer to <em>the Columbus Zoo and Aquarium’s specific exhibits, but rather to those animals in general.</em></td>
</tr>
</tbody>
</table>

**Q1.** Please indicate your level of agreement with the following statements about **POLAR BEARS.** *(Circle one number for each statement.)*

<table>
<thead>
<tr>
<th>Statements</th>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Completely Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>This species has as much right to exist as any human being</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Ensuring this species’ survival is my highest priority</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Wildlife protection should be a high priority within our society</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I am concerned about the well-being of this animal</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I would object if I learned of the mistreatment of this animal</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>The extinction of this species will drastically lower my emotional sense of well-being</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>My connection to this animal has increased my connection to the species as a whole</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I need to learn everything I can about this species</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I will alter my lifestyle to help protect this species</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>
Q2. Please indicate your level of agreement with the following statements about JELLYFISH. *(Circle one number for each statement.)*

<table>
<thead>
<tr>
<th>Statements</th>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Completely Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>This species has as much right to exist as any human being</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Ensuring this species’ survival is my highest priority</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Wildlife protection should be a high priority within our society</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I am concerned about the well-being of this animal</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I would object if I learned of the mistreatment of this animal</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>The extinction of this species will drastically lower my emotional sense of well-being</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>My connection to this animal has increased my connection to the species as a whole</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I need to learn everything I can about this species</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>I will alter my lifestyle to help protect this species</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

Exhibit Contribution to Concern and Care for Wildlife
The following questions will ask about how each part of an exhibit contributes to your level of concern and care for each type of animal.

*Please refer to the display board for examples of each exhibit element*

Please use this definition of empathy to answer the questions below: “being able to understand and care about the experiences of another person or animal, or take their point-of-view.”

Q3. Referring to the definition of empathy above, please indicate how much you think each part of an exhibit contributes to your empathy for POLAR BEARS. *(Circle one number for each statement.)*
Q4. Referring to the definition of empathy above, please indicate how much you think each part of an exhibit contributes to your empathy for JELLYFISH. (Circle one number for each statement.)

<table>
<thead>
<tr>
<th></th>
<th>Does Not Contribute At All</th>
<th>Slightly Contributes</th>
<th>Somewhat Contributes</th>
<th>Moderately Contributes</th>
<th>Contributes a Great Deal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs with information</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Videos</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Interactive Elements</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Theming</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Animal Habitat</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**General Questions**

The following questions will ask about your typical interaction with three types of exhibit elements and some basic demographic information.

Q5. Thinking about your interaction with the following 3 exhibit parts across all zoo visits (and across all exhibits), please rate your typical interaction with each element. (Circle one number for each statement.)

<table>
<thead>
<tr>
<th></th>
<th>Never Interact With</th>
<th>Rarely Interact With</th>
<th>Sometimes Interact With</th>
<th>Very Often Interact With</th>
<th>Always Interact With</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signs with information</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Videos</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Interactive Elements</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

93
Q6. How often do you typically visit zoos, aquaria, nature centers, or wildlife parks such as The Wilds? (Please circle the number that best describes your response.)

1 – Never
2 – Once Every Few Years
3 – A Few Times a Year
4 – Monthly
5 – Once a Week or More

Q7. Did you have any childhood pets?
☐ Yes
☐ No

Q8. Do you currently have any pets?
☐ Yes
☐ No

Q9. Have you seen a polar bear at a zoo, aquarium, or in its natural habitat?
☐ Yes
☐ No
☐ Not sure

Q10. Have you seen a jellyfish at a zoo, aquarium, or in its natural habitat?
☐ Yes
☐ No
☐ Not sure

(Note: The following information will be used for demographic purposes only.)

Q11. Did you come to the zoo with any children (under 18 years old) today?
☐ Yes
☐ No

Q12. What is your age?
☐ 18 – 25
☐ 26 – 35
☐ 36 – 45
☐ 46 – 55
☐ 56 – 65
☐ over 65
Q13. What is your gender?
☐ Male
☐ Female
☐ Other

Thank you!
This completes the survey.
Appendix C. Display Boards Used in Data Collection