

Naturalism and ACI: Augmenting Zoo Enclosures with Digital Technology

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ABSTRACT

Zoos are increasingly introducing digital technologies to enhance visitors' experience of viewing animals, and promote the welfare and wellbeing of captive animals. Consequently, zoos are an immediate and important context for work in the discipline of animal-computer interaction (ACI). However, zoo enclosure design has a long history of transformation in line with existing theories, influenced by notions of naturalism and visitor immersion. In this paper, we discuss this literature in the context of the growing field of ACI, further drawing on interviews with zoo staff conducted as part of a larger project exploring digital enrichment to highlight the relevant implications for design.

Author Keywords

Animal-computer interaction; Zoo exhibits; Naturalism.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

There is increasing academic and professional interest in utilising digital technology for animal enrichment in zoos, particularly with great apes. Atlanta Zoo (USA) recently installed a permanent touch-screen 'tree' in their Orang-utan enclosure [13], and the non-profit 'Apps for Apes' project supplies iPads with (reappropriated) games for great-apes, with over a dozen partner institutions. Similarly, research by game designer Hannah Wirman explored orang-utan digital game play [17,18] finding numerous ways in which it is intrinsically appealing and enriching for captive orang-utans. However, digital enrichment for zoo animals is a new area of investigation for animal-computer interaction (ACI) [8].

Over past half-century, zoos have been transformed from places for public entertainment and (secondarily) scientific

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research to conservation and educational organisations. These shifts have impacted on the design of zoo enclosures as animal homes, entertainment attractions, and zoo keeper workplaces, and reflect broader trends in public opinion and contention between experts as to what is appropriate in terms of animal care and husbandry, the behaviours asked of them, and our interactions with them. Such debates have the capacity to shape, hamper or even thwart the success of animal-computer interactions and animal well-being both at the zoo and in other contexts. In this paper we review this history, focusing on the key notion of *naturalism* and its consequences for the emerging discipline of ACI in the zoo context.

METHOD

To do so, we reviewed literature relating to zoo design, and visitor experiences, as well as examining academic literature and press reports on interactive technology deployed at zoos. The interview data presented in this paper is drawn from a continuing project concerned with developing visitor-facing digital enrichment for animals at Melbourne Zoo, Australia, which has included studies of existing technology use throughout the Zoo. Interviews were conducted with seven members of Zoo personnel representative of organisational functions related to visitor engagement and interpretations, schools' education, and animal care and welfare. Through thematic analysis of these interviews we explored how concepts of naturalism impact on the way that interactions between animals and visitors are constructed. We identified 5 principal themes, as described below. These perspectives are key for approaching the opportunities for ACI in the zoo as they are crucial for the adoption of new technologies.

IMPACTS OF NATURALISM

Evolution of Zoo Design

The 'first generation' of zoo enclosures (typically in reference to Victorian-era constructions) saw captive zoo animals "predominantly housed in concrete enclosures, commonly referred to as first generation exhibits" [2:369]. During the early 1900's, zoos began to respond to animal welfare concerns by keeping animals in larger enclosures with dry or water moats, plants and artificial rocks. These 'second generation' enclosures rarely attempted to replicate the animal's wild environment, and were typically designed to maximise visibility to guests.

The third generation of zoo enclosure designs – commonly



Figure 1 – An example of a first generation zoo enclosure, historic bear caves at Perth Zoo.



Figure 2 - An example of a 'Naturalistic' zoo enclosure, Melbourne Zoo's Orang-utan sanctuary.



Figure 3 - An example of an 'immersive' zoo enclosure, Melbourne Zoo's Lemur Island.

referred to as 'naturalistic' - instead attempts to design enclosures to replicate the natural habitat of animals [1,4], by placing African plants and scenery in lion enclosures, or creating jungle-like environments for orang-utans, for example. These are the predominant style of enclosures in contemporary zoos, and the justifications for this style of enclosure design is often expressed in the literature as an attempt to “illustrate to guests what life in the wild might be like for the animals on view” [10:293] or to “create the illusion that animals are living in their natural environment” [2:369]. These goals align with the way that the modern zoo typically conceptualises itself as a conservation and education organisation [19]. More recently, naturalistic exhibits seek to create for the visitor the sense of being immersed in the animal's natural habitat [4]. Immersive exhibits include free-range enclosures such as Melbourne Zoo's *Lemur Island* (see Figure 3), and themed precincts. Immersive exhibits respond to visitors' desire for recreational experiences, and their desire for good, up-close visibility of animals [11].

While a small number of zoos have begun to experiment with incorporating digital technology into the zoo visit [3,9,14], technology is very rarely central to the design of zoo exhibits. We argue that this lack of technology can be attributed to the notion of 'naturalism' in enclosure design, and that changing attitudes towards animal welfare and technology will see the fifth generation of zoo enclosure designs characterised by the use of digital technologies to significantly improve animal welfare and visitor experience.

UNDERSTANDING THE NATURALISM DEBATE

In this section, we identify the different dimensions of the notion of naturalism in zoos, and discuss how these impact on ACI in the zoo and potentially in other contexts.

Harmony between Animal and Nature

A commonly expressed justification for naturalist design is the suggestion that naturalistic enclosures illustrate the harmony between animals and nature in the wild. Through exhibiting animals within a setting which resembles their natural habitat, Melbourne Zoo aims to evoke connections between animals and their environment:

“So just before you get to orang-utans there's Forest Harvest, [...] that looks at how different animals use the forest, [...] animals rely on the forest, and the forest is their home, and this is what they harvest from the forest.” [Interpretations staff]

While zoo exhibits might in the past have presented the animal's world as untouched and entirely separate from the human world, in this instance visitors are encouraged to draw parallels between animal behaviour and human behaviour within the context of conservation messages.

“[W]hen you come around the corner and you get to Orang-utans, it's about what we harvest from the forest” [Interpretations staff]

“[T]he bead [campaign] story is about women and families essentially, and baboons have these really strong family connections [...] this is the baboon family, this is the bead family, and this is your family, and this is how the three link together.” [Interpretations staff]

Highlighting connections and similarities between wild animals and humans is increasingly seen as a foundation for building visitor's interest in animals and conservation, as expressed by one of the orang-utan zookeepers:

“[P]art of keeping these animals in the zoo is that you showcase them in relation to humans. Once upon a time, we'd steer away from any anthropic view [...] but when you look at [...] tools for engagement and for empathy, that type of stuff, so we're more embracing that now.” [Keeper]

Naturalistic enclosures have often aimed to create an “image of beautiful and independent wildlife living in a landscape undisturbed by humankind” [4] an artifice that can never be fully realised in the zoo. However, this approach is modified by exhibits that represent man-made features and activities as part of the animal's 'natural' habitat, with the aim of embodying conservation messages related to human use of resources [5]. Melbourne Zoo's *Orang-utan Sanctuary* recreates a human run sanctuary for orang-utans displaced by destruction of the forest, in an approach similar to Los

Angeles Zoo's chimpanzee exhibit centred around an abandoned logging camp, described by Coe [5].

Visitor Immersion

For Interpretations staff, a central aim of exhibit design is to suggest to visitors that they are entering the animals' natural habitat and occupying the same space as the animals. This is one goal of zoned precincts which house multiple species enclosures and create an environmental setting which extends to the spaces and paths occupied by visitors, to create *landscape immersion* [4]. For example Melbourne Zoo's South-East Asian themed *Trail of the Elephants* exhibits Sumatran tigers, Asian elephants and orang-utans within a precinct which includes bamboo plantations, winding unpaved paths, 'local' signs, and 'huts'. Such immersive 'journeys' are often heavily leveraged for educational aims, connecting species, stories and human impact on shared environments.

"Our intention is actually to roll out the palm oil message all through Trail of the Elephants. So [...] you'll get palm oil at tigers, you'll get it at elephants, and then when you get to oranges, that's when you'll get the full [message]" [Interpretations staff]

This suggests opportunities for ACI in the zoo to better connect these longer ecological messages that unite the separate enclosures, in addition to considering the impact of an ACI intervention on the experience of other zoo enclosures.

The goal of removing barriers between visitors and animals is more fully realised in free-range exhibits. MZ's *Lemur Island* allows visitors to roam amongst ring-tail lemurs, while the *Australian Bush* exhibit brings together kangaroos, wallabies and emus in a space open to visitors. However, free-roaming animal exhibits require that zoo personnel carefully manage risks to animals' well-being, including visitor noise and encroachment on 'sanctuary' areas, and animals' access to human food.

"[Lemur Island] works really well but it has to be manned and it's stressful for the people in there, because of that tension. So ideally, you'd create spaces [...] where it looks like you can get to them and they can get to you but you can't." [Interpretations staff].

Such concerns suggest the potential for digital technology to heighten visitors' sense of sharing a common space with animals while maintaining physical barriers.

Animal Welfare

In the 1980's, as the third generation of zoo exhibits grew in prevalence, it was widely understood that naturalistic features would promote animals' natural behaviours, in turn fostering visitors' interest in and understanding of a species. [15:454]. The concept of 'natural' behaviour is regularly discussed and studied in animal welfare science. Research in this field indicates that the opportunity for animals to express natural behaviours can improve their welfare [7] and

inversely, welfare can be compromised when highly motivated behaviours are restricted in an animal's environment [16]. Thus from an animal welfare perspective, it is the performance of a specific behaviour, rather than the environmental features used to achieve the desired behaviour that is important. For example, in orang-utans, climbing and swinging are natural behaviours which are catered for at Melbourne Zoo by using artificial equipment such as fibreglass poles, tyres and firehose as opposed to natural vines and trees. The provision of these artificial structures is a much more logistically feasible tactic that zoos can use to encourage these highly motivated behaviours to promote animal welfare without relying on natural rainforest environments.

Artificial features of an animal's environment can also provide solutions for ethical dilemmas in zoos. For example, releasing prey species for carnivores to stalk and chase would be considered ethically unacceptable in most zoos around the world; therefore zoos aim to identify alternative means of fostering the desired, highly motivated behaviours of stalking and chasing. This is often achieved through the use of lures, scent trails and scatter feeding. Across the suite of species housed in zoos, there are clearly many examples of 'natural' behaviours that would be desirable to encourage in animals that don't necessarily require natural environments to achieve this. The challenge is to come up with innovative ways to encourage these key behaviours. Technology is an under-utilised technique in this area.

Visitor Perceptions of Animal Welfare

While the animal welfare goals of naturalism focus on the behaviour that is being encouraged rather than the environment and resources used to encourage it, this can be in conflict with what visitors expect to see as part of a naturalistic animal enclosure. Although 'natural' behaviours are central from the welfare scientist's perspective, the 'natural' environment might be more important from the visitor's point of view. Such perceptions, and consequent perceptions of an animal's welfare, can significantly shape the overall visitor experience; consequently, negative impressions regarding animal welfare were a consideration in the decision to replace a specific enclosure at Melbourne Zoo.

Most prior studies on zoo visitor experience have focused on either animal *behaviour* or animal *environments* as separate variables that correlate with visitor experience [6]; there is a lack of research addressing behaviour and environment collectively. As technology is increasingly incorporated into zoo design, it will be important for zoos to understand the interrelationships between these two factors, to support efforts to enhance animal welfare as well as perceptions of welfare and overall visitor experience.

Animal Intelligence and Engendering Respect

Zoo enclosure design also aims to demonstrate to visitors the intelligence and capabilities of the animals exhibited. It is widely understood that naturalistic exhibits, by promoting

animal activity and natural behaviours, can stimulate visitors' respect for wild animals [6,15:454]. Keepers who work closely with a species seek to represent animals' abilities as a means of strengthening visitors' respect and creating a sense of affinity.

“There's the potential to show the animals' intelligence for what it is. Because as humans we go 'there's humans and animals'. I've had the honour of working with [orang-utans] so I know exactly what they're about. I know you're dealing with hominids [...] it really does break down that divide between us and the rest of the animal kingdom” [Keeper].

This motivates the design of enrichment offered to orang-utans at MZ. These include appropriated human artefacts and activities that would not be considered naturalistic, including playground equipment, iPads and painting. This points to the potential for digital enrichment tailored specifically to a species' physical, sensorial and cognitive strengths to contribute to animal welfare, as well as visitor education.

DISCUSSION

It is clear that the fundamental goals of ACI [12] align with many of the underlying motivations of naturalism in the zoo: i.e. supporting animal welfare, respect for other species and positive human-animal interactions. While this paper focuses heavily on human visitors' experience and perception of zoos (as opposed to animal experience and use of technology), we contend that these considerations are fundamental to ACI if it hopes to expand into the Zoos context.

Animal technology cannot be approached or analysed without regard to the circumstance of its use. Indeed, it is a fundamental ethical obligation of ACI research involving animal participants that research be conducted in a manner that will result in knowledge that is relevant outside the context of the lab. Thus, social constructs like naturalism must be considered. In turn, it is also clear that the concept of 'naturalism' will shape the design of technology for animals in zoos, its implementation, and its evaluation by zoo institutions, and an awareness of this fact is necessary for rigorous design research.

By unpacking the concept of naturalism in this paper, we highlight how naturalism and technology are not inherently in opposition to one another. Technology can be used in zoo enclosures for animal enrichment in such a way as to facilitate visitor perception of an animal's harmony with nature, such as through replicating or enhancing the sounds, smells and obstacles of the natural environment, and need not necessarily be hidden. The modern zoo enclosure is clearly not “a landscape undisturbed by humankind” [4]; visible technology that considers the relationship between the animal and its natural environment is suitable in zoos. To the zoo animal, a digitally enriched enclosure is just as natural as one that faithfully replicates its wild environment, but perhaps far more practical for zoo keepers to ensure and monitor their welfare.

Indeed, it is clear that there are opportunities for ACI to improve the welfare of animals in zoos. As we noted, from an animal welfare perspective, it is the performance of a specific behaviour, rather than the environmental features used to achieve the desired behaviour that is important. Future work must consider how the improvement of digital enrichment to animal welfare should be communicated to visitors, perhaps with further use of technology. Indeed, we suggest that the inclusion of the zoo visitor in the ACI design process in the zoo is a necessary consideration, highlighted by the issues that underline naturalism in the zoo.

FUTURE WORK

In order to better understand some of these tensions and opportunities, we have developed an interactive floor which creates a shared digital space for humans and orang-utans to interact at Melbourne Zoo, with multiple applications that reflect the various interests and capabilities of orang-utans. Through this intervention we aim to investigate strategies to provide stimulation and improve animal welfare, and better connect visitors with orang-utans in ways that align with the conservation goals of their presence in the zoo, including facilitating visitor immersion through a shared digital space and engendering respect for the Orang-utan's via their play of complex applications. A key goal of this research is to compare how naturalistic and non-naturalistic elements of digital enrichment are perceived by zoo visitors. The impact of the 'naturalism' of such games has consequences for visitors' perceptions of the orang-utan's intelligence and welfare, the relationship between the orang-utan and their natural environment, and consequently, the potential role of ACI in contributing to the work of the zoo.

CONCLUSION

In this paper we draw on zoo studies research and interviews with zoo personnel to identify five dimensions of naturalism in zoo design. From these, we outline a number of opportunities for ACI to contribute to zoos' evolution and support the use of naturalism and immersion as part of the work to promote animal welfare and generate meaningful and positive encounters between animals and humans. We provide an overview of a system we have developed with the intention of further interrogating the place of naturalism in the design of digital technology for the zoo. We conclude by noting that ACI also has the potential to shape the evolution of the concept of naturalism through demonstrating how technology can meaningfully improve animal welfare and assist zoos in achieving their conservation and educational goals.

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