



Animal-Visitor Interactions and the Visitor Experience: Visitor Behaviors, Attitudes, Perceptions, and Learning in the Modern Zoo

Mark James Learmonth^{1,*}, Samantha J. Chiew¹, Andrea Godinez², and Eduardo J. Fernandez³

¹Animal Welfare Science Centre, Faculty of Veterinary and Agricultural Sciences, The University of Melbourne

²Burke Museum of Natural History and Culture, The University of Washington

³School of Animal and Veterinary Sciences, The University of Adelaide

*Corresponding author (Email: markjameslearmonth@gmail.com)

ORCID: MJL: <https://orcid.org/0000-0002-2237-0665>, SJC <https://orcid.org/0000-0003-2514-1136>,

AG <https://orcid.org/0000-0003-3660-276X>, EJF: <https://orcid.org/0000-0001-5444-6604>

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Abstract – Animal-Visitor Interactions (AVIs) have become commonplace in zoological institutions and facilities globally. However, most AVI research focuses on the effects of visitors on the welfare of animals, with considerably fewer studies examining the visitor experience itself. Furthermore, robust evaluations of the efficacy of zoo education programs and engagements for increasing visitor awareness of conservation issues, and for fostering long-term pro-conservation behavior changes in them, are under-researched. This paper reviews the current literature that pertains to the effects of zoo visitation and AVIs on visitor perceptions, beliefs, and attitudes. We briefly note some of the known effects that zoo visitors have on zoo animals, then explore the effects that factors such as enclosure design, animal visibility and behaviors, and AVIs can have on visitors' overall experience whilst attending the zoo. We suggest that future research needs to more closely examine the relationships and interactions between zoo visitors and zoo animals; why some zoo visitors over others repeat visitation; what the differences in beliefs and attitudes may be between “zoo visitors” and “non-zoo visitors” (i.e., other general public); and to make a concerted effort to understand: (1) what visitors do after they leave the zoo, and (2) whether visitors adopt long-term pro-conservation behaviors into their daily lives. We further suggest that future research needs to start investigating indirect measures related to the visitor experience, such as: (a) individual conservation support outside of the zoo; (b) internet activity; (c) changes in sustainable purchasing practices related to knowledge gains; (d) financial investment in sustainable or ethical companies after knowledge gains; (e) and the longitudinal effects of zoo visits.

Keywords – Animal-visitor interactions, Human-animal interactions, Visitor attitudes, Visitor behaviors, Visitor experience, Visitor learning, Visitor perceptions

Conservative estimations of annual visitation have indicated that zoos and aquariums, globally, receive at least 700 million visitors every year (Gusset & Dick, 2011; Moss et al., 2014). Historically, zoos were viewed as a leisure activity – venues primarily attended for human awe and entertainment (Carr & Cohen, 2011; Gray, 2017; Reading & Miller, 2007; Tribe & Booth, 2003). Many modern zoos have attempted to pivot from this, to instead be seen as educational and conservation-focused institutions, and

many visitors have indeed reported viewing zoos as educational destinations (Briseño-Garzón et al., 2007; Falk et al., 2008; Packer & Ballantyne, 2002). However, entertainment may still be one of the most common drivers for zoo and aquarium visitation by the public (Roe & McConney, 2015). Animal-Visitor Interactions (AVIs) are quite common in zoological institutions and facilities globally, yet critical examination and evaluation of their impacts (upon both animals and visitors) are conspicuously absent, or are at least underreported (D’Cruze et al., 2019). Nonetheless, the rate of publication of new research and literature examining the effects that zoo visitors may have upon zoo animals is quickly increasing (Binding, et al., 2020; Sherwen et al., 2018; Sherwen & Hemsworth, 2019).

The effects of zoo visitors on zoo animals are now well documented, ranging from highly negative, to innocuous, to positive experiences (Claxton, 2011; Collins et al., 2016; Davey, 2007a; D’Cruze et al., 2019; Fernandez et al., 2009, 2021; Jones et al., 2016; Kreger & Mench, 1995; Mitchell et al., 1992; Sherwen & Hemsworth, 2019). Some examples of factors that influence animal responses to visitors have included visitor noise-level, proximity, and presence versus absence of visitors (Carder & Semple, 2008; Chiew, Butler et al., 2019; Chiew et al., 2020, 2021; Larsen et al., 2014; Learmonth et al., 2018; Sherwen, Harvey et al., 2015; Sherwen, Hemsworth et al., 2015; Sherwen, Magrath et al., 2015). Additionally, these visitor effects on zoo animals have been examined through both the behavioral responses of the animals and through physiological responses, such as the sampling of glucocorticoid concentrations through non-invasive fecal glucocorticoid metabolites (FGM; Chiew, Butler et al., 2019; Chiew et al., 2021; Fanson & Wielebnowski, 2013; Keay et al., 2006; Pifarré et al., 2012; Kuhar, 2008; Sellinger & Ha, 2005; Sherwen et al., 2014; Sherwen & Fanson, 2015; Sherwen, Harvey et al., 2015; Sherwen, Magrath et al., 2015). For a recent review of the visitor effects on zoo animals, see Sherwen and Hemsworth (2019).

An area of inquiry that is still considerably lacking in the scientific literature, though, is that of the effects that zoo visits – and, in particular, viewing of (or encounters with) zoo animals during those visits – have on the zoo visitors. On top of this, there have been almost no studies that have compared beliefs, attitudes and knowledge of zoo practices between zoo visitors and non-zoo visitors (Fernandez, 2019; Godinez & Fernandez, 2019). The main limitation for performing these kinds of comparative studies is the high degree of difficulty in recruiting sufficient suitable candidates, especially in the non-zoo visitor group. However, there is now a moderate amount of published literature in education-related fields that has explored the efficacy of zoos’ educational and/or advocacy programs on both short and long-term conservation-related learning outcomes in zoo visitors that is of importance here (Collins et al., 2016; 2019; 2020a; 2020b; Falk et al., 2007; Hayward & Rothenberg, 2004; Jensen, 2014a; Jensen et al., 2017; Lindemann-Matthies & Kamen, 2005; Moss & Esson, 2010; Moss et al., 2015, 2017a, b; Skibins & Powell, 2013; Spooner et al., 2019; Spooner, Jensen et al., 2021).

This review shall explore the modest amount of AVI research that has been conducted in fields such as ethology, animal welfare, visitor studies, education, and psychology, exploring a few key examples of the known effects visiting a zoo has on the zoo visitor. We initially note what is known about the “visitor effect,” or what effect visitors have on the behaviors and overall welfare of zoo animals. However, much of the paper will focus specifically on the effects that visiting zoos generally and AVIs specifically have on the zoo visitor. For instance, we examine aspects of the zoo experience for zoo visitors as they relate to visitor attitudes, perceptions, and behaviors. Additionally, we shall discuss features of the zoo environment that have already been shown to affect zoo visitors’ experiences and learning, and then pivot to the important discussion of where future research efforts may be best placed, to understand the bi-directional nature of AVIs in zoos.

What is the Visitor Experience?

The “visitor experience” when at a zoo, aquarium, or museum is something that has been variably defined, making direct comparisons of research into the visitor experience difficult. Here, we shall define the visitor experience as the overall, collective experience of visitors, which encompasses individual visitors’ experiences and their perceptions, attitudes and behaviors towards the captive animals,

enclosures, displays, signage, interactive programs, encounters, and conversations that they have while onsite. Visitors' interests when attending zoos, aquariums and museums have been studied regularly since the late-1990's, with visitors reporting reasons for attendance from purely for entertainment, or meeting at these venues for socializing (or bonding time) with other people; through to attending to fulfil a desire for "connection" with wild animals (though definitions of and types of "connections" that are sought are highly individualistic), to have a "close encounter" with wildlife, or for knowledge and education on animal and conservation-related issues (Balmford, 2000; Briseño-Garzón et al., 2007; Clayton et al., 2009; Davey, 2006a, b; D'Cruze et al., 2019; Falk et al., 2007, 2008; Fernandez et al., 2009; Godinez & Fernandez, 2019; Howell et al., 2019; Roe & McConney, 2015; Tribe & Booth, 2003; Yalowitz, 2004). Usually, unless the visitors are part of a school or formal programmatic/educational visit, visitors are not attending these informal learning environments for the main purpose of self-education (Godinez & Fernandez, 2019), but some learning in some visitors may still occur. "Visitor attraction models" describe visitor interests as the preferences and attraction of onsite visitors to certain animals, exhibits or presentations, and there are a range of methods employed to study these interests (Ballantyne et al., 2007; Godinez et al., 2013; Moss & Esson, 2010; Whitworth, 2012).

With all these varied interests, measuring the effectiveness of conservation messaging, educational elements, and public presentations – that are designed to change visitor perceptions and attitudes while onsite and foster long-term changes in public conservation-caring after leaving – are somewhat marred by a quagmire of uncontrollable, interacting and/or confounding factors, and robust measurement techniques are currently lacking (Mellish et al., 2018). However, some clear contributing factors that influence visitor perceptions, attitudes, and behaviors have been identified, and more factors are being discovered with continued research in this area (Clayton et al., 2009; Fernandez et al., 2009; Godinez & Fernandez, 2019). Some of these identified factors are: animal type/taxonomic group (Moss & Esson, 2010; Whitworth, 2012), enclosure/exhibit design (Bitgood et al., 1988; Davey, 2006a, b; Nakamichi, 2007; Skibins & Powell, 2013), animal visibility, activity and behaviors (Bitgood et al., 1988; Chiew, Hemsworth et al., 2019; Davey 2006a, b; Hacker & Miller, 2016; Luebke et al., 2016; Margulis et al., 2003; Miller, 2013; Moss & Esson, 2010; Philpot, 1996; Ridgway et al., 2005), perceived animal wellbeing and welfare (Bexell et al., 2007; Chiapero et al., 2021; Davey, 2007b; Escobar-Ibarra et al., 2021; Howell et al., 2019; Melfi et al., 2004; Miller, 2013; Miller et al., 2018; Packer et al., 2018; Razal & Miller, 2019), proximity to the animal (Chiew, Hemsworth et al., 2019; Howell et al., 2019; Luebke et al., 2016; Whitehouse-Tedd et al., 2018), visual messaging/signage (Clayton et al., 2009; Read & Waran, 1996), live animal training, educational programs and live-animal presentations (Alba et al., 2017; Anderson et al., 2003; Esson & Moss, 2014; Fernandez et al., 2009; Kimble, 2014; Mann-Lang et al., 2016; Miller et al., 2013; Povey & Rios, 2002; Sherwood et al., 1989; Spooner et al., 2019; Spooner, Jensen et al., 2021; Whitehouse-Tedd et al., 2018), and interactions or "close encounters" with animals, often including physical contact (D'Cruze et al., 2019; Hacker & Miller, 2016; Hosey, 2005; Hotchkiss, 1991; Howell et al., 2019; Kreger & Mench, 1995; Luebke et al., 2016; Luebke, 2018; Skibins & Powell, 2013; Spooner, Farnworth et al., 2021; Whitehouse-Tedd et al., 2018; Whitehouse-Tedd et al., 2020). There are also many ethical (and welfare) issues with "close-contact" encounters with animals in zoos that must be explored/addressed if these experiences are to continue in modern, ethical zoos (Carr, 2018; D'Cruze et al., 2019; de Mori et al., 2019a, b; Learmonth, 2020; Rapp et al., 2017; Rose, 2018; Spooner, Farnworth et al., 2021; Whitehouse-Tedd et al., 2018). These ethical and welfare issues have been explored in-depth in Learmonth (2020), and most zoo and aquarium associations have established guidelines that must be adhered to by member institutions that offer these sorts of close-contact encounters (AZA, 2011; WAZA, 2020). Palmer and Sandøe (2016), and Palmer et al. (2018) have likewise explored ethical issues such as these, and questioned value-driven decisions about current and future collections of animals that zoos are housing.

Visitor interests have most often been studied through direct measures of their behavior – such as dwell time (sometimes referred to as "holding time") in front of or nearby enclosures/exhibits, attention towards an enclosure/exhibit (e.g., facing or talking about an exhibit), level of interaction with signage and/or interactive displays, and overall crowd size at presentations or an enclosure/exhibit (Anderson et

al., 2003; Clayton et al., 2009; Fernandez et al., 2009; Godinez et al., 2013; Godinez & Fernandez, 2019; Margulis et al., 2003; Read & Waran, 1996) – or through visitor surveys conducted onsite at these destinations, with both formal (i.e., scientifically published) and informal (i.e., internally reported within the organization only) reporting outcomes (Chiapero et al., 2021; Chiew, Hemsworth et al., 2019; Dove & Byrne, 2014; Clayton et al., 2017; Godinez & Fernandez, 2019; Howell et al., 2019; Jensen, 2014a; Moss et al., 2015, 2017a; Penn, 2009; Spooner et al., 2019; Spooner, Jensen et al., 2021). However, as Spooner et al. (2019) and others note, “reporting on others’ experience is prone to bias and must be viewed with caution” (p.1233) (Donaldson & Grant-Vallone, 2002; Jensen, 2014b, 2017). This applies to both behavioral studies when the visitors are aware of being observed, and the results of visitor questionnaires, as visitors may be likely to try to predict favorable or desired responses and answer (or act) accordingly, rather than always answering honestly. Often these questionnaires also rely on retrospective items to collect information on visitors’ pre-visit attitudes and behaviors (Mellish et al., 2018; Wyles et al., 2013), though some studies have deliberately collected initial questionnaires before visitors’ entry to an attraction (Hoffmaster et al., 2016).

Visitor Attitudes and Perceptions

Often, visitor experience is influenced by preconceived beliefs and perceptions (based on past experiences) of the zoo that individual visitors have before attending, and these preconceived ideas influence their interests, attitudes, and behaviors when onsite. It is pertinent here to differentiate beliefs, attitudes, and perceptions as we define them. As in Chiew, Hemsworth et al. (2019), perceptions are defined as “an individual’s interpretation of specific situations, stimuli or objects into something meaningful to them based on past experiences (Pickens, 2005)” (p. 2), and attitudes are defined as “the “mindset or tendency to act in a certain way where we are trying to understand or explain an individual’s behavior (Pickens, 2005)” (p. 2). Attitudes are derived from internal beliefs (Ajzen, 1991), and are a strong determinant for that individual’s behaviors (Ballantyne & Packer, 2005). Observed relationships between human attitudes and behavior have now been well described by the Theory of Planned Behavior, which attempts to explain and predict a person’s behavior (Ajzen, 1991). It proposes that the beliefs a person holds regarding a particular object form the attitudes of a person and their subjective norms, which in turn can predict and determine a person’s intention and behavior (Ajzen, 1985, 1991). Therefore, knowledge and measurement of the attitudes and perceptions of visitors is important because they (particularly attitudes) are drivers of behavior (Ajzen 1991; Chiew et al., 2021). In psychology, it is well established that an individual’s attitude is defined by three interconnected components: A person’s beliefs about the object such as zoo animals (cognition), their emotional response to the object (affect) and their behavioral tendency towards the object (conation) (Ajzen, 1985; Albarracín et al., 2014; Hemsworth & Coleman, 2011; Pickens, 2005). One or more of these three components can be used to infer an individual’s underlying attitudes, when assessed in a questionnaire containing a series of attitude statements (Hemsworth & Coleman, 2011; Pickens, 2005).

In the context of AVI’s, there has been a recent proposed model of animal-visitor interactions that adapts the Hemsworth-Coleman model of stockperson-animal interactions (Hemsworth & Coleman, 2011; Learmonth, 2019). Research on stockperson-animal interactions shows that the nature of the interactions between farm animals and stockpeople is influenced by a stockperson’s attitude towards animals, their beliefs about other people’s expectations of them as a stockperson, and their beliefs about the extent to which they have control over their ability to appropriately interact with the animals (Coleman et al., 2000; Hanna et al., 2009; Hemsworth et al., 1994). This results in the formation of a sequential relationship between the attitudes and behavior of humans and animal behavior and welfare (Hemsworth & Coleman, 2011). By understanding this relationship, the negative effects of humans on animals such as fear and stress, can be minimized by targeting human attitudes to modify their behavior towards animals and thus, improve the management of human-animal interactions (Coleman et al., 2003; Ellingsen et al., 2014; Hemsworth, 2003; Hemsworth et al., 1994). Consequently, the model proposed in Learmonth (2019), the Chiew-Hemsworth model for zoo AVI’s, highlights how the attitudes of visitors

may be examined alongside the assessment of animal welfare to gain a more comprehensive understanding of the zoo visitor-animal relationship. However, examination of the attitudes and perceptions of visitors that may drive the way visitors behave towards zoo animals has been limited, with only a handful of studies thus far beginning to apply this model (Chiew, Hemsworth et al., 2019; Chiew et al., 2021).

Most research to date on visitor attitudes and perceptions has primarily focused on examining the effects of the various factors of the zoo environment and zoo experience on visitor attitudes and perceptions since it provides zoos with a better understanding of their visitors while at the zoo. As previously mentioned, there are several factors that influence visitor perceptions, attitudes, and behaviors (Clayton et al., 2009; Fernandez et al., 2009; Godinez & Fernandez, 2019). One of the factors that has received a considerable amount of research has been the impact of zoo enclosure design on visitors (Bitgood et al., 1988; Finlay et al., 1988; Davey, 2006b; de Young et al., 2011; Moss et al., 2010; Shettel-Neuber, 1988). For example, ‘naturalistic’ enclosures that promote the welfare of zoo animals are associated with increased positive visitor perceptions of and attitudes towards zoo animals, their welfare, and improved visitor experiences (Coe, 1985; Finlay et al., 1988; Luebke et al., 2016; Lukas & Ross, 2014; Melfi et al., 2004; Nakamichi, 2007; Packer et al., 2018; Rhoads & Goldsworthy, 1979; Tofield et al., 2003; Wolf & Tymitz, 1981; Yilmaz et al., 2010, 2017). Free-range enclosures, which promote natural or species-specific behavior in zoo animals, have also been shown to improve visitor perceptions of the welfare of zoo animals, visitor experience and increase visitor viewing times (Bryan et al., 2017; Mun et al., 2013; Price et al., 1994; Wilson et al., 2003). Additionally, enclosures that have enrichment items for zoo animals have been found to increase visitor ratings of the enclosures, to be associated with positive perceptions of zoo animals and their welfare, to increase positive attitudes towards enrichment items, and to increase viewing times and interactions with zoo animals at exhibits by visitors (Davey et al., 2005; Davey, 2007a; Kutska, 2009; Roth et al., 2017; Tripp, 1985; Wood, 1998). For example, Roth et al. (2017) found that visitor attitudes towards carcass feeding were positive, which also increased positive attitudes towards animal welfare and behavior. However, there is variation within the literature on the effect of different types of enrichments (e.g., naturalistic vs. unnaturalistic) on visitor perceptions and attitudes where some have argued there can be substantial variation in visitor responses to enrichment, in particular to where it is provided (e.g., on exhibit or off exhibit; Cottle et al., 2010; Ings et al., 1997; McPhee et al., 1998), whereas others have found no effect of enrichment type on visitor perceptions (Kutska, 2009). It is worth noting, however, that it is also unclear as to whether these positive visitor perceptions of enclosures when enrichment is present is due to the visitors valuing ‘enrichment’ as an animal welfare strategy, or simply because enrichment may make the observed animals more visible or active.

There have also been a handful of studies that have shown the importance of visual messaging and signage, as well as physical or visual barriers, which can impact visitor perceptions, attitudes, behavior, and experience (Dancer & Burn, 2019; Fogelberg, 2014; Kratochvil & Schwammer, 1997; Reade & Waran, 1996). For instance, Reade and Waran (1996) found visual messages that zoo visitors are exposed to within the zoo environment increased positive perceptions of zoo animals and increased awareness of the benefits of environmental enrichment. Signs at zoos directed at regulating visitor behaviors have been found to have varying effects depending on the wording, specificity and/or visual imagery included or not included (Chiew, Hemsworth et al., 2019; Dancer & Burn, 2019; Parker et al., 2018). Chiew, Hemsworth et al. (2019) found that signs used to attempt to regulate potentially fear-provoking visitor behaviors towards little penguins (*Eudyptula minor*) had a negative effect on visitor attitudes towards some little penguin characteristics. No detrimental effect of signs was found on the overall attitudes of visitors towards little penguins, penguin welfare, the enclosure, or visitor experience. However, signs were found to be ineffective in regulating potentially fear-provoking visitor behaviors (Chiew, Butler et al., 2019; Chiew, Hemsworth et al., 2019). In contrast, Dancer and Burn (2019) found that signs requesting visitors to be quiet were effective in reducing visitor noise levels. Similarly, Parker et al. (2018) found that signs requesting visitors not to feed meerkats were effective in reducing the frequency of visitors feeding the meerkats, but increased attempts to touch the meerkats, which was

suggested as a displacement behavior for not being able to feed the animals. However, these latter two studies did not examine visitor attitudes or perceptions; thus, it is unclear whether signs in these studies influenced visitor attitudes and perceptions. Interestingly, there is some evidence to suggest physical barriers that regulate the close proximity of visitors, or visual barriers that make animal exhibits more immersive and have positive effects on zoo animal welfare, can increase positive attitudes and perceptions of visitors towards zoo animals and these exhibits, can improve visitor experience, and can better regulate potentially negative visitor behaviors towards zoo animals (Blaney & Wells, 2004; Chiew, Butler et al., 2019; Chiew, Hemsworth et al., 2019).

Another factor that has been sporadically researched is the effectiveness of specific conservation and education campaigns or programs on visitor perceptions and attitudes. These campaigns and programs have sometimes been found to increase positive visitor perceptions of, and attitudes towards, zoo animals, to promote conservation awareness, and increase pro-conservation behaviors (Ballantyne et al., 2011; Ballantyne et al., 2018; Clayton et al., 2009; Mellish et al., 2019; Pearson et al., 2014; Rabb & Saunders, 2005; Skibins & Powell, 2013; Tofield et al., 2003). This type of research is particularly important because it allows zoos to assess how effectively they are educating visitors about wildlife, and can incite behavioral changes in their visitors to help conservation efforts (Ballantyne et al., 2018; Godinez & Fernandez, 2019; Howell et al., 2019; Skibins & Powell, 2013; Smith et al., 2008).

The Effects of Learning on Conservation Action

Multiple studies, such as those above, have been undertaken (both internally in organizations, and externally reported in scientific literature) to evaluate the efficacy of visitation, conservation messaging and educational programs in both formal learning settings (e.g., scheduled school visits) and informal, free-choice learning (e.g., zoo visitors' engagement with signage or presentations; Bexell et al., 2007; Chalmin-Pui & Perkins, 2017; Clayton, 2016; Collins et al., 2019; 2020a; 2020b; Dove & Byrne, 2014; Escobar-Ibarra et al., 2021; Hayward & Rothenberg, 2004; Lindemann-Matthies & Kamer, 2005; Lukas & Ross, 2005; Miller et al., 2013; Moss et al., 2014, 2015, 2017a, b; Nygren & Ojalampi, 2018; Spooner et al., 2019; Spooner, Jensen et al., 2021). Indeed, even the American Association of Zoos and Aquariums (AZA) requires accredited facilities to consistently measure the effective impact of their conservation and educational programs/presentations to maintain accreditation (AZA, 2021), as do most of the other regional and global zoo and aquarium associations (Barongi et al., 2015; WAZA, 2005). Most of these studies have investigated direct conservation knowledge gains by comparing visitors' pre-visit knowledge (at point of arrival) with their knowledge of wildlife and conservation initiatives undertaken by individual institutions immediately after viewing certain exhibits, presentations, or engagements (such as Spooner et al., 2019). Zoo visitors have generally been found to have relatively extensive knowledge of anthropogenic impacts upon biodiversity conservation and environmental issues, even if they hold misconceptions regarding the concepts of biodiversity and ecosystems (Dove & Byrne, 2014). However, very few of these studies have tried to quantify the long-term impacts of zoo visits (and specifically conservation-related presentations) on conservation knowledge retention (Collins et al., 2020b; Jensen, 2014b; Jensen et al., 2017; Moss et al., 2015, 2017b; Wagoner & Jensen, 2010), and even fewer studies have tried to measure the conversion of this knowledge into effective pro-conservation actions (such as adopting pro-environmental behaviors or joining or donating to conservation causes) post-visit (Adelman et al., 2010; Collins et al., 2020b; Miller et al., 2013).

As has often been reported, increasing visitors' biodiversity and conservation knowledge does not necessarily result in the adoption of pro-environmental behaviors, but often it does increase the intention to adopt these sorts of behaviors (Clayton et al., 2017; Collins et al., 2020b; Hacker & Miller, 2016; Howell et al., 2019; Moss et al., 2015, 2017a, b; Skibins & Powell, 2013). Two of the largest barriers that visitors report for these low rates of behavioral change are that they are often uncertain how they should become involved other than donating money (Ojalampi & Nygren, 2018), and that they lack the appropriate education, materials, or relevance to their daily lives to adopt the required behaviors outside of an immediate zoo visit context (Grajal et al., 2018; Smith et al., 2012; Stoinski et al., 2002; Swanagan,

2000). Of the very few studies that have so far measured post-visit pro-conservation behaviors, when materials that were relevant to and easy to use in visitors' daily lives (such as Monterey Bay Aquarium's "Seafood Watch Pocket Guide" for helping to choose more sustainable seafood options) were included, there was a much higher rate of adoption of the intended behavior (51% tried using the card) than for distribution of a card that simply detailed conservation organizations that could be investigated and joined voluntarily (10% reported investigating organizations, but zero participants joined an organization; Yalowitz, 2004). Another pertinent barrier to the adoption of pro-conservation behaviors are demographically related factors, such as where individuals live and socio-economic status, rather than a lack of knowledge (Moss et al., 2017a). Thus, it has been urged by some researchers that zoos, aquariums, and museums not only need to better understand why visitors attend their attractions, but they must also be more concerned with (a) what visitors do after they leave, and (b) better inspire visitors' active engagement for animals, welfare, and conservation (Escobar-Ibarra et al., 2021; Safina, 2018). To achieve this, zoos may need to "widen the view of nature conservation, human-animal relations (HAR), and environmental education in zoos" (Nygren & Ojalampi, 2018, as cited in Escobar-Ibarra et al., 2021, p. 2). Outside of the zoo education context, a recent study on the public perception of bats found that after attending a bat-focused festival including an educational exhibit on bats, most adult participants reported increased knowledge of, and intent to help, wild bats in both an immediate and a post-visit follow-up survey (Hoffmaster et al., 2016). Even more recently, Fukano et al. (2021) explored public perceptions and knowledge of the endangered Japanese rock ptarmigan (*Lagopus muta japonica*) after a media-reported 'debut' of captive-bred birds at five Japanese zoos, through direct online questionnaires and through other online sources of information (Google Trends, Wikipedia, Twitter, and donation website visits). They reported a significant increase in knowledge of the birds in prefectures where the birds naturally occur, and suggested that these 'debuts' have the potential to promote public awareness and knowledge of animals and conservation issues on a nationwide scale. This very novel research has attempted to measure indirect knowledge gains and awareness, using multiple measures of public media and internet engagement with conservation efforts by zoos. This is suggested as one of the key areas in which more research is necessary for us to fully understand the impacts of zoo-based education and conservation programs.

One significant predictor of increased knowledge of conservation issues, appreciation of wildlife, and the adoption of pro-conservation related behaviors is repeat visitation to zoos (Clayton et al., 2017; Godinez & Fernandez, 2019; Lukas & Ross, 2005; Miller et al., 2013; Moss et al., 2017a; Yalowitz, 2004). Though it has not yet been uncovered why some visitors are motivated to become repeat or frequent visitors over others. Two questions posed by Godinez and Fernandez (2019) to investigate this are: (a) do repeat visitors continue to visit zoos because they are already conservation-oriented and see zoological institutions as places to fulfil this area of interest? Or, (b) do they become more concerned with conservation issues over time as a result of the information and experiences they have in zoos? Perhaps repeat visitation gives these visitors more exposure and access to engage in in situ conservation actions (such as donating, signing petitions, or buying sustainable products from zoo shops) that may increase both their conservation literacy and their confidence in making pro-conservation choices in their daily lives. This supposition would fit with the reframed zoo visitor knowledge-action paradigm from Godinez and Fernandez (2019):

Visit with in situ action → Knowledge → Concern → Intent → Post-visit action

Animals Affecting Visitors: What We Know So Far

The theory that active animals attract visitors and increase observable visitor behaviors (the "visitor attraction model") is supported by several studies. Visitors spend more time, increase their conversations about animals, and congregate in larger groups when animals are present and active compared to when animals are inactive or out of sight (Altman, 1998; Anderson et al., 2003; Bitgood et al., 1988; Clayton et al., 2003; Collins et al., 2016; Davey, 2006a; Godinez et al., 2013; Sellinger & Ha,

2005). In addition to animal visibility is the actual size of an animal. Some studies suggest that visitors prefer larger-bodied animals (Bitgood et al., 1988; Ward et al., 1998). However, Balmford (2000) re-analyzed the results of Ward et al. (1998) and supplemented the data with additional data collected from London Zoo. They found no discernible difference between time visitors spent at exhibits of large-bodied animals compared to small-bodied animals. Specifically, Balmford cautioned that visitor preference toward certain animals may be negatively affected by external variables, such as time spent viewing an enclosure and crowd size. For example, smaller animals require less space and have smaller exhibits, thereby limiting the size of the visitor crowd capable of viewing that exhibit compared to bigger, large-bodied animal exhibits. This lack of space, and extended dwell time of others, may dissuade some visitors from waiting for their turn at the front of those particular exhibits and they may divert their attention to more open, large exhibits instead.

The catalyst for increased visitor empathy and perceptions is also directly impacted by AVIs, particularly positive visitor experiences with animals in zoo environments (Clayton et al., 2009; Kutska, 2009). How visitors perceive their experience, and visitor opinions regarding the overall welfare of exhibited animals, can be greatly influenced by what behaviors they witness from the observed animals. Bexell et al. (2007) examined visitor perceptions of giant pandas while playing or not playing and found those who witnessed giant panda play were significantly more likely to rate their experience more positively than those who did not observe playing. Altman (1998) found visitor conversations changed based on bear behaviors, with animal behavior conversations occurring the most when the bears were active compared to pacing or out of sight. Furthermore, visitors reported the most positive emotions after witnessing active animals compared to when animals were out of sight or engaged in other behaviors (Luebke et al., 2016). Similarly, Chiew, Hemsworth et al. (2019) found that the closer, more visible, and active (e.g., increased swimming and diving) little penguins were to the visitor viewing area, the more positive visitor experience and visitor attitudes were towards little penguins, penguin welfare, the enclosure, learning, and exhibit manipulations. This particular study highlights how the fewer behaviors indicative of fear displayed by zoo animals such as avoidance, huddling and vigilance, and the more behaviors displayed by animals that are active, such as swimming and diving in penguins, can elicit more positive visitor attitudes toward the zoo animals, their welfare and the enclosure and improve visitor experience (Chiew, Hemsworth et al., 2019).

Another factor that influences visitor perceptions of animal behavior is how visitors interpret the behaviors being displayed. This is particularly important with regard to visitors observing stereotypic activity (repetitive, invariant behavior patterns with no obvious goal or function; Mason, 1991; Mason & Latham, 2004). In a study by Godinez et al. (2013), the researchers examined how visitors identified the predominant behaviors displayed by a jaguar in correlation with visitor activity and their ratings of the animal's wellbeing, exhibit quality, and the visitor's enjoyment. Overall, visitors were able to accurately describe a jaguar's behavior as inactive, active, or out of sight. However, approximately half of all visitors described stereotypic pacing as non-repetitive, active behavior. For visitors who described a pacing pattern or other repetitive behaviors correctly as stereotypic, they were also significantly more likely to rate the jaguar's well-being, exhibit quality, and visitor enjoyment lower than those who described the behavior as non-repetitive, active behavior. Similarly, Miller (2013) found that participants rated the overall welfare of a tiger lower and were less likely to support zoos after witnessing tiger pacing compared to those who observed an inactive tiger.

While zoos have made significant strides in reducing stereotypic activity displayed by their animals through enrichment and other efforts, these studies suggest that visitors view stereotypies as an indicator of poor welfare, which affects multiple aspects of their own behavior and perceptions towards zoos and zoo animals. Future studies could examine education interventions with visitors highlighting behavioral enrichment and other welfare-oriented procedures, and if these efforts affect visitor views of exhibited animals and a zoo's ability to care for them.

Zoo Visitors vs. Non-Visitors

The last area of inquiry that has still not been thoroughly investigated is whether significant differences exist between zoo visitors and non-visitors (i.e., those who have not recently visited a zoo) in terms of conservation literacy, connection with animals, and the adoption of important pro-environmental and pro-conservation behaviors. Almost all the research above has focused exclusively on zoo visitors as they entered the attraction (Fernandez, 2019; Godinez & Fernandez, 2019), and the only study that did attempt a visitor – non-visitor comparison (Read & Waran, 1996) recruited non-visitors from immediately in front of a zoo attraction (defined as those who were present but did not enter the attraction), and this group’s conservation knowledge and attitudes were not measured. This is the first area we suggest needs to be addressed by the scientific community, not only in human-related fields like psychology, but also in predominantly animal-related fields such as animal welfare, as the attitudes and perceptions of society are relevant to the operation and continuation of many captive animal industries.

Conclusions: Future Visitor Experience Research

As suggested above, future research needs to address why visitors are attending zoos, aquariums, and museums, and especially why repeat visitors continue to return. This future research also needs to make a concerted effort to understand: (a) what visitors are doing after they leave the zoo, and (b) whether visitors are adopting long-term pro-conservation behaviors. Thus, much more research effort, more collaboration between zoos and educational institutions, and more funding should be assigned to longitudinal studies of visitor attitudes and behaviors, ideally in comparative studies with non-visitor groups as well (Fernandez, 2019; Fernandez & Timberlake, 2008; Godinez & Fernandez, 2019). We must also focus more acutely on the effects that captive animals are having upon the perceptions and attitudes of visitors after AVIs, and whether these effects are more profound for visitors after close-contact experiences, or simply related to the visitors’ perceived ‘connection’ to the animal(s) with or without a close-contact experience (D’Cruze et al., 2019; Godinez & Fernandez, 2019; Howell et al., 2019; Learmonth, 2020). Additionally, there is a need for further focus on understanding the attitudes of visitors that may drive the way visitors behave towards zoo animals to help better manage the interactions between visitors and zoo animals (Chiew, Hemsworth et al., 2019; Chiew et al., 2021).

In addition, it is suggested here that visitor interests, attitudes, and perceptions must be better understood if we plan to investigate indirect measures related to the visitor experience as well. That is, measuring variables such as: individual conservation support outside of the zoo (donations or involvement with conservation or advocacy organizations), internet activity (how much traffic is coming through specific parts of zoos’ websites? Is there a measurable increase in website traffic if visitors are directed to specific web pages during their visit?), changes in sustainable purchasing practices related to knowledge gains, financial investment in sustainable or ethical companies after knowledge gains, and longitudinal effects of zoo visits (how long do pro-conservation behaviors persist?).

Finally, there is an immediate need to move to measuring practical gains to conservation-related purposes that zoos are championing. Currently, much theoretical work has paved the way for understanding visitor interests, engagement with information, and retention of knowledge. But practical contributions of visitors to conservation (from both direct and indirect measures of their actions) are still lacking clarity. Quantifying exactly how zoo animals affect zoo visitors during visits would be a pertinent first step in progressing practical measures of the overall effects of zoo visitation. To better understand how visitors ‘connect’ with animals, and whether this caring increases practical support, would be greatly beneficial to both scientific understanding as well as to zoo operations. Furthermore, investigating how visitors assess their own experience while at the zoo, and asking them to critically assess their behaviors and attitudes while at the zoo would be interesting for completing the holistic picture of what a zoo visit means to zoo visitors, and how zoos can improve the ‘visitor experience’ while maintaining and protecting modern standards of animal welfare.

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