Animal Behavior and Cognition

ABC 2024, 11(4):404-431
DOI: https://doi.org/10.26451/abc.11.04.05.2024

How Do Perceptions of Zoo Animal Welfare Influence Public Attitudes, Experiences, and Behavioral Intentions? A Mixed-Methods Systematic Review

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Citation – Phillips, N., Maréchal, L., Ventura, B., & Cooper, J. (2024). How do perceptions of zoo animal welfare influence public attitudes, experiences, and behavioral intentions? A mixed-methods systematic review. *Animal Behavior and Cognition, 11*(4), 404-431. https://doi.org/10.26451/abc.11.04.05.2024

Abstract – The public expects zoos to provide high standards of animal care. Failing to meet public expectations can have detrimental impacts on public experiences and behavior, which in turn can compromise zoos' organizational goals relative to conservation and public education. Despite increased research interest in understanding how the public perceives animal welfare in zoo settings, to date the factors that influence such perceptions are still unclear. To address this gap in knowledge, we conducted a mixed methods systematic review using a PRISMA approach to identify the factors that influence public perceptions of zoo animal welfare and the potential ramifications of these perceptions on public attitudes, experiences, and behaviors. A total of 114 peer reviewed journal articles were analyzed: 43 provided qualitative data for thematic synthesis and 85 reported quantitative data for content analysis. Three main groupings were identified that impacted public perception of animal welfare in zoos: human, animal, and environmental factors. Within the human factors, ethical justifications, direct interactions, and inappropriate visitor behaviors were important. For the animal factors, animals' behavior, apparent health status, and the suitability of certain taxa for captivity were found to be key. Finally, several aspects of the environment – conditions of the facility, the exhibit, and welfare-related educational material – were influential. Overall, negative perceptions of animal welfare resulted in negative visitor attitudes towards zoos, detrimentally impacted experiences, and lowered likelihood to visit zoos and engagement in conservation efforts. The articles in this review provided valuable insights into the factors affecting public perception of zoo animal welfare; however, future research may benefit from a more structured approach to increase comparability and validity of results across studies. We conclude by proposing seven recommendations to increase the robustness and validity of future research in this area.

Keywords – Human-animal interactions, Animal-visitor interactions, Visitor perceptions, Visitor behaviors, Welfare perceptions, Zoo research

INTRODUCTION

Public concern for the welfare of captive animals has been increasing and high standards of care are expected across a range of captive settings (Sherwen & Hemsworth, 2019). These expectations extend to all zoological facilities, including wildlife and safari parks, aquariums, and sanctuaries. When care standards are perceived to be insufficient, poor visitor perceptions of zoo animal welfare can occur, which in turn can reduce public financial support and engagement with conservation initiatives (Miller, 2012).

Consequently, reduced public support can negatively impact the ability of zoos to achieve organizational goals, such as achieving high animal welfare, effective public education, and conserving species (Godinez & Fernandez, 2019). Considering the potential consequences of negative zoo visitor perceptions, understanding how animal-visitor interactions impact visitors is important. Much of the research regarding animal-visitor interactions in zoos has primarily focused on the impact of those interactions on the animals (Fernandez & Chiew, 2021), with fewer studies on impacts on zoo visitors (Learmonth et al., 2021). Several literature reviews have provided valuable contributions towards understanding visitor experiences at zoos (Davey, 2006; Fernandez & Chiew, 2021; Fernandez et al., 2009; Godinez & Fernandez, 2019; Learmonth et al., 2021), but to our knowledge no systematic review has been undertaken. More specifically, we presently lack a robust understanding of the impacts of zoo animal welfare perceptions on visitor experiences and behaviors, in addition to the specific factors influencing such perceptions.

Positive and negative perceptions of animal welfare have the potential to influence visitor behavior. For example, the likelihood that the public will visit or re-visit a zoo may be reduced if negative animal welfare is perceived (Miller, 2012), though perceptions of negative welfare are not always a barrier to zoo attendance (Hockenhull et al., 2022). Visitors provide various justifications for continued visitation when welfare concerns are evident in attempts to reduce cognitive dissonance (Curtin & Wilkes, 2007). Supporting conservation goals appears to be a common justification (Shani & Pizam, 2009); for instance, Curtin and Wilkes (2007) found participants in swim-with-dolphin encounters used the perceived conservation activities of these facilities to reduce dissonance when welfare concerns became evident. In contrast, the likelihood of visitors providing conservation donation support may be reduced due to negative welfare perceptions (Miller, 2012). As good welfare, visitor recreation, and conservation are common objectives of modern zoos (Rose & Riley, 2022), and as each objective can potentially be impacted by visitor perceptions of zoo animal welfare, understanding why these attributes influence perceptions is crucial.

Several factors (hereafter referred to as "zoo attributes" and used in this review to describe variables representing human, animal, and environmental-level factors affecting zoo visitor perceptions and experiences) have been highlighted as influential to public perceptions of zoo animal welfare (Learmonth et al., 2021). Human, animal, and environmental zoo attributes mirror those described in farmed (Veissier et al., 2012) and zoo animal welfare measurement (Whitham & Wielebnowski, 2013), and in the One Welfare concept, which "recognises the interconnections between animal welfare, human wellbeing, and the environment" (Pinillos et al., 2016, p. 412). For example, with respect to human-level factors, inappropriate visitor behaviors such as feeding or teasing animals can detrimentally impact visitor perceptions of zoo animal welfare (Shani & Pizam, 2009). At the animal level, behavior perceived to be undesirable or unnatural, such as stereotypic pacing, tends to diminish visitor perceptions of zoo animal welfare (Miller, 2012), while perceiving animals as engaging in play behaviors generally translates to perceptions of good welfare (Packer et al., 2018). Additionally, visitor misinterpretation of animal behavior (e.g., inactivity perceived as abnormal in animals who naturally sleep for large portions of the day) can reduce welfare perceptions (Packer et al., 2018). With respect to the physical environment, naturalistic exhibits (i.e., those designed to mimic aspects of an animal's natural habitat) may aid in improving visitor perceptions of zoo animals and zoo animal welfare (Finlay et al., 1988), as does provision of environmental enrichment (Reade & Waran, 1996). While there are some indications that welfare-related interpretation (i.e. educational material such as signage, interactive displays, models) may enhance zoo visitor perceptions (Warsaw & Sayers, 2020), research is currently limited.

Research investigating how the public perceives animal welfare in zoo settings has increased, yet the factors that are influential to such perceptions remain unclear. Visitors have also shown conflicting perceptions of the same factor when considering implications to welfare. As perceptions of zoo animal welfare may impact visitor behavior, a comprehensive review focusing specifically on zoo animal welfare perceptions and the impacts of these perceptions on visitor experience and behavior is needed. Hence, this systematic review aims to build on the foundations supplied by previous research, with the following objectives: 1) to identify and analyze existing literature exploring what zoo attributes, i.e., animal, human and environment, influence visitor perceptions of animal welfare, either positively or negatively, and 2) to

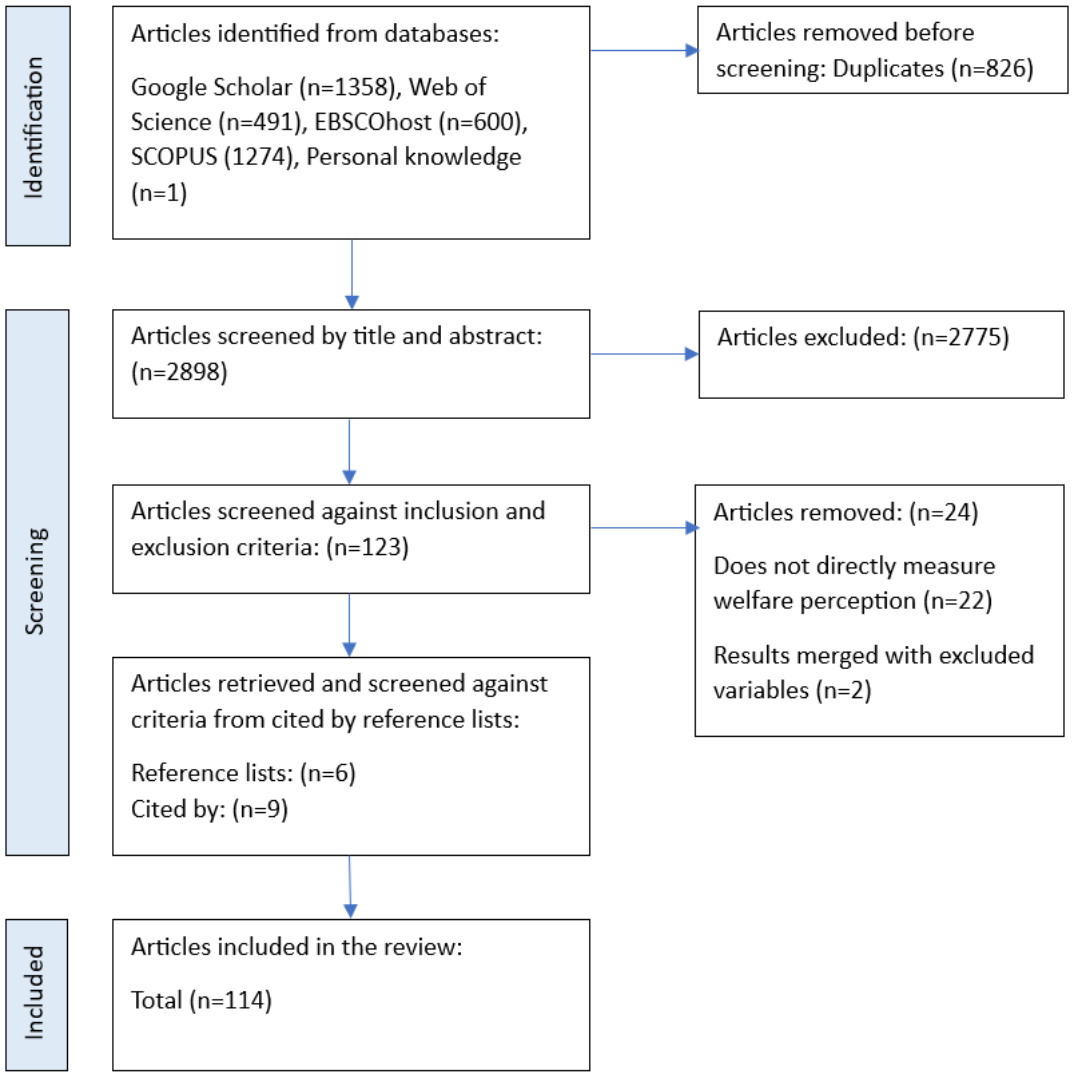
characterize how positive or negative perception of animal welfare impacts visitor attitudes, experiences, and behavior. This review was conducted following The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 Guidelines (Page et al., 2021).

Materials and Methods

The review began with a search of existing scientific, peer-reviewed literature. The search strategy (Supplementary material S1) was assessed for appropriateness by an academic librarian, and searches were first executed on Google Scholar, SCOPUS, Web of Science and EBSCOhost in June 2022, and repeated in August 2023 to capture additional literature published in the time since the review was initiated. These searches resulted in a combined 114 articles included in this review (Figure 1). A full and independent search and screening process was conducted by two researchers (NP and BV) to validate results. The review protocol was pre-registered on Open Science Framework (https://doi.org/10.17605/OSF.IO/26VD9).

Figure 1

PRISMA Flow Diagram Displaying the Search and Assessment Process



Note. This process resulted in final inclusion of 114 articles in this systematic review.

Screening Process

Studies met inclusion criteria if they directly measured zoo animal welfare perception and/or evaluated the impact of welfare perception on visitor attitude, experience, and intended or actual behavior. Animal welfare was defined as by Broom (1986, p. 524): "the welfare of an individual is its state as regards its attempts to cope with its environment." We recognize there are several animal welfare frameworks in the literature. Here, we rely on the Five Domains Model (Mellor et al., 2020), which recognizes that animal welfare is affected by nutrition, physical environment, health, behavioral interactions, and mental state. Included studies could be quantitative, qualitative, or mixed methods, take place within or outside of zoo facilities, and be based in any geographical location. Participants could be any age. Studies were excluded if they were not published within a peer reviewed journal, or if full text was not available or not available in the English language. 'Gray literature' (e.g., book chapters, unpublished works, conference papers/proceedings that are not in peer reviewed journals, theses and dissertations, reports, newsletters) were also excluded. Studies published before 1990 were excluded as significant changes to zoo husbandry practices and conservation initiatives occurred around this time (Miranda et al., 2023), making direct comparisons to earlier studies difficult. Participants could be either visitors to a zoo facility at the time of study participation, or members of the public at a remote location. Participants could not be associated with zoos professionally. Perceptions must have been clearly and directly related to zoo animal welfare; for example, participant opinion of a zoo attribute (such as enrichment items) would not be included in the absence of a clear link between opinion and perceived impacts to zoo animal welfare. Zoos and zoo animals were defined as by the licensing requirements laid out in the UK Zoo Licensing Act 1981 ("Zoo Licensing Act ", 1981, p. 1): " an establishment where wild animals (as defined by section 21) are kept for exhibition to the public, otherwise than for purposes of a circus (as so defined) and otherwise than in a pet shop" and "the public have access, with or without charge for admission, on seven days or more in any period of twelve consecutive months". The term 'wild animals' is defined by the ZLA 1981 as "animals of the classes Mammalia, Aves, Reptilia, Amphibia, Pisces and Insecta and any other multi-cellular organism that is not a plant or a fungus and 'wild animals' means animals not normally domesticated in Great Britain" (p. 14). Therefore, 'wild animals' are defined by this study as those not normally domesticated in the zoo's geographical region. Elephant camps and tiger temples in Southeast Asia were excluded as they fell outside of the scope of this review. See Supplementary material (S2) for articles excluded at this stage.

Data Extraction and Quality Assessment

An inclusive approach (as described by Thomas and Harden, 2008) was followed wherein all text relating to the review question within the findings/results sections was included, alongside any relevant text found within abstracts and discussions. If articles discussed multiple facilities including those other than zoos, only content directly and clearly relating to zoos was extracted (n=11 articles). When articles shared data sets, only unique observations/results from each paper were extracted (n=8 articles). The Mixed Methods Appraisal Tool (MMAT) version 2018 (Hong et al., 2018) was used for quality assessment (Supplementary material S3) to inform analysis and interpretation of results, not to remove studies perceived to be poor.

Analysis

As included papers presented both qualitative and quantitative data, our data analysis was comprised of two complementary analyses: a thematic analysis (qualitative data) and content analysis (quantitative data). Analysis began with an inductive thematic synthesis of qualitative data, as described by Thomas & Harden (2008), using NVivo 12 software (NVivo 12, QSR international, London, UK). The process began with familiarization of the data via multiple readings, followed by coding into descriptive themes. This was a cyclical process as more influential factors to zoo animal welfare perceptions became apparent and the themes required refinement. Once the broad themes had been identified, coding was

repeated in a hierarchical tree structure to develop analytical themes, which provided a more in-depth understanding of the influential factors to zoo animal welfare perceptions and the potential impacts to visitor behavioral intentions. This step involved identifying what factors were influential in affecting perceptions either positively or negatively, and why.

The themes and subthemes identified from the qualitative analysis then informed the coding scheme used to process the quantitative data using content analysis as described by Riffe et al. (2019). This process also began with familiarization of the data, followed by coding the data into the themes and subthemes identified in the thematic synthesis, whilst remaining alert to any potential new themes. All the themes and subthemes created during the thematic synthesis were also evident in the quantitative data, except the subtheme *facility size*, which was exclusive to the qualitative data. Finally, all studies (both qualitative and quantitative) were re-read to ensure no theme relevant to the research question was overlooked within the extracted data. By including both quantitative and qualitative data in a convergent integrated approach, a more comprehensive understanding of visitor perceptions could be gained. Each data set was synthesized narratively (Thomas et al., 2004) to provide a textual description and analysis of combined findings. Repeat assessment of themes occurred, with consideration of articles highlighted as containing potential risks of bias (as described in the previous section) to ensure the validity of the evidence and therefore the validity of the themes created.

Results and Discussion

Descriptive Summary of Included Articles

Due to the similarity of the results obtained from the thematic and content analyses, results are presented together. A total of 114 articles were included in the review, with 43 supplying qualitative data for thematic synthesis and 84 supplying quantitative data for content analysis (some articles supplied both qualitative and quantitative data). Articles spanned 25 years (1993-2023), with the highest rate of articles published in 2021 (14.9% of total). Research populations were mainly based in North America (31.0%), followed by Asia (17.8%), the United Kingdom (16.3%), Europe (14.0%), Oceania (10.9%), Africa (7.8%), and South America (2.3%). Fifty-nine journals were represented, with most articles published in *Zoo Biology* (12.3%) or *Anthrozoös* (12.3%), *Animals* (6.1%), the *Journal of Zoo and Aquarium Research* (5.3%), and *Visitor Studies* (4.4%). Five classes of animal were represented, with most studies including mammals (56.4%), 8.6% including birds, 8.6% reptiles, and only 1.4% including amphibians and 1.4% insects. 23.6% of articles did not specify animal class. Within the class Mammalia, the most represented orders were Carnivora (33.3%), Primates (29.5%), Cetacea (9%), and Proboscidea (7.7%). Most research focused on facilities described as zoos (76.7%), with 6.8% relating to aquariums, 5.3% to marine parks, 3.8% safari parks, 3.0% sanctuaries, 3.0% wildlife parks and 1.5% not stating a facility (i.e., while taking place in a zoo, the specific zoo name and facility type were not supplied). A full list of all included studies and their relative theme contribution can be found in the Supplementary material (S4).

Welfare perceptions were most often measured using a statement of general overall welfare (25.7%), or by asking open questions that led to discussions of welfare in the participants' own words (22.2%). Perceptions of welfare were also measured using statements regarding affective state (17%), health indicators (14%), quality of care (11.7%), and display of natural behaviors (9.4%). The five domains model (Mellor et al., 2020) was not used to categorize the types of welfare perception assessments, as perceptions such as quality of care and those based on participants' descriptions did not meet the criteria for any specific domain. 64.9% of the total articles used one category of welfare perception (i.e., perceived affective state, health, natural behavior, quality of care, or overall welfare perception), 52.7% of which utilized open questions and participant wording. 22.8% of the total articles included two categories of perception, 10.5% used three, and 1.8% used four.

Overview of Themes

Identified themes related to objective 1 (i.e., influential factors to welfare perceptions) were organized within three main categories: human-, animal-, and environmental- related factors. Three themes were described within human-related factors affecting perceptions toward zoo animal welfare (Table 1): *ethical considerations* (with subthemes of beliefs about captivity and animal rights); *direct human-animal interaction*; and *inappropriate visitor behavior*. The term 'direct human-animal interactions' denotes interactions between humans and animals during encounters, shows, training exercises, and husbandry practices. The animal category consisted of three themes (Table 1): *disproportionate suffering*, *animal behavior*, and *apparent health status*. The environmental category included three themes (Table 1): *the facility* (with subthemes of zoo purpose and advertisement, and size), *the exhibit* (with subthemes of naturalistic enclosure, exhibit size, enrichment, group size, condition of the enclosure, diet, sensory stressors, and temperature), and *welfare interpretation*. One theme was described which addressed objective 2 (i.e., potential impacts of welfare perceptions on visitor experience and behavior): *impacts of welfare perceptions on visitor experience and behavior*. Themes were categorized as linked when one attribute highlighted how and/or why the other attribute was influential to welfare perceptions (Table 1). For example, large enclosure size was perceived to facilitate natural behavior, which was perceived to indicate good welfare. See Supplementary Materials (S5) for a breakdown of each theme (e.g., number of studies in which themes appear, and which animal orders and type of zoo facility were represented). Visitor perceptions of zoo animal welfare begin to form before visits have begun, due to variations in preconceived beliefs concerning captivity (Christou & Nikiforou, 2021). Thus, human-level factors regarding ethical perceptions of captivity are the opening themes of the discussion (below).

Human-Level Factors

Ethical Considerations

Beliefs about captivity. Preconceived beliefs regarding captivity were identified as a factor impacting perceptions of zoo animal welfare, as zoos were perceived to be protectors of vulnerable animals and providers of quality care (Alba et al., 2023; Ali et al., 2022; Almeida et al., 2017; Almeida & García Fernández, 2021; Arcari, 2023; Ballantyne et al., 2021; Christou & Nikiforou, 2021; Curtin, 2006; Curtin & Wilkes, 2007; Davey, 2007; Douglas & Katz, 2009; Greaves et al., 1993; Hockenhull et al., 2022; Kutska, 2009; Marseille et al., 2012; Ogle & Nelson, 2022; Otegui Carles et al., 2023; Reade & Waran, 1996; Shani, 2012; Shani & Pizam, 2009; Spiriti et al., 2022; Tishler et al., 2020; Tofield et al., 2003; Yilmaz & Alpak, 2019). For example, sentiments expressed included, "they have protection and a good food supply" (Greaves et al., 1993, p. 58). Origins of the animals in zoo collections impacted perceptions of zoos as protectors, as 'rescued' or captive-bred animals were deemed more acceptable to house in zoos than wild-caught animals (Curtin & Wilkes, 2007; Hockenhull et al., 2022; Otegui Carles et al., 2023; Shani, 2012; Shani & Pizam, 2009). Captive breeding was perceived to habituate animals to the captive environment and therefore reduce suffering (Almeida & García Fernández, 2021; Arcari, 2023; Curtin & Wilkes, 2007; Greaves et al., 1993) and the provision of care and/or protection sometimes led to the belief that some animals were better off in captivity than in the wild (Ballantyne et al., 2021; Hockenhull et al., 2022; Marseille et al., 2012; Otegui Carles et al., 2023; Shani, 2012; Shani & Pizam, 2009). Holding such views appears to attenuate otherwise uneasy feelings about the ethics of captivity, as described by Curtin and Wilkes (2007, p. 135): "several respondents attempted to reduce dissonance by emphasising that the dolphins were either bred in captivity and therefore had become accustomed to it or had been rescued." The release of animals into the wild – either after they have recovered from the circumstances they were rescued from or through participation in breeding programs – was also considered important to ethical acceptance of zoos (Almeida et al., 2017; Greaves et al., 1993; Shani & Pizam, 2009), highlighting that visitors want zoos populated by endangered and/or rescued animals who will ultimately be released into the wild. Yet, zoos house many species who are neither endangered, rescued, or part of release programs (Marcy, 2021).

Table 1

Themes Identified as Affecting Perceptions of Zoo Animal Welfare and Impacts of Those Perceptions on Visitor Experience and Behavior

		Human factors				Animal factors			Environmental factors											
		Ethical considerations							The facility		The exhibit									
		BAC	AR	DHAI	IVB	DS	AB	AHS	ZPA	FS	NE	ES	EN	GS	COE	D	SS	T	WI	IVEB
Ethical considerations	Beliefs about captivity (**BAC**)	42	3	4	1		7	10				3		2	3	8				4
	Animal rights (**AR**)	7	22	7			2	2								1	1			
	Direct human-animal interaction (**DHAI**)	2		21	2	1	3						7							
	Inappropriate visitor behaviours (**IVB**)				11												3			
	Disproportionate suffering (**DS**)	11				18														5
	Animal behaviour (**AB**)	3					42					4	2						1	4
	Apparent health status (**AHS**)	2						24												3
The facility	Zoo purpose and advertisement (**ZPA**)	6					2	1	16										1	2
	Facility size (**FS**)	2								2										
The exhibit	Naturalistic enclosures (**NE**)	8	1		2		1	2			43							1		
	Enclosure size (**ES**)	2	1				12					31								1
	Enrichment (**EN**)	1					6						35					1		
	Group size (**GS**)						8					1	1	15						1
	Condition of the enclosure (**COE**)														20					
	Diet (**D**)						2									18				
	Sensory stressors (**SS**)												1				7			
	Temperature (**T**)					1												8		
	Welfare interpretation (**WI**)																		8	
Impact on visitor experience & behaviour (**IVEB**)																				31

Note. [a] Human-level factors affecting perceptions of welfare are shaded in purple; animal-level factors in blue; and environmental-level factors in green. The impact of those perceptions to visitor experience and behavior is shaded in orange. Letters in brackets in the lefthand theme column identify abbreviated theme names used along the top row. Cells shaded in grey represent links between themes found within the data extracted from the studies in this systematic review. The numbers within the grey shaded cells represent the number of articles that highlighted a link between the themes. The theme that is influential to perceptions of the other theme is situated in the lefthand column. For example, beliefs about captivity were influential to perceptions of animal behavior in a total of 7 articles, and animal behavior influenced beliefs about captivity in a total of 3 articles. The cells shaded in black represent the total number of articles in each theme.

Furthermore, two studies documented assumptions by visitors that zoos were releasing animals into the wild, without the facilities making any such claim (Price et al., 1994; Rice et al., 2021). Reasons behind this mistaken assumption were unclear.

In contrast, within this theme, captivity was perceived to negatively impact zoo animal welfare more often than positively impact welfare (Ali et al., 2022; Almeida et al., 2017; Almeida & García Fernández, 2021; Almeida et al., 2023; Arcari, 2023; Ballantyne et al., 2021; Carson, 2014; Chiapero et al., 2021; Christou & Nikiforou, 2021; Curtin, 2006; Curtin & Wilkes, 2007; Davey, 2007; Douglas & Katz, 2009; Greaves et al., 1993; Hockenhull et al., 2022; Howell et al., 2019; Jiang et al., 2007; Lukas & Ross, 2005; Lukas & Ross, 2014; Marseille et al., 2012; Meshabaz et al., 2020; Packer et al., 2018; Phillips & McCulloch, 2005; Pollastri et al., 2021; Povey & Rios, 2002; Pragg, 2019; Reade & Waran, 1996; Rocha et al., 2016; Shani & Pizam, 2009; Spiriti et al., 2022; Spooner & Stride, 2021; Tishler et al., 2020; Wassermann et al., 2018; Woods, 2002). Articles highlighted beliefs amongst visitors that zoo animals are wild animals imprisoned and denied the freedom of their natural habitats, which zoos can never replicate. Failure to replicate nature was perceived to restrict natural behaviors and lead to boredom, stress, and unhappiness amongst animals; in some cases, this belief was linked to strongly negative perceptions of zoos. For instance, some participants were said to "perceive zoos as places where animals are often abused, suppressed and congested in limited/small spaces" (Christou & Nikiforou, 2021, p. 696).

In addition to protection and provisions of care (Almeida & García Fernández, 2021; Otegui Carles et al., 2023; Shani, 2012), several additional justifications were supplied in the ethical defense of zoos. These included education and research opportunities (Almeida et al., 2017; Almeida & García Fernández, 2021; Arcari, 2023; Curtin & Wilkes, 2007; Douglas & Katz, 2009; Hockenhull et al., 2022; Otegui Carles et al., 2023; Shani, 2012; Shani & Pizam, 2009; Syed et al., 2023), conservation (Arcari, 2023; Christou & Nikiforou, 2021; Curtin, 2006; Curtin & Wilkes, 2007; Otegui Carles et al., 2023; Shani, 2012; Shani & Pizam, 2009), human safety (i.e., safer in comparison to viewing animals in their natural habitat and also increasing safety by removing and preventing the return of animals from natural environments shared by humans and animals) (Almeida & García Fernández, 2021; Greaves et al., 1993; Otegui Carles et al., 2023; Shani, 2012; Shani & Pizam, 2009), and entertainment (Almeida & García Fernández, 2021; Arcari, 2023; Christou & Nikiforou, 2021; Curtin, 2006; Hockenhull et al., 2022; Marseille et al., 2012; Otegui Carles et al., 2023; Shani, 2012; Syed et al., 2023; Wassermann et al., 2018). When justifying captivity, the benefits to humans were considered as much, if not more, than the benefits to animal welfare. Some studies documented the belief that the captivity of some animals benefitted all animals, even if those captive animals experienced poor welfare. Such animals were viewed as "taking one for the team" (Arcari, 2023, p. 5) as they gave visitors "a more in depth understanding of why animals should not be contained" (Hockenhull et al., 2022, p. 78). This perceived sacrifice was viewed as preventing the need for others of their kind to suffer captivity in their place, or potentially in the future.

Animal rights. Study participants believed that zoo animals have a right to life (Yilmaz & Alpak, 2019), to appropriate end-of-life care (Okabe & Matsunaga, 2021), and to choice and control over their environments; consequently, provision of these rights was integral to perceptions of animal welfare as good or bad. Beliefs involving animals' freedom of choice included access to preferred food items (Greaves et al., 1993), chosen activities such as swimming or playing (Marseille et al., 2012; Packer et al., 2018) (as animals should be able to "do whatever they want" (Marseille et al., 2012, p. 35)), and ability to remain within private areas unseen by visitors (Chiapero et al., 2021; Douglas & Katz, 2009; Hassan, 2015; Howell et al., 2019; Tishler et al., 2020; Tofield et al., 2003) and away from noise (Rice et al., 2021). An animal's right to choose to participate in direct interactions including training, performance activities, and receiving direct human contact was highlighted as important to welfare and thus linked to ethical acceptability of these practices (Curtin, 2006; Curtin & Wilkes, 2007; dos Santos Coelho et al., 2022; Lacinak, 2023; Shani & Pizam, 2009). This view was captured by one participant who shared: "it's one thing if the animal wants to do it, and it's a different thing if you stab him with a stick" (Shani & Pizam, 2009, p. 95). Perceptions that animal rights were discarded or suppressed by zoos led to feelings of ethical unease and dislike of zoos (Almeida et al., 2017; Christou & Nikiforou, 2021).

Direct Human-Animal Interactions

The participation of animals in encounters and shows was often perceived as unnatural and thus potentially detrimental, both by visitors taking part in these encounters and by general visitor populations (Almeida et al., 2017; Almeida et al., 2023; Curtin, 2006; Curtin & Wilkes, 2007; Higgs, 2018; Ogle & Nelson, 2022). Direct or close physical contact with humans was highlighted as particularly concerning (Curtin & Wilkes, 2007; Davey, 2007; de Mori et al., 2019; dos Santos Coelho et al., 2022; Minarchek et al., 2021), though this was not the consensus view of study participants. Conversely, direct/close contact was frequently perceived positively as an indication of a close bond between trainers/zookeepers and the animals, which increased perceptions of quality care and welfare (Carter et al., 2020; Curtin, 2006; Higgs, 2018; Hockenhull et al., 2022; Lacinak, 2023; Povey & Rios, 2002; Tishler et al., 2020). Perceptions of welfare as impacted by keeper-animal contact were mediated by species (Lacinak, 2023) and by staff qualification level (Higgs, 2018; Otegui Carles et al., 2023; Shani, 2012). Similar contrasts were seen in perceptions of welfare as influenced by training, with training perceived to provide physical and psychological enrichment in which animals enjoy participating (Anderson et al., 2003; Curtin, 2006; Curtin & Wilkes, 2007; Higgs, 2018; Ogle & Nelson, 2022; Povey & Rios, 2002), but alternatively as being stressful, unnatural, and demeaning (Almeida et al., 2017; Almeida et al., 2023; Curtin, 2006; Curtin & Wilkes, 2007; Higgs, 2018; Ogle & Nelson, 2022). Improved views toward training were more likely if training was perceived to avoid aversive approaches and instead rely on rewards (Hassan, 2015; Otegui Carles et al., 2023; Shani, 2012; Shani & Pizam, 2009). This was illustrated by comments like, "you don't need to use a whip, and you don't need to use something that is not positive reinforcement" (Shani & Pizam, 2009, p. 95). Whether an animal was seen as able to choose to participate in training or other forms of direct contact with humans was important to perceptions of animal enjoyment (Almeida et al., 2023; Curtin, 2006; Curtin & Wilkes, 2007; Hockenhull et al., 2022; Shani & Pizam, 2009).

Inappropriate Visitor Behavior

Other visitors' behaviors were perceived to impact zoo animal welfare (Otegui Carles et al., 2023; Shani, 2012). Behaviors perceived to negatively impact welfare included: feeding animals (Almeida et al., 2017; Hassan, 2015; Mallapur et al., 2008; Price et al., 1994; Shani & Pizam, 2009; Syed et al., 2023); touching animals when they were not supposed to (Hassan, 2015; Price et al., 1994) or not following guidelines when doing so (dos Santos Coelho et al., 2022; Shani & Pizam, 2009); using flash photography in aquariums (e.g., perceived to "scare the little creatures," dos Santos Coelho et al., 2022, p. 70), making too much noise (Almeida et al., 2017; Rice et al., 2023; Syed et al., 2023); teasing (Khan et al., 2023; Mallapur et al., 2008; Shani & Pizam, 2009); and throwing items at animals (Shani & Pizam, 2009; Syed et al., 2023). Informing visitors of which behaviors can be detrimental to welfare and requesting a reduction or end to these behaviors may therefore not only improve the welfare of the animals, but also improve the welfare perceptions of other visitors. However, research exploring the efficacy of this form of interpretation is conflicting (Chiew, Butler, et al., 2019; Collins et al., 2020; Dancer & Burn, 2019; Kratochvil & Schwammer, 1997; Parker et al., 2018; Sherwen et al., 2014; Tay et al., 2023). Further work is suggested to inform approaches to promoting appropriate visitor behavior, including more efficacious methods of welfare interpretation.

Animal-Level Factors

Disproportionate Suffering

Zoos' perceived (in)ability to provide appropriate habitats impacted the perceived acceptability of captivity and thus welfare perceptions toward several taxa, including cetaceans (Curtin, 2006; Curtin & Wilkes, 2007; Hockenhull et al., 2022; Jiang et al., 2007; Wassermann et al., 2018), polar bears (Marseille et al., 2012), primates (Lukas & Ross, 2005; Lukas & Ross, 2014; Phillips & McCulloch, 2005), elephants

(Hacker & Miller, 2016; Miller et al., 2018; Tishler et al., 2020), birds (Rocha et al., 2016; Shani & Pizam, 2009), sloths (Alba et al., 2023), and pythons (Alba et al., 2023). Perceived intelligence (Curtin & Wilkes, 2007; Tishler et al., 2020), sentience (Phillips & McCulloch, 2005), and large size (Devlin & Ogle, 2022) were also contributing factors to perceived negative welfare. Explanations included, "the more intelligent I think an animal is, the more I think they are prone to boredom and that is what puts me off zoos or other captive displays. You can see that they get incredibly bored and the more intelligent the creature, the worse it is" (Curtin & Wilkes, 2007, p. 140). Even in the face of adversity (i.e., climate change), participants "emphasized the fact that a polar bear is part of nature and belongs there, despite the fact that a polar bear in the wild needs to work hard for survival. This group also believed that the polar bear actually does not belong in a zoo" (Marseille et al., 2012, p. 36). Yet, when members of the public were surveyed to explore the most desired traits of zoo animals, and which animals they most desired seeing, several species with these same traits (e.g., charismatic megafauna, such as gorillas) were reported as desirable (Carr, 2016). This creates a potential conflict for zoos, who need to house enough desirable species to attract visitors while simultaneously providing reassurance that these animals –possessing traits which also make them more challenging to house in welfare-friendly ways– receive adequate care within a captive setting. Indeed, a noted influential factor to captivity acceptability was 'likeability', as more 'likable' animals also garnered higher levels of welfare concern (Curtin, 2006; Fennell & Guo, 2023; Ogle & Devlin, 2022).

Animal Behavior

Many studies found that behaviors that visitors perceived to be active and natural were considered positive indicators of welfare (Almeida et al., 2023; Anderson et al., 2003; Ballantyne et al., 2021; Caplow, 2021; Chiapero et al., 2021; Chiew et al., 2021; Chiew, Hemsworth, et al., 2019; Curtin & Wilkes, 2007; Douglas & Katz, 2009; Gaengler & Clum, 2015; Godinez et al., 2013; Gurusamy et al., 2015; Hassan, 2015; Klenosky & Saunders, 2007; Lee, 2015; Marseille et al., 2012; Melfi et al., 2004; Meshabaz et al., 2020; Miller et al., 2018; Otegui Carles et al., 2023; Packer et al., 2018; Povey & Rios, 2002; Riggio et al., 2019; Roth et al., 2017; Salas et al., 2021; Tishler et al., 2020; Warsaw & Sayers, 2020). In contrast, behaviors perceived as abnormal or inactive were thought to be negative welfare indicators (Altman, 1998; dos Santos Coelho et al., 2022; Douglas & Katz, 2009; Godinez et al., 2013; Higgs, 2018; Kutska, 2009; Marseille et al., 2012; Melfi et al., 2004; Miller, 2012; Packer et al., 2018; Pollastri et al., 2021; Salas et al., 2021; Tofield et al., 2003; Turley, 1999; Veasey, 2022; Warsaw & Sayers, 2020; Woods, 2002). For example, inactivity was perceived negatively as "they lay around depressed or sit as if bored" (Packer et al., 2018, p. 64). Yet, visitors may not always accurately judge the so-called 'naturalness' of behaviors (Godinez et al., 2013), nor may they consistently equate natural behaviors with good welfare (Melfi et al., 2004).

Additionally, not all natural, active behaviors were perceived positively by zoo visitors, as several studies found that non-stereotypic walking behavior was viewed as a neutral (Melfi et al., 2004) or negative (Chiew, Hemsworth, et al., 2019; Pollastri et al., 2021) welfare indicator. Visitors may have viewed such locomotion to be abnormal, as walking perceived to be stereotypic pacing was often thought to indicate compromised welfare (Altman, 1998; Godinez et al., 2013; Miller, 2012; Woods, 2002). However, differentiation between stereotypic pacing and normal active behavior appeared to be difficult for many visitors (Godinez et al., 2013; Warsaw & Sayers, 2020). Therefore, several authors have stated the need for further research to explore visitor perceptions of stereotypic behavior and the impacts of interpretation on these perceptions (Godinez & Fernandez, 2019; Godinez et al., 2013; Learmonth et al., 2021; Miller, 2012). We recommend that future research includes attention to how visitors categorize observed behaviors (natural/abnormal). More broadly, given the general lack of research on visitor understanding and perception of stereotypic or other abnormal behaviors (e.g., excessive grooming), a better understanding of visitor accuracy regarding identification of stereotypic behaviors and their influence on perceptions may help inform more effective interpretation in this area.

There appears to be comparably less research focused on visitors' interpretation of, and perception toward, social behaviors and relationships between animals as affecting their welfare, and what research exists appears conflicting. For example, 'timidness' and aggression were sometimes perceived to indicate

negative welfare (Carson, 2014; Chiew et al., 2021), yet displays of dominance were also thought to indicate positive welfare (Packer et al., 2018). Impact of perceived aggression on welfare perceptions may vary amongst species, as, for example, Markwell et al. (2019) reported that zoo visitors expected to witness aggression in Tasmanian devils and were disappointed if aggressive behavior was absent. More consistently, beliefs about play and affiliative social behaviors (like allogrooming) translated to perceptions of positive welfare (Birenboim et al., 2015; Curtin, 2006; Curtin & Wilkes, 2007; Gurusamy et al., 2015; Higgs, 2018; Lacinak, 2023; Melfi et al., 2004; Ojo, 2019; Packer et al., 2018; Salas et al., 2021; Tofield et al., 2003). Yet play behaviors can appear extreme and even violent (Pellis & Pellis, 2017), and communication signals mediating social interactions between animals are often quite subtle (Slade-Cain et al., 2008). Whether visitors can accurately identify the function of such behaviors is therefore expected to mediate welfare perceptions, but this requires further research.

Finally, opportunities for breeding were considered beneficial to welfare (Chiapero et al., 2021; Douglas & Katz, 2009; Lacinak, 2023). However, not all zoo animals are given this opportunity, and when the opportunity does arise, the repercussions are not always acceptable to the public. For example, breeding may contribute to surplus animals and euthanasia, which can potentially result in decreased visit likelihood (Browning, 2018).

Apparent Health Status

Several studies have highlighted that the provision of appropriate and adequate medical care is expected and considered a requirement of good welfare for zoo-housed animals (Douglas & Katz, 2009; Gaengler & Clum, 2015; Howell et al., 2019; Otegui Carles et al., 2023; Shani, 2012; Shani & Pizam, 2009; Syed et al., 2023). Perceptions of good health were evident when animals appeared "well groomed" (Packer et al., 2018), as this signified that animals were "respected" (Yilmaz & Alpak, 2019). Additionally, signs of a healthy weight were viewed positively (Packer et al., 2018), but negative perceptions arose when animals were perceived to show signs of injury or disease, appeared in poor physical condition, or were under or overweight (Chiapero et al., 2021; Christou & Nikiforou, 2021; Meshabaz et al., 2020; Packer et al., 2018; Warsaw & Sayers, 2020; Woods, 2002). Indeed, expectations for robust health may override other expectations: for example, animals may have large, naturalistic enclosures with ample enrichment, but if they appear to be injured or unwell, perceived poor health status may be an overriding factor (Cardoso et al., 2018).

The degree to which physical health was prioritized against other welfare issues varied among studies. For example, Packer et al. (2018) found prioritization of health over affective state and perceived quality of care, while Warsaw and Sayers (2020) documented greater emphasis being placed on behavioral needs and naturalistic environments over health by zoo visitors. In other cases, no significant differences were found (Chiapero et al., 2021). Moreover, perceptions of zoo animal health were influential to visitor experience in some cases (Chiew et al., 2021; Packer et al., 2018), but not others (Veasey, 2022), and perceptions of animal happiness were more important to some visitors' emotional connections than were perceptions of health (Packer et al., 2018). The inclusion of multiple welfare dimensions in future research, including health, may generate a more holistic picture of visitor perceptions of zoo animal welfare and potential impacts to visitor experiences and behaviors.

Environmental-Level Factors

The Facility

*Zoo purpose and advertisement***.** How zoos identify themselves can shape public perceptions of welfare, with wildlife and safari parks favored over zoos (Otegui Carles et al., 2023; Shani, 2012) and marine parks viewed more critically (e.g., perceived as abusive, Hockenhull et al., 2022; Jiang et al., 2007; Wassermann et al., 2018 or lacking in educational value, Hockenhull et al., 2022). Zoos that promote themselves as centers for education and conservation were perceived to provide higher welfare than those

advertised primarily as places for entertainment (Ali et al., 2022; Arcari, 2023; Christou & Nikiforou, 2021). A common objective advertised by zoos is research (Rose & Riley, 2022), though terminology (specifically the term 'scientific research') can detrimentally impact perception of welfare by increasing perceived negative impacts of captivity and decreasing the perceived importance of zoo animal-based research (Carson, 2014). Although considered ethically justifiable (See *beliefs about captivity*), research was sometimes viewed as unenjoyable for the animals taking part (Perdue & Robinson, 2021). However, this trend was inconsistent, as other work found strong visitor agreement with the importance of conducting research in zoos and beliefs that research was good for the animals (Waller et al., 2012). Additionally, animals in the wild were also perceived to benefit from research, for example, "the research that's done there that allows the biologists to know more about how to keep them happy and healthy…. And all that research hopefully will be able to increase their longevity and livelihood in their natural habitat" (Caplow, 2021, p. 196).

Images used in zoo advertising also impact perceptions, with human proximity to animals (Shaw et al., 2022) and keeper presence and captive settings (Spooner & Stride, 2021) generally resulting in more negative welfare perceptions, though effects varied by species and not all studies have found this effect (Alba et al., 2023). Interestingly, negative perceptions associated with zoo images increased the expressed likelihood of conservation donations, though this also varied between species (Spooner & Stride, 2021).

Facility size. Relatively few studies have assessed the impact of establishment size on welfare perceptions, but there is some suggestion that smaller establishments were viewed as less commercial and exploitative (Christou & Nikiforou, 2021), but also less governed by adequate welfare laws and lacking in sufficient resources to provide quality care (Shani & Pizam, 2009).

The Exhibit

Naturalistic enclosures. Consistent amongst the reviewed articles was that naturalistic exhibits (i.e., exhibits designed to be aesthetically appealing and mimic natural habitats, Lukas & Ross, 2014) were associated with more positive welfare perceptions (Ahmad et al., 2015; Alba et al., 2023; Almeida et al., 2017; Almeida et al., 2023; Ballantyne et al., 2021; Blaney & Wells, 2004; Chiew et al., 2021; Chiew, Hemsworth, et al., 2019; Christou & Nikiforou, 2021; Davey, 2007; Gabriel & Montenegro, 2021; Greaves et al., 1993; Gurusamy et al., 2015; Hassan, 2015; Karanikola et al., 2020; Karanikola et al., 2014; Kutska, 2009; Lee, 2015; Markwell et al., 2019; McPhee et al., 1998; Melfi et al., 2004; Miller et al., 2018; Mun et al., 2013; Nakamichi, 2007; Ogle & Nelson, 2022; Otegui Carles et al., 2023; Packer et al., 2018; Povey & Rios, 2002; Pragg, 2019; Price et al., 1994; Reade & Waran, 1996; Shani, 2012; Shani & Pizam, 2009; Snyder & Barrett, 2023; Tishler et al., 2020; Tofield et al., 2003; Warsaw & Sayers, 2020; Wilson et al., 2003; Woods, 2002; Yilmaz et al., 2010). However, naturalistic enclosures may also restrict expression of natural behavior as naturalistic aesthetics do not always equate to usable space (Melfi et al., 2004; Ross et al., 2011). Even if the enclosure is naturalistic, the presence of barriers was perceived negatively if the materials used were reminiscent of bars and/or cages as animals were perceived as confined and imprisoned (Almeida et al., 2023; Christou & Nikiforou, 2021; Greaves et al., 1993; Pragg, 2019; Tofield et al., 2003; Woods, 2002), even where the use of these barriers could increase the animals' useable space (Ross et al., 2011). However, enclosures perceived to allow for (apparent) free ranging were perceived as beneficial to welfare (Almeida et al., 2017; Mun et al., 2013; Price et al., 1994), even if these same enclosures exposed animals to perceived risk of harm (Almeida et al., 2017; dos Santos Coelho et al., 2022; Price et al., 1994). Ultimately, how visitors weigh the relative benefits of so-called natural environments against behavior expression is unclear, suggesting the need for further research (Melfi et al., 2004).

Enclosure size. Unsurprisingly, enclosures perceived as small were consistently associated with more negative welfare perceptions, compared to larger, apparently spacious, enclosures which were perceived to better meet animals' needs by providing adequate space for natural behaviors and physical comfort (Agyeman & Asebah, 2023; Almeida et al., 2023; Arcari, 2023; Ballantyne et al., 2021; Chiapero

et al., 2021; Chiew et al., 2021; Christou & Nikiforou, 2021; Curtin & Wilkes, 2007; Devlin & Ogle, 2022; Hassan, 2015; Howell et al., 2019; Kutska, 2009; Lee, 2015; Markwell et al., 2019; Marseille et al., 2012; Meshabaz et al., 2020; Miller et al., 2018; Ojo, 2019; Otegui Carles et al., 2023; Packer et al., 2018; Povey & Rios, 2002; Price et al., 1994; Shani, 2012; Shani & Pizam, 2009; Snyder & Barrett, 2023; Tishler et al., 2020; Tofield et al., 2003; Wilson et al., 2003; Woods, 2002). How big an enclosure should be (for each species) and how visitors render judgement remains ambiguous, as qualitative findings have often been limited in their description (e.g., "looked too small," Kutska, 2009, p. 298). Perceptions of enclosure size adequacy may be influenced by group size (Sherman et al., 2022) and exhibit location (indoors potentially worse than outdoors) (Devlin & Ogle, 2022), but visitor rationale for these judgements also remains unclear. Furthermore, enclosure size perceptions may be influenced by animal behavior, with perceived abnormal behavior (Woods, 2002) and natural behavior restriction (Curtin & Wilkes, 2007; Tofield et al., 2003) reducing size adequacy perceptions, and perceived natural behavior display increasing perceptions (Howell et al., 2019; Marseille et al., 2012; Packer et al., 2018).

Enrichment. Use of environmental enrichment consistently had a positive impact on welfare perceptions (Agyeman & Asebah, 2023; Alarape et al., 2015; Ballantyne et al., 2021; Birenboim et al., 2015; Caplow, 2021; Chiapero et al., 2021; Christou & Nikiforou, 2021; Davey, 2007; Devlin & Ogle, 2022; Douglas & Katz, 2009; Fennell & Guo, 2023; Gaengler & Clum, 2015; Gurusamy et al., 2015; Higgs, 2018; Ivana et al., 2017; Jacobson et al., 2017; Lee, 2015; McPhee et al., 1998; Otegui Carles et al., 2023; Perdue et al., 2012; Perdue & Robinson, 2021; Povey & Rios, 2002; Razal & Miller, 2019; Reade & Waran, 1996; Rice et al., 2021; Riggio et al., 2019; Roth et al., 2017; Salas et al., 2021; Shani, 2012; Sneddon et al., 2020; Tofield et al., 2003; Veasey, 2022; Woods, 2002), including feeding-related enrichment (Gaengler & Clum, 2015; Riggio et al., 2019; Roth et al., 2017; Salas et al., 2021; Sneddon et al., 2020). Positive perceptions of feeding enrichment are not surprising, as the act of feeding in any circumstance increased welfare perceptions (Melfi et al., 2004; Pollastri et al., 2021; Riggio et al., 2019; Salas et al., 2021). Yet not all visitors were aware of enrichment in general (Ivana et al., 2017) or which items within an enclosure are enriching (Kutska, 2009; Salas et al., 2021). While both naturalistic and unnaturalistic enrichment were perceived positively (Jacobson et al., 2017; Kutska, 2009; McPhee et al., 1998; Razal & Miller, 2019; Riggio et al., 2019; Salas et al., 2021), unnaturalistic enrichment may be more easily identifiable to visitors (Kutska, 2009). Visitor perceptions may be enhanced or improved by the knowledge of enrichment strategies (Reade & Waran, 1996). More targeted signposting as to enrichment strategies in use within zoo enclosures may be useful in improving visitor knowledge of enrichment.

Group size. Many studies identified the importance of zoo animals being kept in species-appropriate group sizes and having social needs met in mediating perceptions of welfare (Almeida et al., 2017; Birenboim et al., 2015; Chiapero et al., 2021; Christou & Nikiforou, 2021; Devlin & Ogle, 2022; Douglas & Katz, 2009; Fennell & Guo, 2023; Gurusamy et al., 2015; Lacinak, 2023; Ojo, 2019; Rocha et al., 2016; Sherman et al., 2022; Veasey, 2022; Warsaw & Sayers, 2020), with social isolation being a primary concern (Almeida et al., 2017; Birenboim et al., 2015; Douglas & Katz, 2009; Ojo, 2019; Rocha et al., 2016). At the same time, one study identified that visitors also worry about overcrowding (Christou & Nikiforou, 2021) and another showed that mixed species exhibits provoked concern if the mix included an animal perceived as dangerous (Hassan, 2015). Humans are generally considered a social species (Lieberz et al., 2021) and anthropomorphizing the needs and feelings of animals is common (Mota-Rojas et al., 2021). Perceptions such as "no animal should be alone" (Rocha et al., 2016, p. 73) are therefore unsurprising, but further research is required to identify what factors are influential to appropriate group size perceptions, particularly for species considered more solitary in nature.

Condition of the enclosure. The reviewed literature was consistent that zoo visitors expect enclosures to be clean and well maintained (Ahmad et al., 2015; Almeida et al., 2017; Arcari, 2023; Chiew et al., 2021; Christou & Nikiforou, 2021; Karanikola et al., 2020; Karanikola et al., 2014; Khan et al., 2023; Kutska, 2009; Mearns & Liebenberg, 2018; Miller et al., 2018; Ojo, 2019; Packer et al., 2018; Syed et al.,

2023; Tofield et al., 2003; Woods, 2002); free from feces (Hassan, 2015; Woods, 2002); safe (Hassan, 2015; Karanikola et al., 2014; Ojo, 2019; Packer et al., 2018); and contain appropriate lighting (Caplow, 2021; Hassan, 2015) and ventilation (Hassan, 2015). Additionally, newer facilities were perceived as more beneficial to welfare over older facilities (Rocha et al., 2016; Shani & Pizam, 2009; Turley, 1999).

Diet. Beliefs that zoo animals had access to adequate and appropriate diets and clean water were consistently associated with more positive welfare perceptions amongst visitors (Almeida et al., 2017; Chiapero et al., 2021; Devlin & Ogle, 2022; Fennell & Guo, 2023; Gaengler & Clum, 2015; Greaves et al., 1993; Gurusamy et al., 2015; Hassan, 2015; Kutska, 2009; Meshabaz et al., 2020; Ojo, 2019; Otegui Carles et al., 2023; Packer et al., 2018; Roth et al., 2017; Shani, 2012; Shani & Pizam, 2009; Syed et al., 2023; Warsaw & Sayers, 2020), although visitors' conception of what constitutes "appropriate" is unclear. Carcass feeding was perceived as beneficial to welfare (Gaengler & Clum, 2015; Roth et al., 2017), though reasoning behind such perceptions is unclear, as natural behavior display was not always considered an indicator of welfare (Gaengler & Clum, 2015).

Sensory stressors. Exhibit locations exposing animals to noise from visitors and infrastructure were perceived to reduce welfare (Almeida et al., 2017; Rice et al., 2021; Syed et al., 2023; Wilson et al., 2003), though noise in general or noise created by visitors was also sometimes perceived as enriching (Rice et al., 2021; Rice et al., 2023; Salas et al., 2021). Proximity to other animals also provoked welfare concern (Almeida et al., 2017; Tofield et al., 2003), though it is not clear if concerns focused exclusively on prey species and the potential stress from the threat of predation, or if concerns extended to the welfare of predatory species who may become frustrated by an inability to perform hunting behaviors.

Temperature. Perceived thermal comfort was influential to welfare perceptions in some cases (Almeida & García Fernández, 2021; Kutska, 2009; Packer et al., 2018; Tofield et al., 2003), although not others (Warsaw & Sayers, 2020; Wilson et al., 2003). This factor may therefore be more relevant for animals known to originate from more extreme climates that differ from the climate of the zoo location. For instance, polar bears were perceived as "*very pitiful, they are sitting in the heat all the time"* (Kutska, 2009). Nonetheless, provision of facilities to protect from weather exposure was expected and perceived as beneficial to welfare (Almeida & García Fernández, 2021; Douglas & Katz, 2009; Price et al., 1994; Tofield et al., 2003; Wilson et al., 2003).

Welfare Interpretation

Finally, several studies have suggested that interpretation regarding zoo animal welfare may be beneficial to improving visitor perceptions of welfare (Anderson et al., 2003; Gaengler & Clum, 2015; Godinez et al., 2013; Kutska, 2009; Melfi et al., 2004; Miller, 2012; Minarchek et al., 2021; Packer et al., 2018; Warsaw & Sayers, 2020), but results are not consistent across studies. For example, perceptions of welfare seem to improve when interpretation includes information about the institution's welfare accreditation, though improvement was lower in participants who initially perceived animals to be experiencing poor welfare (Warsaw & Sayers, 2020). In contrast, interpretation containing information regarding the choices provided to animals did not appear to impact visitor perceptions of welfare (Minarchek et al., 2021). Similarly, several articles found that interpretation regarding care practices improved welfare perceptions (Anderson et al., 2003; Carter et al., 2020; Chiew, Hemsworth, et al., 2019; Okabe & Matsunaga, 2021; Woods, 2002), though only minor impacts were observed elsewhere (Chiapero et al., 2021), and some findings suggest that other variables such as animal activity may be more influential than interpretation (Anderson et al., 2003). Further exploration of the impacts of specific elements of interpretation may help clarify these inconsistencies.

Impact of Welfare Perceptions on Visitor Experience and Behavior

Negative animal welfare perceptions were commonly reported to have a negative impact on zoo visitor experience (Agyeman & Asebah, 2023; Birenboim et al., 2015; Chiew et al., 2021; Curtin & Wilkes, 2007; Dirsehan, 2010; Godinez et al., 2013; Veasey, 2022; Woods, 2002) and satisfaction (Agyeman & Asebah, 2023; Ballantyne & Packer, 2016; Karanikola et al., 2020; Karanikola et al., 2014; Lee, 2015; Moorhouse et al., 2015; Packer et al., 2018), though welfare perception was not always a contributing factor to visitor satisfaction (Shinwary et al., 2020). Positive perceptions of welfare improved both visitor happiness (which in turn increased visitor enjoyment and improved experience) (Klenosky & Saunders, 2007) and emotional experience/connection to the animals (Birenboim et al., 2015; Howell et al., 2019; Markwell et al., 2019; Miller et al., 2018; Minarchek et al., 2021; Packer et al., 2018). In turn, positive emotional experiences and satisfaction were pivotal factors in the decision making of zoo visitors when considering revisiting (Javed et al., 2022), and emotional experience may also impact conservation learning (Powell & Bullock, 2014). In contrast, negative perceptions of welfare were reported to reduce the likelihood of visiting (Hockenhull et al., 2022; Jiang et al., 2007; Mannan et al., 2017; Miller, 2012; Moorhouse et al., 2017; Moorhouse et al., 2022; Muzzo et al., 2023; Turley, 1999; Wassermann et al., 2018), and donating to conservation efforts (Klenosky & Saunders, 2007; Miller, 2012; Miller et al., 2018; Sampaio et al., 2021).

Yet, the qualitative data presented in several of the reviewed studies suggest that negative perceptions of welfare may not always impact the likelihood of zoo visitation. For example, self-interest was a justification for captivity despite welfare concerns (see *beliefs about captivity*) and the desire of children to attend zoos was often given as an overriding factor in the decision to visit, despite conflicting negative welfare perceptions (Christou & Nikiforou, 2021; Hockenhull et al., 2022; Wassermann et al., 2018). Cultural differences may also inform visit frequency despite welfare perceptions (Moorhouse et al., 2017). Negative perceptions of zoo animal welfare may therefore not actively prevent zoo visits, even by those who hold strongly negative beliefs about the ethics of zoos. The impacts of these conflicting feelings and actions, and how these in turn impact the behaviors of such 'reluctant visitors', should thus be more clearly addressed by future research.

In general, 'non-visitors' were considered to have lower perceptions of zoo animal welfare when compared to those defined as 'zoo visitors,' though welfare perceptions of both populations were influenced by similar factors like animal behavior and enclosure size (Davey, 2007; Reade & Waran, 1996; Turley, 1999). However, the term non-visitor seems to be used interchangeably to denote both people who choose not to visit zoos (Davey, 2007; Turley, 1999) and those merely not on site at a zoo at the time of research (Davey, 2007; Reade & Waran, 1996). This may create ambiguous results; therefore, having a definitive definition of non-visitors may be beneficial for meaningful comparisons. Godinez and Fernandez (2019) encourage future inclusion of comparisons between visitors and non-visitors to provide a "true control group" to evaluate the efficacy of zoo-based education amongst these two populations. We propose defining 'non-visitors' as those who do not visit zoos. Sub-categories of non-visitors may consist of those who choose not to visit on animal welfare grounds, general lack of interest, cost, or other restricting factors. Each sub-category likely has differing opinions of zoos, which may impact perception research. 'Zoo visitors' may be defined as those who visit zoos and subcategorized as on or off site.

Summary

The objectives of this systematic review were two-fold: first, to identify the zoo attributes that influence visitor perceptions of zoo animal welfare, and second, to characterize how positive or negative perception of animal welfare impacts visitor attitudes, experiences, and behavior. A total of 114 articles were reviewed and ultimately nine themes (3 human-level [*ethical considerations*, *direct human-animal interactions*, *inappropriate visitor behaviour*], 3 animal-level [*disproportionate suffering*, *animal behaviour*, *apparent health status*], and 3 environmental-level [*the facility*, *the exhibit*, *welfare interpretation*]) described to capture attributes influencing zoo animal welfare perceptions (Objective 1).

One theme (*impact of welfare perceptions on visitor experience and behavior*) summarised how the valence of welfare perceptions consistently influenced visitor experiences and behavior (e.g., negative perceptions contributing to negative experiences and vice versa, Objective 2). Links between themes were evident, highlighting how and why each attribute was influential to welfare perceptions, which in turn have the potential to impact visitor attitudes, experiences, and behaviors.

Links between themes also provided insight into how zoos may potentially improve their communication with visitors regarding zoo animal welfare, but the *welfare interpretation* theme highlighted a need for further research to identify effective strategies to engage visitors with welfare-related interpretation. Effective communication is also required in instances where visitors have misinterpreted the impact of factors such as group size, enclosure design, and animal behavior on welfare, which can lead to inaccurate negative perceptions of animal welfare. Such misinterpretations may be mitigated through interpretation about research and animal welfare, though additional research in this area is required. As negative perceptions can result in visitor behaviors which may diminish the ability of zoos to achieve organizational goals such as conservation, education, and entertainment, establishing how zoos may effectively communicate with visitors regarding zoo animal welfare is important. However, of primary importance is the impact visitor perceptions may have on zoo animal welfare, as in the case of inappropriate visitor behaviors which may negatively impact animals in addition to other visitors' experiences. Moreover, a better understanding of visitor perceptions may help highlight areas where zoos may benefit from improving. For example, the themes *condition of the enclosure* and *apparent health status* highlighted factors which (if perceived accurately by visitors) may detrimentally impact the welfare of captive zoo animals if not adequately addressed by zoos. More research is required to ascertain why visitors are reaching judgements of some themes, such as *enclosure size*, *group size*, and *animal behavior*, to inform effective interpretation development.

Limitations

We acknowledge that studies meeting inclusion criteria may have been inadvertently missed despite our adherence to the PRISMA guidelines. Furthermore, the replicability of searches performed using Google Scholar can be impacted by factors such as location, and EBSCOhost results can vary dependent on institutional subscriptions (Gusenbauer & Haddaway, 2020). Nonetheless, measures were taken to limit negative impacts to this review's methodology (e.g., search strategy assessment by an academic librarian, independent searches by two researchers, and utilization of four search systems). The exclusion of gray literature and studies not available in the English language may have introduced result bias, although inclusion can reduce search reproducibility (Paez, 2017) and introduce translation errors (Balk et al., 2013). Gray literature on the topic of visitor perceptions of welfare is often conducted by zoos but not published, making it difficult or impossible to obtain through the search strategy and creating difficulties when striving for consistency and reproducibility of the search. Therefore, such research should be encouraged to be published in peer-reviewed journals so this knowledge can be incorporated and more easily accessed to further our understanding of visitor perceptions of zoo animal welfare.

Future Research

While studies included in this review have provided valuable insight into how visitors perceive animal welfare in zoos, several gaps (Table 2) or inconsistencies were identified. We conclude by sharing seven recommendations to guide future work in this area (Figure 2). These recommendations focus on improving consistency in measures used to gauge visitor perceptions, as follows:

1. *Define key terms.* Ambiguity regarding how studies define key terms (e.g. animal welfare, non-visitors) can hinder direct comparisons. Additionally, as disagreement regarding definitions is evident between researchers (Birch, 2022), the potential for variations between visitors is probable. Establishment of clear definitions may therefore be beneficial to future research.

2. *Consider the dimensionality of welfare conceptions in measurement of perceptions.* Variations between how welfare perceptions are measured (e.g. welfare as happiness, health, ability to display natural behaviors, quality of care, overall welfare) can hinder direct comparisons between studies. Additionally, visitors consider some measurement categories to be more important to welfare than others, and category hierarchy varies between visitors (Chiapero et al., 2021; Packer et al., 2018; Warsaw & Sayers, 2020). Researchers may risk missing valuable perspectives or even misrepresenting their research population's views by imposing their own conceptions of welfare onto the measurement instruments. The inclusion of multiple welfare measurements, in addition to open-ended questioning, may therefore be beneficial to future research.

3. *Consider connecting themes for confounding impacts.* Connected themes (i.e. attributes highlighting how/why other attributes were influential to welfare perceptions) should be considered as potential confounding factors when designing perception research. Exclusion of connected themes may provide an incomplete or inaccurate overview of perceptions, and therefore inclusion may increase result validity.

4. *Include emotional impacts.* Emotional response to influential factors appears to be intertwined with experiences and perceptions (Howell et al., 2019; Klenosky & Saunders, 2007; Markwell et al., 2019; Miller et al., 2018; Minarchek et al., 2021; Packer et al., 2018): inclusion of emotional measurements is therefore also suggested to obtain a more in-depth understanding of how perceptions may impact visitor attitudes, experiences, and behaviors.

5. *Include a range of facility types.* How zoos choose to identify themselves (e.g. zoo, safari park, marine park) can impact welfare perceptions (Greaves et al., 1993; Otegui Carles et al., 2023; Shani, 2012), yet most research has taken place within facilities identified as zoos. Expanding research to encompass a range of facilities may therefore be beneficial as results may not easily translate between facilities.

6. *Include a range of geographical locations.* Cultural differences can impact welfare perceptions (Moorhouse et al., 2017; Otegui Carles et al., 2023), yet research in this area is limited to several geographic regions, notably North America. It may therefore be beneficial for research to expand and explore perceptions in a wider range of geographical locations.

7. *Include a range of animal classes.* Much of the work in this area has focused on perceptions toward the welfare of mammals; however, these perceptions do not necessarily translate to other animal classes, as human empathy and compassion towards animals can be dependent on how phylogenetically close the species is to humans (Miralles et al., 2019). Future research may therefore benefit from including an increased range of animal classes to understand welfare perceptions across a range of contexts.

Table 2

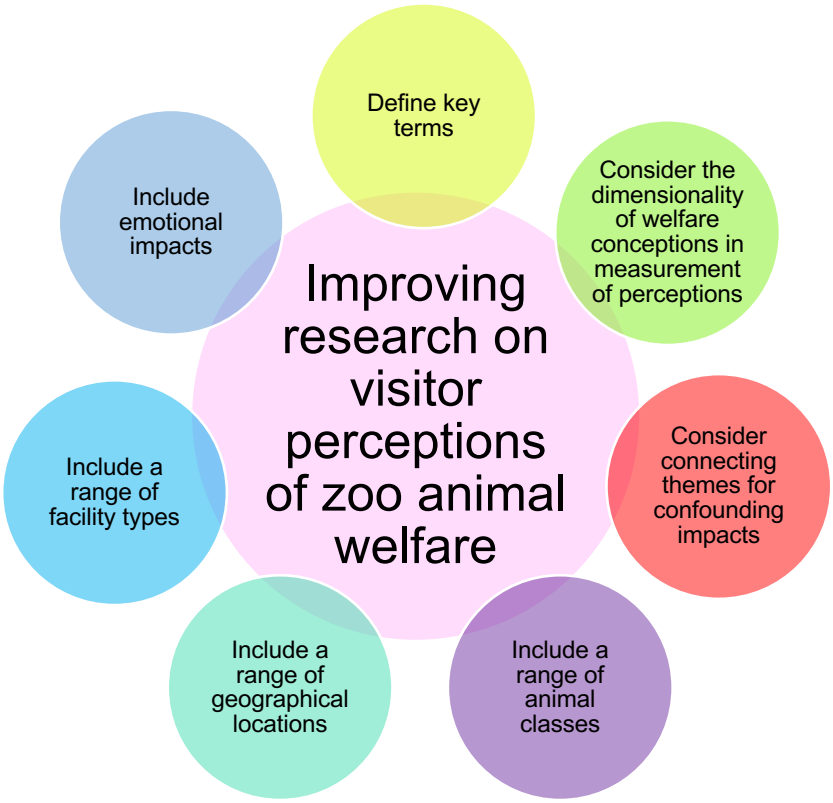
A Summary of Animal Types, Facility Types, and Geographical Locations, Currently Represented or Underrepresented in Existing Research for Each Theme

	Beliefs about captivity	Animal rights	Direct human-animal interactions	Inappropriate visitor behavior	Disproportionate suffering	Animal behavior	Apparent health status	Zoo purpose & advertisement	Facility size	Naturalistic enclosures	Enclosure size	Enrichment	Groups size	Condition of the enclosure	Diet	Sensory stressors	Temperature	Welfare interpretation	Impact on visitor experience & behavior
Animal type																			
Unspecified	57.1	63.4	19	81.8	0	35.7	70.8	37.5	100	44.2	51.6	40	60	75	61.1	71.4	37.5	12.5	54.8
Mammals	42.9	36.4	61.9	18.2	77.8	59.5	20.8	62.5	0	48.8	38.7	54.3	26.7	20	27.7	28.6	62.5	62.5	41.9
Reptiles	4.8	4.5	9.5	0	16.7	2.4	8.3	18.75	0	7	6.4	2.9	13.3	0	5.6	0	0	0	0
Birds	4.8	9.1	19	0	11.1	11.9	4.2	12.5	0	11.6	9.7	8.6	0	5	5.6	0	0	25	3.3
Insects	2.4	0	4.8	0	0	0	0	12.5	0	0	0	0	0	0	0	0	0	0	0
Fish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amphibians	0	0	0	0	11.1	0	4.2	0	0	0	3.2	2.9	6.7	0	5.6	0	0	0	0
Invertebrates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Facility type																			
Zoo	88.1	81.8	81	90.9	66.7	88.1	95.6	81.25	100	97.7	96.7	94.3	93.3	100	100	100	100	100	80.6
Safari Park	4.8	0	9.5	18.2	11.1	9.5	8.3	12.5	0	7	9.7	5.7	0	5	11.1	0	0	0	6.4
Wildlife Park	7.1	4.5	9.5	18.2	0	4.8	8.3	18.7	0	7	6.4	8.6	0	0	16.7	0	0	0	0
Aquarium	9.5	4.5	14.3	27.3	5.6	9.5	8.3	18.7	0	9.3	9.7	11.4	0	5	11.1	0	0	0	9.7
Sanctuary	0	0	0	0	0	2.4	0	0	0	0	0	0	0	0	0	0	0	0	9.7
Marine Park	16.7	22.7	23.8	9.1	33.3	4.8	4.2	18.7	50	4.6	9.7	0	0	0	0	0	0	0	12.9
Unspecified	0	0	0	0	0	2.4	4.2	0	0	0	0	2.9	6.7	0	0	0	0	0	3.3
Geographical location																			
North America	31	18.2	33.3	18.2	55.6	35.7	21.2	37.5	50	32.6	35.5	40	33.3	20	44.4	14.3	50	25	38.7
United Kingdom	21.4	22.7	14.3	18.2	22.2	9.5	4.2	37.5	0	11.6	9.7	8.6	0	5	5.6	28.6	12.5	0	16.1
Europe	21.4	22.7	19	18.2	11.1	14.3	12.5	12.5	50	16.3	12.9	17.1	26.7	25	11.1	28.6	12.5	0	16.1
Asia	16.7	18.2	14.3	36.4	11.1	14.3	29.2	6.2	0	20.9	12.9	11.4	20	20	27.8	14.3	0	12.5	19.3
Africa	0	0	4.8	0	0	4.8	8.3	0	0	0	6.4	8.6	6.7	10	5.6	0	0	0	9.7
Oceania	9.5	9.1	9.5	0	0	21.4	16.7	6.2	0	18.6	19.3	14.3	13.3	20	11.1	14.3	25	50	16.1
South America	2.4	4.5	4.8	9.1	0	4.8	4.2	0	0	2.3	3.2	2.9	6.7	0	5.6	0	0	12.5	0
Unspecified	0	0	0	0	0	0	4.2	0	0	0	0	0	0	0	0	0	0	0	3.3
Total articles	42	22	21	11	18	42	24	16	2	43	31	35	15	20	18	7	8	8	31

Note. Human-level factors affecting perceptions of welfare are shaded in purple; animal-level factors in blue; and environmental-level factors in green. The impact of those perceptions to visitor experience and behavior is shaded in orange. Total articles represents how many articles supplied data relevant to each theme. The values in each cell represent the percentage of articles within each theme which included the specific contexts (i.e., animal and facility types and locations) listed in the lefthand column. Cells with high percentages are the most represented contexts within each theme, and low percentages are under-represented within the data.

Figure 2

Recommendations for the Study of Visitor Perceptions of Zoo Animal Welfare



Conclusion

Key human, animal, and environmental factors were identified as influential to how visitors perceive zoo animal welfare, both positively and negatively, and these perceptions can subsequently impact visitor attitudes, experiences, and behavior. Zoos must therefore consider how visitor concerns can be addressed and positive perceptions enhanced, whilst primarily ensuring animals are indeed receiving high standards of care. Yet, several areas require further exploration to better understand what factors influence the perceptions of welfare in zoo animals, and research exploring how zoos may effectively communicate with visitors regarding animal welfare is currently limited. Further work addressing the gaps highlighted in existing research may benefit from increased consistency when assessing visitor perceptions of zoo animal welfare and may therefore benefit from the developed guidelines.

Acknowledgements

With thanks to Andrew Cooke (Department of Life and Environmental Sciences, University of Lincoln) for his advice and guidance regarding table design and to Carole Bee (University of Lincoln Library) for her advice and assessment of the search strategy.

Author Contributions: Conceptualization: NP, LM and JC; Methodology design: All; Investigation: NP and BV; Formal analysis: NP; Writing-original draft: NP; Writing- review & editing: LM, JC, and BV; Visualization: All.

Funding: The authors received no specific funding for this work.

Conflict of Interest: The authors declare no conflicts of interest.

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Supplementary Materials

The following supplementary material (S1-S5) can be accessed at Phillips, N. C., Maréchal, L., Ventura, B., & Cooper, J. (2024). Dataset for: How Do Perceptions of Zoo Animal Welfare Influence Public Attitudes, Experiences, and Behavioral Intentions? A Mixed-Methods Systematic Review. https://osf.io/v97eq/