A MULTI-PRONGED APPROACH TO STUDYING HUMAN-ANIMAL INTERACTIONS IN ZOO SETTINGS

by

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To my cats, Berlioz, Aurelia, and Freyja

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ABSTRACT

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Zoos of the past focused primarily on animal exhibition, yet the modern zoo has shifted to a focus on animal conservation and public education. This change has coincided with a negative shift in public opinion towards zoos after documentaries such as *Blackfish*, leading to comparatively more positive views of sanctuaries. These preferences seem to be influenced by the lack of animal exhibition at sanctuaries, suggesting that human influences on animals are important to public perceptions of zoos. Thus, human-animal interaction research is essential to understanding perceptions of zoos and human influences on captive animals. This dissertation addresses both factors. Study 1 assessed public opinions on zoos versus sanctuaries, and investigated how these opinions are impacted by knowledge of zoo practices. Highlighting any positive information, but particularly in relation to conservation, led to more positive public opinions. Studies 2 and 3 considered human-animal interactions through human impacts on captive animals, as further knowledge could both increase animal welfare, and then, positively influence public opinion. Study 2 examined the influence of visitors on the behaviors of zoo-housed parrots in an aviary. Birds engaged in decreased positive behaviors, increased negative behaviors, and more birds were present as visitor numbers increased. The increase in negative behaviors was minimal compared to the increase in birds present, which may indicate the birds were not negatively impacted by visitors. Study 3 evaluated the judgment biases of two ambassador animals after exposure to zoo visitors. The chicken displayed pessimism whether it was held or perched, but the tegu displayed pessimism only when no visitor touch occurred. This suggests negative effects of visitor interactions for the chicken, but touch interactions may not be aversive to the tegu. All three studies contribute to our understanding of human-animal interactions for the improvement of animal welfare and public perceptions of these facilities.

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LIST OF ABBREVIATIONS

AZA	An initialism for the Association of Zoos and Aquariums, a non-profit organization that accredits zoos and aquariums based on particular standards, such as conservation, education, and animal welfare.
WAZA	An abbreviation for the World Association of Zoos and Aquariums, an international group of zoos and aquariums and other associations focused on animal care and conservation.
USDA	The United States Department of Agriculture is a federal agency that regulates areas related to food, agriculture, and natural resources, but also the welfare of particular animals outlined by the Animal Welfare Act.
IUCN	An initialism for the International Union for Conservation of Nature, which is an international organization that furthers conservation goals and sustainability for natural resources.

CHAPTER ONE

GENERAL INTRODUCTION

The field of animal welfare has evolved rapidly over the past several decades as technological and methodological advances have revealed important predictors of the physical and psychological health of captive animals. The influential Five Freedoms model (Farm Animal Welfare Council, n.d.) emphasized that captive animals should be free from thirst, hunger, fear, pain, distress, and other aversive states. Yet, reducing negative states does not automatically promote positive states. More recently, the Five Domains model differentiates physical (e.g., lack of disease) and affective (e.g., lack of distress) welfare components, but also promotes positive effects (Mellor, 2016). The Five Domains model has been updated over the years as new research informs our understanding of animal welfare, with the recent inclusion of the impact of human-animal interactions (Mellor et al., 2020). Research on this topic has been increasing (e.g., Edes et al., 2021; Jones et al., 2021; Wascher et al., 2021), with work on companion, farm, and wild animals revealing that the interactions between animals and humans can affect an animal's welfare. These impacts are important to understand across settings, but particularly within the zoo setting as humans are a frequent feature of the environment for zoo-housed animals, that typically have little choice in this exposure. Depending on habitat design, captive animals may see visitors from afar or up close in walk-through or human contact habitats, and even animals housed "off-exhibit" (i.e., outside of public view) are frequently exposed to animal care staff. However, the impact of human exposure is not straightforward. Human impacts can be detrimental (e.g., Blaney &

Wells, 2004; Davis et al., 2005), neutral (e.g., Bernstein-Kurtycz et al., 2021), or beneficial for animals (e.g., Claxton, 2011; Vasconcellos et al., 2016); indeed, individual animals may actively seek human interaction (e.g., Fife-Cook & Franks, 2021). With such variation in effects, it is necessary to understand the factors relevant to how human interactions affect animal welfare so that we may predict when exposure decreases animal welfare.

Human-animal interaction effects can be assessed in either direction (i.e., human impacts on animals or animal impacts on humans) and with a variety of methods. Researchers have often focused on the impact zoo visitors have on the welfare of the animals (e.g., Chiew, Butler, et al., 2019; Goswami et al., 2023; Larsen et al., 2014; Malley et al., 2021; Sherwen et al., 2015; Williams et al., 2021). Assessing an animal's welfare is difficult, as it must be inferred from nonverbal behaviors, and no one method affords a perfect assessment of welfare (Dawkins, 2021). Most methods focus on behavioral (e.g., Brand et al., 2016; Learmonth, 2019; Wagman et al., 2018; Whitham & Wielebnowski, 2009; 2013) or physiological assessment (e.g., Berger, 2011; Eguizábal et al., 2019; Shepherdson et al., 2013; Wielebnowski et al., 2002; Wielebnowski & Watters, 2007; Yamanashi, 2018), but there is increasing focus on the benefits of cognitive assessment (Clegg, 2018). Researchers can also assess the perceptions of visitors based on their interactions with animals at the zoo (e.g., Muller et al., 2021; Perdue & Robinson, 2021; Rank et al., 2021). Visitor perceptions are an informational metric for zoos for multiple reasons, such as increasing visitor numbers and investigating the impact of public educational programs. Zoos benefit from a multi-pronged approach to studying the effects of human-animal interactions, which can provide information relevant not only to improving the lives of animals in human care, but also to improving the impact of the zoo on visitors.

Although assessing human attitudes towards zoos is valuable, it is also important to directly test the impact of human management strategies and visitor effects on animals. Assessing the welfare of captive animals in an objective manner has been a subject of scientific discussion since the 1960s, and for good reasons (Clegg, 2018). A high degree of welfare facilitates longer lifespans for the animals in human care. In addition, key goals of accredited zoos today include conservation and reintroduction (i.e., release into the wild), and proper welfare is essential to achieving these goals. Populations for captive breeding programs can be sustained only when animals are properly cared for by the zoo (Escobar-Ibarra et al., 2021). Therefore, much research has focused on factors that affect animal welfare and how to assess animal welfare across a wide array of species. However, assessing welfare is not often straightforward. For example, determining the valence of stress is difficult; that is, whether stress is positive (i.e., pleasurable for the animal) or negative (i.e., unpleasant for the animal; Dawkins, 2021). Indeed, the field of animal welfare could benefit from a stronger focus on assessing the affect of captive animals to better understand this valence.

With approximately 6,700 species of animals housed across AZA (Association of Zoos and Aquariums; i.e., a non-profit organization that verifies that zoos and aquariums meet high standards of welfare and education) -accredited zoos, understanding the impacts on animals of their interactions with humans is daunting. Although visitor impacts on a variety of species have been assessed (Learmonth, 2020), much of this work has focused on mammals (e.g., Asiatic lions, *Panthera leo persica*: Goswami et al., 2023;

clouded leopards, *Neofelis nebulosa*: Wielebnowski, et al., 2002; koalas, *Phascolarctos cinereus*: Larsen et al., 2014; slender-tailed meerkats, *Suricata suricatta*: Williams et al., 2021; Western lowland gorillas, *Gorilla gorilla gorillas*: Malley et al., 2021; white rhinoceros, *Ceratotherium simum*: Carlstead & Brown, 2005), and specifically on keeper-animal interactions. Effects of visitors on birds also have been examined (e.g., African penguins, *Spheniscus demersus*: Williams et al., 2021; little penguins, *Eudyptula minor*: Chiew, Butler, et al., 2019, Sherwen et al., 2015; black-casqued hornbills, *Ceratogymna atrata*: Rose et al., 2020; common ravens, *Corvus corax*: Wascher et al, 2021; crows, *Corvus Corone*: Wascher et al, 2021). However, there are many additional species in need of research attention, including those often seen as less behaviorally diverse, such as reptiles (Carter et al., 2021). Many animals are housed outside of AZA-accredited facilities, in places such as sanctuaries (i.e., establishments meant to house animals for their lifetime, typically off-exhibit) or roadside zoos (i.e., menageries for the exhibition of animals, typically smaller than AZA-accredited zoos), and not enough is understood about effects of their interactions with humans. It is important to study the impacts of humans as a function of particular housing conditions given that animals likely fare differently across different housing conditions. For example, animals in sanctuaries may be less habituated to humans and may feel effects more strongly compared to animals in AZA-accredited institutions. Conversely, singly housed animals in smaller institutions may benefit from increased human interaction, but these effects may be species-specific. Expanding our knowledge of human impacts in different institutions is important as sanctuaries have been a popular transfer recommendation for show animals (i.e., animals trained for public presentation purposes) with the goal of improving their welfare (e.g., Doyle, 2017; Parsons & Rose, 2018).

A variety of factors have been implicated as affecting the welfare of captive animals, including habitat design, weather patterns, retreat space, surrounding noise, chronobiology (i.e., temporal or rhythmic phenomena in animals, such as activity patterns), and more (e.g., Anderson et al., 2002; Beaudin-Judd et al., 2019; Berger, 2011; Jakob-Hoff et al., 2019; Morgan & Tromborg, 2007; Zhang, 2021). One important factor, human-animal interaction, is unavoidable in the captive environment. Human-animal interaction includes interactions with zoo visitors, animal care staff, or other zoo workers. Whether human-animal interactions lead to positive, neutral, or negative outcomes depends on several factors, such as the relationship of the humans to the animal, how the humans are behaving, the number of humans present at a given time, the species of animal, individual differences in the animal, aspects of the habitat, and more (e.g., Hill & Broom, 2009; Larsen et al., 2014; Mason, 2010; Pifarré et al., 2012; Sherwen et al., 2015; Sherwen & Hemsworth, 2019). Typically, interactions with familiar keepers are more beneficial and impactful for captive animals than interactions with zoo visitors (Cole & Fraser, 2018; Ward et al., 2018). However, there is controversy surrounding animal use in programs that involve prolonged human handling, whether by a trained professional (e.g., trained dolphin shows) or by visitors (e.g., elephant riding). This more intensive human handling may be a source of stress for the animals and warrants additional research. In addition, many U.S. zoos use ambassador animals in education presentations; that is, presentations accompanied by trained animals meant to teach visitors about animals and conservation. Not much is known about the impact of these presentations on the animals

(Spooner et al., 2021). Thus, more research is needed to ensure that education presentations provide informational benefits to visitors without compromising the welfare of the ambassador animals.

It is now understood that a holistic approach to assessing welfare is the most beneficial for the animal (Dawkins, 2021; Mellor et al, 2020). This involves the use of a variety of methods, including behavioral, physiological, cognitive, and health-related measures. Behavioral measures include assessment of the frequency of stereotypies, natural behaviors typical for wild individuals, and behaviors typical for a given individual. Physiological measures are typically assessed with fecal or urinary glucocorticoid metabolites, such as cortisol or corticosterone, due to the ease of collection and noninvasive nature. Health measures are usually assessed by a veterinarian through lack of disease, proper body functioning, and more. Yet, many of these measures are inconclusive by themselves, as they do not determine the valence of potential stress experienced by an animal (Dawkins, 2021). For instance, the HPA (Hypothalamic-pituitary-adrenal) axis that activates in response to stressors can be equally activated in situations at opposite ends of a valence spectrum, such as the presence of a predator or interacting with a sexual partner (Mendl et al., 2009). Thus, new measures for the assessment of affect, cognitive bias tests, have been developed to determine the valence of an animal's affective state, which influences their interpretation of ambiguous stimuli and impacts their welfare (Clegg, 2018).

This dissertation reports the results of a series of studies that assess human-animal interactions with three different methodological approaches. Chapter 2 focuses on human (i.e., college student and community participants') perceptions of zoos and sanctuaries through a self-report survey method. Specifically, I assessed how human perceptions of zoos and aquariums changed based on the provision of information about the regulations zoos must follow or about their conservation work. Across three surveys, I assessed how the type of information provided about the role of the zoo in animal welfare and conservation influenced participants' perceptions. The first survey assessed whether information about regulatory functions of zoos affected participants' attitudes. The second survey aimed to determine whether personalized information about a specific animal increased the impact of this information. The third survey manipulated the personalization of the information with a charismatic or a less popular species in a nested between-subjects design. Taken together, the results of these surveys address whether providing participants with knowledge about the welfare and conservation practices of modern zoos is associated with more positive attitudes about zoos, and whether this information is more effective when focused on individual members of a species rather than the species, in general.

Chapter 3 reports the results of a study that directly measures the impact that zoos are having on the welfare of a commonly housed but less commonly studied taxa - the parrot family (psittacines). I assessed the behavioral reactions of captive parrots to zoo visitors in a walk-through aviary. The purpose was to investigate whether the birds' behavior changed in the presence of zoo visitors and, if so, to determine if this change was indicative of a change in welfare. Chapter 4 presents a study that assessed the cognitive biases, particularly optimism versus pessimism, of ambassador animals in response to their interactions with humans. The animals' optimism was assessed as a function of a) whether they were handled by visitors (tegu) or b) how they were handled during interactions with visitors (chicken). These studies address different types of human-animal interaction: one, the visitor effect and the other, the impact of participating in an ambassador program. Previous studies on human-animal interactions have shown a variety of effects on zoo animals, including positive, negative, or no change in various welfare assessments (e.g., Larsen et al., 2014; Mason, 2010; Pifarré et al., 2012; Sherwen et al., 2015; Sherwen & Hemsworth, 2019). More recent investigations into education programs report neutral to positive effects on animal welfare, although negative effects have also been identified (Spooner et al., 2021). Thus, this research investigated the effects of humans on the welfare of animals, particularly understudied birds and reptiles, in two unique contexts: a walk-through aviary and as part of an ambassador program.

CHAPTER TWO

HUMAN PERCEPTIONS

The perceptions of zoo visitors are important for multiple reasons, particularly because funding is typically dependent on the number of people that visit and spend money at the zoo (Greenwell et al., 2023). Without sufficient funding, zoos cannot properly care for their animals. In addition, one of the main goals of AZA-accredited zoos is to educate the public about the animals in their care, conservation efforts, and human impact on animals' natural habitats. Thus, ensuring visitors have a positive and educational experience at the zoo is a key aspect of maintaining accreditation, increasing and improving educational outreach, and ensuring that zoo visitors return. Yet, the perceptions of visitors based on their interactions with the zoo and their animals is under-researched (Learmonth et al., 2021), although a few relevant studies have been published (e.g., Muller et al., 2021; Perdue & Robinson, 2021; Rank et al., 2021). Researchers have focused more heavily on the impact of educational outreach, identifying positive effects of education on visitors (e.g., Collins et al., 2020a; Kleespies et al., 2022; Randler et al., 2007), particularly when the education program is long-lasting (Collins et al., 2020b), although not every education program results in knowledge retention (e.g., Jensen, 2014; Malamud et al., 2010).

Zoos, the oldest thought to have existed more than 5,000 years ago, were not established with these lofty education and conservation goals, but instead have their origins in menageries with the purpose of displaying exotic animals from distant locations for human entertainment. Unfortunately for the animals on display, high levels of mortality were reported (Kisling, 2000), likely due to the lack of knowledge or care as to the animals' needs. It was not until the mid-1800s that zoos and aquariums more similar to today's institutions were founded in Europe (Baratay & Hardouin-Fugier, 2002). These institutions were more concerned with education and scientific knowledge than the menageries of the past, a trend that has continued in recent years. However, animal welfare did not come into its own as a legitimate area of scientific inquiry until the mid-1900s, and much of this research occurred in the agricultural industry (Melfi, 2009). Adapting to changing public perceptions, modern zoos have expanded their focus beyond animal display and public entertainment to include conservation, research, education, and animal welfare, so much so that these are requirements considered for AZA accreditation. These changes are in response to current environmental concerns and new understandings of animal needs but also are thought to improve the perceptions of zoos by visitors (e.g., Brando & Herrelko, 2021; Rank et al., 2018, Warsaw & Sayers, 2020).

A number of factors have been implicated in influencing visitor perceptions, such as the activity, visibility, and perceived welfare of the animals, design of the enclosures, and more (see Learmonth et al., 2021 for a review); although, it is important to note that visitors come to the zoo with beliefs from past experiences that influence their perceptions as well. When it comes to enclosure design, a well-researched area of visitor perceptions, visitors report more positive perceptions and attitudes towards the zoo and the zoo animals when the enclosures appear to allow more free-ranging animal behavior and appear naturalistic (e.g., Lukas & Ross, 2014; Melfi et al., 2004; Mun et al., 2015; Price et al., 1994; Yilmaz et al., 2010; 2017). Naturalistic enclosures are meant to benefit animal behavior in a functional manner, but also to be more aesthetically appealing to visitors (Balantyne et al., 2007). One study on the effects of a new naturalistic habitat for apes demonstrated that such enclosures also can increase visitors' knowledge of the animals housed within them (Lukas & Ross, 2014). Thus, habitat design can reinforce conservation goals to visitors, an important objective of modern zoos. Zoo visitors have indicated more positive perceptions and increased viewing times when enrichment is present (Davey, 2007; Davey et al., 2005; Roth et al., 2017; Wood, 1998). This effect could be attributed to the fact that increased enrichment may lead to increased animal activity and play (e.g., Wood, 1998). Visitors report more positive experiences when animals are visible and engaged in positive behaviors such as playing (e.g., Bexell et al., 2007; Chiew, Hemsworth, et al., 2019; Leubke et al., 2016). For example, visitors displayed more responsiveness and curiosity when chimpanzees were engaging in foraging behaviors compared to when they were not (Wood, 1998). Thus, naturalistic animal behaviors and environments may facilitate positive perceptions of zoo visitors and should be taken into account when considering habitat design to encourage public support.

With the recent controversies surrounding zoos and aquariums due to documentaries such as *Blackfish*, it has become challenging for zoos to maintain a positive public image. The Blackfish documentary addressed the controversy of housing orcas in captivity and focused on Tilikum, a captive orca at SeaWorld Orlando. Multiple deaths were allegedly linked to Tilikum, and the film argues that this was due to extreme stress caused by captivity and forced performances. The situation portrayed in Blackfish led to an increase in negative perceptions towards zoos and aquariums by the public, leading to what some refer to as the “Blackfish Effect” (Parson & Rose, 2018). For example, many musicians subsequently refused to perform at SeaWorld, SeaWorld announced the end of its orca breeding program, and some have urged SeaWorld to transfer remaining orcas to sanctuaries (e.g., Dennis, 2014; Parson & Rose, 2018; The Maui News, 2019). Sanctuaries are viewed by some as a better option than zoos or aquariums, possibly due to the potential for approximation to the wild, limited human contact, not displaying animals for public traffic, or lack of breeding programs (Bruck, 2024; Doyle, 2017; Heger, 2023; Parson & Rose, 2018). More recently, the Tiger King documentary ignited public interest in the welfare of captive big cats. This documentary focused on Joe Exotic, the former owner of the Greater Wynnewood Exotic Animal Park, and his feud with the CEO of Big Cat Rescue, Carole Baskin. The series followed allegations of animal abuse against Exotic, and his later convictions for violating the Lacey Act and the Endangered Species Act (U.S. Attorney’s Office, 2020). These situations have rightfully raised concerns among the public as to how captive animals are treated and whether current regulations are ensuring their welfare, so much so that changes in legislation on big cat ownership have been passed (Wu, 2020). These changes coincide with findings that those who watched Tiger King reported more negative attitudes toward exotic cat ownership, although this association is lessened in those with dark personality traits (e.g., psychopathy, antagonism, narcissism) and low empathy (O’Connor & Vonk, 2023). These controversies indicate that zoos and aquariums must adapt to address changing public perception.

Among those criticizing zoos, some argue that captivity is unethical in all situations except when necessary (e.g., animals with injuries that cannot survive in the wild) and call for the transfer of zoo animals that cannot be released to the wild to sanctuaries (e.g., Doyle, 2017). As described by the Global Federation of Animal Sanctuaries (GFAS), an accreditation body meant to ensure high standards of care for sanctuary animals, an animal sanctuary is "any facility providing temporary or permanent safe haven to animals in need while meeting the principles of true sanctuaries" (GFAS, n.d.). GFAS (n.d.) describes the principle of true sanctuaries as "…providing excellent and humane care for their animals in a non-exploitative environment and having ethical policies in place, regarding tours, commercial trade, exhibition, acquisition and disposition, breeding, and more." Sanctuaries accredited by GFAS or another accreditation body, such as the American Sanctuary Association (ASA), are required to meet specific standards of care and are barred from breeding, buying, and selling animals. However, accreditation is a voluntary process, at least in the United States. Thus, not all facilities calling themselves sanctuaries can be assumed to provide the best quality of care for their animals (Bruck, 2024). This is true for non-accredited zoos as well, although facilities within the United States publicly exhibiting or commercially selling warm-blooded animals must follow the Animal Welfare Act (i.e., a federal law identifying minimum standards of care for captive animals; U.S. Department of Agriculture, n.d.), and endangered animals are also regulated by the Endangered Species Act (i.e., a federal law intended to protect species listed as endangered; U.S. Fish and Wildlife Service, n.d.). Some states regulate the care of (some species of) captive wild animals, and the regulations vary widely. Therefore, the welfare of captive animals can vary drastically across zoos and sanctuaries.

However, not much is known about how knowledge of regulations on zoos and sanctuaries might impact public perceptions of zoos and sanctuaries. The majority of research focuses on public opinions about zoos, in general, or about specific zoos, rather than identifying factors that may affect these opinions (e.g., Almeida et al., 2017; Gurusamy et al., 2015; Meshabbaz et al., 2020). For instance, Meshabaz et al. (2020) assessed the opinions of Iraqi university students on the Duhok Zoo in their region. Their opinions echoed public sentiment towards more notorious animal welfare issues. Specifically, students reported that the zoo failed to meet the needs of most of the animals, and also that the zoo needed to focus on conservation and educational programs. In another study asking about zoos in general, elementary students were more likely to be in favor of zoos, instead of against them, and focused heavily on the facilities and amusements that zoos provide but were also likely to identify with statements on a zoo's role in conservation and education (Almeida et al., 2017). In addition, Australian and Indian adults reported that the most important reason for their zoo visits was to support conservation of the animals (Gurusamy et al., 2015). Yet, there has been only one study investigating the impact of accreditation knowledge on zoo opinions, and it was conducted at the Wellington Zoo in New Zealand (Warsaw & Sayers, 2020). Although most participants were not previously aware of zoo accreditation programs, providing information on these programs reassured 72% of participants about the welfare of the animals at these facilities. Zoo visitors were presented with a hypothetical scenario of an animal at a zoo, first asked about the perceived welfare of the animal, and then asked if knowledge of the zoo's accreditation would assure them of the animal's welfare. This is in line with research indicating that AZA accreditation predicts fewer Animal Welfare

Act noncompliant items, a potential indication of better animal welfare (Riedman et al., 2022).

I attempted to replicate and extend these findings to a broader sample. By using student and community samples rather than restricting the study to zoo visitors, I assessed the opinions of a more diverse group, including those that may be opposed to the existence of zoos. First, I assessed perceptions of zoos and sanctuaries and how these may be affected by information on conservation practices, AZA accreditation, or USDA regulations (randomly assigned). Perceptions of zoos and sanctuaries were assessed separately before and after presentation of the randomly assigned information with a scale intended to assess several facets of their roles (e.g., how well they provide clean habitats, natural environments, etc.). Due to research indicating the importance of conservation to the public and the reassurance of accreditation programs (e.g., Gurusamy et al., 2015; Warsaw & Sayers, 2020), I hypothesized that learning more about conservation practices, AZA accreditation, or USDA regulations would lead to more positive perceptions of zoos but would have no effect on perceptions of sanctuaries, as sanctuaries have fewer regulations and the information presented would not apply directly to sanctuaries. A control condition also was presented to ensure that it was the specific content and not just general information about zoos that may lead to changed perceptions and to control for potential priming effects of having attitudes activated by the pre-assessment.

Study 1a Method

Participants

Participants were recruited from the Oakland University Psychology participant pool via SONA in addition to snowball sampling from social media websites such as Facebook, Twitter, and Reddit. All participants were at least 18 years old. I collected data from a total of 509 participants, with data from 384 participants remaining for analyses after data cleaning. Specifically, data were removed if participants missed more than 90% of responses (n = 41), missed more than half the values on any of the zoo and sanctuary ratings (n = 57), responded that they paid no attention to the survey (n = 1), or responded incorrectly on either of the two attention check questions (n = 26). All participants currently resided in the U.S., and 298 of the participants identified as female (77.6%), 71 identified as male (18.5%), 11 identified as non-binary (2.9%), 3 did not respond (.8%), and 1 identified as transgender female (.3%). Participants were allowed to select more than one race; thus, participants may be represented in more than one category: 295 participants were white (76.8%), 41 participants were black (10.7%), 22 participants were Asian (5.7%), 21 participants identified as other (5.5%), 8 participants were Hispanic or Latino (2.1%), 2 participants were American Indian or Alaska Natives (.5%), and 1 participant was Native Hawaiian or a Pacific Islander (.3%). The average age of participants was 21.7 years old (SD = 7.0).

Procedure

Participants were directed to a secure website, Qualtrics.com, where they were asked to answer demographic questions as well as questions about their experiences with animals and zoos in addition to questions relating to their attitudes towards zoos and sanctuaries. Participants were randomly assigned to one of four conditions in which they were provided with general information about one of the aims of zoos. Before participants were asked about their opinions on zoos or sanctuaries, they viewed paragraphs containing information on zoos and sanctuaries and how to differentiate them.

Measures

Prior Experience with Zoo Accreditation

Participants were asked about their knowledge of accreditation and welfare of zoo animals (See Appendix F). This was a 4-item measure with questions such as, “What is your familiarity with animal welfare accreditation programs for zoos/aquariums?” and “Are you familiar with the American Zoological Association (AZA)?” Participants responded to these questions on a scale from “not familiar” (1) to “extremely familiar” (5). The responses to these questions were averaged to create a single score representing prior experience with zoo accreditation. I controlled for level of prior experience in the analyses because it might be expected that participants that were highly knowledgeable about these practices already would not be impacted by the experimental manipulation. However, I did not eliminate these participants as this was a prediction that I wished to test. The measure was internally consistent, with a Cronbach’s alpha of .903.

Study 1a Zoo Requirements

Participants were randomly assigned to read one of four paragraphs designed to provide general information about the requirements for zoos: control, AZA accreditation, USDA regulations, and AZA conservation. The control paragraph contained information about zoos, such as how many zoos there are and how many animals are housed within them. The AZA accreditation paragraph discussed the accreditation process, such as what is assessed and the qualifications of those performing the assessment. The USDA regulations paragraph discussed the federal rules related to the public display of captive animals, such as nutrition requirements and the types of inspectors that investigate zoos. The AZA conservation paragraph discussed information on how conservation work is accomplished, such as the amount of money AZA organizations have spent on conservation goals. The materials appear in full in Appendix A.

Zoo/Aquarium and Sanctuary Opinion

Participants' opinions on zoos/aquariums and sanctuaries were assessed with an *ad hoc* measure developed for the current research on how well the institution accomplished specific goals (Appendix G). I created this measure for this study as I could not find an existing measure regarding the general assessment of zoos and sanctuaries with regard to meeting conservation and welfare goals. Each participant completed the measure four times; once before and once after the intervention and separately for zoos/aquariums and sanctuaries. This was an 11-item measure with responses on a 5-point Likert scale, ranging from "Not well at all" (1) to "Extremely Well" (5). Sample items included: "How well do zoos: … Provide natural environments," "Educate visitors," and "Provide clean habitats." Responses were averaged across all items to provide a total zoo or sanctuary opinion score in which higher scores indicated more positive opinions. I did not compute a measure of internal consistency for this measure as this measure was not meant to assess a stable trait or characteristic and participants may believe that zoos and sanctuaries perform differently across functions.

Data Analysis

All analyses were conducted via IBM SPSS version 29.0.1.1. For each study, I ran a full factorial mixed-model ANOVA to assess the change in attitudes towards zoos and sanctuaries (within subjects) before and after (within subjects) as a function of the manipulation of information (between subjects). Information consisted of four levels (control, AZA, USDA, conservation). The participants' familiarity with zoo accreditation was included as a covariate. When *post hoc* tests were performed, t-tests were used for categorical independent variables, whereas Pearson correlations were utilized for continuous variables.

Study 1a Results

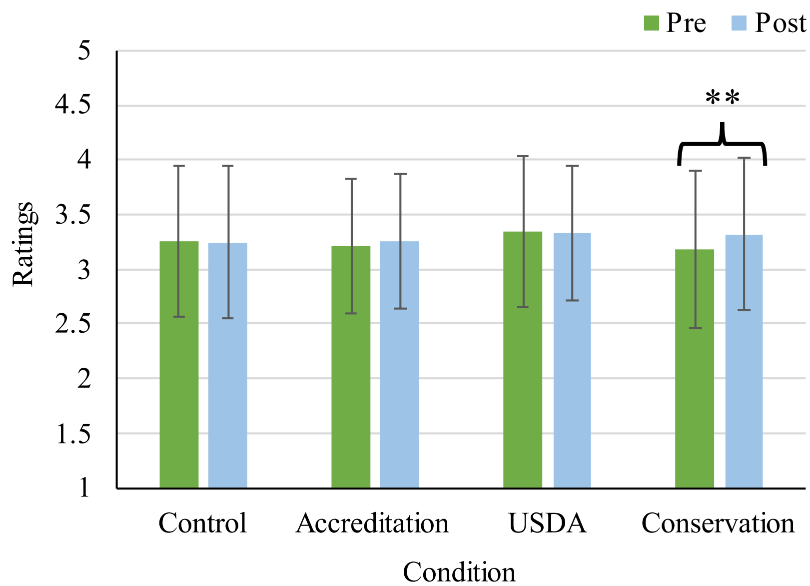
A mixed-model ANOVA to assess opinions with facility (zoo, sanctuary) and pre-post as within subjects variables, condition (control, accreditation, USDA, conservation) as a between subjects variable, and familiarity as a covariate revealed main effects of facility ($F(1, 379) = 107.569$, $p < .001$, $\eta_p^2 = .221$), pre-post ($F(1, 379) = 10.830$, $p = .001$, $\eta_p^2 = .028$), and familiarity ($F(1, 379) = 5.488$, $p = .020$, $\eta_p^2 = .014$), but no significant main effect of condition ($F(3, 379) = .734$, $p = .532$, $\eta_p^2 = .006$). Participants had significantly more positive opinions towards sanctuaries ($M = 3.412$, SD = .034) than zoos ($M = 3.121$, SD = .039), and more positive opinions following the provision of information (post, $M = 3.286$, SD = .034; versus pre, $M = 3.247$, SD = .034), and the more familiar they were with zoo practices ($r = .112$, $p = .028$).

These significant main effects were qualified by the following significant interactions; pre-post by condition ($F(3, 379) = 2,753$, $p = .042$, $\eta_p^2 = .021$), pre-post by familiarity ($F(1, 379) = 8.127$, $p = .005$, $\eta_p^2 = .021$), and facility by familiarity ($F(1, 379)$

= 54.175, $p < .001$, $\eta_p^2 = .125$). Figure 1 shows the *significant post hoc* comparisons for pre-post by condition.

Figure 1

Changes in Ratings of Zoos and Sanctuaries by Condition



Note. ** indicates $p < .01$

Only the conservation condition revealed more positive opinions post- compared to pre-information (t (97) = -2.839, p = .006, CI [-.233, -.041]). The control (t (97) = .190, p = .850, CI [-.072, .087]), accreditation (t (94) = - 1.067, p = .289, CI [-.136, .041]), and USDA conditions (t (92) = .405, p = .686. CI [-.087, .132]) did not lead to significant changes in opinion. *Post hoc* comparisons for pre-post by familiarity revealed that familiarity with accreditation practices was associated with higher pre-information opinions (r = .149, p = .003) but was not significantly associated with post-information opinions (r = .060, p = .242); whereas, post-hoc comparisons for facility by familiarity revealed that familiarity with accreditation practices was positively associated with zoo opinions ($r = .287$, $p < .001$) but was not significantly associated with sanctuary opinions ($r = -.074$, $p = .146$). No three-way interactions were significant.

Study 1a Discussion

Participants reported more positive opinions of sanctuaries than zoos overall, which may be due to the media suggesting the promise of sanctuaries for captive animals that would not fare well upon release to the wild (e.g., Heger, 2023; The Maui News, 2019). Participants may also be influenced by the term “sanctuary,” as small changes in words can influence judgments (Hauser & Schwarz, 2018). Participants also have more positive opinions after reading an informational paragraph compared to before reading the paragraph. However, further analysis revealed that it was when participants read information on AZA zoo conservation work specifically that they had significantly more positive opinions compared to after reading about basic zoo information, AZA accreditation requirements, and USDA requirements. This finding might reflect the fact that conservation efforts are directed at saving species – sometimes in their natural environments – and knowing that zoos are engaged in this work may mitigate visitors’ concern about the ethics of captivity. Consistent with this perspective, participants who were already more familiar with zoo accreditation had better opinions of zoos (but not sanctuaries) than those unfamiliar prior to being provisioned with relevant information. This finding supports the conjecture that the provision of information would be most beneficial for those that were not already aware of the positive efforts being made by zoos in the areas of conservation and welfare. The fact that a simple manipulation involving the provision of information mitigated the benefits of prior knowledge and experience suggests that education efforts may be successful in improving public perceptions of zoos.

However, given that only one condition led to significant changes in opinion and the magnitude of the effect was small, I sought to explore whether other types of information might lead to larger effects. Previous research has indicated that more targeted information can have a greater impact. For example, more targeted information led to a greater affective response when reading stories on mass violence (e.g., Maier et al., 2017), encouraged more engagement with a narrative on smoking (Kim et al., 2012), and increased a reader’s empathy towards those suffering from drought (Wald et al., 2021). Therefore, I decided to modify the informational paragraphs to provide more targeted information.

Study 1b

I hypothesized that individualized examples would make it more likely for participants to process and recall the information, having rendered it more meaningful or salient, as previous research has underscored the impact of personalized stories (Kim et al., 2021; Maier et al., 2017; Wald et al., 2021). Therefore, Study 1b presented specific examples of individuals representing popular species with regard to the same topics that were presented in Study 1a; conservation practices, AZA accreditation, or USDA regulations and neutral control information.

Study 1b Method

Participants

Participants were recruited from the Oakland University Psychology participant pool, in addition to social media websites such as Facebook, Twitter, or Reddit using snowball sampling. All participants were at least 18 years old. Data were collected from a total of 597 participants, with data from 398 participants remaining for analyses after data cleaning. Specifically, data were removed if participants missed more than 90% of responses (n = 34), missed more than half the values on zoo and sanctuary ratings (n = 28), responded that they paid no attention to the survey (n = 2), or responded incorrectly on the attention check question (n = 44). In addition, data from 91 of the SONA participants were removed as they were shown an incorrect version of the control paragraph; thus, I resampled for just this condition (reflected in our total sample number). Regarding country of residence, 393 participants resided in the U.S. (98.7%), 2 in Canada (.5%), 2 did not respond (.5%), 1 in Australia/New Zealand (.3%), and 1 in Sweden (.3%). For the gender distribution, 298 participants identified as female (74.9%), 89 participants identified as male (22.4%), 7 participants identified as non-binary (1.8%), 3 identified as transgender female (.8%), and 1 participant identified as transgender male (.3%). Participants were allowed to select more than one race; thus, participants may be represented in more than one category: 312 participants were white (78.4%), 29 were black (7.3%), 25 identified as other (6.3%), 24 were Asian (6.0%), 20 were Hispanic or Latino (5.0%), 2 were American Indian or Alaskan Natives (.5%), 2 did not respond (.5%), and 1 was Native Hawaiian or a Pacific Islander (.3%). The average age of participants was 22.3 years old (SD = 8.6).

Procedure

The procedure was identical to that of Study 1a, except that the informational paragraphs were designed to be specific to a target species. For example, participants were randomly assigned to read one of four paragraphs designed to provide species-targeted information about the requirements for zoos: control, AZA accreditation, USDA regulations, and AZA conservation. In the control paragraph, participants read information about giant pandas housed in zoos, such as how they are leased from China and which zoos house them. The AZA accreditation paragraph contained information about AZA Animal Care Manuals (i.e., standards of care for specific species), focusing on orangutans and their need for climbing materials. The USDA regulations paragraph contained information on how USDA rules improve the welfare of captive animals, focusing on gorillas and social housing requirements. The AZA conservation paragraph contained information on zoos working together for a conservation success story with Przewalski's horse. The target species in each paragraph was chosen for relevance to the information provided (e.g., Przewalski's horse is one of the best examples of a successful conservation story for the AZA) and because each species is recognized to elicit public interest and affection. The materials appear in full in Appendix B. Measures were reused from Study 1a. The Prior Experience with Zoo Accreditation measure reused in Study 1b had similar internal consistency as it did in Study 1a, with a Cronbach's alpha of .911.

Study 1b Results

A mixed-model ANOVA to assess opinions, with facility (zoo, sanctuary) and pre-post as within-subject variables, condition (control, accreditation, USDA, conservation) as a between- subjects variable, and familiarity as a covariate revealed significant main effects of pre-post ($F(1, 393) = 10.451$, $p = .001$, $\eta_p^2 = .026$), facility ($F(1, 393) = 69.362$, $p < .001$, $\eta_p^2 = .150$), and familiarity ($F(1, 393) = 7.128$, $p = .008$, $\eta_p^2 = .018$), but no significant main effect of condition ($F(3, 393) = 2.363$, $p = .071$, $\eta_p^2 = .018$). Participants had more positive opinions post information ($M = 3.456$, SD = .034) than pre information (M = 3.364, SD = .033), and more positive opinions towards sanctuaries (M = 3.561, SD = .037) than zoos (M = 3.259, SD = .035). In addition, participants who were more familiar with accreditation practices had more positive overall opinions (r = .130, p = .010).

Familiarity by facility ($F(1, 393) = 25.052$, $p < .001$, $\eta_p^2 = .060$) was the only significant interaction effect. As familiarity with accreditation practices increased, opinions on zoos were more positive (r = .238, $p < .001$) whereas familiarity was not significantly associated with opinions of sanctuaries (r = -.010, p = .837).

Study 1b Discussion

Consistent with the results in Study 1a, participants had more positive opinions of sanctuaries than zoos, and more positive opinions after reading compared to before reading the information randomly assigned. In addition, participants who were more familiar with zoo accreditation had more positive opinions than those who were less familiar, and more familiarity with zoo accreditation was associated with more positive zoo opinions, but not sanctuary opinions. Unlike in Study 1a, greater experience with accreditation practices was associated with more positive opinions of zoos both before and after the information was provided. Thus, unlike in the previous study, the provision of information did not specifically bolster the opinions of those with less prior experience.

There was another key difference in these results compared to those of Study 1a. There was no interaction between condition and pre-post, indicating that opinions improved across all conditions post-information, but the specific information presented was not important. This suggested that priming participants to think about popular zoo animals alone may have led to more positive attitudes about zoos without regard for the information about specific initiatives zoos are engaged in to promote conservation and positive welfare. In particular, the giant panda, which was described in the control condition, is a popular animal (e.g., Guo & Fennell, 2023; Woods, 2000). Thus, I decided to further assess the impact of species popularity on changes in zoo/sanctuary opinion while also manipulating the degree of personalization. Lastly, because conservation information was the only impactful information in Study 1a, all paragraphs in Study 1c focused on conservation work.

Study 1c

In Study 1c, the information varied along two factors: the popularity of the target species (pine snake vs. Giant panda) and the extent to which the information presented general facts about the target species or was personalized to a representative individual. The species representing differences in popularity were chosen based on previous research on preferences for pandas and snakes (e.g., Ballouard et al., 2013; Guo & Fennell, 2023; Polák et al., 2020; Woods, 2000). Pandas also were chosen as participant opinions increased post-information in Study 1b across all conditions, which included the control condition (focused on pandas). I hypothesized that more personalized information and information about more popular species would result in more positive perceptions of zoos compared to less personalized information and information about less popular species. Furthermore, I hypothesized that the effect of personalizing the information might be significant only for the popular species – the Giant Panda – and not for the snake. However, it is also possible that personalizing the information may have greater benefits for the less popular snake, as pandas may already elicit positive regard regardless of how the information is presented.

Study 1c Method

Participants

Participants were recruited from the Oakland University Psychology participant pool. All participants were at least 18 years old. I collected data from a total of 347 participants, with data from 280 participants remaining after data cleaning. Specifically, data were removed if participants missed more than 90% of responses (n = 12), missed more than half the values on zoo and sanctuary ratings (n = 13), responded that they paid no attention to the survey (n = 1), or responded incorrectly on the attention check question (n = 41). All participants currently resided in the U.S. (99.6%) except one, who resided in Europe (.4%). 208 participants identified as female (74.3%), 61 identified as male (21.8%), 9 identified as non-binary (3.2%), one identified as transgender male (.4%), and one identified as other (.4%). Participants were allowed to select more than one race; thus, participants may be represented in more than one category: 191 of participants were white (68.2%), 40 were black (14.3%), 26 were Hispanic or Latino (9.3%), 17 selected other (6.1%), 16 were Asian (5.7%), 2 were American Indian or Alaska Natives (.7%), and 2 were Native Hawaiian or Pacific Islanders (.7%). The average age of participants was 20.4 (SD = 4.3).

Procedure

The procedure was similar to Studies 1a and 1b, except that participants were not asked about their prior experience with zoo requirements in this survey. In addition, participants were randomly assigned to paragraphs focused on conservation information differing across two dimensions: personalization (personal vs general) and popularity (pine snake vs panda). The personalized giant panda paragraph included information on conservation of giant pandas and a target story about a rescued giant panda named Poe. The general giant panda paragraph included information on conservation of giant pandas and their general requirements for living in a zoo. The personalized snake paragraph included information on conservation of the Louisiana pine snake and a target story about a rescued snake also named Poe. The general snake paragraph included information on conservation of the Louisiana pine snake and their general requirements for living in a zoo. The materials appear in full in Appendix C.

Study 1c Results

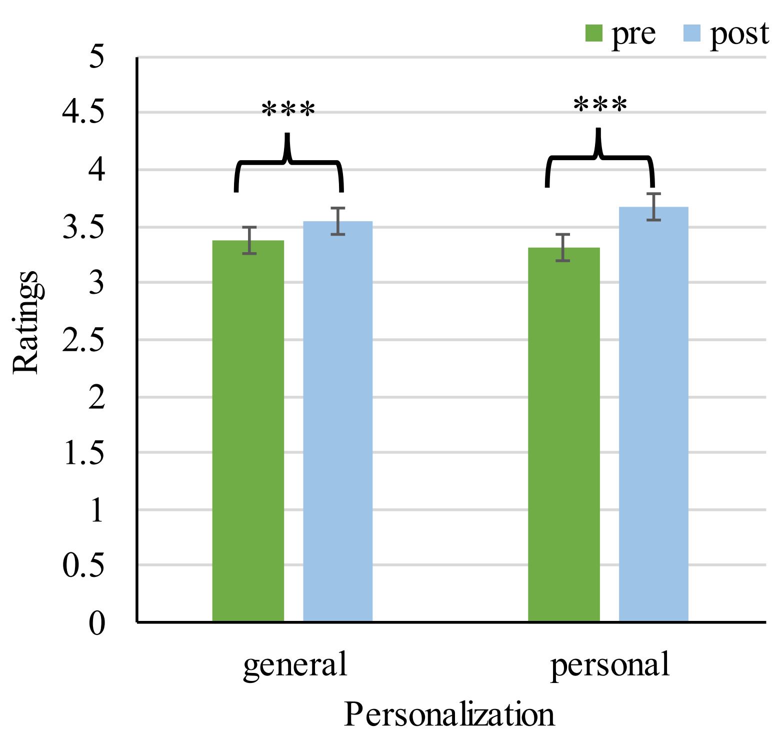
A mixed-model ANOVA to assess opinions, with facility (zoo, sanctuary) and pre-post as within-subject variables, and personalization (general, personal) and species (snake, panda) as between-subjects variables, revealed main effects of pre-post ($F(1, 276) = 69.063$, $p < .001$, $\eta_p^2 = .200$) and facility ($F(1, 276) = 91.138$, $p < .001$, $\eta_p^2 = .248$), but not species ($F(1, 276) = .055$, $p = .815$, $\eta_p^2 = .000$) or personalization ($F(1, 276) = .227$, $p = .634$. $\eta_p^2 = .001$). Participants had more positive opinions post information ($M = 3.613$, SD = .043) than pre information ($M = 3.346$, SD = .042), and more positive opinions of sanctuaries ($M = 3.641$, SD = .043) than zoos ($M = 3.318$, SD = .042).

The interactions of pre-post by personalization ($F(1, 276) = 7.408$, $p = .007$, $\eta_p^2 = .026$) and pre-post by facility by species ($F(1, 276) = 4.719$, $p = .031$. $\eta_p^2 = .017$) were significant. Figure 2 displays the interaction of pre-post by personalization. Opinions were significantly more positive following the provision of both general (t (139) = -4.311, $p < .001$, CI [-.265, -.098]) and personalized information (t (139) = -7.321, $p <$

.001, CI [-.449, -.258]) compared to before the information was provided, but the effect was stronger for more personalized information. To explore the three-way interaction, additional mixed-model ANOVAs were conducted separately for each type of facility. For zoos (F (1, 278) = 0.290, p =.591) and sanctuaries (F (1,278) = 2.609, p = .107), there were no significant interactions between pre-post measurement and species. See Figure 3.

Figure 2

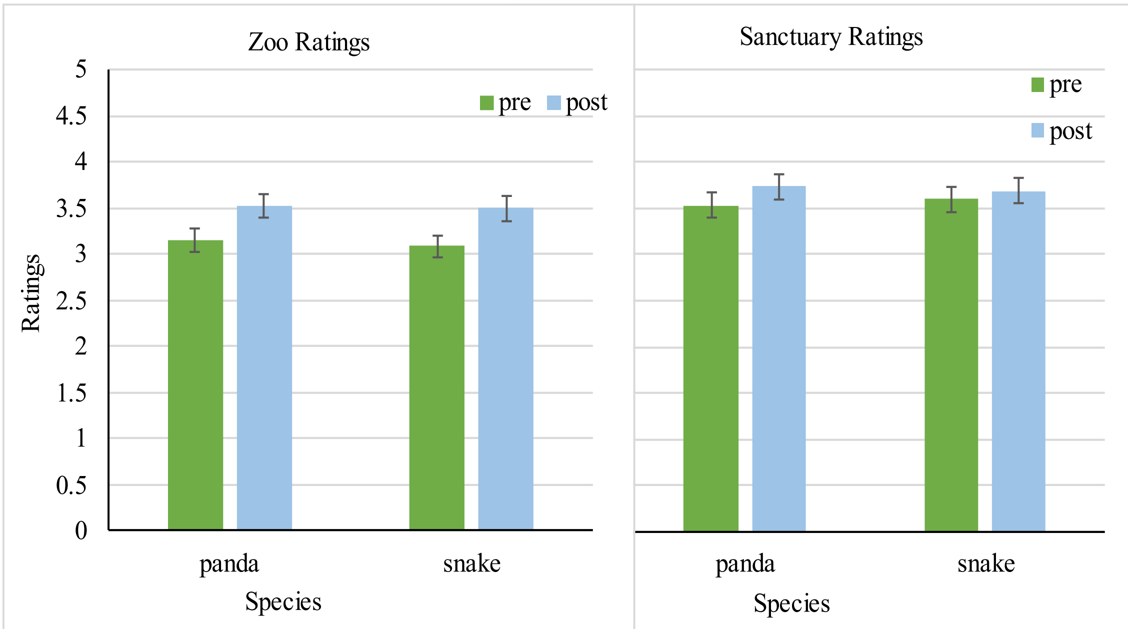
Score on Measure of Positive Regard Across General and Personal Information Pre-Post Measurement.



Note. *** indicates $p < .001$

Figure 3

***Score on Measure of Positive Regard Across Species and Facilities Pre-Post Measurement*.**



Note. Ratings of zoos are displayed on the left side of the figure, whereas ratings of sanctuaries are on the right.

Study 1c Discussion

Consistent with Study 1a and Study 1b, participants had more positive opinions of sanctuaries than zoos and more positive opinions post-information compared to pre-information. In contrast to predictions, opinions were more positive after reading both general and personal information and for both popular and less popular species. The results suggest that highlighting any positive activity of the zoos towards any animal in their care may prime participants to think more positively about zoos.

General Discussion

There is little research regarding the impact of information about the regulations and practices of zoos, such as conservation and welfare, on visitor impressions of zoos. This series of studies is among the first to manipulate the provision of information about these activities among members of the community that are not necessarily zoo visitors, providing access to a more diverse sample with presumably a broader range of existing knowledge and opinions than zoo visitors specifically. Across all three studies, participants rated sanctuaries more positively than zoos. These opinions may reflect recent calls for zoo animal transfers to sanctuaries so as to remove animals from public display (e.g., Doyle, 2017; Parsons & Rose, 2018). The fact that these facilities are labeled "sanctuaries," which is a term used in other positively viewed contexts (Bruck, 2024), may play a role in these differences in opinion. Although I did not assess how participants viewed the term sanctuary to account for this possible issue, I did provide participants with paragraphs explaining how sanctuaries and zoos differ. In particular, these paragraphs explained how animals come into the care of a sanctuary or a zoo, the federal regulations they both may face, and their relevant accreditation organizations.

When providing general information in Study 1a, participants' opinions became significantly more positive following information on AZA accredited zoos' conservation activities, whereas information on USDA regulations and AZA accreditation had no significant impact. The significant impact of conservation information is in line with previous research indicating conservation as the most important reason visitors specify for their zoo attendance (Gurusamy et al., 2015) and as a necessary focus of particular zoos (Meshabbaz et al., 2020). These combined findings indicate that zoos that prioritize conservation needs may indeed be favored by the public compared to those that do not. This hypothesis is further supported by the findings of Study 1c in which every informational paragraph focused on conservation and opinions increased across every condition.

However, when information was about a specific individual zoo animal in Study 1b, positive opinions of zoos and sanctuaries increased across conditions. This lack of effect of condition may have occurred due to the species identified in each paragraph, which were selected to provide realistic examples of the positive zoo work emphasized in each condition. The control condition included information on pandas, identified as a popular animal (e.g., Guo & Fennell, 2023; Woods, 2000), which may have impacted the participants' opinions. Therefore, I assessed the impact of species' popularity and degree of personalization, as this was a focus across Studies 1a and 1b, in Study 1c. However, I did not find differences in opinions based on whether the information provided was specific or general or if the information was about a popular or unpopular species. Participant opinions increased across all conditions, regardless of the differences in information. It should be noted that all information provided was positive with regard to zoo activities and missions. This finding suggests that highlighting the positive efforts of zoos to care for any species in their care may prime participants to rate zoos more positively compared to when they have not been provided with concrete examples of the work that zoos do.

On the other hand, previous familiarity with accreditation was associated with more positive zoo opinions across Study 1a and Study 1b. In Study 1a, previous familiarity was also associated with more positive pre-information opinions, indicating that prior knowledge of accreditation may lessen the impact of the experimental manipulation and that provision of information may be most beneficial for those that do not already have a strong appreciation for the kind of work that zoos perform. However, this finding was not replicated in Study 1b or tested in Study 1c, so further work is needed to probe the impact of personal experience with zoos and their policies on attitudes. Notably, the current participants were not restricted to those already attending zoos, so I may have reached an audience that was more diverse in attitudes compared to most research in this area. The findings are in line with prior research indicating that knowledge of accreditation programs reassured participants of animal welfare (Warsaw & Sayers, 2020). Interestingly, I did not find a significant effect of AZA accreditation information in Study 1a. It may be that a small paragraph of information was not enough to influence participants and that this information may need to be presented in a different manner. This would coincide with the fact that I observed only small changes in opinions overall. This may indicate that this information could be delivered in a more engaging format, such as in a video or by a docent at the zoo. Indeed, some research suggests that zoo visitors gain more knowledge when information is presented by video than by signage (Perdue et al., 2021).

Although this study extended research to community participants rather than zoo visitors only, this study was not without limitations. The samples were modest in size and dominated by college students and women. In Study 1b, species was confounded with the type of information provided. In Study 1c, I controlled the species while manipulating personalization (and vice versa) but provided information on only two species. It is also possible that the more positive opinions post-information across studies were due to retesting effects rather than the manipulation itself, which could have been assessed via a condition that presented unrelated information as filler between the two outcome measures. Therefore, future work is needed to determine how zoos can combat negative perceptions and improve visitor attitudes. However, the present studies are among the first to focus on the role of knowledge about regulations and practices and will contribute to the growing understanding of public attitudes toward zoos. Because there is misinformation about differences between zoos and sanctuaries (e.g., Bruck, 2024; Doyle, 2017; Fusari, 2017; GFAS, n.d.), the focus here on comparing attitudes toward these two types of facilities may be an important direction for future research.

CHAPTER THREE

BEHAVIORAL OBSERVATIONS

Behavioral observations are often utilized by zoos to assess animal welfare due to low cost and effort of collection, transparency, and ease of quantification. Compared to other methods of welfare assessment, behavioral observations are also less invasive for the animals, making them less stressful to implement. Zoos commonly assess the presence of “good” behaviors - those behaviors typically seen in wild populations or necessary for the animal to survive (e.g., eating, drinking), and the absence of “bad” behaviors - those behaviors not typically seen in wild populations or that may cause harm to the animal (e.g., overgrooming, regurgitation, aggression). It is also useful to note “time or activity budgets” or the proportion of the animals’ day spent engaging in each of these activities. For instance, an animal may engage in many healthy and typical behaviors, but if a high proportion of their day is also spent engaging in stereotypic behaviors (i.e., a repetitive behavior that has no apparent function; Mason et al., 2007), the animal may require intervention. When assessing behavior, it is necessary to know what is typical for the species and for the individual due to species-wide and individual variation. For example, coping style and reactivity to stress may vary within and across species (Von Holst, 1998; Wielebnowski, 2003; Whitham & Wielebnowski, 2013).

A variety of factors may influence the behavior of captive animals, but humans are always an influence in the captive environment. How humans influence a captive animal’s welfare may be unique to that individual but there also may be species-specific responses. Species vary in the pressure they face from predators in their environment, thus leading species to evolve mechanisms to cope with their specific environmental problems. These species differences have led to species-specific challenges in captive housing (Mason, 2010). The degree to which differences between species, such as behavioral flexibility (i.e., how well an animal copes with novelty) or migratory lifestyle, influence how an animal is affected by zoo visitors are unanswered questions. Frequently, studies conducted on visitor effects analyze only a single species, but Queiroz and Young (2018) assessed these effects across species. Specifically, they analyzed which physical and behavioral factors of varying species influenced animals' reactions to zoo visitors. This study showed that typical habitat (i.e., open or closed) and activity cycle (i.e., diurnal versus nocturnal) were important predictors of zoo visitors' effects. Yet, these results were restricted to mammals, particularly primates (e.g., chimpanzees [*Pan troglodytes*], gorillas [*Gorilla gorilla*], howler monkeys [*Alouatta fusca*]), ungulates (e.g., fallow deer [*Dama dama*], marsh deer [*Blastocerus dichotomus*], red deer [*Cervus elaphus*]), and carnivores (e.g., lions [*Panthera Leo*], ocelots [*Leopardus pardalis*], pumas [*Puma concolor*]; Queiroz & Young, 2018). Other species differences may influence how animals react to zoo visitor presence, such as predator versus prey status or social versus non-social lifestyles. Whether an animal is a prey or predator species will affect their fear response, thus possibly influencing their response to zoo visitors (Sherwen & Hemsworth, 2019). The impact of visitors on social species may be buffered by their conspecifics (e.g., Scott et al., 2017), such that an optimal group size may mitigate negative effects of zoo visitors. Social species housed in inadequate social environments, or non-social species housed socially, may therefore be more negatively affected by zoo visitors. Thus, research is needed to identify both which species-level factors are influential for visitor effects and how visitors affect species other than mammals.

Previous research has demonstrated that certain aspects of human visitor groups impact zoo animal welfare. One important factor is the size of visitor groups. For instance, captive meerkats showed the highest levels of fecal glucocorticoid metabolites, a measure of their stress response, when exposed to large numbers of visitors throughout the day (Scott et al., 2017). A study with macropods (e.g., kangaroos and wallabies) found that, as the number of zoo visitors present at the habitat increases, vigilance behaviors (i.e., an erect posture with gaze fixed on visitors or overhead rope course) increased and resting behaviors (i.e., animals laying on side or back with head down) decreased (Meade et al., 2021). Effects of visitors on vigilance and resting behaviors are not limited to mammals, as similar patterns have been found in other groups as well, such as elasmobranchs – a subclass of cartilaginous fish (e.g., Truax et al., 2023). However, because visitor density is often confounded with other environmental factors, such as season and temperature, it is difficult to disentangle effects of the number of visitors from related variables. Temperature has been shown to be a better predictor of hornbill behavior than visitor presence (Rose et al., 2020). Other studies have demonstrated the importance of noise level of the visitor group, showing that noisy visitors can increase vigilance behaviors in certain individuals across a variety of mammal species, and popular species may have the greatest exposure (e.g., Larsen et al., 2014; Quadros et al., 2014). In addition to group size and noise level, the proximity of the visitors impacts welfare. In a study on little penguins (*Eudyptula minor*), penguins showed fewer avoidance behaviors when visitors were further away, and visitors were less likely to engage in potentially threatening behavior (i.e., hitting the enclosure, quick movements, and touching the pool water) at a greater distance (Chiew, Butler, et al., 2019). Thus, not all groups of humans have equivalent impacts on the animals they are viewing.

Mammals, particularly primates, have dominated the literature on visitor effects (Rose et al., 2020; Sherwen & Hemsworth, 2019), and there is limited research on birds. Of the species assessed, flamingos and penguins are the most common (e.g., African penguins, *Spheniscus demersus*: Ozella et al., 2015; Williams et al., 2021; Chilean flamingos, *Phoenicopterus chilensis*: Kidd et al., 2022; Rose et al., 2018; Rose et al., 2021; Rose et al., 2022; gentoo penguins, Pygoscelis papua: Collins et al., 2016; Edes et al., 2021; greater flamingo, *Phoenicopterus roseus*: Kidd et al., 2022; Rose et al., 2018; Rose et al., 2021; Rose et al., 2022; humboldt penguin, *Spheniscus humboldti*: Zhang et al., 2021; king penguins, *Aptenodytes patagonicus*: Edes et al., 2021; little penguins, *Eudyptula minor*: Chiew, Butler, et al., 2019, Sherwen et al., 2015; southern rockhopper penguin, *Eudyptes chrysocome*: Edes et al., 2021). Although parrots are well-represented in other areas of research, such as assessments of their cognitive abilities (Auersperg & von Bayern, 2019), not much is known about their responses to zoo visitors (Hosey, 2008). One study with a singular male long-billed corella (*Cacatua tenuirostris*) suggested that human presence was enriching (Nimon & Dalziel, 1992). However, Collins and Marples (2015) found conflicting results depending on the species. Two moluccan cockatoos (*Cacatua moluccensis*) were found to withdraw from visitors, whereas two citron-crested cockatoos (*Cacatua sulphurea citrinocristata*) increased their social behaviors in the presence of visitors. With such a limited sample size from which to draw inferences, more research on the effects of humans on zoo parrots is warranted.

This observational study investigates how the typical daily activity of birds of several parrot species varies with the presence of zoo visitors in a walk-through aviary. This aviary allowed direct contact with the birds, and the zoo sold feed sticks to entice the birds to land on visitors, but also had an off-exhibit interior area for the birds. This research extended previous work analyzing visitor impacts in walk-through habitats: aviaries (Blanchett et al., 2020; Rose et al., 2022), as well as other designs, such as walk-through wallaby or kangaroo habitats (Jones et al., 2021; Meade et al, 2021). I assessed behavioral changes in several species of parrots: cockatiels (*Nymphicus hollandicus*), Eastern rosellas (*Platycercus eximius*), princess parrots (*Polytelis alexandrae*), and red-fronted parakeets (*Cyanoramphus novaezelandiae*) based on the number of visitors in the enclosure. Several behaviors were recorded in this study. I measured where birds were located within the aviary, their movement toward or away from approaching visitor groups, and whether they engaged in species-typical neutral behaviors like resting, drinking, or positive conspecific (e.g., mating or feeding offspring) or human interactions (e.g., perching or eating). I also measured the presence of behaviors indicative of negative states; for example, whether an animal was pacing or behaving agonistically toward a conspecific or a human. In addition, I assessed the change in typical behaviors in the presence of visitor groups. To measure these behaviors, ethograms were utilized based on the species-typical behaviors of these parrots (see Table 1). This study serves the applied benefit of identifying how the birds in this aviary react to zoo visitors, demonstrating whether there is a need for changes to improve their welfare.

I hypothesized that the birds' behaviors would vary with the number of visitors in the aviary. Due to the low frequency of certain behaviors, recorded behaviors were combined into the categories of positive and negative behaviors. The positive category, which included behaviors indicative of positive states, included resting, drinking, affiliative bird interaction, human interaction, human feed, and moving toward humans. The negative category, which included behaviors potentially indicative of stress, included moving away from humans, agonistic bird-bird interaction, pacing, and agonistic human interaction. I expected the number of birds engaging in positive behaviors to decrease as the number of visitors increased. In addition, I expected the number of birds engaging in negative behaviors to increase as the number of visitors increased.

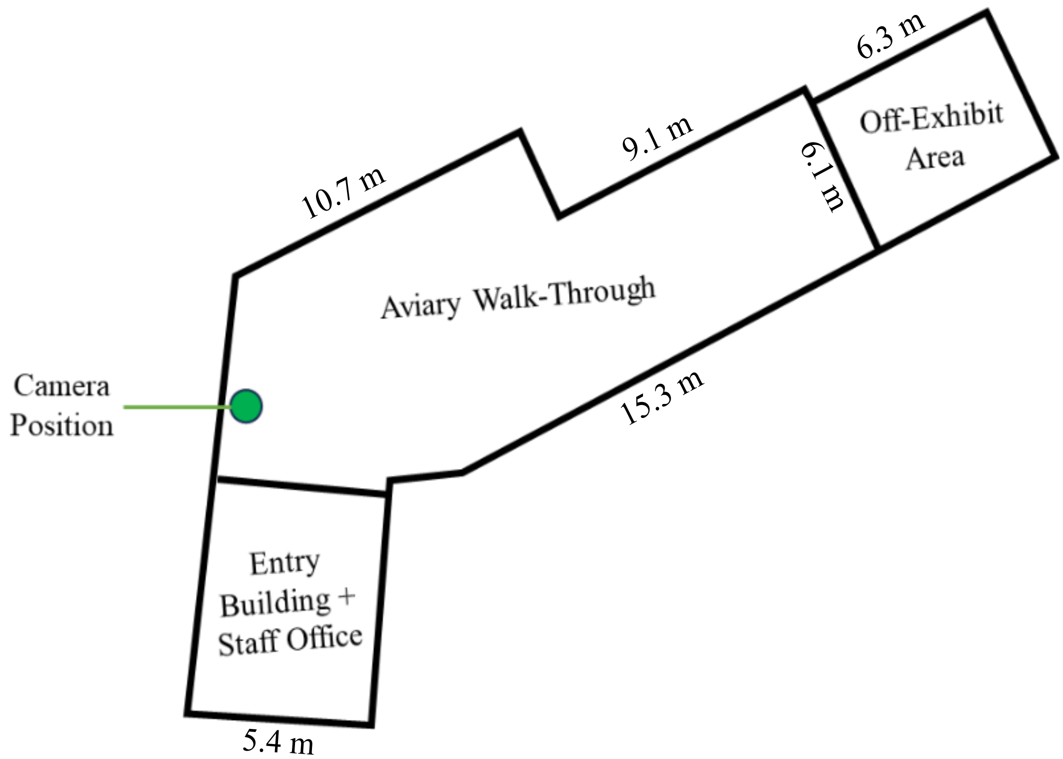
Method

Subjects

IACUC approval was waived for this study as it was strictly observational. All subjects in this study were studied in their on-display walk-through enclosure at the Alexandria Zoo in Alexandria, Louisiana. This aviary houses multiple parrot species indigenous to Australia (cockatiels, Eastern rosellas, princess parrots, and red-fronted parakeets). At the time of the study, there were 62 cockatiels (32 male, 29 female, and 1 unidentified), 2 male Eastern rosellas, 2 princess parrots (1 male and 1 female), and 5 male red-fronted parakeets. These parrots were recent transplants from another zoo but were housed at the zoo for several months before the study. Within the aviary, the parrots had the choice to move freely from an off-exhibit indoor area with freely available food to an enclosed larger outdoor section open to visitors (see Figure 4). The only food provided in the outdoor section of the enclosure were the feed sticks brought in by visitors.

Figure 4

Diagram of the Aviary



Note. The visitors entered and exited through the entry building, and a staff office was located between the entry/exit walkways. The aviary walk-through consisted of the outdoor area of the birds' enclosure as well as a walkway for visitors. The off-exhibit area was indoors, could only be accessed by staff and the birds, and housed the birds' food.

Materials

Subjects were filmed using several GoPro cameras placed in three different locations within the walk-through section of the aviary. Two Hero 10 GoPros were placed on either end of the long walk-through area (i.e., one near the visitor entrance and one near the birds' indoor area), and a 360-degree Hero MAX was placed in the center of the enclosure. All videos were stored on an external hard drive.

Procedure

Data were collected on days when the zoo was open to the public, as the researchers were not able to observe when the zoo was closed. Data were recorded all 7 days of a week for 5 weeks to ensure equal recordings across days of the week. Observations of 30 minutes occurred at randomly assigned intervals between 07:30 am PST and 17:00 pm PST, ensuring observations were evenly distributed across time of day. The aim was to collect approximately 70 hours of video footage per camera position. However, the zoo closed early or closed completely due to weather conditions (i.e., excessive rain or heat) on some of the observation days. This study reports on a representative sample of approximately 30 hours of footage. In an effort to ensure the footage used here was representative of both times when visitors were present and absent, data from 10 days of footage from the entrance camera position (i.e., the position most likely to record visitors, see Figure 5) across 3 Mondays, 2 Tuesdays, 3 Saturdays, and 2 Sundays were analyzed here. Mondays and Tuesdays represented the zoo's least busy days, whereas Saturdays and Sundays tended to be the zoo's busiest days.

Once testing concluded, multiple independent naïve coders coded the behaviors of the birds and the zoo visitors in the videos. I utilized instantaneous scan sampling, meaning that coders recorded the total number of visible birds engaging in any of the target behaviors, rather than focusing on the behavior of any particular individuals, as well as the number of visible zoo visitors at each 1-minute interval. Table 1 presents an ethogram of target behaviors that the coders were asked to record. I selected behaviors that represented both species-typical behaviors (e.g., drinking, resting, etc.) as well as stress-related behaviors (e.g., agonistic interactions, pacing, etc.). Behaviors were classified as either positive or negative behaviors. Positive behaviors included the total number of resting, drinking, affiliative bird interactions, human interactions, human feedings, and movement toward visitor behaviors. Negative behaviors included the total number of movements away from visitors, agonistic bird interaction, pacing, and agonistic human interaction behaviors. A primary coder coded all videos and a secondary coder coded 20% of the same videos. Reliability between coders was assessed via ICC for visitor number, positive behaviors, negative behaviors, and bird number.

Figure 5

View of Aviary from Entrance Camera Position

Note. The bird most visible in this photo is an Eastern rosella.

Table 1

Ethogram of Parrot Behaviors

Target	Location/Behavior	Coding Description
Birds	Above the Ground	Record the approximate number of birds of each species in the upper region of the aviary. This means that the bird is **not** standing on the floor of the aviary, so they could be in the air, on a branch, or on a post.
	On a Human	Record the approximate number of birds of each species that are perched on a person.
	On the Ground	Record the approximate number of birds of each species that are standing on the floor of the aviary or on a drinking bowl (these are the black circles on the ground of the aviary).
	Resting	Record the approximate number of birds of each species perched or sitting and closing their eyes while relatively still. They could be resting anywhere within the aviary, including on a person.
	Drinking	Record the approximate number of birds of each species perched on a water bowl (these are the black circles on the ground of the aviary) and actively consuming the water.
	Moving Toward	Record the approximate number of birds of each species moving **toward** humans. This could include flying or moving along a branch or the ground.
	Moving Away	Record the approximate number of birds of each species moving **away from** humans. This could include flying or moving along a branch or the ground.
	Affiliative Conspecific Interaction	Record the approximate number of birds of each species interacting with other birds in a non-aggressive manner (e.g., perching immediately next to another bird, feeding a juvenile bird, preening another bird, copulation).
	Agonistic Conspecific Interaction	Record the approximate number of birds of each species behaving aggressively towards other birds (e.g., biting, chasing with lunged head, hissing).
	Pacing	Record the approximate number of birds of each species walking back and forth in a fixed manner without an obvious goal.
	Agonistic Human Interaction	Record the approximate number of birds of each species behaving aggressively towards humans (e.g., biting, chasing with lunged head, hissing).

Table 1 - Continued

Target	Location/Behavior	Coding Description
	Non-Feeding Human Interaction	Record the approximate number of birds of each species perched on the body of a human (e.g., on their hand or shoulder) not actively eating.
	Human Feeding	Record the approximate number of birds of each species perched on the body of a human while eating from their hand (e.g., eating a feed stick). The feed sticks look like a wooden tongue depressor with seed attached to it.
Visitors	Number	Count the number of humans within the enclosure, this includes keepers, workers, and visitors

Data Analysis

All analyses were conducted with R statistical software v. 4.2.1 (R Core Team, 2022). To account for behaviors that could occur only in the presence of humans, I summed the number of birds engaging in all positive and negative behaviors during each interval to create the outcomes of positive and negative behaviors. It was essential to group behaviors together into overarching categories as some single behaviors (e.g., human feeding, moving toward humans, etc.) occurred too infrequently to be used to test visitor effects. To determine if the likelihood of these positive or negative behaviors varied with visitor presence, I conducted a separate generalized linear mixed model for the number of birds exhibiting a behavior belonging to each behavior category (positive, negative) at each one-minute interval. I included time of day (morning, afternoon) as a fixed factor and date (categorical for all 10 days) as a random factor in both models, as environmental factors can be more influential than visitor presence (e.g., Rose et al., 2020). The residuals were zero-inflated and, therefore, I conducted a poisson model to account for this issue. I utilized the lme4 (Bates et al., 2015) and lmer Test package for the mixed model (Kuznetsova et al., 2017). I also ran a poisson GLMM with total number of birds visible, a category created by combining the number of birds across the three locations, and time of day as fixed factors and date as a random factor to assess whether changes in the number of birds exhibiting positive or negative behaviors may vary with the number of birds present for observation during different observation periods. Particularly during high visitor numbers, there may have been fewer birds present, and more escaping to other areas of the aviary, due to potential stress, which may artificially decrease the number of birds observed engaging in negative behaviors.

Results

Reliability

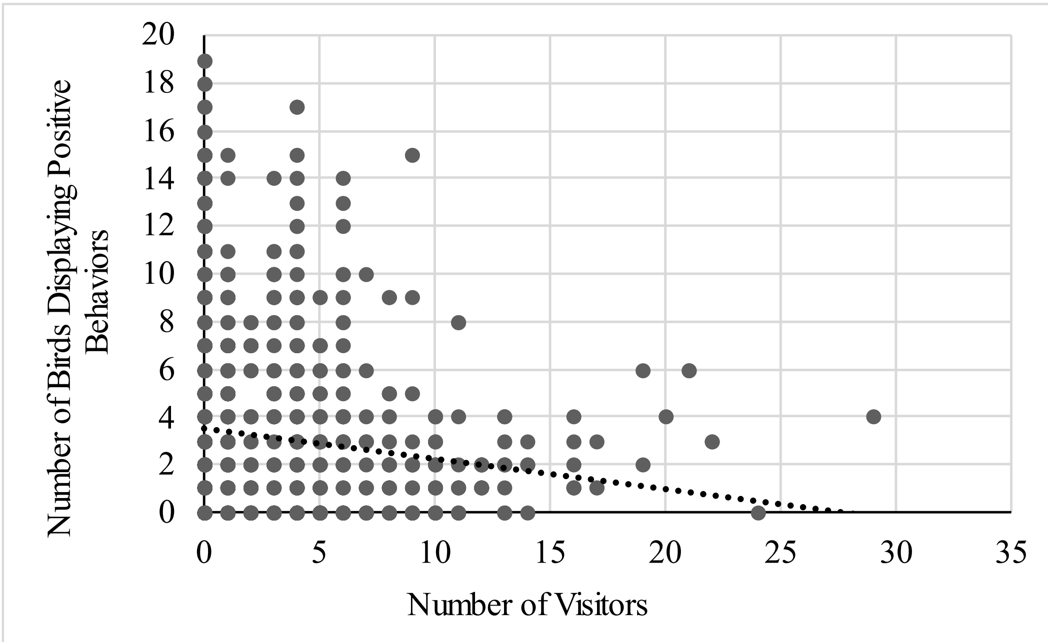
The results of intra-class correlations indicated excellent reliability with Cronbach's alphas of .985 for visitor number, .827 for positive behaviors, and .876 for bird number. However, reliability was not adequate for negative behaviors, with $\alpha = .085$.

Visitor Effects

Both predictors had statistically significant associations with positive behaviors: visitor presence ($z = -4.441$, $p < .001$, $SE = .05$) and time of day ($z = -20.185$, $p < .001$, $SE = .028$). The number of birds engaging in positive behaviors decreased as visitor presence increased (see Figure 6), and increased in the afternoon ($M = 4.143$, SD = 4.545) compared to the morning ($M = 2.512$, SD = 2.907; see Figure 7).

Figure 6

Number of Birds Displaying Positive Behaviors by Visitor Number in the Aviary

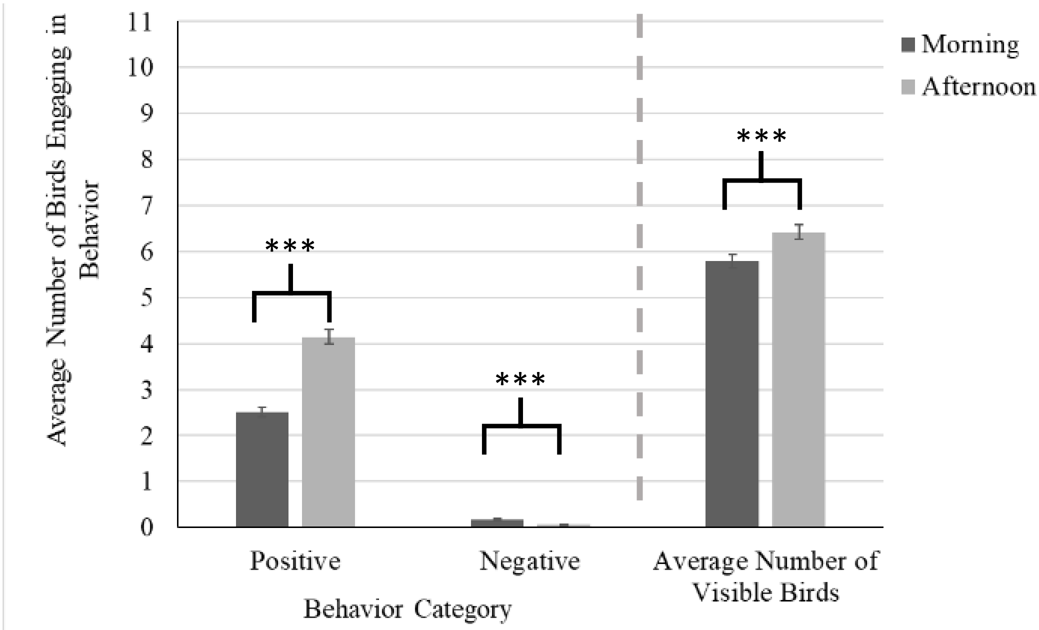


Note. Each dot could represent either one or multiple observation intervals, and the trendline represents the linear relationship of the data.

The generalized linear mixed model for negative behaviors also indicated that both visitor presence ($z = 5.078$, $p < .001$, $SE = .016$) and time of day ($z = 7.316$, $p < .001$, $SE = .173$) were associated with significant changes in behavior. The number of birds engaging in negative behaviors increased as visitor presence increased (see Figure 8), but the number decreased slightly from the morning ($M = .172$, SD = .857) to the afternoon ($M = .059$, SD = .353; see Figure 7).

Figure 7

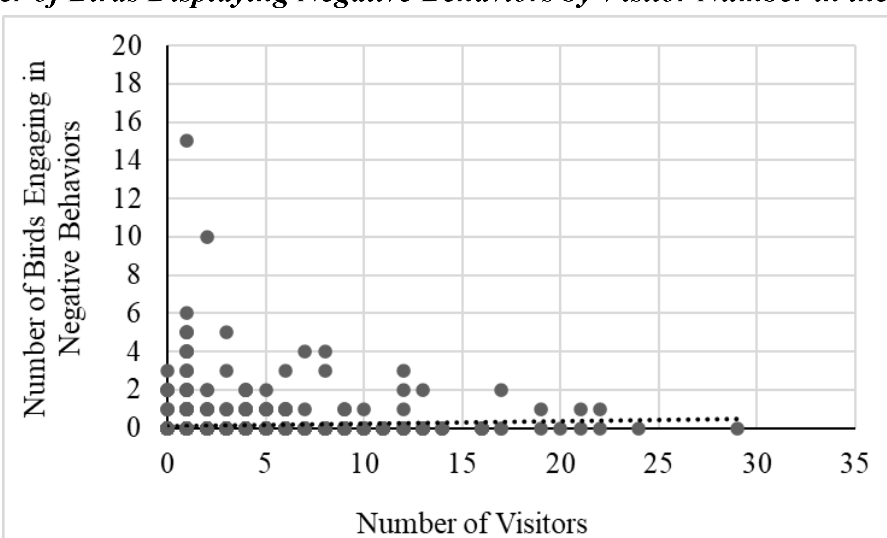
Average Number of Birds Engaging in Positive and Negative Behaviors and Average Number of Birds Visible by Time of Day



Note. Error bars depict standard error of the mean.

Figure 8

Number of Birds Displaying Negative Behaviors by Visitor Number in the Aviary

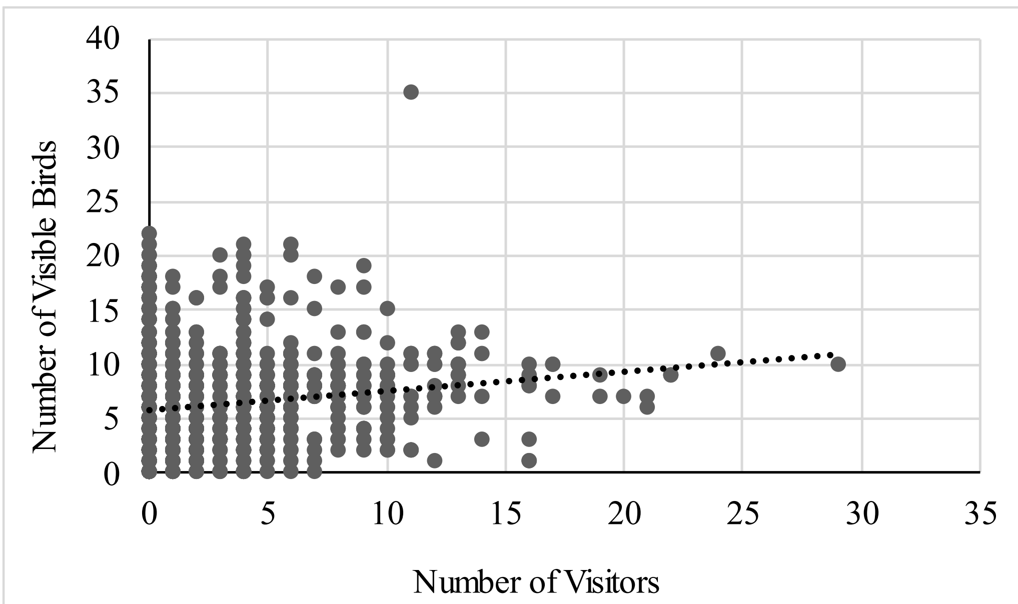


Note. Each dot could represent either one or multiple observation intervals, and the trendline represents the linear relationship of the data.

Time of day ($z = -4.494$, $p < .001$, $SE = .020$) and visitor presence ($z = 6.782$, $p < .001$, $SE = .003$) were also significant predictors of the number of birds visible in the main aviary. The number of birds present increased as the number of visitors increased (see Figure 9), and the number of birds present increased in the afternoon ($M = 6.423$, SD = 4.406) compared to the morning ($M = 5.787$, SD = 4.248; see Figure 8).

Figure 9

Number of Birds Recorded by Number of Visitors in the Aviary



Note. Each dot could represent either one or multiple observation intervals, and the trendline represents the linear relationship of the data.

Discussion

There were many more instances of birds engaging in positive behaviors than negative behaviors and, in fact, negative behaviors were rare. The infrequency and lack of saliency of negative behaviors may have contributed to the low reliability for negative behaviors so these results must be taken with an abundance of caution. However, the number of birds engaging in positive behaviors decreased as the number of humans within the aviary increased, and negative behaviors increased as the number of humans increased. Yet, the average number of negative behaviors was much lower than the average number of positive behaviors. That is, the increase in negative behaviors was not proportional to the decrease in positive behaviors. Initially, I thought this may indicate that the birds were moving away from the camera area when there were more visitors, as they could have moved towards the back of the aviary or the indoor portion of their habitat where they were not visible, which might also be indicative of deleterious effects of visitors. However, the opposite effect was found; the number of visible birds in the area increased as the number of visitors increased. As the number of birds did not decrease with increased visitors, this suggests that the birds were potentially engaging in other behaviors not captured by the ethogram when visitor number increased. Given this finding, the ethogram may have benefitted from inclusion of other behaviors, as knowledge of the behaviors the birds were displaying could provide us with a better understanding of visitor effects. Previous research in birds has identified associations between visitor presence and behaviors such as preening and vigilance (Rose et al., 2022), which were not assessed here. Some of the current birds within the aviary were known to overgroom, possibly due to the recent stress of moving, so grooming could have indicated positive or negative behaviors and could not have been easily categorized.

In addition to visitor number, I found that time of day was a significant predictor of changes in the number of birds engaging in both positive and negative behaviors, as well as bird presence, in general. The number of birds engaging in positive behaviors increased in the afternoons compared to the mornings, which aligns with the decrease found for negative behaviors. These changes could also be accounted for by the fact that the number of visible birds increased in the afternoons. It is interesting that some of the birds were more likely to come to the forefront of the aviary at these times as the temperature typically increased throughout the day, and this study took place in August. The outdoor portion of the aviary contained a number of mist hoses for cooling down, which could be the reason for this finding. However, the indoor portion of their habitat was climate controlled. This may be the reason the average number of visible birds for both times of day was quite low, around six birds, in comparison to the approximately 70 birds within the aviary. It did rain heavily and inconsistently throughout the study; thus, it is also possible that it was raining more often in the mornings, causing the birds to retreat to the indoor portion of the aviary. The increase in positive behaviors later in the day could also be due to a daily habituation effect towards the visitors, as the birds were not exposed to human presence overnight.

It is initially concerning that we saw an increase in negative behaviors as visitor number increased, as this would indicate the birds were negatively impacted by visitor presence. However, it should be noted that very few negative behaviors were observed overall. Across day and time of day, all averages of the number of birds engaging in negative behaviors were less than 1. This is a positive sign and could indicate that these birds were positively adjusting to their relatively new home at the Alexandria Zoo at the time of the study. Indeed, it could be argued that any significant changes in the number of birds engaging in these behaviors by our predictors are not meaningful changes, as very few birds were displaying these behaviors in the camera position coded compared to the total number in the aviary (around 70 birds). In addition, I observed that the number of birds increased as visitor density increased, which suggests that some of the birds were seeking out humans. The presence of humans could be reinforcing to the birds for several reasons, most importantly that visitors could purchase feed sticks. Thus, some of the birds may realize that with increasing visitor presence in the aviary came a higher chance at receiving supplemental feed. It is possible that the rest of the birds in the aviary were avoiding visitors, although they were not avoiding visitors more when more visitors were present. Additional observations from other camera angles are needed to clarify some of the effects reported here.

Unfortunately, the coding of video from other camera positions proved too time consuming for the coders of this project. The total number of visible birds in the camera position selected for coding almost never exceeded 25 birds; thus, we do not have the behavioral data for the majority of the birds present within the aviary at a given time. Planned future analyses will include the behaviors of the birds located towards the back of the aviary, because if birds were negatively affected by the presence of visitors, they would likely move away from the most heavily human-populated area of the aviary. However, previous research suggests that the birds located away from the central area of the aviary may not be engaging in behaviors indicative of negative welfare. For example, goats and sheep performed fewer undesirable behaviors when allowed a full retreat area as compared to when they were provided a half-retreat or no retreat area (Anderson et al., 2002). Gorillas showed few differences in behavior as crowd size varied, possibly due to availability of retreat spaces (Stoinski et al., 2012). As it seems the ability to remove oneself from human presence can mitigate negative impacts (Sherwen & Hemsworth, 2019), it would have been useful to replicate or refute such findings in the present birds. However, a test of this hypothesis would require limiting the birds' access to the retreat areas, which would not be desirable from a zoo management standpoint.

The present study employed the use of instantaneous scan sampling to record bird behaviors. To secure an accurate representation of behaviors with this method, I assessed behaviors throughout the day as well as across many different days. This was done to account for the fact that it has previously been debated whether scan sampling accurately captures daily behavior (e.g., Gilby et al., 2010). Despite this debate, scan sampling was necessary for this research given the inability for coders to accurately identify approximately 70 individual birds. In addition, I attempted to capture reactions to specific situations (i.e., visitors), so scan sampling was likely sufficient given that I was not aiming to capture accurate absolute values of behavior frequency.

Even with the limitations presented, this research adds to the literature by furthering our understanding of human impacts in walk-through habitat designs. Given the close proximity to humans in these habitats, understanding the welfare impacts on the housed animals is a necessary endeavor. It is interesting that the current findings differed from previous research on human impacts in aviaries. Blanchett et al. (2020) found no changes in stress-related behaviors (e.g., pacing, aggression) and typical behaviors (e.g., feeding, resting) with changing visitor numbers, as compared to the decreased positive and increased negative behavioral changes reported here. The design of their aviary was different in that there was considerable foliage throughout and the aviary was larger in size. This may underscore the importance of natural habitat design and extensive room for movement in preventing negative human impacts. Yet, another study on aviary-housed birds found several significant impacts of human presence in two habitats with natural designs (Rose et al., 2022). In one habitat, birds engaged in increased movement and preening with increased visitor presence as indicated by numbers or increased sound levels, whereas birds in another habitat engaged in increased vigilance behaviors. The differences also may be accounted for by the species assessed, as we report on several parrot species, whereas both Blanchett et al. (2020) and Rose et al. (2022) examined many non-parrot species. For example, Rose et al. (2022) report on the behaviors of a variety of pigeons, doves, curlews, tinamous, and more, and Blanchett et al. (2020) report on the behaviors of various ducks, pigeons, herons, ibises, guineafowl, and more. Therefore, the current study provides novel information on visitor effects in Psittaciformes. Yet, more research is needed to mitigate the possible negative impacts of visitor presence on the behaviors of birds in aviaries.

CHAPTER FOUR

COGNITIVE BIAS TESTS

There is general agreement among researchers that nonhuman animals experience at least some emotional states (Scarantino et al, 2021). Yet, the research regarding animal emotional states is rife with inconsistencies regarding definitions of emotions and relevant terminology (Nematipour et al, 2022; see Vonk et al., 2024 for a review). What is certain is that presuming emotional states allows researchers to predict animal behavior (Mendl et al., 2009); thus, researchers in various fields, such as neuroscience, psychopharmacology, and animal welfare, have worked to develop valid assessments of these states, in addition to confirmation that animals experience these states (Kremer et al., 2020). Much of the past research on animal emotional states has focused on negative states (Proctor et al., 2013), which makes detection of positive emotional states – a necessary focus for the field of animal welfare (Mellor, 2016) – difficult.

A recent welfare assessment method, cognitive bias testing, allows for the assessment of emotional biases that affect how information is processed (Harding et al., 2004). The judgment bias task, one of several variations of the cognitive bias test, assesses optimism and pessimism through an organism's response to ambiguous stimuli (Bethell, 2015), thereby providing indicators of positive as well as negative emotional states. An individual's affective state can influence the perception of ambiguity through multiple means. That is, feeling optimistic or pessimistic can influence what an individual pays attention to, how they judge stimuli, what they remember, and more (e.g., Coles & Heimberg, 2002; Dunn et al., 2009; Eysenck et al., 1991; Novak et al., 2015). In addition, an individual's affect may bias their tendency towards risk aversion and prediction of expected utility (Mendl et al., 2009). An individual that is optimistic would anticipate receiving a reward when interacting with ambiguous stimuli, whereas an individual that is pessimistic would not anticipate a reward or might expect something aversive from interacting with ambiguous stimuli. Optimism reflects a positive emotion state, whereas pessimism reflects a negative emotion state. Therefore, assessing an animal's judgment bias might shed light on their affective state, which in turn is helpful to understand their perceptions of the environment.

A multitude of animals from insects to primates have demonstrated judgment biases in response to manipulations presumed to impact affective states (Lagisz et al., 2020). However, much of this research assessed animals outside of a zoo setting (Clegg, 2018). Within zoos, only a small number of species have been assessed. Bottlenose dolphins (*Tursiops truncatus*) exhibited pessimistic cognitive biases in association with more frequent anticipatory behaviors as well as optimistic cognitive biases in association with more affiliative behaviors (Clegg & Delfour, 2018; Clegg et al., 2017). Gorillas (*Gorilla gorilla gorillas*) and an American black bear (*Ursus Americanus*) have been assessed as well (McGuire & Vonk, 2018; McGuire, Vonk, Fuller, & Allard, 2017; McGuire, Vonk, & Johnson-Ulrich, 2017; Vonk et al., 2021), but unfortunately these tests produced ambiguous results due to their complexities. Cronin et al. (2018) found Japanese macaques (*Macaca fuscata*) exhibited response slowing towards conspecific images compared to control images during more extreme anthropogenic noise conditions, but no change was found for chimpanzees and gorillas. A more recent study found that a grizzly bear (*Ursus arctos horribilis*) was possibly more pessimistic during the absence of a training session with food reinforcement, although this effect was not found for the second bear tested (Bernstein-Kurtycz et al., 2024). With only six species assessed in zoo settings, cognitive bias tests are underutilized, particularly when one considers their unique ability to assess the valence of captive animals' emotional states. Certain versions of cognitive bias tests, the speeded response (e.g., Bethell et al., 2016; Cronin et al., 2018) and potentially dot probe studies (e.g., Cassidy et al., 2023; Wilson & Tomonaga, 2018), could be implemented relatively easily and quickly by zoos due to the lack of intensive training requirements. This indicates that cognitive bias tests could be a critical resource in zoo settings for the improvement of animal welfare.

Of the non-pharmacological studies utilizing judgment bias tests specifically, the majority assessed mammals (Lagisz et al., 2020). Fewer studies have examined the judgment biases of birds (canaries, *Serinus canaria*: Lalot et al., 2017; chickens, *Gallus domesticus*: Anderson et al., 2021; Deakin et al., 2016; Lourenço-Silva et al., 2023; Seehuus et al., 2013; Wichman et al., 2012; Zidar et al., 2018; crows: McCoy et al., 2019; European starlings, *Sturnus vulgaris*: Bateson & Matheson, 2007; Bateson et al., 2015; Brilot et al., 2010; Gott et al., 2019; Matheson et al., 2008; Japanese quails, *Coturnix japonica*: Horváth et al., 2016; ravens, *Corvus corax*: Adriaense et al., 2019; red junglefowl, *Gallus gallus*: Munari, 2021), although the judgement bias test is becoming a popular welfare assessment method in livestock poultry (Košťál et al., 2020). Even fewer studies have examined judgment biases of insects and fish (bumblebees, *Bombus terrestris*: Solvi et al., 2016; convict cichlid, *Amatitlania siquia*: Laubu et al., 2019; fruit flies, *Drosophila melanogaster*: Deakin et al., 2018; honeybees, *Apis mellifera*: Bateson et al, 2011; Schlüns et al., 2017), and no studies have examined judgement biases of reptiles (Lagisz et al., 2020). The studies on poultry have primarily manipulated the environment and its complexity to understand environmental impacts on affective states, with conflicting results, but no studies have assessed the impact of humans directly. As the agricultural field frequently utilizes the judgment bias test, it is surprising that zoos have yet to fully adopt this methodology (Clegg, 2018).

This methodology could be implemented easily with ambassador animals, in particular, who typically have more training experience and can be more easily separated from conspecifics, making them ideal targets for a methodology requiring training. These animals participate in education presentations meant to teach visitors about animals and conservation, yet not much is known about the impact of participation on the ambassador animals (Spooner et al., 2021). They are often exposed to handling by visitors, which is not a typical experience for most zoo animals and could have significant impacts on their welfare. The AZA has created an Ambassador Animal Evaluation Tool to assess an animal's suitability for education programs (AZA, n.d.), but there are minimal guidelines on judging welfare in an ambassador animal (Spooner et al., 2021). A study examining ambassador animal welfare at 17 AZA-accredited zoos for several armadillo species, African hedgehogs (*Atelerix albiventris*), and red-tailed hawks (*Buteo jamaicensis*) showed no effect of education programs specifically, but fecal glucocorticoid metabolites and undesirable behaviors increased with greater handling durations, and rest behavior decreased (Baird et al., 2016). Another study across multiple zoos demonstrated that giraffes (*Giraffa camelopardalis*) spent less time ruminating (i.e., masticating, regurgitating, and swallowing cud) and more time idle when utilized in all-day visitor feeding programs, but not in part-day programs, and there was no association with stereotypic behaviors (Orban et al., 2016). In dromedary camels (*Camelus dromedarius*), salivary cortisol levels were lower when camels were being utilized for visitor rides as compared to seasons when they were not, suggesting the either the visitor rides or the food reinforcement received during such rides were enriching (Majchrzak et al., 2015). These studies demonstrate mixed findings in regard to welfare impacts on ambassador animals. Thus, implementing the judgment bias methodology could contribute to a better understanding of how education presentations might affect the welfare of ambassador animals.

To address this paucity of research and demonstrate the usefulness of the judgment bias test for assessing zoo animal welfare, I assessed the effects of human interaction on judgment biases in two ambassador animals at the Alexandria Zoo: a red tegu (*Salvator rufescens*) and a domestic chicken (*Gallus domesticus*). Chickens are a common subject for judgment bias research with farm animals, but this is the first study on the judgment bias of a zoo-housed chicken, and the judgment bias of a lizard (Bethell, 2015; Benn et al., 2019). This is also potentially the first welfare assessment of ambassador animals examining changes in affect, as others utilized behavioral and/or physiological measures (Spooner et al., 2021). This particular species, the red tegu, is an omnivorous terrestrial lizard native to South America which grows to a relatively large body size (Fitzgerald et al., 1993; Jarnevich et al., 2018). To assess these animals, I modified a procedure developed by Harding et al. (2004) and modified recently for use with crows (McCoy et al., 2019). The ambassador animals were required to learn that one location was associated with a large reward, whereas another location was associated with no reward. Then, one novel location was introduced by the researchers located equidistant between the previously known locations, and the latency to approach this novel location was compared to the latencies for the known locations. This indicated the judgment bias of these animals towards ambiguous stimuli. A latency to the ambiguous location similar to the no reward location indicated pessimism, and a latency to the ambiguous location similar to the latency to approach the large reward location indicated optimism.

These responses were compared across human impact manipulations for both the tegu and the chicken. The respective manipulations were chosen to address factors thought to be aversive to each animal, as indicated by their primary care staff, which included two caretakers. Both the tegu and the chicken took part in visitor interactions around the zoo. However, I addressed the impact of visitor touch (touch or no touch) for the tegu, and the impact of keeper handling (perch or hold) for the chicken. Based on the care staff's assessment of the animals' preferences, I expected that the chicken would demonstrate pessimism in the hold condition (i.e., staff keeping their arms around the chicken preventing wing movement) as compared to the perch condition, and the tegu would demonstrate pessimism in the touch condition as compared to the no touch condition. Previous research has also indicated that visitor touch may be aversive for prolonged periods, albeit in different species (Baird et al., 2016). Whether the impact of these programs is positive or negative, or potentially neutral, this study provided meaningful data for zoos and demonstrated the utility of the judgment bias protocol in assessing welfare.

Study 3a Method

Subject

The subject was an adult female chicken (*Gallus domesticus*) that served as an education animal at the Alexandria Zoo in Alexandria, Louisiana. This chicken was housed with a crested screamer (*Chauna torquata*) in an outdoor habitat near the zoo's education buildings, which was on a path not often frequented by zoo visitors. At the time of the study, she was a recent addition to the zoo. Thus, this animal had minimal training experience from participating in previous educational programs and was naive to the judgment bias test. On days when testing occurred, daily feeding occurred after testing.

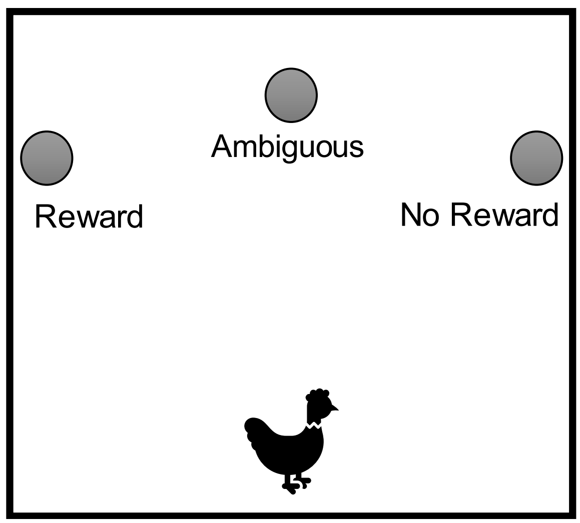
Materials

All testing occurred within an indoor education building attached to the chicken's home habitat. This area was secluded from visitors, but the chicken was exposed to random keeper entrances and noises from their two-way radios, as well as noises from the reptiles and birds housed in this building. Trials were carried out within a caged square arena made out of moveable metal fencing. This fencing was 2.4 m by 2.2 m with sides approximately .7 - .9 m tall. (see Figure 10). The height was .9 m in the back half of the arena, whereas the height was .7 m in the front half of the arena due to differences in the two portions of moveable fencing utilized. One metal bowl was utilized as a food container throughout the study. The bowl was opaque so that the chicken could not see the reward within the container until she approached the container. This bowl was placed in four different locations depending on what phase and what trial was occurring. In habituation trials, the container was placed in the middle center of the testing arena.

During training trials, the container would be placed on either the right (no reward) or left (reward) side of the testing arena. The middle (ambiguous) location was equidistant from both of these locations in addition to being the same distance from the animal's starting point. The container used had food placed within it before trials started so that scent could not be used as a cue. Rewards consisted of high value food (mealworms) as rated by the bird's keepers and approved to be used across multiple trials by the veterinarian. A GoPro HERO10 was used to film all trials.

Figure 10

Vertical View of Enclosure Setup



Note. Distance to containers was 2.1 m for the chicken and 1.6 m for the tegu.

Procedure

Sessions occurred at approximately 11:00 am on Mondays, Sundays, and Thursdays. The researcher assessed both the chicken and the tegu each day, and the order of sessions were randomly decided. The indoor trial arena, the containers, and the camera were set up prior to retrieving the chicken for sessions. The container was placed in particular locations depending on the trial (reward, no reward, and ambiguous). The reward and no reward locations were 2.3 m apart from each other, and both locations were 2.1 m from the starting point of the arena. On ambiguous trials, the same container was placed equidistant (1.2 m) from the high reward and no reward locations, and this location was also 2.1m from the starting point of the arena. Once the trial was set up, the keeper retrieved the subject from its outdoor habitat and brought the bird to the entrance of the arena. Between trials, the bird was picked up by the keeper and positioned so that the setup of the arena was not visible to the bird. The keeper was blind as to which container location contained the reward on the first trial, although they inevitably saw the reward locations as they viewed the bird across later trials. All trials were recorded for later coding by naïve coders. The researcher recorded the bird's latency to move from the starting position to the container (i.e., touching the container or positioning their head directly over top of the container) live during testing. This latency was used as the criterion for advancing to the next phase.

Habituation

One session (5 trials each) of habituation occurred per day. The bird was required to receive a minimum of one session of habituation, but habituation continued until the bird could retrieve the food in under 1 minute in 4 out of 5 trials within a session. At the start of a trial, the keeper placed the bird at the middle front of the arena (see Figure 10) facing a baited container directly in front of the bird, so that this location was neutral compared to the testing locations. The experimenter and the keeper stood quietly behind the arena in the opposite direction of the baited container so that they were not visible to the bird when it was moving toward the container. The trial was scored as successful if the bird retrieved the food in under one minute. All habituation trials continued until the reward had been retrieved. If the animal had not retrieved the reward after three minutes and was not moving toward the food, the keeper attempted to direct the animal toward the baited container. This phase ensured the bird was familiar with the container, knew that the container contained food, and retrieved the food quickly.

Training

One training session (6 trials each) occurred per day until criterion was met. Of these 6 trials, 3 trials were high reward trials and 3 trials were no reward trials, presented in a pseudorandomized order. The last of the 6 trials was always a reward trial. Before each training session, the bird was given a single habituation trial to maintain motivation. At the start of a training trial, the bird was placed at the middle front of the arena (see Figure 10). The experimenter and the keeper then stood quietly behind the arena so that they were not visible to the bird when it was moving toward the container. All trials ended after three minutes to ensure the bird had time to eat the reward. Trial length was kept constant in training and testing regardless of whether the reward was retrieved to ensure that the bird did not approach more quickly on ambiguous trials in testing to hasten the next rewarded trial (not because they are optimistic). As seen in Figure 10, the locations of the high reward container and no reward container are indicated by the left and right circles. Only one container was present on each trial, so that high reward trials consisted of only the high reward container, and no reward trials consisted of only the no reward container. The experimenter set up the high and no reward containers with the same procedure so as not to cue the birds to their difference. To move to the testing phase, the bird was required to reach a specific time difference in their approach to the no reward and high reward conditions. Specifically, the final three no reward trials were paired with the final three high reward trials and the bird was required to demonstrate a faster time on each of the three pairs of trials across two consecutive sessions to move to testing.

Testing

The chicken received eight 5-trial sessions of testing after completing training. Two sessions occurred per day. Testing sessions occurred on a separate day from the last training session. The testing sessions consisted of 2 high reward trials, 2 no reward trials, and 1 ambiguous trial. The locations of the high reward and no reward containers remained the same as in previous phases, and the ambiguous container was equidistant from both of these containers and the same distance from the starting point. The ambiguous trials were randomly presented among the 5 trials within a session, with the constraint that the first trial was never an ambiguous trial. On ambiguous trials, the container was baited 50% of the time but was scented with food on every trial. To further differentiate this ambiguous container, it was filled with newspaper shreds to cover the potential food so that the bird would not know if it contained food upon approach. Once a trial started, the experimenter and the keeper stood quietly behind the arena so that they were not visible to the bird when it was moving toward the container. All trials ended once three minutes passed. Limiting testing to eight sessions helped to ensure that the ambiguous location remained ambiguous; however, some learning may have occurred as sessions progressed. Four sessions were conducted after the chicken experienced a football hold (i.e., keeper's arms wrapped around the wings) while interacting with zoo visitors and four sessions were conducted after the chicken experienced a perched hold (i.e., feet on top of the keeper's arm with the other arm in front of the bird's chest) while interacting with zoo visitors. Each day of testing, the chicken received a football hold condition and a perched hold condition in randomized order. In both conditions, the bird was carried by a familiar keeper around outside areas in the zoo and experienced physical contact from at least three humans. This interaction lasted around 10 minutes each time, and then the bird was immediately returned to the testing arena. Once habituation, training, and testing was complete, coders naïve to the manipulation recorded latencies to approach the food locations and foraging behavior from the video recordings.

Data Analysis

All analyses were conducted via IBM SPSS version 29.0.1.1. To assess the impact of visitors on the subjects, I ran generalized linear mixed models with trial type (reward, no reward, ambiguous) and condition (chicken: perched or football hold) and their interaction as fixed factors, session as a random factor, and latencies to reach the container as the outcome variable. Session was included as a random factor to help control for changes in the subject's behaviors across sessions due to factors such as weather, care staff present, etc. I compared latencies of ambiguous trials to both reward and no reward trials. The gamma distribution was used as the data was not normally distributed and it led to a better fitting model than the gaussian distribution, assessed through a lower AIC. However, both models led to similar conclusions. I also utilized a Satterthwaite approximation, as this is more appropriate for small sample sizes. To probe interactions, separate GLMMs were conducted for the two conditions.

Study 3a Results

Reliability

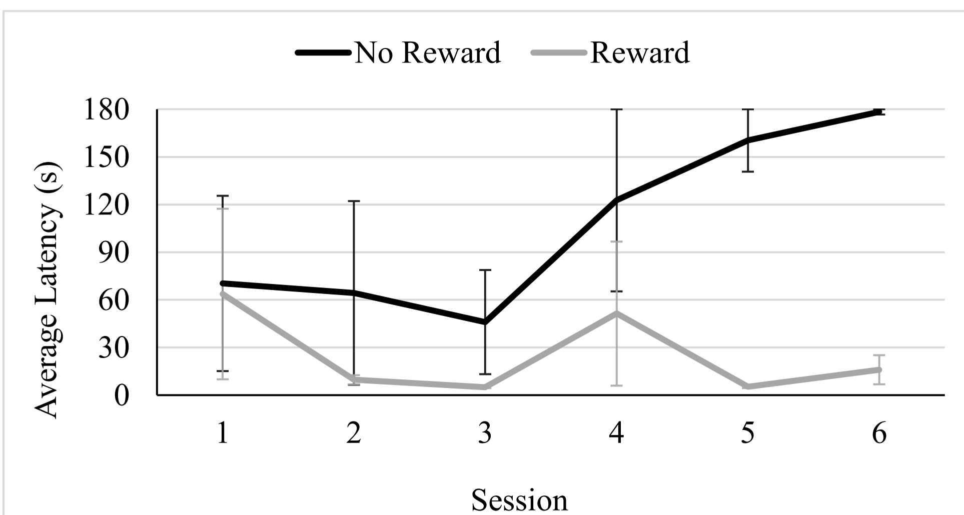
A primary coder coded all videos and a secondary coder coded 20% of the same videos. Reliability between coders for latency to approach was assessed via ICC for the chicken and the tegu. Cronbach's alphas were .999 for the chicken and 1.000 for the tegu.

Training

The chicken passed criterion in the habituation phase after 5 sessions and then moved on to training. Figure 11 shows the chicken's average approach time on training sessions by trial type (reward and no reward). The chicken passed the training criterion in session 6, moving forward to testing sessions when the discrimination was learned sufficiently.

Figure 11

Average Latency to Approach Across Training Trials by Trial Type and Session Number for the Chicken



Note. Error bars depict standard error of the mean.

Testing

The model fit with a corrected AIC of 414.676. There was no main effect of condition ($F(1,34) = .015$, $p = .904$; perched: $M = 45.298$ s, $SE = 8.964$ s, football hold: $M = 129.399$ s, $SE = 116.142$ s), but there was a significant main effect of trial type ($F(2,5) = 41.162$, $p < .001$). The model indicated that there was a significant difference between approach times for reward trials ($M = 23.549$ s, $SE = 31.715$ s) and ambiguous trials ($M = 135.659$ s, $SE = 34.679$ s; $t = -4.879$, $p = .027$, $SE = .515$, CI [-4.399, -.625]), but there was not a significant difference between the no reward trials ($M = 140.455$ s, $SE = 20.759$ s) and ambiguous trials ($t = .118$, $p = .912$, $SE = .591$, CI [-1.578, 1.717]). There was also no significant interaction between condition and trial type ($F(2,5) = 1.220$, $p = .366$).

Study 3a Discussion

There was a significant difference between the chicken's average approach time in the ambiguous trials compared to the reward trials with the average approach latency greater in the ambiguous trials compared to the reward trials. This, coupled with the finding that the average latency to approach in ambiguous trials did not significantly differ from the average latency in no reward trials suggests pessimism. Importantly, this effect did not interact with condition, suggesting that the chicken's pessimism was not affected by the change in hold style by the keeper during her interactions with visitors. This indicates that the chicken may be more pessimistic due to visitor interactions rather than any holding position during those interactions. However, future studies would need to include a baseline condition without human interaction to further assess whether the chicken was pessimistic due to visitor interactions, or in general. This condition was not included here because it is critical to minimize exposure to the ambiguous location to maintain the condition of ambiguity.

Study 3b Method

Subject

This study assessed 1 male red tegu (*Salvator rufescens*) that served as an education animal at the Alexandria Zoo in Alexandria, Louisiana. The tegu was housed in an indoor habitat within the same educational building that testing occurred, although testing occurred in a different room. This building was infrequently open to the public, and the tegu was housed in a back room, so the tegu's interaction with visitors was mainly limited to educational and other on-site programs. These educational programs provided the animal with minimal training experience, but he was naïve to the judgment bias test. On days when testing occurred, daily feeding occurred after testing.

Materials

All testing occurred within an indoor education building that housed the tegu's home habitat. This area was secluded from visitors, but the tegu was exposed to the same noises in this building as the chicken, although it may be more habituated to these noises as this was its daily habitat. Trials were carried out within an approximately square cardboard arena. This arena was 1.6 m by 1.7 m with sides .9 m tall (set up similarly to Figure 10), smaller than the chicken's arena to account for the tegu's slower speed. One opaque blue plastic lidded soap container was utilized as a food container throughout the study. This container was placed in the same locations as the setup for the chicken for habituation, training, and testing trials. The reward and no reward locations were 1.5 m apart from each other, and both locations were 1.6 m from the entrance to the arena. On ambiguous trials, the container was placed equidistant (.8 m) from the high reward and no reward locations, and this location was also 1.6 m from the starting point of the arena. The container had food placed within it before trials started so that scent could not be used as a cue. Rewards consisted of high value food (meat cubes) as rated by the tegu's keepers and approved to be used across multiple trials by the veterinarian. A GoPro was used to film all trials.

Procedure

The details of the procedure for the tegu were similar to those of the chicken. However, the tegu received a different manipulation. During testing, the manipulation for the tegu centered around physical interaction with visitors. Four sessions were conducted after the tegu experienced physical touch of various visitors, and four sessions were conducted after the tegu experienced nonphysical interaction with various visitors. Each day of testing, the tegu received a visitor touch condition and a no visitor touch condition in randomized order. In both conditions, the tegu was carried by a familiar keeper around outside areas in the zoo and experienced interaction with at least three humans (aside from the keeper). Similar to the chicken, this interaction lasted around 10 minutes each time, and then the tegu was immediately returned to the testing arena to begin sessions. The analytic approach was the same as above.

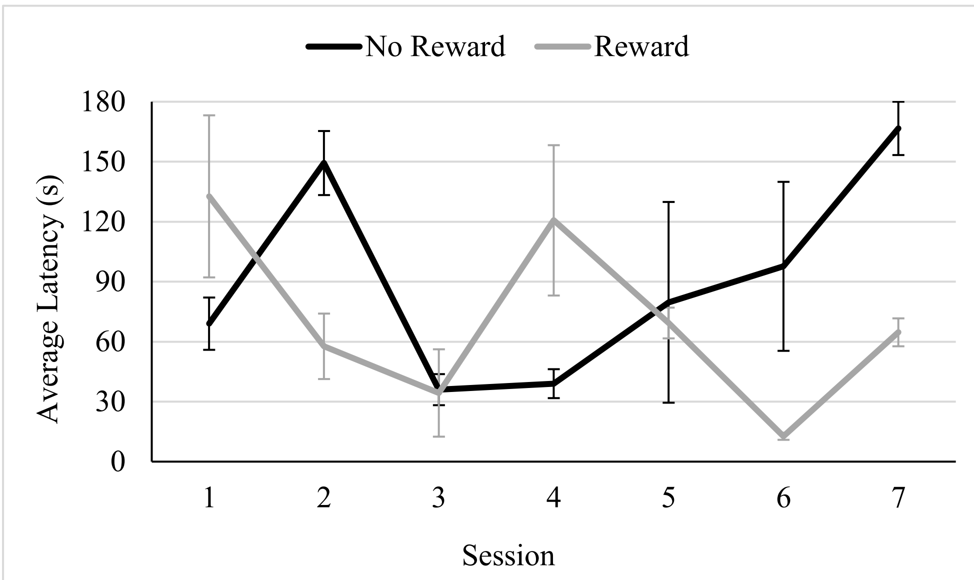
Study 3b Results

Training

The tegu passed criterion in the habituation phase after two sessions, and then moved on to training. The tegu's average latency to approach time in the training phase on both trial types (reward, no reward) are depicted in figure 12. The tegu passed criterion on session 7, which allowed it to advance to testing sessions after demonstrating discrimination between trial types.

Figure 12

Average Latency to Approach Across Training Trials by Trial Type and Session Number for the Tegu



Note. Error bars depict standard error of the mean.

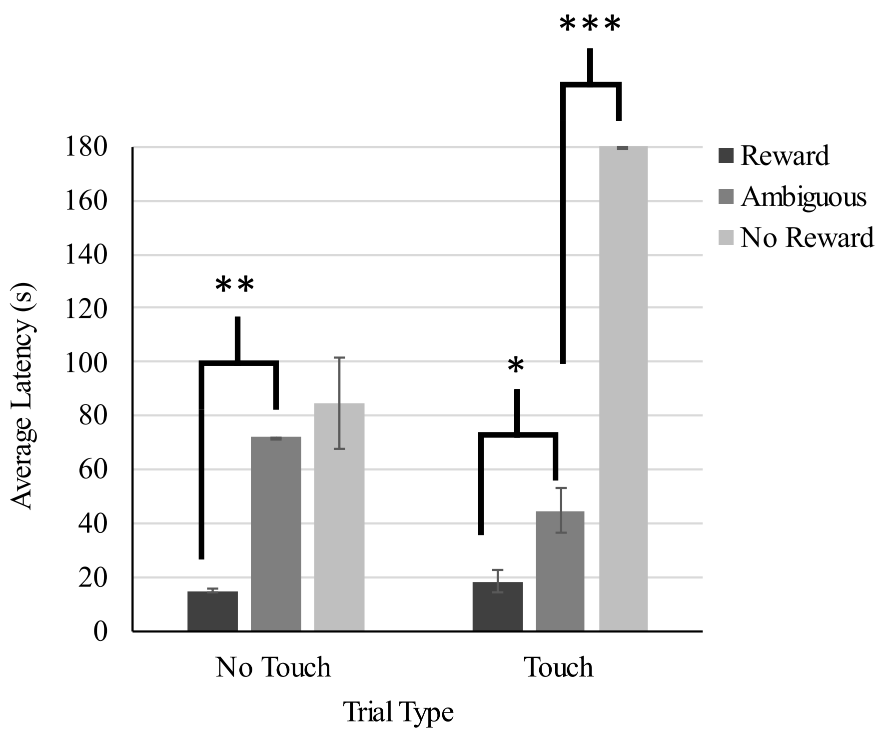
Testing

The model fit with a corrected AIC of 181.460. Results of the GLMM demonstrated no main effect of condition ($F(1,9) = 1.068$, $p = .329$; visitor touch: $M =$ 56.100 s, $SE = 5.590$ s, no visitor touch: $M = 49.580$ s, $SE = 3.275$ s), but there was a main effect of trial type ($F(2,6) = 66.471$, $p < .001$). The tegu approached more slowly on ambiguous trials ($M = 56.778$ s, $SE = 5.212$ s;) compared to reward trials ($M = 16.652$ s, $SE = 1.785$ s, $t = -3.192$, $p = .043$, $SE = .277$, CI [-1.716, -.051]) and more quickly compared to no reward trials (*M* = 123.428 s, *SE* = 12.209 s, *t* = 7.579, *p* = .027, *SE* = .184, CI [.431, 2.352]). However, these effects were qualified by a significant interaction between condition and trial type (*F*(2,6) = 10.344, *p* = .012). The tegu's approach times between the ambiguous trial type and the no reward trial (*t* = -4.556, *p* = .006, *SE* = .270, CI [-1.926, -.533]), but not the reward trial type (*t* = -2.433, *p* = .079, *SE* = .282, CI [-1.506, .133]), significantly differed across conditions (See Figure 13).

Separate GLMMs were conducted to probe the interaction further. Models fit well with corrected AICs of 194.437 and 204.031. In the no touch condition, there was a significant effect of position (*F* (2,17) = 8.831, *p* = .002). Latency to approach on reward trials (*t* = -2.994, *p* = .008, 95% CI[-63.122, -10.936]) but not no reward trials (*t* = 1.131, *p* = .274, 95% CI[-16.957, 56.152]) significantly differed from latency to approach on ambiguous trials. In the touch condition, there was an even more significant effect of position (*F* (2,7) = 231.318, *p* < .001). Latency to approach on reward trials (*t* = -2.672, *p* = .026, CI[-43.711, -3.543]) and no reward trials (*t* = 14.569, *p* <.001, 95% CI[-108.724, 148.892]) significantly differed from latency to approach on ambiguous trials. Thus, the tegu was somewhat pessimistic in the no touch but was neither optimistic nor pessimistic in the touch condition. However, as can be seen in Figure 13, his latency to approach on ambiguous trials was more similar to the reward, compared to the non-reward trials in the touch condition.

Figure 13

Average Latency to Approach Across Trial Type and Condition for the Tegu



Note. Error bars depict standard error. *** indicates $p < .001$, ** indicates $p < .01$, and * indicates $p < .05$.

Study 3b Discussion

The designation of optimism and pessimism depends upon the comparison of the subject's approach latency to the ambiguous stimulus to both reward and no reward conditions. That the tegu responded significantly more slowly to the ambiguous stimulus compared to the reward stimulus, but also significantly more quickly than to the no reward stimulus suggests neither optimism or pessimism overall. The tegu's intermediate approach latency on ambiguous trials may suggest that he perceived the intermediate spatial position of the ambiguous stimulus and was suitably uncertain as to what to expect on these trials. Interestingly, the difference in his latency to approach the location on the ambiguous and no reward trials depended upon condition. Whereas the data are suggestive of pessimism in the no touch condition, the data in the touch condition are not consistent with pessimism, with the tegu approaching the ambiguous stimulus much more quickly than the no reward stimulus. Somewhat surprisingly, this suggests that the tegu may have been experiencing less negative affect in the condition with touch compared to the condition without.

General Discussion

These results indicate distinct differences between the chicken and the tegu. The tegu assessed here was not negatively affected by the touch of visitors. It is encouraging that these results imply the lizard did not experience negative affect following the visitor touch condition, which indicates in part that he can continue his interactions with visitors that include touch at potentially no cost to his welfare. However, his response to the ambiguous stimulus in the no touch condition was indicative of pessimism, suggesting that his visitor interactions should include a touch component. On the other hand, the chicken demonstrated pessimism no matter the condition. It is true that the chicken was not negatively affected by differences in hold positions, but the chicken could be negatively affected by visitor interactions in general. This interpretation would be consistent with previous research on the negative effects of prolonged human handling in hawks, hedgehogs, and armadillos, which showed increased fecal glucocorticoid levels and undesirable behaviors in such conditions (Baird et al., 2016). Thus, the chicken's interactions with visitors may need to be reconsidered. It is difficult to integrate these results with other findings as there is minimal research on changes in affect following human interactions in zoo animals. Of the few previous studies on cognitive biases in zoo animals, only one examined the influence of humans on three primate species, and this was an indirect effect of anthropogenic noise (i.e., air show noise). Only the macaques, compared to the gorillas and chimpanzees, showed response slowing to conspecific images compared to control images when anthropogenic noise occurred (Cronin et al., 2018). Response slowing on simple tasks in these studies is thought to indicate anxiety, similar to results in humans (Bar-Haim et al., 2007), or that subjects' attention is focused on vigilance behaviors (Cronin et al., 2018; Ebitz et al., 2013), and is expected to be more extreme with threatening content. However, the macaques did not show response slowing to forward facing faces, which were thought to be threatening, compared to averted faces, which could have been due to their use of both female and male faces or lack of statistical power. The macaques did show a change in response to social versus non-social stimuli, albeit not the expected change, which indicated some level of change in affective state (Cronin et al., 2018). Interestingly, the macaques were a more recent addition to the zoo (i.e., data were taken during their second year of exposure to the noise) compared to the apes that had 13 years of exposure to the air show, similar to the chicken in this study, that was also a recent addition. This reinforces the idea that habituation to human influences is an important factor to determining whether human influences will be aversive. Both the gorillas and chimpanzees in that study, as well as the tegu here, had been at the zoos for longer periods of time and displayed neutral affects after exposure to more intense human influences (i.e., touch for the tegu and loud jet noises for the apes). These comparisons must be tempered by the fact that noises from jets in an air show substantially differ from direct human touch.

The manipulation utilized in Bernstein-Kurtycz et al.'s (2024) cognitive bias study in grizzly bears was more comparable to the manipulation in the study presented here. Grizzly bears were tested after four experimental conditions varying by the occurrence of two factors: a visitor tour behind the scenes and a keeper training session. One bear responded more slowly to the ambiguous stimulus compared to the reward, but not the no reward stimuli, suggesting pessimism only in conditions where food reinforcement was withheld but did not seem affected by the presence or absence of zoo visitors during a tour. The bears displayed a lower proportion of frustration behaviors when presented with food reinforcement compared to when there was no reinforcement regardless of whether visitors were present. It is important to note, however, that proportions of frustration behaviors were low overall (under .1). Unfortunately, I did not assess behavioral impacts in the chicken or the tegu. These subjects also did not receive food reinforcement during the current visitor interactions, only during certain trials of testing – reward and 50% of ambiguous trials, although the food was not always eaten or found in ambiguous trials. However, the tegu and chicken both have a history of food reinforcement when involved in training and education sessions with keepers, which could influence their perceptions of these sessions and visitor interactions. It is possible that visitor presence did not have a large impact on the bears, as compared to our chicken, because the bears were not touched by visitors. In addition, the bears were able to move around somewhat freely, potentially giving them more of an escape opportunity and preventing negative effects (Sherwen & Hemsworth, 2019), whereas the chicken and tegu were being held by care staff. Even so, our tegu showed less pessimism in the no touch, compared to the touch condition. Habituation may account for these results as well, as the bears had been trained for visitor tours previously. Therefore, the bears and tegu may have become more used to visitor presence in their time at the zoos compared to the chicken.

However, these results must be interpreted cautiously due to the short-term interactions assessed here, as the animals were exposed to visitors for an approximately ten-minute span before being tested. These animals have been frequently exposed to visitors in their past given their ambassador animal status; thus, a ten-minute exposure period may not have been long enough to cause any of the effects found here. I initially wished to assess the animals' judgment biases after longer education programs; however, the zoo had no active education programs at the time of this study. Indeed, the judgment bias task has been considered less effective for assessment of short-term effects as animals may show a positive judgment bias given the supposed stressor has come to an end (Bethell, 2015). Therefore, the results I saw for the tegu in the touch condition could indicate relief at the removal of the stimulus. This was a potential cause in judgment bias tests in horses and sheep (Doyle et al., 2009; Freymond et al., 2014) On the other hand, the pessimism across conditions demonstrated by the chicken could have been a general affect caused by more long-term factors. Future research could benefit from assessing judgment biases following longer, more intensive, and more consistent visitor interactions.

Even so, these results demonstrate the promise of the judgment bias task for ambassador animal assessment. The chicken and the tegu both learned the discrimination between the reward and no reward location relatively quickly and comparably – the tegu in seven sessions and the chicken in six sessions. Previous studies have demonstrated the usefulness of the task in chickens (Košťál et al., 2020), although its promise for reptiles had only been theorized before this project (Benn et al., 2019). The current data show that tegus may learn spatial discriminations relatively quickly, which will be useful for future explorations of their cognition. I utilized a location-based discrimination with three distinct locations; however, other discriminations could be utilized based on the needs or abilities of various animals, such as colors, sizes, sounds, etc. (see Bethell, 2015, for a review).

Although this study aimed to fill gaps within the literature, there were several limitations. First, assessing the impact of human interactions meant that many different variables could be affecting the judgment bias of the animals. Specifically, impactful variables could be the individual keeper handling the animal, differences in visitor behavior, weather, and more. Previous research has indicated that these variables can impact animal behavior over and above visitor effects (Rose et al., 2020), thus leaving room for ambiguity. Testing took place in Louisiana in August, during an abnormal drought, and in a building without air conditioning, meaning temperature and weather could have affected the animals more than any human interaction. Indeed, I attempted to control some variation by including session in the models as a random factor. The models were also lacking power due to the minimal number of subjects and trials ran, which was necessary to keep the ambiguous location ambiguous over successive exposures. It could also be that further keeper interaction during the testing procedure overshadowed any effects of the change in hold during visitor interactions for the chicken. The chicken was held in a manner to prevent it flying into the arena when it was placed inside for testing; thus, the results could indicate the chicken's general dislike of handling. It would have been ideal to include baseline conditions in which the chicken was not handled at all and/or visitors were not present. However, it is important to limit exposure to the ambiguous stimulus so that it remains ambiguous, thus limiting the number of tests that could be conducted. Lastly, this study involved an extremely small sample from one zoo, so it is important to recognize that the results may not generalize to other ambassador animals.

Even with these limitations, this study bridged the current gap in the animal welfare and cognition literature in multiple areas. Judgment biases are just beginning to be better studied in birds (e.g., Košťál et al., 2020; McCoy et al., 2019), and the current research extends this mainly agriculturally based literature to zoo animal welfare. In addition, this is the first lizard, to the author's knowledge, to be assessed with a judgment bias task, although the promise of judgment bias tests as a welfare assessment tool for reptiles has been acknowledged previously (Benn et al., 2019; Bethell, 2015). Given that affect can alter cognition through a variety of methods (Mendl et al., 2009), it is worth investigating the judgment biases of lesser studied animals and the circumstances that may impact these biases. This study also provided information as to the effect of human interaction on the ambassador animals that participate in close-up visitor interactions. These animals often experience close human interaction for prolonged periods, yet not enough research has investigated their impact on the welfare of the animals (Spooner et al., 2021). The current research suggests that various differences in human interaction could affect the judgment biases of these ambassador animals differently depending on the individual, but further research is needed to understand if this practice should be reconsidered or encouraged for ambassador animals as a whole.

CHAPTER FIVE

GENERAL DISCUSSION

Research is beginning to address the effects of human and animal interactions, and the studies presented here aim to approach this topic through multiple methodologies and points of focus. In Study 1, I examined public opinions in regard to zoos and sanctuaries and the effect of knowledge of zoo regulations and practices on these opinions in three survey studies. Studies 2 and 3 approached human-animal interactions from the animal's perspective. Study 2 examined human impacts through behavioral changes in a walk-through aviary. In Study 3, I recorded the judgment biases of two ambassador animals following visitor interactions. All three studies addressed gaps in the literature to better understand how the public perceives facilities housing captive animals and how captive animals are impacted by human activities and interactions. Research in these areas is essential as the welfare of animals in captivity is directly affected by such factors: through visitors and staff at zoos or through public opinion and regulations concerning how they should be housed.

Study 1 represented a novel approach to understanding public perceptions of zoos as previous research has exclusively surveyed zoo visitors, who may be predisposed to viewing zoos positively, rather than surveying those who may not already attend zoos. In Study 1a, I examined the opinions of a less biased sample of participants towards zoos and sanctuaries before and after they read a paragraph of information on either USDA regulations, AZA accreditation, or conservation practices. Only the paragraph on conservation practices led to an increase in positive opinions, and those with prior familiarity with zoo practices had more positive opinions, suggesting that knowledge of zoo practices may lead to more positive zoo opinions.

The overall effects in Study 1a were small, and previous research had indicated that personalized stories may be more impactful on a number of measures (e.g., Kim et al., 2021; Maier et al., 2017; Wald et al., 2021). Therefore, I made the informative paragraphs more specific to a target species in Study 1b. I replicated the finding that participants more familiar with zoo practices had more positive opinions, but favorable opinions of both participants with high or low familiarity were bolstered by the information presented. In addition, participant opinions were more positive following all conditions, including the control, which suggested that the particular information presented may not be impactful. Because all scenarios involved animals anecdotally considered to be popular or charismatic, it is possible that any positively framed information about these species would lead to positive appraisals of the facilities housing these animals. To determine if the positive effects were limited to popular animals, or to animals described as individuals, Study 1c assessed changes in participant opinions following paragraphs that varied in personalization and species popularity by presenting general or individualized information about a corn snake or a giant panda. Similar to Study 1b, participant opinions became more positive for all conditions, suggesting that highlighting any positive information on zoo animals in a general or specific manner may increase positive opinions. These findings can be useful as they suggest that providing more information about the practices involving animal welfare may bolster public opinion and support.

At the same time, across all three studies, participants had more positive opinions towards sanctuaries than zoos, which reflects shifting opinions represented in the media on such topics (e.g., Doyle, 2017; Parsons & Rose, 2018). This may be due to the fact that animals may not be exposed to human visitors at all or as much in some sanctuaries as compared to zoos, indicating that animals' exposure to humans may be an important factor in the public's opinions of zoos. With these findings, zoos can be better informed on how to manage public opinion with the increasing scrutiny faced by zoos. Future research could focus on other presentation methods for this information, such as through videos or a docent, to see if those methods lead to larger changes in opinions than seen here. The public's opinions of zoos are also impacted by whether the animals in their care are treated well (e.g., Davey, 2007), which was why we asked participants about their opinion on how well zoos care for their animals as part of the opinion measure in Study 1.

Studies 2 and 3 contribute more directly to that aim by researching animal welfare at zoos, particularly in relation to human factors. If we know how welfare might be improved, we can potentially improve public opinions. In Study 2, I conducted an observational study of the behavior of aviary-housed birds in response to changes in visitor presence. This is a common method of assessing welfare impacts on zoo animals (e.g., Sherwen et al., 2015; Stoinski et al., 2011; Wascher et al., 2021), but this study added to gaps in the literature regarding welfare impacts on parrots and animals in direct contact with visitors. Humans are an ever-present factor in captive environments; thus, they are likely to affect welfare, as indicated by the recent addition of human animal interactions to the Five Domains model of animal welfare (Mellor et al., 2020) To understand human impacts, the behaviors of the birds were recorded over the course of 30 hours across 10 days that differed in visitor numbers (i.e., weekdays and weekends). Behaviors were grouped into categories that were indicative of typical bird behavior: positive (e.g., affiliative conspecific interactions, resting) and negative (e.g., aggressive interaction with humans, pacing) behaviors. Birds engaged in fewer positive behaviors and increased negative behaviors as visitor numbers increased, but there were few negative behaviors overall, meaning that the decrease in positive behaviors was not compensated by an increase in negative behaviors. The number of birds in the vicinity of the camera also increased as visitor number increased, indicating that birds were not withdrawing selectively from humans when they were present in high numbers. Birds both within view and out of view may have been engaging in behaviors that were not captured by our ethogram. Indeed, we did not examine behaviors such as preening or vigilance, which have been shown to be impacted by visitors in previous research (Rose et al., 2022). Although negative behaviors increased in visitor presence, the small number of negative behaviors recorded is a positive sign given the large number of bids in the aviary, as it seems that the majority of the birds observed were not engaging in these behaviors. Further examination of the other camera positions not reported here will provide a better understanding of the rest of the birds in the aviary and determine whether the retreat space provided is sufficient to mitigate negative welfare impacts. Even so, this study's findings provided meaningful applied benefits to the birds assessed here, as well as supplementing the limited data on human impacts in walk-through aviaries.

Study 2 was observational and quasi-experimental, meaning it was impossible to examine causal factors, but Study 3 aimed to directly manipulate aspects of human interactions in more carefully controlled conditions. The third study analyzed changes in affect utilizing a judgment bias protocol in ambassador animals following visitor interactions. By assessing ambassador animals, we could investigate human impacts presumed to be more invasive than the impacts on the birds in Study 2, which had more control over their human exposure. In addition, few ambassador animals have been examined in zoo welfare studies, which is surprising given their close contact with human visitors, and very few zoo welfare studies have utilized the judgment bias protocol (although see Bernstein-Kurtycz et al., 2024; Bethell, 2015; McGuire & Vonk, 2018; Vonk et al., 2021), one of the only welfare assessments that purports to assess affect. Due to the need for research in such areas, I assessed judgment biases of a red tegu and chicken to ambiguous stimuli following visitor interactions: visitor touch or no touch for the tegu or perched hold or football hold for the chicken. The chicken and tegu differed substantially in their judgment biases. The difference in the tegu's latency to approach the no reward versus the ambiguous locations depended upon condition; specifically, the tegu was less pessimistic in the touch condition. However, the tegu was not optimistic overall because he approached the ambiguous stimulus more slowly than he approached the reward stimulus across conditions. Conversely, the chicken's judgment bias did not vary by condition, but she displayed an overall pessimism across conditions. It is difficult to determine the exact reason for these outcomes, as I could not control all potentially influential factors. The tegu's results may indicate a preference for human touch, but it is also possible that he experienced relief at the removal of an aversive stimulus. The chicken's pessimism may indicate a lack of preference for visitor interactions or staff handling no matter the holding type, but environmental factors, such as the extreme heat at the time of the study, could have been impactful as well. Although this study engaged a small sample size, and the results themselves are somewhat ambiguous, it was potentially the first judgment bias assessment of a lizard as well as a zoo-housed ambassador chicken. These studies demonstrate the feasibility of conducting such research within a reasonable timeframe and with a minimal budget and staff involvement. The applied benefits of this study serve to inform care staff on how to best care for these animals, which are furthered by the far-reaching impacts of expanding the welfare assessment methods utilized in zoos, particularly towards under-studied groups.

All three studies highlight the importance of furthering our understanding of human-animal interactions, particularly in captive animals. AZA estimates that over 780,000 animals are under the care of AZA accredited zoos and aquariums (AZA, 2023), and this number doesn't include the countless animals housed at sanctuaries, WAZA accredited facilities (World Association of Zoos and Aquariums), or unaccredited facilities worldwide. In these captive environments, animals will be exposed to humans, whether through visitors or care staff. Thus, it is a feature of their environment that is likely affecting their welfare in some direction: for the better, for the worse, or for potentially no change (e.g., Larsen et al., 2014; Mason, 2010; Pifarré et al., 2012; Sherwen et al., 2015; Sherwen & Hemsworth, 2019). Variance in the impacts of human interactions on the subjects of this dissertation were readily apparent despite the relatively small scope of the work. I witnessed changes in both positive and negative behaviors in aviary parrots, and suggestive evidence of pessimism in a chicken and a tegu, albeit for different reasons. Research in this area has been expanding in recent years, but there are still gaps to be filled to ensure captive animals, who have little choice in their exposure to these human influences, receive the highest quality of care. This is essential from an ethical viewpoint, but also serves to further the goals of AZA accredited facilities. When animals exhibit positive welfare signs through engaging behaviors, visitors are more curious and more likely to report positive experiences (Bexell et al., 2007; Chiew, Hemsworth, et al., 2019; Leubke et al., 2016; Wood, 1998), which will likely help in AZA’s education goals. In addition, animals experiencing negative welfare may have reduced reproductive output as a result, which is problematic for AZA conservation efforts (Edwards et al., 2019). To accomplish these goals, there is a need for increased zoo research opportunities that allow for studies of lesser studied animals, such as the birds and lizard presented here. Many animal welfare studies have focused on mammals, which is surprising given how commonly housed other species are in captive facilities (Benn et al., 2019). Many studies (including Chapter 3 here) suffer from small sample sizes but this could potentially be remedied through studying smaller reptiles and amphibians that can be housed in larger numbers at zoos. The IUCN red list reports that 41% of amphibians and 37% of sharks, rays, and chimaeras are threatened (IUCN, 2023), making research on human impacts in zoos and aquariums, particularly as organizations involved in their conservation efforts, essential.

On the other side of this issue, recent shifts in public opinions towards facilities that house captive animals (e.g., Bruck, 2024; Dennis, 2014; O’Connor & Vonk, 2023; Parson & Rose, 2018) further underscore the importance of human-animal interaction research. Zoos and aquariums, and other captive facilities, face ever increasing pressure to ensure the welfare of their animals, or potentially move animals thought to not fare well in captivity to sanctuaries (e.g., Bruck, 2024; Parson & Rose, 2018). Positive public perceptions of zoos and aquariums are necessary to the functioning of these organizations, as they typically rely on funds collected from visitors, and accredited facilities are expected to ensure their educational value (e.g., Collins et al., 2020b; Greenwell et al., 2023; Kleespies et al., 2022). Research in this area has prominently utilized zoo visitors (e.g., Godinez & Fernandez, 2019; Warsaw & Sayers, 2020), likely due to ease of collection for zoo staff, yet this does not generalize to the public's viewpoint of zoos. Thus, the first study presented here provides a unique viewpoint from a sample of mainly college aged adults as to how zoos are doing in the public eye, and how these opinions may be changed by information on zoo regulations and practices. Public opinion is important to highlight the positive work that zoos do to improve the lives of captive animals and preserve the natural habitats of their wild counterparts through conservation outreach, such as the success story of the previously extinct in the wild Przewalski's horse highlighted in Study 1. Increasing public opinions can then begin to match the research that supports increased animal welfare in accredited facilities (Riedman et al., 2022). Even though using animals as ambassadors can potentially help service these goals, and allowing humans to interact with animals may help them appreciate those species, we must assess the impact of those programs on the animals themselves and ensure the welfare of the animals in human care is never compromised.

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APPENDIX A

FIRST SURVEY CONDITIONS

AZA Accreditation Paragraph.

For a zoo to be accredited by the American Zoological Association (AZA), zoos and aquariums must undergo a thorough review. First, AZA selects the Accreditation Commission members who evaluate each zoo/aquarium. These experts are leaders in their fields with many years of experience and education in zoo/aquarium operations, animal management, and veterinary medicine. The Accreditation Commission evaluates every zoo/aquarium to make sure it meets AZA's standards for animal management and care, including living environments, social groupings, health, nutrition, and enrichment to stimulate natural behavior and provide daily variety. They also evaluate the veterinary program, involvement in conservation, research, education programs, safety policies and procedures, security, physical facilities, guest services, and the quality of the institution's staff. Accreditation also evaluates each institution's finances, its governing authority, and its support organization. There is also a detailed questionnaire which assesses their policies, procedures, records, lists, and reports. The application takes many months to complete and evaluate. After the Accreditation Commission studies the application, a team of inspectors visit the zoo or aquarium in person. The inspectors spend several days at the zoo or aquarium visiting every area, interviewing staff, checking records, and examining the physical facilities and the animals. The inspectors then write a report and submit it to the Accreditation Commission. The Accreditation Commission then meets to consider all candidates for accreditation. They examine the application, the supporting documents submitted by the zoo or aquarium, the inspection team's report, and any information and comments received from outside organizations and individuals. The zoo or aquarium's senior officials must go to the Accreditation Commission's meeting to answer questions before the Accreditation Commission makes a final decision.

USDA Regulations Paragraph.

The USDA's (United States Department of Agriculture) Animal Care unit, a unit within the Animal and Plant Health Inspection Service, administers the Animal Welfare Act (AWA). This is a federal law that establishes regulations for the standards for the humane care and treatment for certain animals that are exhibited to the public and other uses. Facilities using regulated animals for regulated purposes must provide their animals with adequate housing, sanitation, nutrition, water and veterinary care, and they must protect their animals from extreme weather and temperatures. Highly-trained USDA inspectors located throughout the United States conduct routine, unannounced inspections of all facilities licensed or registered under the AWA to assess these facilities' compliance with AWA. Inspectors are classified as veterinary medical officers (VMOs) or Animal Care inspectors (ACIs). All VMOs have graduated from a veterinary medical college, and many have been private-practice veterinarians prior to joining USDA Animal Care. ACIs have education in the biological sciences and/or extensive experience in the care and handling of animals. Inspectors use the AWA standards and regulations as the baseline by which they assess a facility's level of care provided to animals. If inspectors identify items that are not in compliance with the federal standards, the USDA Animal Care unit holds those facilities responsible for properly addressing and correcting those items within a set timeframe. If the noncompliance is not corrected, or if it is of a serious enough nature, the USDA has the option to pursue appropriate regulatory compliance and enforcement actions. The Animal Care unit may seek a civil or criminal penalty if noncompliance is found in the future.

AZA Conservation Paragraph.

Conservation is a priority for American Zoological Association (AZA) accredited zoos and aquariums and is a key component of their missions. They prioritize saving species on the brink of extinction or ensuring species never reach such a precarious state. The AZA works with zoos and aquariums to ensure the conservation of many different species including, but not limited to, gorillas, elephants, and polar bears. This is accomplished through partnerships for conservation with the AZA and accredited zoos and aquariums with numerous government wildlife agencies and non-governmental conservation organizations that allow for collaborative work to advance global conservation efforts. To support conservation work even further, AZA-accredited zoos and aquariums take a leading role in conserving the natural resources utilized in their business operations to lessen the threats to wildlife posed by habitat loss. In addition, AZA-accredited zoos and aquariums conduct or facilitate research that explores animal care, animal health, animal welfare, animal management, species and habitat conservation, animal biology, and conservation education and public engagement. The AZA and these zoos and aquariums also offer grant opportunities and other conservation funding for those needing financial support for conservation activities. Each year, the AZA publishes an Annual Report on Conservation and Science to summarize the conservation activities of the AZA community. In 2019, some highlights from this report were that $231.5 million was spent on field conservation, 2,555 total education programs, 987 species and subspecies benefitted from field conservation efforts, $26.3 million was spent on research, and 561 species and subspecies were studied.

Control Paragraph.

A zoo (short for zoological garden) is a facility in which animals are housed within enclosures, cared for, displayed to the public, and in some cases bred. Zoos contain a wide variety of animals that are native to all parts of the Earth. The term "zoological garden" refers to zoology, the study of animals, and the abbreviation "zoo" first appeared in the United Kingdom around 1847. The Philadelphia Zoo was the United State's first zoological park and continues to operate as a scientific and cultural center today. There are many different types of zoos, including safari parks, aquariums, roadside zoos, petting zoos, and animal theme parks. Across thirteen countries, there are 240 accredited zoos and aquariums, with 217 of those are in the United States. Across all of these facilities, there are approximately 800,000 animals, 6,000 species, and 1,000 threatened or endangered species in the care of zoos or aquariums. The Taronga Zoo in Sydney, Australia is one of the largest zoos in the world, housing more than 2,000 animals. Due to the variety of species held, zoos often must take precautions to accommodate animals that cannot survive in the native climate of the zoo. Today in the United States alone, zoos are visited by over 181 million people annually. Globally, 700 million people visit zoos and aquariums every year, or about 10 percent of the world population. In accredited zoos, this includes over 50 million children visitors and 12 million student learners from field trips that attended these zoos.

APPENDIX B

SECOND SURVEY CONDITIONS

AZA Accreditation Paragraph.

Zoos that are AZA accredited must pass a rigorous evaluation of all aspects of animal care and management. These zoos must follow standards of care outlined by the AZA in Animal Care Manuals (ACMs). These ACMs provide a compilation of animal care and management knowledge that has been gained from recognized species experts. For example, there is an ACM about the standard of care required for orangutans. The ultimate goal of this ACM is to facilitate excellent orangutan management and care, which will ensure the well-being of orangutans at AZA-accredited institutions. The ACM outlines physical descriptions of both Sumatran and Bornean orangutans, their natural history, their necessary environment, their habitat design, their social environment, their nutrition and veterinary care, and much more. For instance, the ACM requires that orangutan exhibits include tall climbing structures to reflect the fact that orangutans naturally spend much of their time in the trees. These structures allow orangutans to exhibit their natural climbing behaviors which promotes their physical and psychological well-being. The Toronto Zoo is a good example of such an enclosure, as the orangutans can climb on tall tree-like beams with attached raised platforms and climbing ropes. Many species can become obese in zoos if they are not able to engage in sufficient physical activity. The heaviest known male orangutan in captivity was an obese male named "Andy," who weighed 450 lb - more than twice the weight of a typical adult male orangutan in the wild. Allowing the orangutans to climb and swing and providing them with appropriate foods ensures that they will be healthy in captive settings. Ultimately, success in orangutan management and care through following ACMs will allow AZA-accredited institutions to contribute to orangutan conservation, and ensure that orangutans are in our future for generations to come.

USDA Regulations Paragraph.

The U.S. Department of Agriculture (USDA) is responsible for enforcing the Animal Welfare Act, an act signed in 1966. It is the main federal law in the United States that regulates the treatment of animals in research and exhibition. As just one example, the USDA enforces the rule that dealers, exhibitors, and research facilities must develop, document, and follow an appropriate plan for enhancing the environment of nonhuman primates to promote their psychological well-being. As part of this plan, nonhuman primates must have their needs for social contact met. For instance, a zoo cannot house a single gorilla living in social isolation. In addition, the habitats must allow for the primates to engage in species-typical activities. These rules ensure the welfare of captive primates is a top priority for zoos that house them. A famous example of a primate that would have benefitted from these rules is the gorilla, Willie B, who lived in social isolation in an indoor cage for the first 29 years of his life. Eventually in 1988, at the age of 30, Willie was provided with a lush outdoor environment and a troop of female gorillas at Zoo Atlanta. He went on to father several offspring and this success inspired the zoo to rescue another famous gorilla, Ivan, from a life of isolation in a shopping mall. Because of his years in isolation, it was difficult for Ivan to adjust to life outdoors with other gorillas and the zoo engaged in significant training to allow him to socialize with other gorillas in the years before his death. The lessons learned from these famous cases have ensured that no primate spends their life alone.

AZA Conservation Paragraph.

The Asian wild horse (*Equus ferus przewalskii*), also known as takhi and Przewalski's horse, is known as a success story for zoo conservationists. These horses roamed the grassland steppes of Europe and Asia for millennia. Mongolians call them takhi because it means spirit, or worthy of worship. These horses are so vital to the Mongolian national identity that the country's ceremonial banner is made with horsetail hair. However, by the late 1960's, these horses were driven to extinction in the wild due to human persecution, grazing competition, and high mortality from harsh winters. Thankfully, before Asian wild horses disappeared entirely, several zoos rescued more than a dozen individuals. Over the next several decades, zoos worldwide bred them and worked with in-country partners to reintroduce the descendants of these captive horses back to the wild. Thanks to the efforts of these zoos, there are more than 500 Asian wild horses running free across Mongolia, Kazakhstan, China, and Russia today. The largest number of them live at Hustai National Park, within 60 miles of Mongolia's capital, Ulaanbaatar. However, their numbers are not yet stabilized and active conservation and management continues to ensure their survival. For instance, in the seven Takhi reintroduction sites that exist, they must continue to ensure that Takhis sent from zoos are acclimated through semi-reserve areas before full reintroduction. This ensures that reintroductions are more likely to be successful.

Control Paragraph.

Zoos all over the world are known to house a variety of species. In particular, pandas are a well known species kept in zoos varying from China to the United States. Pandas have been kept in zoos as early as the Western Han Dynasty in China, where the writer Sima Xiangru noted that the panda was the most treasured animal in the emperor's garden of exotic animals in the capital Chang'an (present Xi'an). However, pandas became a more popular zoo species in China's zoos in the 1950s. Since then, the Chinese government has either gifted or leased giant pandas to zoos around the world. For example, giant pandas were recently on loan from 2013-2017 to the Toronto Zoo in Canada where they gave birth to the first giant pandas born in Canada in 2015, resulting in record numbers of visitors to the zoo. Pandas are so popular they increase zoo visitation at any zoo housing them. Between the Panda Centers in China and these other zoos around the world, there are approximately 500 Pandas in captivity today. Giant Pandas can be found in Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Indonesia, Japan, Malaysia, Mexico, the Netherlands, Russia, Singapore, South Korea, Spain, Taiwan, Thailand, the United Kingdom and the United States. Specifically, giant pandas in the United States are kept at Zoo Atlanta, Memphis Zoo & The Smithsonian National Zoo. One female Panda housed at Zoo Atlanta, named Lun Lun, is an avid climber that enjoys climbing structures in her habitat. She is considered to be one of the most beautiful pandas due to her round fluffy cheeks, and her favorite scents are cinnamon and mint.

APPENDIX C

THIRD SURVEY CONDITIONS

Personalized Giant Panda Paragraph.

Conservation of wild animals is a major focus of AZA (Association of Zoos and Aquariums) accredited zoos as it is one of the requirements for accreditation. As a Species Survival Plan (SSP) managed species, the giant panda, a species currently considered vulnerable by the IUCN, has been rescued from the brink of extinction. Zoos have been instrumental in this process as they collaborate to sustainably manage an ex situ population (i.e., within zoos) while simultaneously supporting in situ conservation (i.e., in the wild) of the species. In support of wild populations, sometimes individuals are taken in by zoos to be rehabilitated if they have been injured in the wild with the goal of re-releasing them once they are able to survive on their own. For example, a panda named Poe was found in the wild with injuries that were severe enough to put his health at risk. Thus, Poe was taken in by a zoo participating in the SSP and rehabilitated. Poe was one of the most popular animals during his time at the zoo because of his active and curious personality, and he formed a deep bond with the keepers there. He was quick to approach the door to his habitat when keepers prepared to interact with him. As part of his rehabilitation, keepers had to work closely with Poe to ensure he would have the skills to find and process his primary food source - bamboo - upon release. To do this, keepers spent time finding inventive ways to motivate Poe to search for his food in his home habitat. Keepers also had to weigh Poe daily to ensure he was eating enough. Keepers had fun training Poe to get on the scales. It was an emotional event for the zoo staff when Poe was healthy enough to be released back into the nature reserve, which provides a safe environment and ensures an abundance of food. This support of wild populations by zoos is necessary to prevent the extinction of this species.

General Giant Panda Paragraph.

Conservation of wild animals is a major focus of AZA (Association of Zoos and Aquariums) accredited zoos as it is one of the requirements for accreditation. As a Species Survival Plan (SSP) managed species, the giant panda, a species currently considered vulnerable by the IUCN, has been rescued from the brink of extinction. Zoos have been instrumental in this process as they collaborate to sustainably manage an ex situ population (i.e., within zoos) while simultaneously supporting in situ conservation (i.e., in the wild) of the species. In support of wild populations, sometimes individuals are taken in by zoos to be rehabilitated if they have been injured in the wild with the goal of re-releasing them once they are able to survive on their own. In captivity, zoos will house the pandas in individual habitats with freely available water and other necessary resources. To rehabilitate the pandas, keepers attempt to mimic how the pandas obtain their food in the wild. Pandas exclusively eat bamboo, which is difficult for zoos to obtain so they sometimes have to grow their own, which is a lot of work for zoo staff. Zoo staff also have to monitor the pandas' weight to ensure they are eating enough. This work ensures that the individuals are able to survive on their own when they are released into the wild later. When they are released, individuals are guided into nature reserves, which provide safe environments and ensure an abundance of food. This support of wild populations by zoos is necessary to prevent the extinction of this species.

Personalized Snake Paragraph.

Conservation of wild animals is a major focus of AZA (Association of Zoos and Aquariums) accredited zoos as it is one of the requirements for accreditation. As a Species Survival Plan (SSP) managed species, the Louisiana pine snake, a non-venomous species currently considered endangered by the IUCN, has benefited from this focus. Zoos have been instrumental in this process as they collaborate to sustainably manage an ex situ population (i.e., within zoos) while simultaneously supporting in situ conservation (i.e., in the wild) of the species. In support of wild populations, sometimes individuals are taken in by zoos to be rehabilitated if they have been injured in the wild with the goal of re-releasing them once they are able to survive on their own. For example, a Louisiana pine snake named Poe was found in the wild with injuries that were severe enough to put his health at risk. Thus, Poe was taken in by a zoo participating in the SSP and rehabilitated. Poe was one of the most popular animals during his time at the zoo because of his active and curious personality, and he formed a deep bond with the keepers there. He often seemed to approach keepers when they prepared to interact with him. As part of his rehabilitation, keepers had to work closely with Poe to ensure he would have the skills to find and process his primary food source upon release. To do this, keepers spent time finding inventive ways to motivate Poe to search for his food in his home habitat. Keepers also had to weigh Poe daily to ensure he was eating enough. Keepers enjoyed handling Poe to obtain his weight. It was an emotional event for the zoo staff when Poe was healthy enough to be released back into the wild. This support of wild populations by zoos is necessary to prevent the extinction of this species.

General Snake Paragraph.

Conservation of wild animals is a major focus of AZA (Association of Zoos and Aquariums) accredited zoos as it is one of the requirements for accreditation. As a Species Survival Plan (SSP) managed species, the Louisiana Pine Snake, a non-venomous species currently considered endangered by the IUCN, has benefited from this focus. Zoos have been instrumental in this process as they collaborate to sustainably manage an ex situ population (i.e., within zoos) while simultaneously supporting in situ conservation (i.e., in the wild) of the species. In support of wild populations, sometimes individuals are taken in by zoos to be rehabilitated if they have been injured in the wild with the goal of re-releasing them once they are able to survive on their own. In captivity, zoos will house the snakes in individual habitats with freely available water and other necessary resources. To feed the snakes, keepers attempt to mimic how the snakes would obtain their food in the wild. Because pine snakes burrow, the keepers have to spend a lot of time providing appropriate substrate and tunneling materials for their habitats. This ensures that the individuals are better prepared to survive on their own when released into the wild later. When they are released, individuals are guided into gopher tunnels as a safe home and source of food. This support of wild populations by zoos is necessary to prevent the extinction of this species.

APPENDIX D

IRB APPROVAL FOR STUDY 1

OAKLAND UNIVERSITY

Institutional Review Board

March 4, 2021

Protocol #: IRB-FY2021-281

Research Team:
Jordyn Truax
Jennifer Vonk

Based on applicable federal regulations, the following study, "Zoo Opinion Survey" has been determined to be Exempt, with the following categories Category 2.(ii). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording).
Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation.

Letter and Consent Documents:
This letter along with the IRB approved (date-stamped) consent documents can be found in Cayuse in the Submission Details page under Letters and Attachments, respectively.
The IRB date stamped consent documents must be downloaded and used in consenting participants.

Modifications:
Any changes to this exempt project must be reviewed by the IRB prior to initiation by submitting a MODIFICATION request. Do not collect data while the changes are being reviewed. Data collected during this time cannot be used in research.

Record Retention:
Exempt projects will be retained by the IRB office for three years after the last action on the project.

You are approved to start the research. Please retain a copy of this notification for your records.

If you have any questions, please contact the IRB office.

Thank you.

The Oakland University IRB

APPENDIX E

IACUC APPROVAL FOR STUDY 3

cayuse
Animal Oversight

Reference: IACUC Protocol # 2022-1190

Protocol Title: Cognitive Bias in Program Birds and Reptiles

Principal Investigator: Vonk, Jennifer

Approval Period: 12/02/2022 - 12/02/2025

Dear Professor Vonk, Jennifer:

The Institutional Animal Care and Use Committee (IACUC) has reviewed the amendment to protocol number 2022-1190, noted the required modifications provided by you upon committee's request (if applicable), and approved the project amendment referenced above. The reason for the amendment is:

- Adding addition bird species: one female domestic chicken (Gallus domesticus)

The amended protocol retains the original approval period (starting 12/02/2022 and ending 12/02/2025) and assigned application # 2022-1190. This is your formal approval notice; please save it for your records. Be aware that protocols expire at 12:01 AM on the expiration date. Ninety (90) days before the protocol approval expires, Cayuse will send you an alert email prompting you to submit a De Novo application to renew the project, if desired.
Any unanticipated problems, changes in, or halting of the activities proposed in the project, as described, must be promptly reported to the IACUC Administrator.

In addition, all faculty, staff, and students involved in the project must be trained and qualified to conduct the project in a responsible manner. Please note, in this regard, that you, the Principal Investigator, are fully responsible at all times.

Please let me know if you have any questions.

Sincerely,

Janet Schofding
Animal Research Facility Manager and IACUC Administrator

APPENDIX F

PRIOR EXPERIENCE WITH ZOO ACCREDITATION MEASURE

Participants were asked to rank their familiarity with a variety of aspects related to AZA accreditation. Responses were given on the following scale.

1 = Not familiar, 2 = Somewhat familiar, 3 = Moderately familiar, 4 = Very familiar, 5 = Extremely familiar

Number	Item
1	What is your familiarity with animal welfare accreditation programs for zoos/aquariums?
2	Are you familiar with the American Zoological Association (AZA)?
3	Are you familiar with the animal conservation work done by zoos/aquariums?
4	Are you familiar with practices typically used in zoological settings to assess animal welfare?

APPENDIX G

ZOO/AQUARIUM AND SANCTUARY OPINION MEASURE

Participants were asked "What is your opinion on how well (zoos/aquariums or sanctuaries) generally:" Responses were given on the following scale.

1 = Not well at all, 2 = Slightly well, 3 = Moderately well, 4 = Very well, 5 = Extremely well

Number	Item
1	Provide natural environments
2	Care for the physical well-being of animals
3	Care for the emotional well-being of animals
4	Educate visitors
5	Engage in conservation work to protect animals in their natural habitats
6	Engage in breeding and/or reintroduction efforts for disappearing species
7	Entertain the public
8	Follow accreditation practices
9	Provide clean habitats
10	Provide appropriately sized habitats
11	Conduct research to improve our understanding of animals