Evaluating the Effectiveness of Education in Zoos

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Abstract

Increasingly, research has demonstrated that traditional zoo-only sites are meeting their overall mission to convey biodiversity and conservation messages to visitors. However, robust evaluations of specific zoo experiences and studies from non-traditional zoo settings such as theme park zoos are missing from the literature. This thesis investigates the impact of specific zoo experiences and tests whether a combined theme park and zoo is also able to meet the zoo mission. Theme park zoos represent the extreme entertainment end of the zoo spectrum, thus test whether learning can occur in commercialised entertainment settings. Data were collected at a combined theme park and zoo during peak season, May to October, 2013 through to 2016. A combination of paired and unpaired pre-post-surveys were collected to test the immediate effects of educational experiences and the overall impact of zoo visits. A single theme park zoo visit was found to lead to significant increases in visitors' animal knowledge. In contrast, such a visit did not impact on conservation attitudes. Information signs were found to be the most important source of animal and conservation information for visitors. Additionally, whilst live animal shows effectively conveyed animal facts, the use of 'trick' behaviours appeared to cause confusion and hindered learning. Non-animal shows, which used theatre and puppets, were found to be a successful alternative to live animal shows and effectively conveyed animal and conservation information to both adults and children. This research indicates that zoos should provide information at a range of levels from factual knowledge through to practical opportunities for conservation behaviours. Currently, theme park zoos effectively convey factual information, thereby fulfilling part of the zoo mission. However, knowledge alone is not enough to influence visitor behaviour. For theme park zoos to meet the aims of modern zoo practice they must model sustainable behaviours and help visitors engage with conservation issues and solutions.

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Preface

'No-one will protect what they don't care about, and no-one will care about what they have never experienced' – Sir David Attenborough

In 2013 I was working as a zoo keeper and educator at a small zoo in Surrey, UK. As a practitioner I felt passionate about the role zoos play in educating the public. I had seen first-hand the surprise of individuals as they touched a snake's skin for the first time and the sense of awe as they saw birds of prey fly overhead. I was particularly moved on a cold December afternoon when a small boy, around the age of 10, gave me a feather. The boy had been to every talk I had given that day and I had observed him reading the information boards with his family. He gave me the feather to say thank you for 'teaching' him about the animals.

Practitioners across the globe have countless stories of how they have impacted others. Whilst this anecdotal evidence is pleasing to receive it does little to prove what has actually been learned by visitors and how this impacts on their conservation attitudes. As a primary school teacher I used learning theories to reflect upon my practice. However, I was surprised by the lack of teaching qualifications or education training amongst zoo educators and shocked by the lack of robust evaluation in zoos. This prompted me to pursue a PhD researching zoo education. Although I approached my research with an open mind, I am pleased that my overall findings support the educational value of zoos. However, I have identified areas of improvement which zoos must address if they are to successfully fulfil their mission of education and inspiring pro-environmental action in visitors.

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Declaration

I, Sarah Louise Spooner, declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, university. All sources are acknowledged as references.

The format of this thesis is as a collection of papers; as such my supervisors appear as co-authors on each chapter. These individuals are justified as authors in accordance to the International Committee of Medical Journal Editors guidelines (ICJME 2017) as they have advised me in the design and analysis of my research, commented critically on drafts and have agreed to be accountable for the work as and when papers are published.

ICJME. (2017). Defining the Roles of Authors and Contributors. Retrieved from http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html

Introduction

This thesis investigates the effectiveness of current education provision in zoos and aquariums (hereafter referred to as zoos) at delivering animal and conservation information to zoo visitors. This is evaluated through an in-depth case study at Flamingo Land Resort Ltd., North Yorkshire, UK.

Flamingo Land is both a theme park and zoo and, as such, represents a diverse and complex environment. Whilst theme park zoos are relatively common worldwide, they are rarely included in the zoo literature. Consequently this thesis demonstrates the educational provision of non-traditional zoo sites and tests whether learning can occur in commercialised entertainment settings. Flamingo Land is a member of the World Association of Zoos and Aquariums (WAZA) and is formally committed to the United Nation's Aichi targets to increase public understanding of biodiversity and encourage public actions to slow its loss (Barongi, Fisken, Parker, & Gusset, 2015; CBD, 2011).

Much of the current zoo evaluation literature examines the impacts of zoo visits overall (Jensen, Moss, & Gusset, 2017; Moss, Jensen, & Gusset, 2015, 2017a). This thesis examines the impacts of specific components of a zoo visit enabling practitioner-focused recommendations to be made. The components evaluated represent commonly used education provisions, including animal information signs and live animal shows. As these educational resources are widely used amongst zoos it is hoped that many institutions will benefit from these research findings. In addition, this thesis examines the impacts of zoo educational theatre. Theatre and storytelling are growing in popularity within zoos (Hawkey, 2003; Proffitt, 2013) and impact evaluation is vital to inform future practice. As theatre does not require live animals it also provides a contrast to the more traditional live animal shows.

Whilst zoos provide many different types of education including formal school-group teaching, this thesis focuses on informal education. It considers specifically the visiting public on a leisure visit.

The thesis is presented as a series of papers. Whilst they have been designed to follow a logical, progressive order, each chapter can be read as a stand-alone unit. Although this has resulted in repetition between sections, particularly in the introduction and methods sections, it has facilitated ease of submission of the work for peer-reviewed publication.

Additionally it allows zoo practitioners, for whom the findings are intended, to select particular aspects of zoo education provision as required without reading the document as a whole. The referencing styles and formatting have been altered from the individual journal requirements to provide consistency and meet thesis requirements, however, chapters are written in the style of the journals they are being submitted to.

Chapter 1: An evaluation taxonomy for the educational impact of zoos.

Chapter one aims to set out a framework for evaluating zoo education in relation to the zoo mission. The chapter examines what is meant by learning and considers different theories and their potential application within zoos. The chapter examines the differences between learner-centred and top-down teaching and considers appropriate uses for both. It also introduces learning theories including Vygotsky's Zone of Proximal Development and Socio-Constructivism (Vygotsky, 1978). Dialogic teaching and the use of discussion as a stimulus for raising conservation issues are also considered.

Zoos ultimately aim to inspire behaviour change in visitors. Therefore, chapter one also examines the main drivers of behaviour based on Value Belief Norm Theory, Theory of Planned Behaviour and Model of Responsible Environmental Behaviour (Ajzen, 1991; Hines, Hungerford, & Tomera, 1986; Oreg & Katz-Gerro, 2006; Stern & Dietz, 1994). It discusses the economic drivers of behaviour and examines how modelling sustainable behaviours on-site could inspire visitor engagement in conservation.

The chapter concludes by proposing a Zoo Learning Taxonomy based on Bloom's Taxonomy of Learning (Bloom, 1956). This Zoo Learning Taxonomy is intended as a tool for practitioners to identify learning gaps and to evaluate current resource provisions against the overall zoo mission.

This chapter is in preparation for submission to the International Journal of Science Education and hence follows this format.

Chapter 2: A review of education research in zoos.

This chapter aims to review current education evaluation studies and identify gaps in the literature. Education is the prime justification for zoos continued existence in a modern society. However, until recently, there has been limited robust evidence of the success of zoo educational provision (Moss & Esson, 2013). Chapter two examines the common problems found in much of zoo literature and discusses the reliability of study findings.

The chapter considers recent multi-national impact evaluations which have in contrast provided strong evidence for the educational impacts of a zoo visit. Chapter two also considers where the findings from this thesis contribute within the current literature and concludes with considerations regarding future zoo research.

Chapter two is formatted for Zoo Biology.

Chapter 3: Evaluating zoo animal information signs for environmental education.

Chapter three is the first empirical research paper in this thesis. It aims to evaluate the success of animal information signs at conveying animal and conservation information to visitors. Animal information signs are the most consistently used form of public education in zoos and, as such, understanding their impact on visitor learning is critical. Chapter three uses the Zoo Learning Taxonomy (outlined in Chapter 1) to examine the level of learning provided by five animal information signs. Visitor questionnaires are then used to investigate what information was recalled from signs, examine reading motivations and assess conservation action awareness. The chapter shows the success of animal information signs at conveying basic information. However, it also acknowledges that current sign content is predominantly focused at the knowledge category of the Zoo Learning Taxonomy. Signs should go further to influence conservation attitudes and actions.

Chapter three is written in the format of PLoS One where the paper is currently under peer-review.

Chapter 4: Effectiveness of entertainment-focused live animal shows at delivering information to public audiences

Live animal shows, which combine animal facts with trained behaviours, are commonly used to engage zoo visitors. However, these type of visitor experiences feature little across the zoo literature and as such there is limited evidence for their success. Chapter four aims to determine the impact of two separate live animal shows at the study site; a mixed species bird show and a sea lion show. Visitors were questioned before and after seeing the live animal shows on their awareness of animal and conservation information. The effect of trick-like behaviours, intended to convey particular learning objectives, were also examined. The chapter highlights the importance of live animal shows in terms of their reach and ability to inform large audiences. It cautions against the continued use of trick behaviours as educational hooks which are potentially misleading for show audiences.

This chapter is written in the format of Leisure Studies.

Chapter 5: Evaluating the impacts of theatre based wildlife and conservation education at the zoo.

Given the controversy of live animal shows chapter five aims to determine the potential of a novel form of zoo education not involving live animals. Specifically, it measures the effectiveness of the 'Mia and Mylo Show', an educational theatre performance. The theatre performance aimed to inform visitors about animal facts and conservation work abroad. The chapter quantitatively demonstrates the success of theatre as an educational tool for conveying information to both adults and children. The benefits of song and on-screen information are also noted. The chapter recommends that theatre content should increase its scope beyond factual recall and focus on conveying conservation actions.

This chapter is written in the format of Environmental Education Research, where it is currently under review.

Chapter 6: Can a theme park fulfil the aims of a modern zoo? A case study of Flamingo Land Resort, UK.

Chapter six places the zoo experiences, detailed in the previous chapters, in context by examining the impact of a theme park zoo visit overall. It aims to establish which activities and information visitors engage with and recall. Pre- and post-visit surveys of theme park zoo visitors were conducted and allowed changes in knowledge and attitudes to be examined. The study indicates the success of a theme park zoo visit on increasing visitor knowledge but notes limited impact on attitudes. The chapter also highlights the impact of information signs on increasing visitor conservation awareness.

This chapter is written in the format of Environmental Education Research

Discussion

The thesis concludes with a summary of each study's main findings and their implications for future zoo practice. The limitations are also outlined and recommendations are made for future research.

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Chapter 1: An evaluation taxonomy for the educational impact of zoos.

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Disclosure

At the time of data collection Andrew R. Marshall was employed by the organisation under study (Flamingo Land Resort Ltd.) and both he and the lead author were in receipt of grant funding from the same organisation at the time of submission.

Abstract:

Much of what is learned during our lifetime occurs beyond the classroom. Informal educational environments, such as zoos, offer exposure to novel objects and experiences which guide learning. Modern zoos aim to improve visitors' biodiversity awareness and, ultimately, positively influence visitor behaviour. Biodiversity loss is of major concern and increasing public awareness of the issues and solutions is vital. Altering behaviour requires consideration of social, economic and cultural factors in addition to knowledge. Understanding both theories of learning and drivers of behaviour enable zoos to target resources at achieving the zoo mission. However, many zoo educators lack formal training in teaching and learning. This paper outlines key learning theories and their application in a zoo context. Our proposed Zoo Learning Taxonomy aims to aid zoo educators in assessing which aspects of zoo education are effective and consider where further educational provisions are needed.

Key words: Blooms Taxonomy, conservation education, environmental education, informal learning, social constructivism

Introduction

Hundreds of millions of visitors go to zoos and aquariums each year, making these organisations ideally placed to teach public audiences about conservation (Gusset & Dick, 2011). Education is now one of the main objectives of the modern zoo mission (Patrick et al., 2007). Members of the World Association of Zoos and Aquariums (WAZA) support the United Nations' Aichi targets in aiming to raise biodiversity awareness and actions to prevent its loss (Barongi et al., 2015; CBD, 2011). Biodiversity loss is occurring at unprecedented rates and is exacerbated by human actions (Cardinale et al., 2012; Sala et al., 2000). Changing consumer behaviours may help mitigate environmental problems, such as pollution, excessive plastic use and carbon emissions, and empower individual responsibility for solutions including making responsible consumer choices (Grajal et al., 2016; McKenzie-Mohr, 2000; Moss et al, 2017b). The zoo mission targets behaviours within the zoo and ultimately aims to impact on daily actions and choices.

The effectiveness of zoo education should be measured in consideration of the zoo mission. As the zoo mission consists of biodiversity understanding and inspiring pro-environmental behaviour, it is important that learning and behavioural outcomes are assessed. In order to evaluate their practice and identify gaps in resource and experience provision educators need to understand which aspects of learning and behaviour are targeted. It is important that evaluation methods are structured and robust.

Although existing learning theories can be applied to zoo contexts, most are designed for implementation in a classroom. They specifically measure learning impacts and do not consider the behavioural aspects necessary for fulfilling the zoo mission. On the other hand behavioural theories ignore the learning aspects. Zoo specific evaluation tools are needed in order to evaluate institutional practice against both learning and behavioural outcomes of the zoo mission.

Currently few evaluation tools are suitable for measuring zoo education provision against the zoo mission. Learning objectives of zoo educational activities are not always clear and the measurement of their impact is often limited (Roe, McConney, & Mansfield, 2014). Consideration of learning and behaviour theory is crucial for evaluating educational outcomes and yet has been little applied in a zoo setting. We propose a zoo learning taxonomy to enable practitioners to set and measure learning and behavioural outcomes. This also provides a standardised framework for researchers to measure zoo educational effectiveness against. The taxonomy is based on established learning and behaviour theory applied specifically to the zoo mission.

In this paper we provide an overview of established theories of learning and behaviour and consider how they relate to zoo educational practices. We then present the evaluation taxonomy.

Learning theories and practice

The majority of what is learned in a lifetime is acquired outside of the classroom through experiences and social interactions (Falk & Dierking, 2010; Falk, Moussouri, & Coulson, 1998). A zoo visit provides direct teaching to visitors as well as informal opportunities to learn through discovery and observation. In order to claim the educational success of a zoo experience visitors must have learned from it.

Often institutions, including many zoos, measure educational success by the number of individuals they have taught (Luebke & Grajal, 2011; Roe et al., 2014). However, teaching and learning are not synonymous. Whilst vast numbers of people may be 'taught' (presented with information intended to convey a specific message), there is no guarantee that the recipients of that 'teaching' are actually 'learning' (that is, developing a personal understanding of the concept presented). Therefore, measuring the number of visitors exposed to information provides no evidence of educational success.

Learning can occur without any explicit teaching or additional input as individuals make connections between existing ideas (Alexander, 2008). If this occurs during an educational experience learning may be greater than the intended outcome. Conversely, learning may be delayed (Howe, McWilliam, & Cross, 2005), with individuals developing their understanding after they have left the zoo site. Consequently the educational success of an experience may go unrecorded. In addition, learning can be influenced by multiple factors (Daniels, 2001; Piaget, 1972). Completely isolating the effects of a single experience is, therefore, challenging.

It is important that zoo educators recognise the complexities of learning in order to provide visitors with the best opportunities to learn. Understanding learning theory can help zoo educators select suitable strategies for imparting information. Whilst, there are many theories of learning, these often share underlying principles and have evolved concurrently.

No single theory completely explains learning across all settings. Educators and researchers may use different theories depending on the context.

Teaching approaches

Teaching strategies can be generally divided into two; top-down and learner-centred. These strategies fundamentally differ in the way the roles of teacher and learner are viewed. This impacts on the level of autonomy of the learner and the control they have over the direction of learning.

Level of control is important because if learners feel in charge of their own learning they are more likely to see it as worthwhile and invest time and energy in. If the direction of learning is determined by someone else, the learner may view the task or information presented as less relevant to them and therefore be less interested (Grajal et al. 2016).

Top-down teaching presents information directly to the learner, as in traditional teacher-led classrooms (Pollard, 2002). In a top-down approach the educator is seen as the authority on a subject and the learners are the recipients of selected information. Top-down teaching is convenient for presenting factual information to large audiences such as in live animal shows and keeper talks. Top-down experiences can also include signage where the information presented is purely factual and doesn't encourage independent thinking. The disadvantage of top-down approaches is that they remove control from the learner. Top-down approaches convey what the educator values as important and not necessarily what the visitor is receptive to. Consequently, educators risk re-teaching known information or losing visitor interest. As top-down approaches present specific information, this can result in a superficial awareness based on recall rather than deeper learning connections.

In contrast to top-down approaches, learner-centred approaches place control with the learner. The educator facilitates opportunities to learn rather than providing information directly. Central to learner-centred teaching is the belief that learning is a personal process, where the learner interprets experiences and information to reach their own understanding (Daniels, 2001; Hodson & Hodson, 1998; Piaget, 1972). In these 'learner-centred' approaches, educators devise opportunities for learners to discover answers for themselves (Piaget, 1972, 1998). Learner centred approaches are appropriate for a zoo setting as visitors select which experiences they engage with and make personal interpretations of information. This is especially important for adult learners as adults are responsible for their own lifestyles and behaviours compared to children. Resources which adults choose to engage with and which are relevant to them are therefore more likely to influence behaviours (Jacobson et al 2006).

Learner-centred approaches have the advantage that understanding becomes deeply embedded as individuals incorporate ideas into their own understanding. This can be especially important for developing concepts such as conservation caring as individuals need to have a strong personal drive in order to develop environmental actions. However what is learned from learner-centred, discovery experiences is dependent on the individual and the connections they are able to make. Higher order connections, such as linking human activities to biodiversity loss, are unlikely to be made without explicit guidance. More likely outcomes are sensory understandings such as the size, smell or weight of objects. This tactile awareness is a learning outcome in itself and can promote long-term memories (Medved & Oatley, 2000). Zoos have the ability to create more impactful and authentic experiences not possible in schools or through digital media (Braund & Reiss, 2006), for example, through immersive exhibits where the visitor and animal share a habitat. These types of experience can help visitors develop a more personal understanding of a topic, although, learning remains dependent on the individual. If zoos aim to convey more complex concepts, learning opportunities need to be specifically structured to promote them.

Learning Theories

Piaget's Cognitive Development Theory suggests that children learn from concrete experiences that they can manipulate or sense (Jacobson et al. 2006). This implies that children learn best from tactile, sensory experiences and that abstract concepts such as environmental concerns or even understanding ecosystems such as the rainforest, may be too vague for children under 10. This suggests that individuals should fully understand their own environment before trying to explore an exotic or abstract one. It is postulated that only 35% of high school graduates are able to work at a Formal Operational level,that is being able to understand and explain complex and abstract concepts (Jacobson et al., 2006). If this is the case, it implies that zoos should ensure their visitors have a good understanding of what biodiversity is at a local level before trying to express ideas on a global scale. Sobel (1996, 2005) supports the idea of working from a local level outwards, arguing that often individuals know more about what is happening globally than they do outside their own door. He argues that children are disconnected and fearful of the natural world and issues such as habitat degradation present a negative or abstracted view of nature (Sobel 2005). Therefore encouraging individuals to experience nature first hand is vital to overcoming an 'ecophobia' (Sobel 1996).

Experiential Learning suggests that learning occurs in a cycle moving from experience, to processing information, to generalising and applying the concept in other contexts. Theorists such as Dewey favoured an experiential learning approach where individuals learn by doing i.e. sensory experiences create deeper connections in the brain and link to emotional responses and memory. Kolb expanded this idea in his learning cycle whereby learners engage in a task, explore activities then receive a period of instruction or explanation before applying to other situations in the elaboration phase. Kolb also suggested that learning could be increased by presenting information in different ways e.g. visually, kinesthetically or through audio which would target different areas of the brain thereby speeding up learning (Jacobson et al.2006, Bates 2016, Kolb et al., 2011).

In 1994 Gardiner and Armstrong suggested the theory of multiple intelligence. The theory proposed that intelligence can occur at different levels with individuals being better at some aspects than others for example, showing linguistic, mathematical or musical aptitude. As individuals have different intelligences it is suggested that information be presented in different ways inorder to target the multiple learning needs of those being educated (Jacobson et al., 2006, Bates, 2016). Although worth mentioning as a learning strategy, the very nature of learning outside the classroom caters for these multiple needs as individuals can select aspects of the experience to suit them. For example, those with a mathematical preference may be interested in animal weights, longevity or the numbers of individuals left in the wild. This may contrast to musically oriented individuals who may concentrate on the sounds the animals make. However, it is worth acknowledging different learning styles in relation to conveying a specific educational message, such as the need for conservation, as to convey such abstract concepts, specific experiences would need to be tailored.

Inquiry based learning can be ideal for conveying science education in formal settings. Either the facilitator leads the learner by providing guided questions or the learner asks their own questions in a 'pure inquiry' approach. This gives the learner full autonomy over their learning and thus creates a meaningful experience which is targeted at the learners level and which avoids ideas being too abstract. However, whilst inquiry approaches can be simulated in non-formal settings through questioning techniques, pure inquiry takes time to develop and may frustrate learners who have asked a question with the intention of being told a straight answer.

An alternative to inquiry based learning is to follow an aims based curriculum (Reiss and White 2014). This is where the learner's needs and the needs of society form the driving force behind what is taught. The advantage is that learning is highly relevant to the individual and that it creates individuals who are more ready to engage with society both morally and practically. In terms of environmental issues an aims based approach focuses on the ultimate outcome, conservation action, and therefore avoids telling people facts simply for the sake of it. Whilst in principle this approach seems ideal for conveying environmental information in reality there can be problems, namely that individuals visit informal settings, such as zoos, for different purposes. Therefore, whilst zoos may aim to encourage conservation action, the visitor's aim may be to have a positive social experience. This misalignment of aims could be problematic and lead to visitor frustration at being told information that they feel is irrelevant to their immediate needs.

Whilst we don't dispute that inquiry based, experiential learning theories have a place in informal learning we have chosen to focus on constructivism. Constructivism focuses on what has gone before and structures experiences to help the learner build their own understanding. Constructivism has the advantage that it acknowledges the process of learning within a social and cultural context. This is particularly important in an informal learning setting such as a zoo as individuals often choose to visit as a social outing with peers and therefore their socio-cultural background has a direct influence on learning. Constructivism is also important in a behaviour change context as it acknowledges the existing position of the learner and the factors affecting their behaviour prior to trying to move the learner towards a more conservation oriented action.

Constructivism

Visitors bring prior knowledge and experience to the zoo. This influences how new information is interpreted. Learner-centred educational theorists Vygotsky and Piaget both recognised the importance of past influences on learning (Daniels, 2001; Piaget, 1972; Vygotsky, 1978). Piaget argued that learners 'accommodate' existing concepts and 'assimilate' them with new experiences to build a personal understanding (Piaget, 1998).

Vygotsky developed this further, stressing that personal understanding sits within a social, cultural and historical context (Daniels, 2001; Vygotsky, 1978). As learners construct their own understanding, these theories are known as Constructivism or Socio-Constructivism (Hodson & Hodson, 1998).

Vygotsky (1978) believed that learners could extend their learning with the help of a more experienced individual to guide understanding. Vygotsky termed the space between 'actual development' (what the learner can achieve alone) and 'potential development' (what the learner can achieve with support) the Zone of Proximal Development (ZPD) (Figure 1.1). The ease at which a learner moves through the ZPD is determined by external influences. External influences in the ZPD are: 'Tools' such as language and objects, which can aid in demonstrating learning; 'Community' which are the rules and practices the learner follows; and 'Networks' being the social and cultural influences that may alter acceptance of an idea. In this learning model the educators' role is to guide the learner through the ZPD by creating opportunities to develop new concepts or connect existing ideas in new ways. For example, when educators ask open ended questions they encourage visitors to make connections and develop a more complete awareness of an issue. Bruner (1991) argued that any subject, no matter how complex, can be conveyed if broken into manageable units. Bruner believed that learning occurs in a spiral, starting with what is comfortably known and increasing in complexity each time information is revisited (Bruner, 2006). Therefore, it is important to understand the current knowledge levels of visitors and build on this knowledge to reach a desired outcome. In other words, although a zoo visit may be a single learning event it should build on what is already known and form a foundation for the next stage of learning.

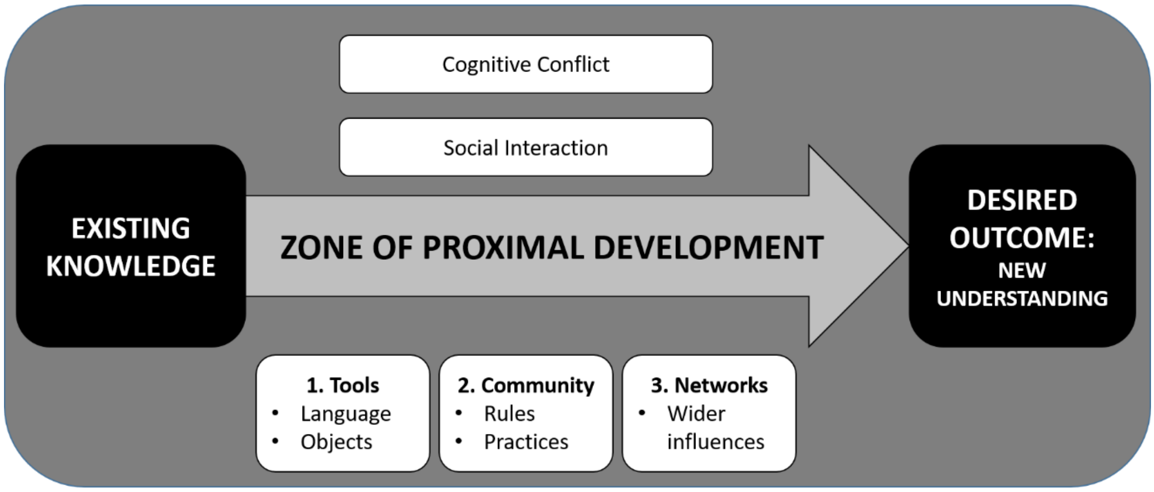

Figure 1.1. Model of Socio-Constructivist Learning Theory with external influences (tools, community, networks) shown. In addition, processes of learning through social interaction and cognitive conflict are shown as these also effect learner progression through the ZPD

Language and culture (social interactions) are central to Socio-Constructivism (Hodson & Hodson, 1998; Vygotsky, 1978) and both are constantly evolving (Alexander, 2008; Bruner, 1982, 2006). Allowing learners to discuss ideas in their own terms is crucial for creating personal learning experiences. Whilst Socio-Constructivism is a learning theory, the use of discussion (known as Dialogic Teaching) has been demonstrated to be a successful teaching strategy (Jay et al., 2017). Discussion forces the learner to test their views amongst peers and face counter arguments which create ‘cognitive conflict’ (Alexander, 2008; Howe et al., 2005; Mercer, 1996). In this cognitive conflict the learner is in an unbalanced state (disequilibrium) and will strive to reach a balanced state (equilibrium) either by strengthening their own arguments or by adopting new information (Howe & Tolmie, 2003; Limon, 2001). Consequently, discussion helps individuals consider new perspectives (Stern & Dietz, 1994). Discussion can also increase confidence in addressing complex issues, such as conservation (Clayton et al, 2017; Geiger et al, 2017). Whilst educators may be reluctant to engage visitors in controversial environmental discussions, the zoo visit offers a prime opportunity to tackle issues not normally considered (Swim & Fraser, 2014). Discussion is learner-centred as it removes the hierarchy of the educator as ‘authority’ and gives the learner control of the debate. This is especially important for environmental issues where individuals need to understand their personal contribution in order to alter their behaviour (Grajal et al., 2016).

Informal settings

Falk and Dierking (2000) propose a contextual model for learning outside the classroom. This model suggests that three elements 'personal context', 'socio-cultural context' and the 'physical context' combine to stimulate engagement (Figure 1.2). The personal context includes emotions and motivations, the physical provides an opportunity for those emotions by providing an experience to inspire or stimulate thought and the socio-cultural context is the conversations, interactions and expectations which influence the level of learning that takes place. This model is particularly useful in an informal learning context as it considers all aspects which influence learning in a non-classroom setting. It provides a useful model for educators when designing their resources as it encourages them to consider the different factors which lead to engagement in learning. Without this engagement, individuals are unlikely to learn as they will not be interested or focused on the materials provided. The model acknowledges the physical setting as an important part of the learning experience as it provides sensory cues for future memories. Braund and Reiss (2004) extend the contextual model further arguing that time is an important component as this can alter the contexts in which learning is set. Whilst providing a good model of informal education the Falk and Dierking Contextual Model doesn't provide a framework for evaluating educational success.

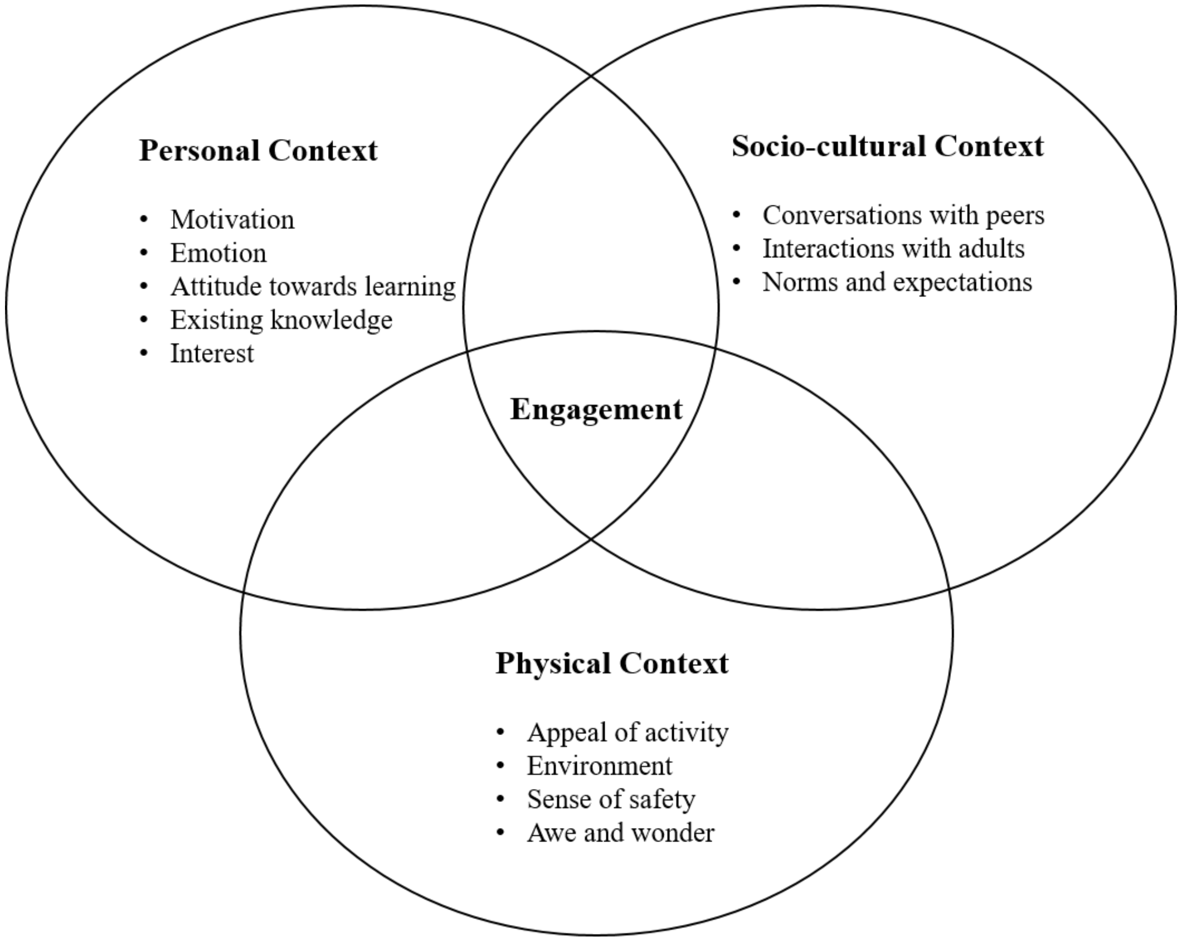

Figure 1.2 Contextual Model of Learning in Informal Contexts (Falk and Dierking 2000).

We chose to use Bloom's taxonomy (1956) as a base for evaluating education outside the classroom (as detailed below). Bloom offers two taxonomies one focusing on the cognitive domain, e.g. changes in knowledge and understanding, the other in the affective domain, considering emotions and attitudes. Whilst emotions and attitudes are important for engaging with environmental problems, we decided to focus on the cognitive domain as a basis for understanding whether zoos effectively convey information to their visitors. Although evaluating educational success could be measured by examining specific aspects of learning, we wanted to consider learning as a spectrum from basic acquisition of facts to more complex understanding. Therefore, Bloom's work provided a basis onto which the zoo mission could be plotted and educational outcomes measured against. Unlike the Falk and Dierking model an adapted Bloom's model provides a gradient to assess where aspects of learning are being met and where educational provision can be extended.

A mixed approach

Although the learner-centred, Constructivist approaches may provide a more meaningful understanding for the learner; certain topics cannot be discovered through exploration and discussion alone. Science is founded on a set of indisputable facts which must be accepted (Driver, 1995). Certain Threshold Concepts are fundamental and need to be understood in order to progress (Land, Meyer, & Smith, 2008). Threshold Concepts challenge an individual's views, are difficult to forget, and provide connections between existing ideas (Land et al., 2008). In this respect they have a similar effect to cognitive conflict in forcing the learner to rethink their existing understanding, but go one step further by presenting a solution to that conflict. In biology such concepts include recognising the inter-relatedness of nature and the complexity of living things (Taylor, 2008). Examples of Threshold Concepts in zoo education could be that zoo animals act as representatives of a species and, captive breeding helps maintain a stable population should the wild population become extinct. In addition, zoo reintroduction programmes are only possible if a sustainable ecosystem is available to put the animals back into. Without understanding these concepts learners may view zoo animals in isolation and not consider their importance to the species survival as a whole.

Constructivist approaches can prepare learners for Threshold Concepts and guide them through the ZPD. However, the concepts themselves need to be directly taught (Cousin, 2008). Considering this, zoo education should provide both opportunities for visitors to create personal understandings as well as directly presenting them with factual information. This, for example, allows visitors to develop an awareness of biodiversity issues and the drive to act sustainably.

Presentation

The way information is presented can additionally affect how well it is received by the learner. Information can be presented as visual, audial, kinaesthetic or a combination of all three and learners will have individual preferences as to what methods work best for them. In order to cater for all learning preferences it is important that zoos present information across a range of media.

The perception of the institution in which the educational experience is set is also a factor in learning. Actor Network Theory (ANT) considers institutions as a network of smaller internal and external systems (Patrick, 2016). Each system has its own motives which affect how the institution is portrayed. Public perception of an institution as a whole, it's 'brand', affects it's authority as an educator. Brands have associated connotations which people align themselves with (Aaker, 1997; Fournier, 1998). The public perception of the 'zoo' brand is varied (Patrick, 2016). Many people believe zoos have a responsibility to inform about conservation issues and environmental realities (Stoinski et al., 2002). However, the entertainment focus of a zoo visit can sanitise how zoos present information and affect visitor engagement with learning (Beardsworth & Bryman, 2001; Braund & Reiss, 2006; Falk et al., 1998). Carr and Cohen (2011) found that whilst zoos intend to convey conservation, their websites and marketing material reinforce the image of an entertainment venue. If zoos want to provide strong education and environmental messages they must be viewed as an authority in these areas, and the zoo's associated systems, e.g. marketing, websites and merchandise, should be aligned with this overall message. To be a credible authority for inspiring pro-environmental behaviour, zoos should model these behaviours themselves. This has been done successfully in some Australian zoos where eco-friendly on-site practice and large scale campaigns have raised the profile of conservation actions (Pearson et al., 2014; Smith et al., 2012 Smith et al., 2010).

Actor Network Theory also links with Systems Theory, the belief that we should teach about the interrelatedness of all things (Jacobson et al. 2006). This is particularly relevant when considering environmental education as it is critical to teach about biodiversity and the ecosystem as a whole rather than just teach about a single species in isolation. If people don't appreciate the interaction between animals and their environments they may fail to acknowledge that protecting a single species within a zoo is not enough on its own to save a species and that protecting the habitat and ecosystem as a whole is the ultimate aim.

Behaviour theories and practice

The ultimate educational goal of zoos is to elicit more pro-environmental behaviours amongst visitors (Barongi et al., 2015). International studies suggest that zoos believe visitors are not interested in learning about conservation actions, yet, many visitors expect to be taught such information by zoos (Roe & McConney, 2015; Stoinski et al., 2002). Providing information during a zoo visit can improve awareness of conservation actions in the future (Jensen et al., 2017). However, the complexity of factors affecting behaviour means that simply ‘knowing’ what to do is not enough (Ballantyne & Packer, 2005; Bamberg & Moser, 2007; Hungerford & Volk, 1990).

Value-Belief-Norm theory suggests that an individual’s actions are based on their fundamental beliefs (Stern, 2000; Stern & Dietz, 1994). Establishing positive conservation attitudes is therefore crucial for influencing behaviour. As zoos are known to increase emotional concern towards animals (Clayton et al., 2017; Luebke, Watters, Packer, Miller, & Powell, 2016) it is often hoped that this alone will inspire positive actions to protect species.

Hines et al.’s (1986) Model of Responsible Environmental Behaviour indicates that undertaking an environmental action is a complex process. Whilst certain levels of knowledge and skills are necessary, they are not the only factor. Social, cultural and moral drivers, in addition to the practicality and confidence at the success of an action, influence whether pro-environmental behaviours occur (Bamberg & Moser, 2007; Hines et al., 1986; Hungerford & Volk, 1990; Jansson, 2011; Stern & Dietz, 1994). The Theory of Planned Behaviour (Ajzen, 1991) supports this by stating that ‘actual behaviour’ requires a combination of ‘intention’ and ‘control’ over the action.

Self-efficacy over an action is crucial. If an individual feels empowered to act and that their action will make a difference they are more likely to follow through with that action. However, if the same individual does not believe that their actions will have an impact they are unlikely to commit long term to that behaviour change (Jacobson et al., 2006). This is crucial when considering environmental problems. If an individual feels that an issue such as global warming is overwhelming in scale they may not feel that their actions as an individual have the capacity to make a difference. What is important is finding actions which individuals can undertake which have a direct and tangible impact on reducing environmental problems. Examples are the ‘#OneLess’ and the ‘No Straw Please’ campaigns (OneLess 2017, Plastic Pollution Coalition 2017) which encourage individuals to use less plastic. These campaigns emphasis the damage to wildlife that a single straw or plastic item can do, thereby linking individual actions with environmental impact.

Self-efficacy over an action can be linked to Bourdieu’s concepts of habitus, cultural and social capital and Sen’s capability model (Gokpinar and Reiss, 2016). Bourdieu argued that an individuals choices were influenced by their ‘capital’, economic (the amount of monetary wealth a person has), social (a person’s network or community) and, cultural (a person’s exposure to books, resources, museums, education and skills). Therefore, in order to engage in a conservation action an individual must have the capital in order to act. An individual’s action is further influenced by the ‘field’ or context in which that action takes place. For example, if a zoo provides opportunities for visitors to engage actively in campaigns, places to recycle and actively discourages plastic use the environment is conducive to environmental action.

Sen (1993) differentiates between ‘functions, what a person can achieve, and ‘capabilities’, the desire to achieve a particular outcome. He argues that having the resources alone is not sufficient for an action to be guaranteed, rather the ‘capability’ to act is of crucial importance. An individual’s socio-cultural factors and personal norms influence what they hold as their capabilities and what they see as important to achieve. Therefore, when considering whether individuals are likely to engage in a pro-environmental or conservation action it is necessary to consider their ability to do so in terms of capital and function as well as an individuals desire or ‘capability’ to achieve that outcome.

Economic factors are also a major driver of behaviour (McKenzie-Mohr, 2000). Individuals weigh benefits against the costs of their actions. If environmentally considerate actions incur a high cost they are less likely to be adopted and vice-versa (Hines et al., 1986; Jansson, 2011). A zoo visit already incurs an entrance cost and convincing visitors to spend more in support of conservation is a challenge. Moreover, many pro-environmental actions have delayed impact or influence environments outside the local community making them less appealing to individuals (Clayton et al., 2017).

The global ecosystem is a public good and consequently everyone is responsible for its protection. Benefits, such as carbon absorption and resource provision, make global environments invaluable. Most zoo visitors are unaware of their personal impact on the environment or of what actions are effective in addressing environmental issues (Esson & Moss, 2014; Grajal et al., 2016). Zoos should help visitors understand their personal influence on the environment, both positive and negative, if they are to change the way individuals behave.

People tend to be loss-averse and attach more weight to a small loss (cost) than to a large gain (Hanley, Shoegren, & White, 2001). Informing visitors that their actions have vast environmental benefits may be less effective than the fear that species will be lost or resources cost more. The effect of loss aversion was demonstrated by the success of the

UK and Irish tariff on single-use plastic bags at dramatically reducing usage (Convery, McDonnell, & Ferreira, 2007). Unfortunately, individuals are not acting out of compassion but due to an avoidance of cost. This makes it difficult to persuade people to buy eco-friendly products when there are cheaper alternatives.

More effective at encouraging visitor uptake of environmentally sustainable behaviours are small, positive actions, that can be embraced at little or no cost (McKenzie-Mohr, 2000; Smith, Weiler, Smith, & Van Dijk, 2012). On-site actions can empower visitors and encourage them to undertake such behaviours at home (Smith et al., 2010). Conservation actions need to be easily achieved with minimal alteration to existing practices if they are to be adopted into everyday routine. Even a small action can require a large intention to change (Moss et al., 2017b). In modelling environmentally-friendly alternatives on-site, zoos can demonstrate how changes can be made without disrupting lifestyles. Notable flagship projects have shown zoo visitors that minor alterations to shopping habits can protect the environment e.g. the Don't Palm Us Off and Sustainable Fish Campaigns (Pearson et al., 2014). As consumer choices are critical to human-driven environmental impact, these consumer-focused campaigns are vital (Grajal et al., 2016; Moss et al., 2017b; Stern, 2000). If visitors can rethink habitual practices during a zoo visit the chance of making responsible choices offsite are increased (Smith et al., 2010). However, current research is based on visitors stated conservation actions and further studies are needed to test actual behaviour outside of the zoo (Ballantyne & Packer, 2011).

Behaviours need to be developed with visitors as personalised solutions to create both a drive for action and a perception of control (Clayton et al., 2017; Esson & Moss, 2014; Hungerford & Volk, 1990; McKenzie-Mohr, 2000; Smith et al., 2010). Zoos also need to understand the barriers to conservation actions and discuss options with visitors. Learner-centred approaches are potentially more effective at enabling visitors to take personal responsibility and develop their own solutions compared to presenting top-down generic solutions.

Developing a framework for learning and behaviour evaluation

Understanding what behaviours and learning are conveyed during a zoo visit allows the impact of zoos to be evaluated and gaps in provision addressed. Aligning what is taught with what is measured is vital (Crowe, Dirks, & Wenderoth, 2008). Formal education uses specific learning objectives to measure success, however, not all informal learning experiences are based around learning objective and even fewer are evaluated against them (Roe et al., 2014).

Setting focused and measurable learning objectives is important for their evaluation. Objectives that are broad or vague, such as ‘to learn …’ or ‘to know …’ are difficult to measure. Bloom’s taxonomy is commonly used in formal education to set realistic learning objectives. It considers learning as six levels; ‘Remembering’, ‘Understanding’, ‘Applying’, ‘Analysing’, ‘Evaluating’ and ‘Creating’ (Bloom, 1956). These form a hierarchy, building from basic knowledge to developing a complex understanding.

The practice of conveying specific facts to visitors in a top-down approach, focuses on Bloom’s first and lowest level of learning: ‘Remembering’. Although factual knowledge has value, it’s use is limited unless applied in context (Perkins, 2008) and is not an automatic precursor to behaviour change (Hines et al., 1986; Hungerford & Volk, 1990; Saunders, 2003).

Bloom’s next level, ‘Understanding’ moves beyond knowing about an issue and considers its implications. Although ‘Understanding’ provides some context, the learner remains disconnected from the broader connections between concepts. These first two objectives require mainly memorizing skills (Crowe et al., 2008). It is only once the third level of Bloom’s taxonomy is reached, ‘Applying’, that connections across concepts are made.

The highest levels of cognitive learning are achieved when individuals can ‘Analyse’, ‘Evaluate’ and ‘Create’ knowledge. These happen when learners combine concepts to form arguments or problem solve. Dialogic (discussion based) teaching encourages these as visitors must use facts and examples to create an opinion. Solving environmental problems requires visitors to understand both issues and possible solutions and adapt these to fit their own lifestyles; it therefore requires all learning levels of Bloom’s taxonomy.

Bloom’s taxonomy aligns well with the Model of Responsible Environmental Behaviour (Hines et al., 1986), Theory of Planned Behaviour (Ajzen, 1991) and Value-Belief-Norm Theory (Stern & Dietz, 1994) (Figure 1.3). As such it provides a robust base for setting learning objectives which additionally aim to change behaviour.

Critics of Bloom’s Taxonomy argue against viewing learning as discrete levels (‘Remembering - Creating’), as learning doesn’t occur in a linear or isolated way (Anderson et al., 2001; Marzano, 2006). However, using a taxonomy focuses teaching on conveying a precise message with measurable objectives. It is therefore advantageous to resource planning and provision. It is important that educators recognise that learning may cross several levels as individuals make connections. This is positive as the learner is developing their own understanding beyond the intended learning objectives and aligns with the learning theories described above.

Bloom's taxonomy works well in a classroom setting as teachers repeatedly see students and can build experiences through the learning levels. However, in informal settings educators may only see visitors once and this limits what is achievable. By considering the zoo mission as a whole and breaking it into stages educators can devise experiences which target a range of objectives.

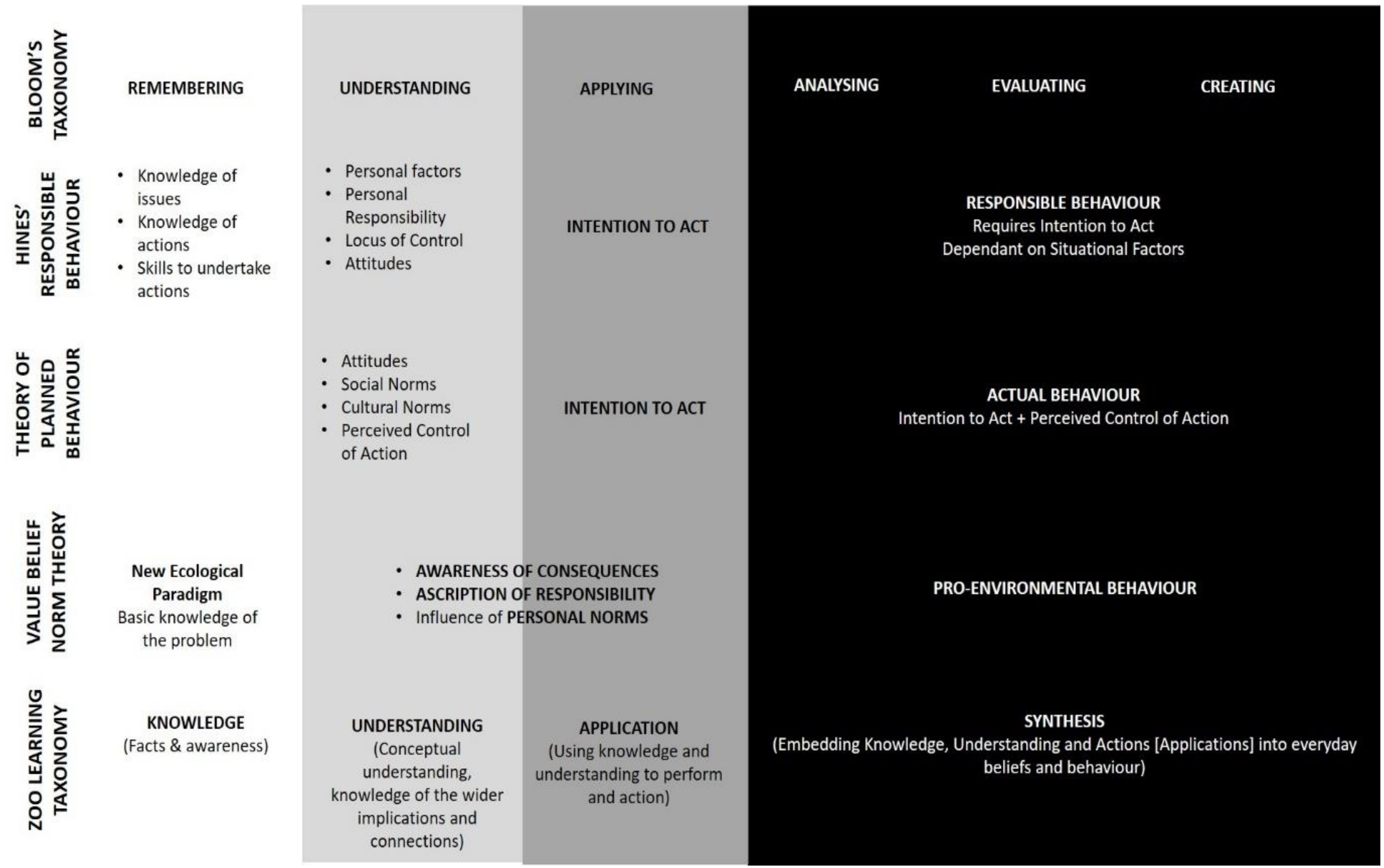

Figure 1.3. Demonstration of the overlap between Bloom's Taxonomy, Hines' Responsible Behaviour Model, Theory of Planned Behaviour, Value Belief Norm Theory and the Zoo Learning Taxonomy

To make Bloom's taxonomy applicable to the zoo mission we have created a Zoo Learning Taxonomy (Figure 1.4). We retained the first three of Bloom's levels but reduced 'Analyse, Evaluate and Create' to a single category: 'Synthesis' (Figure 1.3). This condensing is justified as the top levels of Bloom do not follow the same hierarchy as the other levels and can occur in alternative orders, for example 'Evaluation' can occur at the end or beginning of a learning process (Anderson et al., 2001; Crowe et al., 2008). Our Zoo Learning Taxonomy uses these four learning levels to form a matrix of 12 stages based on the zoos' mission of increasing biodiversity awareness and encouraging pro-environmental actions. These range from visitor's having a basic factual knowledge (level 1) to being fully environmentally considerate (level 12). Whilst the levels progress as a hierarchy and fulfilment of the earlier stages may inform higher levels it is not necessary for visitors to undertake every step during a visit. Individuals will arrive with different prior knowledge and some may make bigger cognitive jumps than others (Ballantyne & Packer, 2005). Each level (1-12) should be considered as a target for education resources. Smaller objectives for educational resources can be set within levels to further specify learning and behaviour outcomes. Although achieving level 12 is highly unlikely during a single visit, individuals with strong environmental beliefs and prior conservation experience may reach, or be at, this level. These upper levels are included in the taxonomy both as a target and a reminder that zoos should cater for all visitors including those already aligned with the zoos' conservation aims. These 'on target' individuals are a valuable resource in inspiring others. Sharing experiences through visitor discussions could promote this.

The Zoo Learning Taxonomy aims to aid educators in establishing what outcomes their current resources target. Ideally, to achieve behaviour change, zoos should aim at the upper end of the taxonomy (Application and Synthesis), however, developing attitudes and actions is only possible once visitors have a basic understanding of the issues. Therefore, zoos must devise experiences which cover the whole matrix of levels. In this respect visitors, no matter their starting level, should be able to extend their learning during a visit.

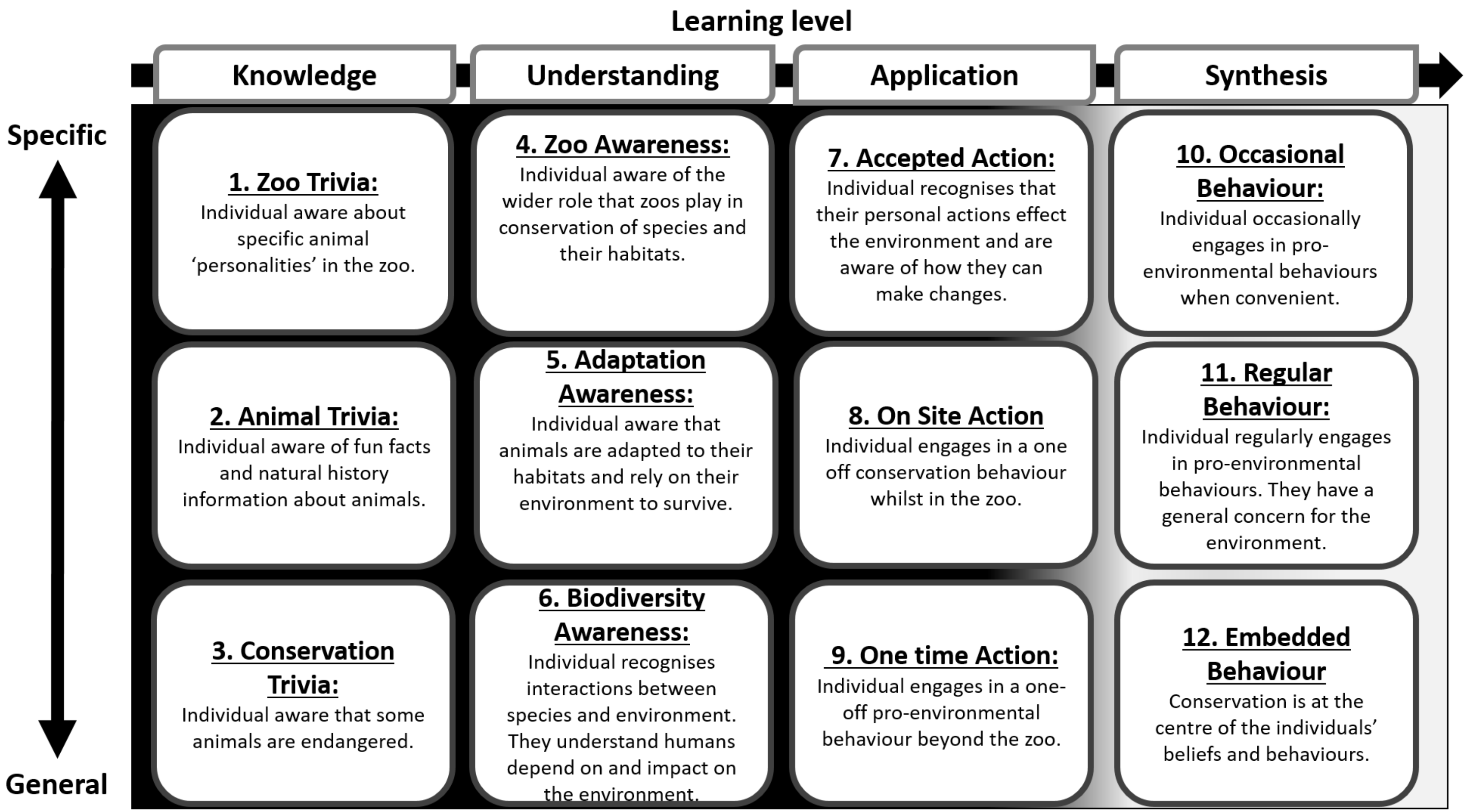

Figure 1.4. The Zoo Learning Taxonomy showing the areas of animal learning expected in a zoo, adapted from Bloom's (1956) Taxonomy. Background shading indicates the measurability of learning levels from a single zoo visit, from high (black) to low (white).

Our learning taxonomy can be used with any type of teaching strategy or learning theory as it is based on setting and evaluating learning outcomes. It is, therefore, applicable across the diverse range of teaching strategies used in zoos. The Zoo Learning Taxonomy extends Bloom's (1956) Taxonomy to include behavioural outcomes linked to the zoo mission. Therefore enabling educators and researchers to target and assess zoo education against both learning and behavioural outcomes.

Conclusions

Both learning and behaviour are complex processes and are influenced by many externalities including social and economic factors. How information is presented and how the institution is perceived will affect how learning outcomes are received by visitors. Recognising both visitor perceptions and prior experiences are crucial for creating meaningful zoo visits which result in learning.

Awareness of different learning theories is important for developing more effective evaluation of zoo education and tailoring higher impact experiences. The intended learning objective may affect which approach is selected. Although we highlight some theories of learning and behaviour we acknowledge that many more exist and can be of benefit to zoo practitioners.

Our Zoo Learning Taxonomy can help researchers and educators identify gaps in current knowledge and resource provision and create new analyses and experiences based on the areas not currently covered. In focusing experiences around learning objectives, outcomes can be measured and their effectiveness assessed. More research which tests zoo education provision using a learning theory approach is needed to establish what learning zoos successfully address and where more input is required. The Zoo Learning Taxonomy can aid this by providing a standardised measurement matrix to evaluate zoo education against.

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Chapter 2: A review of education research in zoos.

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Abstract:

Zoos mission statements frequently claim to increase visitors' biodiversity awareness and conservation actions, and yet the quantitative evidence for this remains limited. A review of the evidence indicates that, although there is a multitude of zoo-based research and findings picture zoos as having a positive impact on visitors' animal and conservation awareness, these studies vary in scope and quality. This paper considers the methods used in studies which claim zoo educational success and evaluates the reliability of their findings and methods. We find that many studies have relied on reported learning, retrospective testing and biased attitude statements as indicators of educational success. More robust, multi-national studies have demonstrated overall zoo educational impacts. Successes and failures have not yet been diagnosed from the core zoo educational elements or from non-traditional zoo sites. Studies are needed to investigate the impact of on-site educational experiences such as information signs, shows and novel forms of engagement on visitors' conservation knowledge and attitudes.

Introduction

Over 700 million visits are made to zoos each year (Gusset & Dick, 2011) and attendance continues to rise (Whitworth, 2012). If zoos can educate their vast audiences about animal facts, conservation issues and conservation actions, their potential impact is enormous. Conservation focused education is now a fundamental theme in most zoo mission statements (Patrick et al., 2007) and supports the United Nations Aichi targets (Barongi et al., 2015; CBD, 2011).

The Aichi targets are the foundation of the World Zoo and Aquariums Association (WAZA) zoo mission to educate about biodiversity conservation and inspire behavioural action. Target 1 focuses on knowledge transfer to promote biodiversity understanding amongst the public. According to Target 1 the public should also be aware of sustainable and conservation actions to prevent further biodiversity loss. Target 12 aims to halt and reverse species loss through conservation breeding and reintroduction. Although this may be outside of zoo education goals it is important that visitors are aware of the zoos' work to be able to support it. Despite having clear goals, in the form of the zoo mission, there is no structured evaluation method which zoos can use to set and measure learning and behavioural outcomes in respect of the Aichi targets. Consequently evaluations occur at a range of levels and measure varying aspects of the zoo mission.

Zoos are encouraged to evidence their educational success through evaluation. However, evaluating informal education is challenging. Unlike in classroom settings, there are no formal assessments of learning and some visitors are reluctant to participate in research during their leisure time. Despite a plethora of visitor experience studies (Schram, 2013) few are robust enough to overcome the challenges of measuring learning and provide conclusive evidence of zoo educational success (Marino et al., 2010; Moss & Esson, 2013). The studies which do exist generally agree that zoo visits have a positive educational impact on visitors. Bias in their methodology means that caution is required when interpreting results.

The focus of this paper is the methodological rigour of existing zoo education research. We consider commonly occurring problems and how some studies have addressed these. We additionally examine where future research is needed.

Common problems in zoo evaluation

The general problem of traditional zoo education research is most strikingly and comprehensively captured by a decisive rebuttal of one zoo association self-appraisal. Falk et al. (2007) conducted a large scale study on 216 American zoological institutions (n = 5500), commissioned by a leading zoo authority, the Association of Zoos and Aquariums (AZA), to investigate the impact of zoo visits on conservation attitudes and understanding. The study claimed that zoo visits prompt visitors to reconsider their role in environmental issues and see themselves as key to solutions, thereby meeting the zoo mission. The study also claimed long-term knowledge gains from a zoo visit. The study was hailed as the first large-scale zoo research to evidence positive long-term impacts from a zoo visit and was widely used by the AZA to publicise zoo success (Marino et al., 2010). However, subsequently Falk et al's (2007) study has faced intense criticism for its methodological flaws which undermine the validity of its findings. Marino et al. (2010) identified six major errors in Falk et al.'s (2007) study. Criticisms include that Falk et al. (2007) did not directly measure knowledge and instead relied on retrospective-pre-tests collected on exit; negative responses and refusals were ignored; visitors were informed that the research investigated educational impacts, therefore increasing desirability bias; and survey statements were positively biased (Marino et al., 2010). These methodological biases mean that Falk et al.'s (2007) findings of zoo impact success are likely overstated. In addition to the flaws highlighted by Marino et al. (2010) the 'identity-related-motivations model' used by Falk et al. (2007) to divide visitors into groups was criticised by Dawson and Jensen (2011). They argued that Falk et al.'s (2007) model was too reductive and ignored the potential for visitors to fall into multiple categories. Particularly, Falk's model ignored important demographic characteristics which potentially influenced learning (Dawson & Jensen, 2011). Falk et al. responded to criticisms, stating that the study was not designed to prove visitors' perceived value of zoos and was intended as a descriptive study (Falk et al. 2010). They argue that in using retrospective pre-testing, response-shift bias was avoided (i.e. visitors didn't look for answers during their visit). Falk et al. (2010) also claim that because their study supports findings from other zoo research, their claims of educational success stand. However, as other zoo studies share similar methodological flaws this does not evidence zoo impact.

Reviews of zoo evaluations indicate that methodological errors are still prevalent. Luebke and Grajal (2011) found that most American zoo evaluations (97 zoos) measure educational success using attendance figures, rather than whether learning outcomes have been achieved. Attending a learning experience is not a guarantee that messages will be received by all audience members. Accordingly, attendance measures inflate levels of reported learning. Roe et al. (2014) demonstrated that the problem is an international issue, with current zoo education evaluation dominated by claims based on anecdotal evidence (reported visitor learning and visitor satisfaction) and by assuming that the number of people taught equates to the number of people who have learned.

Luebke and Grajal's (2011) review also identified a lack of knowledge testing using pre-post-measures. Pre-post-(repeat) testing is important as it allows changes in visitor knowledge to be tracked and claims of educational impact to be evidenced (Jensen, 2015b). Instead, many zoo evaluations use retrospective pre-testing, where visitors are asked on exit to predict how they would have responded prior to their visit (Falk et al., 2007: Wagner et al., 2009). Critiques of retrospective pre-testing claim that it unreliably estimates learning (Marino et al., 2010; Wagoner & Jensen, 2014). As learning is influenced by many factors, it is difficult for visitors to accurately recall what they knew before a visit. Additionally, negative associations with failing to learn and desire to please the researcher mean that visitors are more likely to over-state any potential increases in knowledge (Donaldson & Grant-Vallone, 2002; Marino et al., 2010).

Pre-post-(repeat) testing can be challenging in an informal learning setting as visitors may be reluctant to answer multiple questionnaires and this can lead to small sample sizes. Experimentally modelling repeat testing using unmatched groups has demonstrated similar findings to repeat samples whilst avoiding respondent bias found in reported measures or retrospective pre-testing (Chapter 5). Although knowledge change cannot be directly tracked, general improvements in visitor learning can be identified. Increased knowledge of threatened species and conservation concern were seen in both Balmford et al.'s (2007) study and Clayton et al (2017) using an unmatched pre-post-visit sample. Bruni et al. (2008) combined both unmatched pre-post- groups and repeated pre-post- testing and found similar increases in conservation concern as a result of a zoo visit, demonstrating the similarities between methods.

Why problems occur:

Successful zoo education, based on the zoo mission criteria, is achieved if visitors improve their biodiversity understanding or conservation efforts. However, zoo studies vary in what they measure as educational success.

Evaluation studies within informal learning environments, such as zoos, are challenging. Learning is influenced by many factors including past experiences (Piaget, 1998; Vygotsky, 1978). Hence evaluations must test visitors' existing knowledge and measure change as a result of the experience itself. Repeat testing in leisure settings can, however, be difficult. Alternative methods which attempt to predict visitor's prior knowledge have led to biased methodology in many zoo studies (Jensen, 2015b; Marino et al., 2010; Wagoner & Jensen, 2014). Additionally, many zoos struggle to complete any form of evaluation due to lack of time, expertise and resources (Jensen, 2015a).This has led to errors in survey design, implementation and interpretation which have all affected the reliability of past research.

Large scale zoo evaluations offer more generalizable findings and stronger evidence of impact. They also, however, require co-ordination across sites and standardised evaluation measures and for these reasons they are not common in the zoo literature. On the other hand, smaller scale or case studies are easier to implement and may provide more practical guidance for individual sites, but without specialist evaluation these studies are more prone to error in both design and data collection (Jensen, 2015b). Furthermore, findings from studies of this type are harder to generalise across the whole zoo community unless viewed collectively with other, similar, studies.

Robust evaluation

Until recently, robust international studies were absent from the zoo literature. In other words the educational claims of zoos were based only on small scale or methodologically weak studies (Dierking, Burtnyk, Buchner, & Falk, 2002).

A series of large scale international studies by Moss, Jensen and Gusset (Jensen et al., 2017; Moss et al., 2017a, 2017b; Moss, Jensen, & Gusset, 2015) have provided a comprehensive baseline evaluation of the impact of zoo visits on visitors' biodiversity knowledge and long-term understanding of conservation actions. These studies used repeated measures testing, asking the same respondents both before and after their visit, and follow-up repeat testing to measure long term impact. Moss et al. (2015) provided evidence of zoos meeting Aichi target 1 when they identified improvements in aggregate biodiversity understanding and ability to state conservation actions as a result of a single zoo visit.

These large-scale, international studies provide credible evidence of zoo success as they track knowledge changes by repeat testing individuals across a large sample. Yet, whilst these studies are enormously important in justifying the impacts of zoos overall they may be too broad to influence zoo practice at an institution level. Although there have been many single site zoo studies which have examined zoo experience (Schram, 2013) many of these suffer from the aforementioned methodological weaknesses.

Understanding the impact of experiences within the zoo visit is also required (Clayton et al., 2017). Weiler and Smith (2009) found that zoo experiences may have an additive effect on visitor learning. Therefore, research on both the individual and combined effects of zoo experiences is required. Moreover, non-traditional zoos, such as those which include an additional attraction are rarely considered in the zoo literature. As external factors, such as the way an institution is perceived may influence learning (Patrick, 2016) it is important to consider visitor learning in different types of zoo setting.

One of the most common sources of animal information in zoos is signs. Moss et al. (2017a; 2015) found that sign information impacted learning during a zoo visit but did not investigate sign content learning specifically. Observation studies suggest that around 30% of visitors engage in sign information (Clayton et al., 2009), yet, this is not an accurate measure of engagement (McManus, 1990). Most sign studies use ‘dwell time’, the amount of time spent reading, as an indication of learning (Arndt et al., 1992; Bowler et al. 2012). Time is a poor learning indicator as individual reading speeds differ (Sanford & Finlay, 1988) and does not show achievement of learning outcomes. Other sign studies are museum or science-centre based (Bitgood, 2006; Bourdeau & Chebat, 2003; Wandersee & Clary, 2007). Whilst these studies offer some insight into visitor behaviour they are not directly applicable to a zoo environment. Therefore, zoo-based studies of the educational potential of information signs are required.

Animal Shows and keeper talks are also frequently used by zoos to convey information. Despite their prevalence there are limited guidelines or research to indicate educational impact. Animal-visitor interactions are generally viewed positively by visitors and have been shown to increase dwell time at exhibits (Anderson et al., 2003; Miller et al., 2013; Povey & Rios, 2002). However, the impact of entertainment-focused animal shows on visitor knowledge is relatively unknown and the use of ‘trick’ behaviours to present educational messages faces welfare criticism without evidence to support its benefits (Acampora, 2005; Finlay et al., 1988). Consequently, studies on the impacts of live animal shows on visitor learning are also required. Understanding the impacts of non-animal alternatives would also be valuable.

Measuring learning and behaviour

Despite the focus of the zoo mission on learning and behaviour very few studies take a theoretical approach to their evaluation. Learning occurs at different levels and it is crucial that what is being taught matches what is being measured (Crowe et al., 2008). Applying learning theory approaches could help practitioners and researchers to be more reflective, as well as focus objectives and measures around the central zoo mission (Matiasek & Luebke, 2014).

Using a learning taxonomy can successfully highlight weaknesses in educational provision. Patrick’s (2014) study examined the level of questioning engaged in during a zoo visit. She found 60% of visitor-visitor questions were at the lowest level of learning (recall of information). Visitors rarely engaged in deeper concepts such as applying conservation actions to their lives. This finding supported Clayton et al. (2009) who found that over 50% of visitor statements were purely descriptive (n = 3117). Awareness of the level of provision allows targeted improvements, for example, by promoting more complex questioning which encourages debate instead of recall.

In addition, greater attention within zoo education should be given to culture and society as they are influential in both learning and behaviour (Hines et al., 1986; Hungerford & Volk, 1990; Oreg & Katz-Gerro, 2006).

Zoos ultimate mission to influence behaviour cannot be achieved through knowledge increase alone (Hines et al., 1986; Hungerford & Volk, 1990). Therefore zoos should specifically target and measure behaviour in addition to knowledge and understanding (Pearson et al., 2014; Smith et al., 2012). Behaviour targeted studies have demonstrated success in raising visitor awareness of conservation issues and solutions (Esson & Moss, 2014; Pearson et al., 2014; Smith et al., 2012). Studies which track behaviour changes beyond the zoo and compare behaviours before and after a zoo visit are still missing.

The progression of impact evaluation research

Zoo research has come a long way and is still making great progress (Figure 2.1). In the 1980s and 1990s zoo research focused on small scale zoo-led studies. These provided information for the zoos themselves, but were not always published or widely available. Many of these studies suffered from methodological weaknesses. This led to the Royal Society for the Protection of Cruelty to Animals (RSPCA) producing a welfare report (RSPCA, 2011) which criticised zoos for their lack of peer-reviewed evidence to support their educational claims. At the same time the UN Convention on Biodiversity produced the Aichi targets which refocused the zoo mission on engaging the public with biodiversity (CBD, 2011). Since 2011 zoo research has increased its focus on conservation and biodiversity and is using more robust methodology to evidence impact (Moss et al. 2015; 2017a; 2017b). Studies are also moving from testing visitor’s knowledge to measuring behavioural intentions, although intent is not a guarantee of action (Hines et al., 1986).

The target for fulfilling the Aichi targets is 2020. Zoos have not yet proven that they are completely meeting targets. The ability to evidence the behavioural impacts of a zoo visit increases as technologies develop.

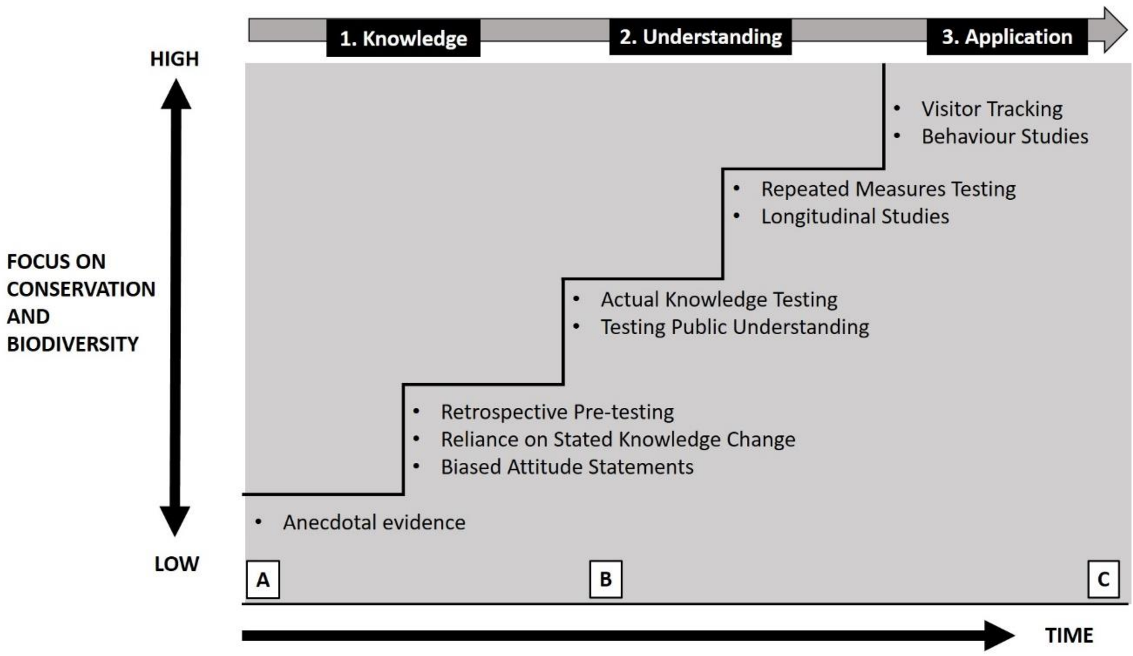

Figure 2.1: Zoo Research Staircase; focus of zoo education research overtime. Key publications and targets are denoted by letters, A: 1981 Zoo Licence Act, B: Aichi targets established (2011), RSPCA 'the welfare state 2005-9' produced (2011), C: 2020 date for achieving Aichi targets.

Evaluation is a continuous process (Figure 2.2). Individual institutions pilot small scale studies with local impact. Critiques question the flaws in these research strategies and suggest better evaluation measures (RSPCA, 2011; Marino et al. 2010; Roe et al. 2015). Baseline studies are created using large scale studies, influenced by comments from the critiques (Moss et al. 2015; 2017a: 2017b; Jensen et al 2017). Diagnosis studies are eventually carried out at the institutional level to evaluate practices in detail and provide guidance for improvements. Zoos then act upon this guidance and the cycle begins again. The intention being that with each iteration overall improvements are made.

We are currently in a period of 'diagnosis' as large international studies have provided benchmarks of overall evidence of impact. Targeted studies are now needed to test how specific aspects of a zoo visit can be improved and guide practitioners. Overall benchmark evaluations will need to be repeated to assess whether improvements have been made and have been effective.

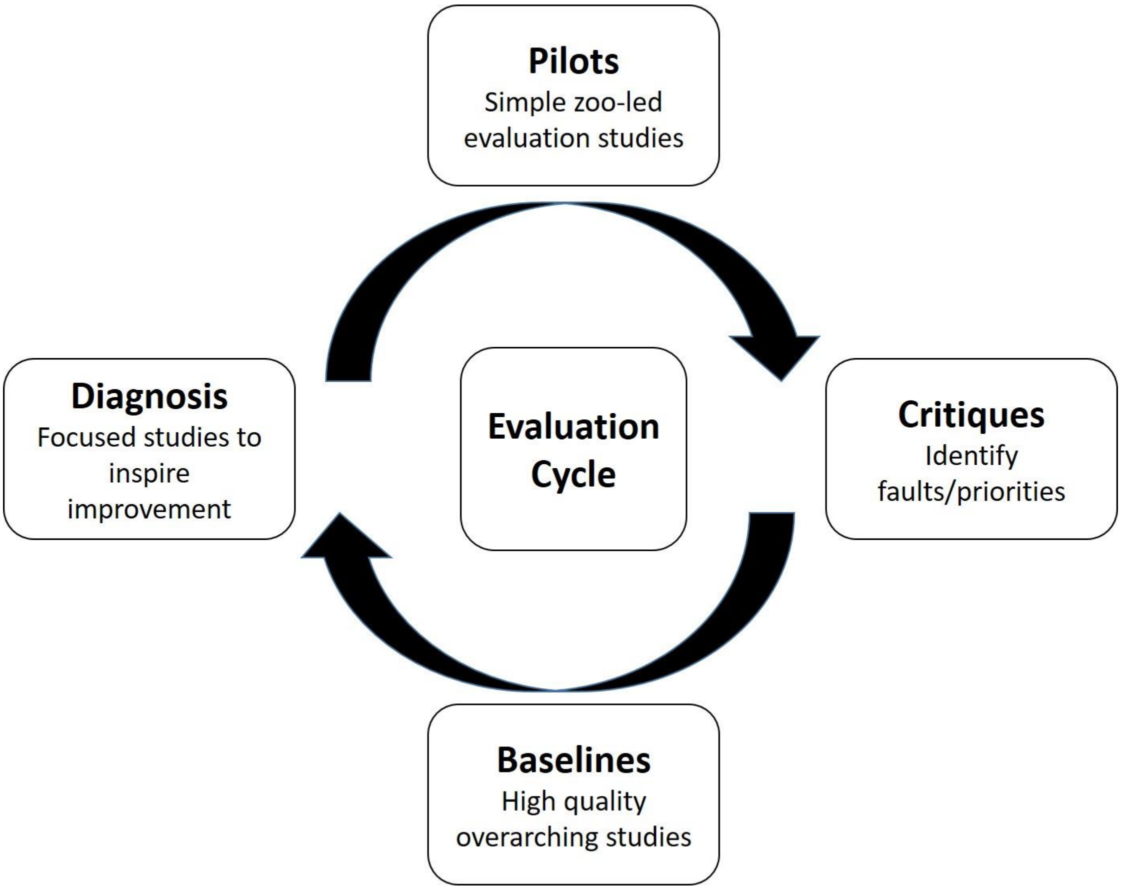

Figure 2.2: Evaluation cycle; with each step informing the next step.

Conclusions

Zoos have an important role in educating visitors about biodiversity and conservation. Claims of educational successes appear throughout zoo research literature. Much of this research suffers from recurring methodological problems. These include: reliance on retrospective pre- testing, reported learning and biased data collection (Khalil & Ardoin, 2011; Matiasek & Luebke, 2014; Roe et al., 2014; Wagoner & Jensen, 2014).

Recent international studies have provided robust overarching evidence of zoos meeting Aichi target 1, to raise visitor awareness of biodiversity and conservation actions. Zoo evaluation studies have increased in complexity over time, moving away from small scale, knowledge-focused, research towards large-scale studies testing visitor's conservation actions. However, these studies do not include all zoos and their findings provide overall evidence rather than practical guidelines. Smaller scale evaluations of specific zoo experiences are still needed to inform educational practitioners. Unlike past research these small studies need to be conducted using robust methodology to improve reliability of their findings and can be combined to form a body of knowledge for best practice in zoo education.

Evaluation is a continuous process. Small scale research which influences practice should be combined with larger scale benchmark studies which track overall impacts to provide a complete picture of zoo visit impact. Aims of practice and evaluation need to align and be targeted at achieving the zoo mission.

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Chapter 3: Evaluating zoo animal information signs for environmental education

Short title: Zoo animal information sign evaluation

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Abstract

Over 700 million visits are made to zoos annually and the animal information sign is the most consistent form of public education found therein. However, this fundamental aspect of zoo education remains untested, because no research has quantified its effectiveness for delivering information relevant to the conservation mission of zoos. We examined the level of learning provided by five zoo animal information signs using our Zoo Learning Taxonomy. We used visitor questionnaires to investigate which sign-related information was remembered, reading motivations, and impact on environmental awareness. Animal identification was both the main focus of zoo signs and the main reason for sign reading. Animal information signs contained predominantly 'Knowledge' level information regarding animal and conservation facts. The signs achieved their intended outcomes of conveying these facts and also some 'adaptation' awareness regarding animal dependence on habitats. Sign-readers answered more than double the number of overall animal related questions correctly than non-sign-readers. Sign information was most effectively conveyed when it was memorable at a glance, with clear graphics and limited text. Nevertheless, sign information was not sufficient to ensure 'Application' or 'Synthesis' learning, namely actions that sign-readers could undertake to help conservation. Given the prevalence of animal information signs across zoos and the zoo mission to encourage public pro-environmental behaviour, future sign design should consider including conservation actions and practical advice.

Keywords

Informal education, public knowledge, reading motivation, sign design, visitor engagement, learning taxonomy

Introduction

Globally, zoos and aquariums (herein termed zoos) attract more than 700 million visits each year (Barongi et al., 2015) and education and conservation action are intrinsic to most of their mission statements (Moss & Esson, 2013; Patrick et al., 2007). Zoos therefore claim to have worldwide impact on international biodiversity targets including United Nations' Aichi Target 1, which aims to increase public understanding of biodiversity, and Target 12, which aims to prevent further biodiversity loss (CBD, 2011). Modern, progressive zoos therefore aim to influence public behaviour and values in order to establish environmentally-friendly actions which support conservation (Barongi et al., 2015).

International zoo studies have demonstrated that a single zoo visit can increase biodiversity knowledge, including raising public awareness of conservation actions (Moss et al., 2015). More than 5600 visitors across 26 World Association of Zoos and Aquariums (WAZA) member institutions were asked to explain their understanding of biodiversity and actions to help conservation, both before and after a zoo visit. A significant change in public awareness of biodiversity was noted after the zoo visits with sign-reading acknowledged as a significant factor. However, the study used self-reported sign-reading and did not test sign content or whether any knowledge was gained directly from reading the information.

Evaluation of the content of zoo signs and how they are engaged with by visitors, including identifying the motivations for reading signs, is needed. Animal information signs are the predominant signage in most zoos (Serrell, 1988), and yet the content of these signs and their effect on visitor awareness has not been researched.

Theoretical Background

Social constructivist theory argues that learning is a process where understanding is built through experiences and social interactions (Vygotsky, 1978). Zoo visitors come with pre-existing views and add to these to form their own interpretation of information (Ballantyne et al., 2007; Falk, et al., 2007; Hooper-Greenhill, 2004). This personal construction of understanding is particularly important for developing environmental beliefs and concerns (Hines et al., 1986; Medved & Oatley, 2000). It is important that educators acknowledge visitors' existing knowledge before adding to it. However, many zoo experiences happen unguided, without an educator present. In order to create information suitable for a wide range of backgrounds and move learners beyond their existing knowledge, it is important to consider the learning process. Bloom (1956) summarised learning as sequential steps in which understanding becomes progressively more complex. Although Bruner (2006) suggests that learning is more complex than this linear process, the simplicity of Bloom's taxonomy is helpful for setting targets and designing resources for practitioner use.

Bloom's stages of learning are: 'Remembering', 'Understanding', 'Applying', 'Analysing', 'Evaluating' and 'Creating'. The lowest levels of learning, 'Remembering' and 'Understanding', involve acquisition of facts and their basic interpretation within a context (e.g. knowing animal trivia). 'Applying', involves using this awareness in new contexts, (e.g. recognising how personal actions affect the environment). In the 'Analysing', 'Evaluating' and 'Creating' stages learners incorporate new ideas within their own understanding and values. Zoos ultimately aim to inspire pro-environmental behaviour in their visitors. This behaviour is only achieved by acting at the highest levels of learning as it requires both an understanding of the implication of ones actions and a reasoned choice to behave in a certain way. Zoos should be targeting resources to these levels of learning if they wish public behaviour to follow suit.

Bloom's levels of learning are commonly used to set measurable objectives in formal education (Crowe et al., 2008; Marzano, 2006), but they are rarely applied to zoo settings (Patrick, 2014). The highest of Bloom's levels of learning, although key for developing pro-environmental behaviour, are hard to measure during a single zoo visit and are designed for classroom environments. To improve the relevance of Bloom's taxonomy for zoos we suggest simplification to four levels: 'Knowledge', 'Understanding', 'Application' and 'Synthesis'. In addition, we propose a 'specificity' dimension: whether learning is site-specific (e.g. knowing facts about the zoo itself) or more generalisable (e.g. knowing how this information extends to the wider context). This 'Zoo Learning Taxonomy' (Fig.3.1) can be used to measure the learning potential of current zoo resources and evaluate their success. We acknowledge that during a zoo visit only learning up to the 'application' stage will be measurable through actions achieved on site. 'Synthesis' level learning develops over time to form regular behaviours and these will occur beyond the zoo gates. We include 'synthesis' in the taxonomy as it is still important to target resources to this level if pro-environmental behaviour is the ultimate aim.

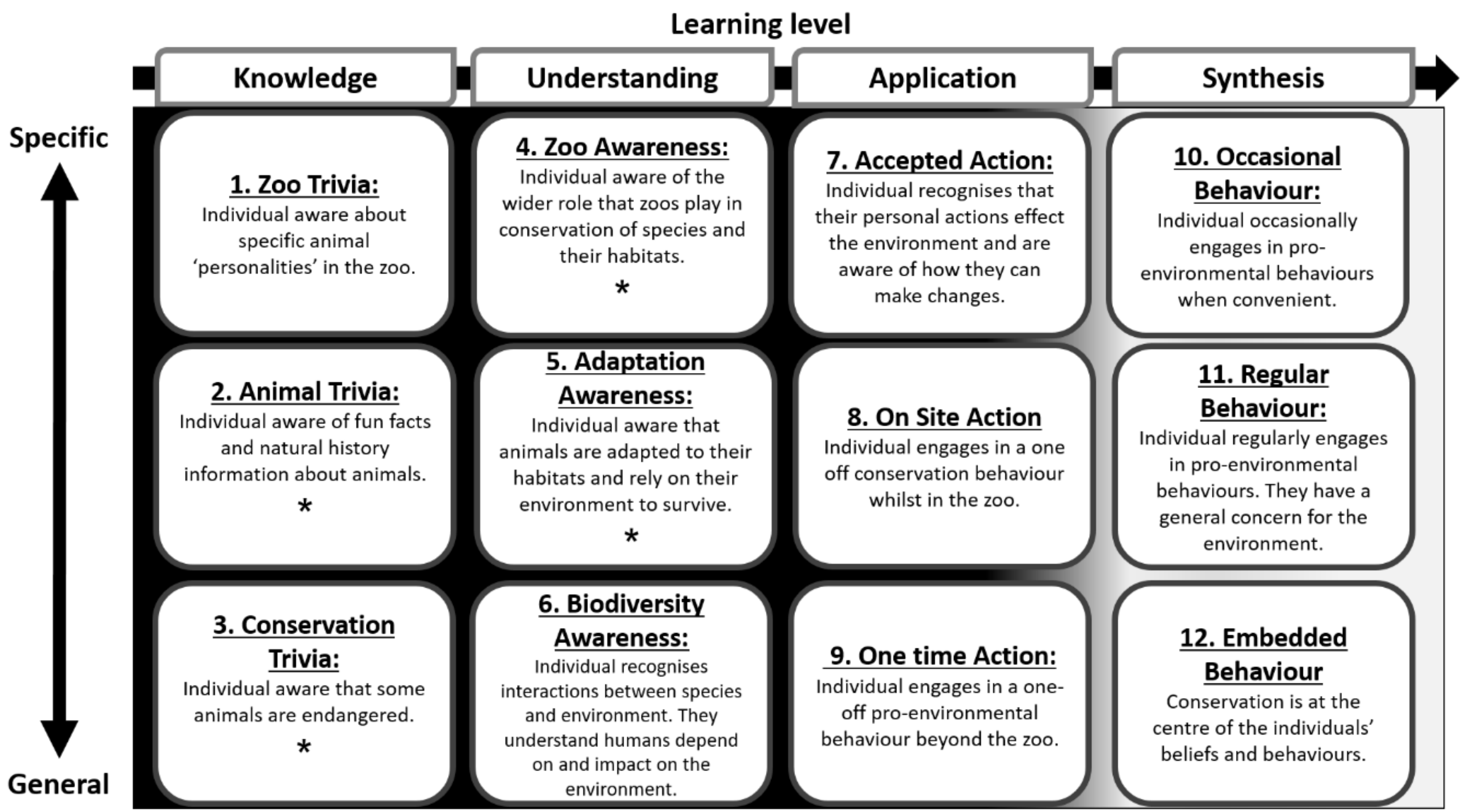

Fig. 3.1. 'Zoo Learning Taxonomy' showing the areas of animal learning expected in a zoo, adapted from Bloom's (Bloom, 1956) Taxonomy. The areas of learning covered by a typical animal information sign are highlighted using a (*). Background shading indicates the measurability of learning levels from a single zoo visit, from high (black) to low

Zoo Animal Information Signs

'Animal information signs' are here defined as those used to provide information about each species of animal held at a zoo (Serrell, 1988). They are relatively cheap to produce, require little maintenance and provide a constantly available source of information (Hall, Ham, & Lackey, 2010). Animal information signs are estimated to be read by 20-30% of all zoo visitors (Clayton et al., 2009; Martin, 2012; Moss et al., 2015) equating to 140-210 million people annually.

Sign content in zoos is decided by individual institutions. In the UK, government guidelines require zoos to provide accurate information including 'the species name (both scientific and common), its natural habitat, some of its biological characteristics and details of its conservation status' (DEFRA, 2012b). These categories align with known public preferences for information on animal facts (34%), threat status (31%) and where the animal is found (28%) (Fraser, Bicknell, Sickler, & Taylor, 2009). When mapped on the Zoo Learning Taxonomy this information predominantly targets the 'Knowledge' and 'Understanding' levels of learning (Fig. 3.1)(Kaye, 1994). This narrow content focus is surprising given zoos' mission to increase awareness of environmental issues and encourage public action (Barongi et al., 2015; WAZA, 2005).

There are no specific guidelines on how to present biodiversity information (DEFRA, 2012a, 2012b). Previous studies on sign design recommend using concise texts, between 30-100 words, with short sentences (Bitgood, 1989, 2000; Screven, 1992; Wandersee & Clary, 2007) yet many zoo signs far exceed this length.

Museum studies provide support for using concise texts. Shorter texts are read for longer and have increased recall than longer texts (Bourdeau & Chebat, 2003; Thompson & Bitgood, 1988). Bitgood et al. (2006) found that whilst 12% of respondents read texts of 100 words (n = 43), only 4.5% read those exceeding 200 words. This is referred to as the General Value Principle where readers minimise the mental energy cost of reading for maximum information gain (Bitgood, 2006). As museums are thought to attract more learning motivated individuals than zoos (Falk et al., 1998, 2007; Moss & Esson, 2010), zoo visitors may be less likely to read signs fully. Zoo specific studies are required to establish how much information zoo visitors actually engage with.

It has been argued that controversial conservation images could inspire pro-conservation action in zoo visitors (Esson & Moss, 2013; Stoinski et al., 2002). However, concerns about presenting hard-hitting environmental realities in family-orientated settings have prevented the widespread uptake of such techniques. It is therefore important to establish what visitors gain from 'standard' animal signs before such alternatives can be fully advocated.

The present study examines whether animal information signs effectively deliver their intended objectives of conveying animal and conservation facts. The objectives of this study were to (1) identify motivations for reading zoo animal information signs; (2) establish whether animal information signs lead to higher levels of knowledge in sign-readers compared to non-sign-readers; (3) determine what information is retained and from what sign sections; and, (4) establish whether the content of animal information signs has inspired conservation action.

This is the first zoo-based study to examine sign content in detail, the level of learning conveyed and the motivations for reading.

Materials and Methods

Our study was conducted at a World Association of Zoos and Aquariums (WAZA) affiliated zoo, in the UK. As a WAZA member, the zoo was committed to promoting the Aichi biodiversity targets. The zoo site was combined with a theme park. Site-wide visitor surveys in 2016 indicated that the modal highest education level of visitors was a secondary school certificate (GCSE; 20.6%, n = 160 Chapter 6). We hypothesise that if signs can convey information to visitors in this entertainment-orientated environment, more typical zoo settings (without a theme park) should be able to achieve the same, if not greater, results.

We examined animal information signs for five different species: alpaca (*Vicugna pacos*), greater rhea (*Rhea americana*), lowland tapir (*Tapirus terrestris*), capybara (*Hydrochoerus hydrochaeris*) and mara (*Dolichotis patagonum*). These animals were chosen as they were not species typically associated with zoos, as such, visitors should be less familiar with information about them. Signs were all positioned along one pathway to control for exhibit influence and were easily visible by both researcher and visitor. All signs were of the same layout, size, colour and height (45cm). Signs following the same layout throughout an institution and which are easy to access are thought to be read more often as they require little additional effort to be understood (Bitgood, 2000, 2006; Wandersee & Clary, 2007).

Sign content was typical of most zoo animal information signs and included information specified by UK licensing requirements (Fig. 3.2). Signs were on average 244 words long (95% CI 221 – 267) and comprised of a central text (containing a species description followed by general natural history facts, aimed at a broad audience). There were also four peripheral sections: (1) ‘habitat’ including a map, photograph, and description of geographic distribution and environment; (2) ‘threat’ including a scale bar showing the International Union for the Conservation of Nature (IUCN) Red List status (2015); (3) ‘appearance’ including photographs of the species; and (4) ‘did you know?’ including two or more ‘fun facts’.

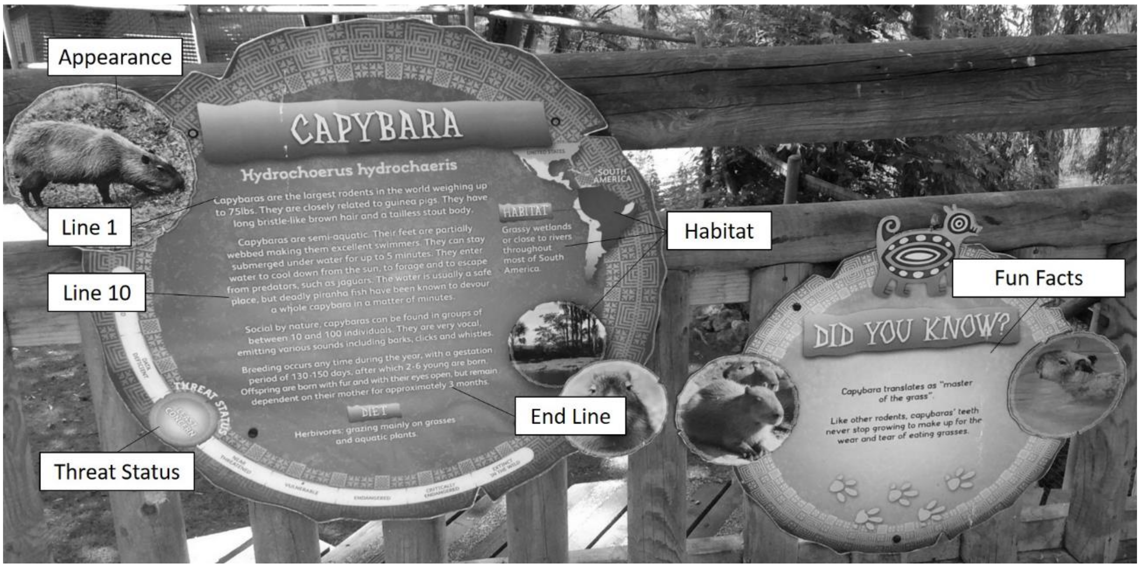

Fig. 3.2. Photograph showing an example of the animal information signs tested in this study; labels show each of the sign sections investigated.

Discussion with the zoo’s education team established that the animal information signs were designed with the following objectives: a) to help visitors identify the animals; b) to provide natural history information; c) to provide ecological information on habitat and geographical range; and d) to inform visitors of threat status.

We examined the animal information sign content using the Zoo Learning Taxonomy (Fig. 3.1) and thematic analysis. Signs predominantly contained ‘Knowledge’ level content (86% of sentences) focusing on species facts. ‘Understanding’ level content formed 14%

of sentences with each sign covering between five and seven concepts including animal adaptations and behaviours.

Previous studies on sign use have measured effectiveness using ‘dwell time’ (time spent reading) (Arndt et al., 1992; Bowler et al., 2012; Sanford & Finlay, 1988). However, this does not measure impact nor does it account for differences in reading abilities. We used a quasi-experimental design which compared the number of accurate responses to sign-related questions, between those who had read and those who had not read sign information. Our experiment tested how much impact the sign content had on readers regardless of reading speed.

All individuals who had been observed to have ‘read’ a test sign were approached after they had finished reading and were asked questions about the sign’s content. Reading was assumed if a visitor stopped in front of, and appeared to be focused on, a sign for longer than two seconds (McManus, 1990). Respondents were unaware that they were being observed whilst reading or that they would be questioned on the information seen. This allowed us to assess how much information is read by visitors in an exhibit context and avoided ‘priming’ responses (visitors being aware that they will be asked questions on sign content and consequently memorising the answers to potential questions).

The comparison non-sign-reading group were selected on an n-th visitor basis by questioning individuals before they had entered the exhibit. This ensured no exposure to the information prior to testing. A second control group of individuals who walked through the exhibit but did not ‘read’ signs (i.e. did not meet the reading criteria defined above) were questioned to ensure that the non-sign-readers were a representative sample and that differences in response were due to sign information and not due to exhibit influences.

Respondents were given an interviewer-administered questionnaire (collected weekdays, May-September 2014). Questions were specific to each of the five animal signs (Appendix A.1) and were based on information found in the first (‘line 1’), middle (‘line 10’) and ‘end line’ of the main text plus the four peripheral sign sections. This enabled us to establish what sign sections and how far into the text the respondent had read. Questions on animal threat status were presented to all respondents as a choice card with threat levels listed in a random order. Sign readers were additionally asked to state why they read the sign. Their responses were grouped by theme to determine reading motivations. Recognising why visitors engage with zoo signs was necessary in order to establish whether current sign content meets visitor needs.

The signs tested did not contain any explicit ‘Application’ or ‘Synthesis’ level information, e.g. linking personal actions to the environment. Since zoos intend to inspire behaviour change and animal information signs are so prominent across zoos, we tested whether the public could move from recalling threat status to identifying personal conservation actions without specific links being provided. We therefore asked all respondents ‘what do you think you could personally do to conserve the animal or their habitat in the wild?’.

Knowledge retention was tested using a repeat questionnaire, identical to that used in-visit, sent via email six months after the visit. Three reminder emails were sent 10 days apart.

Respondents gave consent to be part of the study and additional adult consent was sought for under 18s. The study was granted ethical approval from the University of York Environment Department Ethics Committee.

Data analysis

Answers to questions were coded correct (1) or incorrect (0) using a pre-defined coding table based on information available on the signs (Appendix A.2). Border-line cases (46 responses out of 1638 total, 2.8%) were coded as incorrect. During the coding, respondent’s test condition (non-sign-reader or sign-reader) was obscured from the data set so as not to bias coding. Personal actions to protect the animal or their habitat were coded (0) no action, (1) general nonspecific action (2) personal nonspecific action (3) personal specific action.

All questionnaire answers were compared between sign-readers and non-sign-readers, also including demographic and education covariates to account for biases external to sign reading. Demographic covariates were calculated using postcode data and associated scores on the Index of Multiple Deprivation (IMD; combining income, education, health and employment information from local area statistics) (NPEU Tools, 2010). We note that IMD scores based on postcode data can be methodologically problematic as they provide aggregate statistics for the area in which the respondent lives and not individual information. This introduces the risk that the individuals in the present study do not follow the same pattern as the aggregate for their postcodes. In the absence of specific income information, IMD scores were seen as the best available data for comparison between the sign-reading and non-sign-reading groups. IMD was used in conjunction with age and level of post-secondary school biological education to establish that the two groups shared similar aggregate characteristics (Table 3.1).

Table 3.1. Comparison between sign-readers and non-sign-readers.

	Sign-readers (N = 118)	Non-sign-readers (N = 116)
IMD quintile	3-4th	3-4th
Number of males (mean age 95%CI)	47 (28-36 years)	40 (34 – 41 years)
Number of females (mean age 95%CI)	71 (30-37 years)	76 (31-37 years)
Number of individuals with post-secondary biological education	12	9

Statistical analysis was performed using R (CRAN, 2014). Data were checked for skew and heteroscedasticity prior to analysis and did not require transformation. We used Binomial Generalised Linear Models (GLMs) to compare the effect of sign reading on correct responses. Covariates were also included in all models to account for external bias including age, gender, visitor group size, IMD score, post-secondary biological education, animal species, and prior experience of the zoo. A Poisson GLM was also used to model the same variables against the overall number of correct answers. Backward-forward stepwise selection was used for all GLMs. Where the variable, ‘sign reading’, was dropped by the model selection process, univariate GLMs were included for this variable, employing False Discovery Rate (αFDR) correction for repeat testing (Garcia, 2004). We calculated summary data as mean and bootstrapped confidence intervals (95% CI; 10,000 iterations). We compared responses given in-visit and after six months using Wilcoxon signed rank tests due to insufficient sample size for modelling.

Results

Out of the 573 individuals approached, 234 agreed to participate in the questionnaire (40.8% response rate). These included 118 sign-readers and 116 non-sign-readers. Additionally 15 non-sign-reader ‘control’ individuals (not observed to ‘read’ the signs but who visited the exhibit) were surveyed.

Six-month questionnaires were sent to 155 respondents of which 53 were completed (34.19% response rate).

There was no significant difference between the composition of sign-reader and non-sign-reader comparison groups (Table 3.1).

Knowledge level learning

Overall, sign-readers answered more than double the number of animal questions correctly than non-sign-readers (25.4% correct non-sign readers, 51.2% correct sign-readers) (Fig. 3.3). Reading the signs had a significant positive effect on knowledge (S.D. non-sign-readers = 0.92, S.D. sign-readers 1.15, effect size (ES) = 0.95, w = 3560, p=<0.001,). Reading was found to be a significant predictor of overall correct responses when tested using Poisson GLM and explained 25.7% of the model deviance (Table 3.2). Knowledge differences were greatest between the sign-reading and non-sign-reading groups for questions relating to ‘appearance’ (45.94%), ‘line 1’ (35.19%) and ‘fun-facts’ (41.51%) sections of signs. Sign-reading also significantly predicted correct responses to animal appearance questions (explaining 24.6% of the model deviance) and fun facts (explaining 29.8% of the model deviance) when tested against other variables. Reading was a significant predictor of correct response to all questions except those relating to ‘line 10’ and ‘end line’ (Table 2) indicating that visitors may not read to the end of the sign.

We found a seven percent (but not significant) aggregate drop in overall knowledge for sign-readers six months post-visit (Fig. 3.4, p = 0.2, v = 385, n = 43). The biggest drop in knowledge was for ‘fun facts’, for which 24% fewer correct responses were given by sign-readers six months post-visit (n = 43), albeit still more correct responses than non-sign-readers.

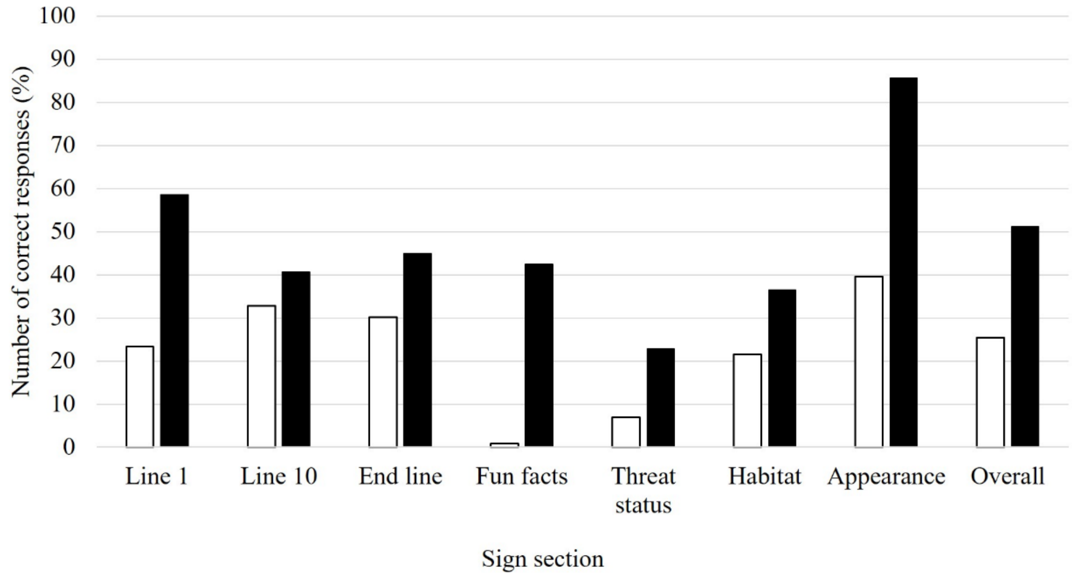

Fig. 3.3. Percentage of responses that were correct for each sign section, for sign-readers (n = 118; black bars) and non-sign-readers (n = 116; white bars) Reading was a significant predictor of correct response for all sign sections except Line 10 and End Line (Table 3.2).

Table 3.2. Predictors of correct response to questions regarding animal information sign sections (sign-readers n = 118, non-sign-readers n = 116) from minimum adequate models (MAMs) and significant GLMs for sign-reading where not preserved in the MAMs.

Model (and variables)	**Significant variable *[and model]* statistics**
Line 1 MAM (a, c2-5, d2-5)	reading*capybara (+) %D = 3.4, p = 0.003 *[AIC = 252.52, %D = 26.6, α_{FDR} = 0.011]*
Line 1 reading (a)	reading (+) %D = 9.7, p = <0.001
Line 10 MAM (a-b, c2-5)	species (-) %D = 18.6, capybara(-) p<0.001, rhea(-) p = 0.006, tapir(-) p = 0.007 *[AIC = 264.55, %D = 18.6, α_{FDR} = 0.043]*
End line MAM (a-b, c2-5, d2-5, e-f)	species(-) %D = 40.5, capybara(-) p = <0.001, rhea(-) p = 0.002, tapir(-) p = <0.001 *[AIC = 198.06, %D = 44.5, α_{FDR} = 0.011]*
Fun facts MAM (c2-5,g1-5,h)	species (-)%D = 30.3, capybara (-) p = 0.004 *[AIC = 152.26, %D = 60.0, α_{FDR} = 0.004]*
Fun facts reading (a)	reading (+) %D = 29.8, p = <0.001,
Threat status MAM (a, c2-5, f)	reading (+) %D = 6.4, p = <0.001; species(+) %D = 11.9, capybara (+) p = 0.033, tapir (+) p = 0.006 *[AIC = 171.18, %D = 20.4, α_{FDR} = 0.021]*
Habitat MAM (a-b, c2-5,d2-5, f, h)	age (+) %D = 9.4, p = <0.001 species (-)%D = 7.4, capybara(-)p = 0.008 gender (♂+) %D = 3.2, p = 0.003 education(+) %D = 5.2, p = 0.008 *[AIC = 253.19, %D = 20.1, α_{FDR} = 0.017]*
Habitat reading (a)	reading(+) %D = 2.3, p = 0.013
Appearance MAM (a-b,c2-5, d2-5, e)	reading (+) %D = 24.6, p = 0.003 species (-) %D = 11.1, capybara(-) p = 0.003 *[AIC = 234.71, %D = 31.7, α_{FDR} = 0.018]*
All sections MAM (a-b,c2-5,d2-5, f, i)	reading(+) %D = 25.7, p = <0.001 age (+) %D = 1.5, p = 0.022

	species(-) %D = 18.8, capybara(-) p = <0.001, mara (-) p = <0.001, rhea(-) p = 0.012, tapir(-) p = 0.002 reading*animal species(+) %D = 3.7, capybara(+) p = 0.005, mara (+) p = 0.022 *[AIC = 781.76, %D = 43.1,* α_{FDR} *= 0.033]*

a-i = MAM variables: a reading; b age of respondent, c animal species (1 alpaca, 2 capybara, 3 mara, 4 rhea, 5 tapir); d reading*animal species (reading interaction with animal 1-5 as in c); e previously visited (had the respondent previously visited the zoo); f gender; g IMD (1 <8.59, 2 8.6-13.79, 3 13.8-21.35, 4 21.36-34.17, 5 >34.18); h group size (number of people with the respondent); i post-secondary school biological education completed.
+/- = positive/negative relationship.
AIC = Akaike Information Criterion.
%D = percentage deviance explained (significant variables only).

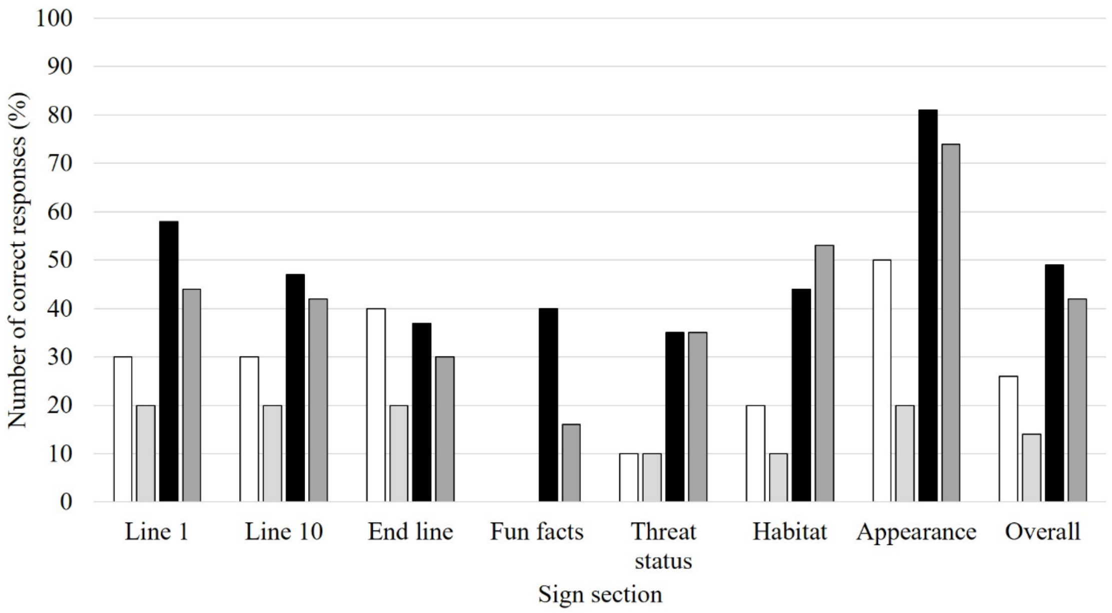

Fig. 3.4. Percentage of correct responses given for questions relating to each sign section in-visit (white = non-sign-readers n = 10, black = sign-readers n = 43) and six months post-visit (pale grey = non-sign-readers n = 10, dark grey = sign-readers n = 43).

Threat and habitat awareness were both correctly reported significantly more often by sign-readers than non-sign-readers (16.0% and 15.9% difference, respectively). However, sign-reading was only significant for threat status questions (explaining 6.4% of the model deviance) when modelled together with other covariates (Table 3.2). Awareness of threat status was retained six months post-visit (0.0% change, $n = 43$).

Application level learning

We found no significant difference between sign-readers and non-sign-readers in their knowledge of environmentally-friendly actions ($p = 0.58$, $w = 6570.5$, $n = 234$). More than a quarter (29.9%) of visitors stated that they were 'unsure' or 'did not know' of any personal action they could undertake to help conservation ($n = 36$ sign-readers, $n = 34$ non-sign-readers).

Other findings

The top three reasons for reading an animal information sign were: to identify the animal (42%), to answer a question about the animal (18%), and to learn facts (18%). Three percent of sign-readers ($n = 118$) said seeing the animal on TV encouraged reading and 15% said they read most or all zoo signs during a visit.

IMD scores, on a quintile scale, were not a significant predictor of correct response for any sign section. Neither were differences found in responses between the main non-sign-reading group (asked before entering the exhibit) and the control group ($p = 0.34$, $v = 15.5$). This supported our hypothesis that the non-sign-reading group was an accurate representation of visitor knowledge prior to any sign exposure. The finding suggests that any difference between sign-readers and non-sign-readers may be as a direct result of sign exposure and not due to differences in knowledge or due to the effect of the exhibit.

Discussion

The results show that zoo animal information sign content regarding animal and conservation facts is conveyed successfully to visitors.

Messages were most successfully conveyed when presented with limited text or as high quality graphics. Zoos should, therefore, place key messages in a prominent position within an animal information sign for most effective recall. This supports findings from museum studies that short signs are most often read and can be more accurately recalled

(Bitgood, 1989; Bourdeau & Chebat, 2003; Thompson & Bitgood, 1988). Even with short texts, readers rarely read to the end of a sign (McManus, 1990; Screven, 1992; Wandersee & Clary, 2007), making the first line of information crucial.

The observed correct reporting of threat status by sign-readers indicates that animal information signs fulfil the 'conservation trivia' component of our Zoo Learning Taxonomy (Fig. 3.1) and effectively convey 'knowledge' level information about conservation urgency to their readers. Moreover, awareness of animal threat status six months post-visit suggests that this knowledge may be more permanent. The presentation of animal threat status as a scale bar (Fig. 3.2) may have aided recall and supports the use of clear graphics to convey information to zoo visitors.

The finding that reading was not a strong predictor of habitat awareness indicates that visitors may use other cues for information, such as the exhibit design. Habitat awareness is important for understanding the interconnections between animals and their environments (Wagoner & Jensen, 2010). In addition to designing exhibits which accurately reflect species habitats, ecosystem signage may be required.

Whilst 'fun facts' sections had some of the highest recall immediately after reading, we caution against using these sorts of animal trivia. Recall of 'fun facts' dramatically fell after six months, suggesting that such information has little benefit for long-term learning. Furthermore, despite possible public interest in 'odd facts and behaviours' (Fraser et al., 2009), this type of 'Knowledge' has limited conservation value and falls within the lowest section of the Zoo Learning Taxonomy (Fig.3.1).

We note that these signs did not contain any messages to encourage conservation action ('Application' and 'Synthesis' level information). Accordingly, we found no difference between sign-readers and non-sign-readers in their ability to identify personal actions to protect animals and their habitats. Visitors were unable to make the connection between the conservation facts presented, such as threat status, and their own behaviours. This needs to be explicitly taught (Smith et al., 2012). We acknowledge that many zoos, including the study site, have separate conservation-specific information. The high proportion of visitors who were unsure of how to help conservation indicates that mission statement is not achieved with signage alone. The provision of 'Application' level information is a priority to fulfil the zoo mission statement. This information should include practical advice on how individuals can change their behaviour to support animal conservation.

Conclusions

This is the first zoo-based study to establish that zoo animal signs are effective for building knowledge regarding both natural history and conservation. Despite visitors having expressed animal identification as the primary reason for reading signs, the inclusion of broader information encourages broader learning, at least where text is minimised and appropriate graphics are used. The demonstrated 'Knowledge' and 'Understanding' level facts fall short of zoos' mission to encourage pro-environmental actions. Zoos must present 'Application' level information on their signage if they wish to encourage behaviour change. Future sign design should therefore limit animal and conservation trivia and focus on the promotion of conservation attitudes and actions. This paper contributes to the zoo education literature by quantifying knowledge gains achieved through reading animal information signs. We are also the first study to compare learning outcomes from this educational resource against a learning taxonomy.

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Appendix A

A.1: Blank example of animal sign questionnaire used to collect sign readers and non-sign-readers responses

Introductory statement

The University of York and Flamingo Land are jointly carrying out research to improve the zoo signs and understand more about our visitors. The survey should take around 5 minutes to complete and you are free to withdraw from the questionnaire at any time. All information given will be used anonymously and data stored securely. Please be as honest as possible with your answers**.**

Questions [and answer options/instructions]

Do you consent to your responses being used anonymously by University of York and Flamingo Land for research purposes?

Yes / No

1b. If under 18:

Does the accompanying adult consent to responses being used anonymously by University of York and Flamingo Land for research purposes?

Yes/ No [Please Initial]

What is the composition of your group, including yourself?

[ ] adult males (18 years+),

[ ] adult females (18 years+),

[ ] child male,

[ ] child female

What gender are you? [open response]

How old are you? [open response]

Have you had any formal (post-secondary) training in the life sciences (biology, ecology or natural sciences)?

Yes / No

5b. If yes: [Please specify]

Have you visited Flamingo Land before? Yes / No

6b. If yes:

When was your last visit? [Open response]

What is your MAIN reason for visiting today? Please select ONE

[Show response card containing the following]

Zoo Animals

Bars & Clubs

Theme Park Rides

Holiday Village

Stage Shows

Zoo Education

Other [Please specify]

Are you: [please specify]

A day visitor

Staying in the Holiday Village

Local resident

What is your home postcode? [open response]

Please provide a contact email address [open response]

10b. Would you be willing for us to contact you in about 6-months-time using the email address that you have provided?

Yes / No

Do you currently support conservation / wildlife charities?

Yes/ No

11b. if so which?

[Please specify]

Have you been up this pathway already today?

Yes/ No

The following questions are about [Animal A, B, C, D, and E]

(At this point the interviewer selected a question set from (A) Alpaca, (B) Capybara, (C) Mara, (D) Greater Rhea, or (E) Lowland Tapir. Question sets were distributed in a random order based on the frequency of sign reading for each species. This allowed sample sizes for each animal to be similar between sign-readers and non-sign-readers)

SIGN-READERS ONLY

Why did you view the sign?

[open response]

ALL RESPONDENTS

What does an [Animal A, B, C, D, E] look like?

[open response]

Why do you think we have the animal here?

[open response]

Where do you think [Animal A, B, C, D, E] lives in the wild?

[open-response]

How threatened do you think [Animal A, B, C, D, E] are? Please select [show threat status card]

NE – Not Evaluated

EX – Extinct

E – Endangered

EW – Extinct in the Wild

LC – Least Concern

CE – Critically Endangered

DD – Data Deficient

V – Vulnerable

NT – Near Threatened

Sign Question 1 (line 1) *

[open response]

Sign Question 2 (line 10) *

[open response]

Sign Question 3 (End Line) *

[open response]

Sign Question 4 (Did you know?) *

[open response]

Is there anything else that you can tell me about the animal?

[open-response]

What do you think you could personally do to conserve the animal or their habitat in the wild?

[open-response]

What is Flamingo Land doing for conservation?

[open-response]

Any further comments?

[open-response]

* Species-specific questions 18-21:

(A) Alpaca

18. To what family does the alpaca belong?

19. Are alpaca social animals?

20. Can alpaca cope with dry conditions?

21. How can you tell an alpaca and a llama apart?

(B) Capybara

18. Capybara are the largest ……..in the world?

19. What dangers face capybara when swimming?

20. How long are capybara dependant on their mothers?

21. What does the word Capybara mean?

(C) Mara

18. What is the mara also known as?

19. When does mating occur?

20. What is kept in the communal burrow?

21. How fast can mara run?

(D) Greater Rhea

18. Are greater rhea the largest birds in America?

19. Who is responsible for rearing the chicks?

20. What is rhea habitat being used for?

21. What does a rhea use its large wings for?

(E) Lowland Tapir

18. What do lowland tapir use their long noses for?

19. What are lowland tapir's two main senses?

20. How are lowland tapir populations being helped in South America?

21. What is the largest species of tapir in the world?

A.2: Table used to code responses to animal information sign-related questions as correct or incorrect.

Responses deemed correct for each question

(Animal) Question no.	Accepted as a correct answer
(A)14	Like a llama, description which includes several of the features: pointy ears, long nose, long legs, furry, horse-like, camel-like, emperor’s new groove, furry with a long neck
(A)16	South America, Chile, Bolivia, Andes, Peru, mountains, hillsides
(A)17	NE- Not Evaluated
(A)18	Camel, Llama
(A)19	Yes
(A)20	Yes, copes with dry environments,
(A)21	Ears, shape of ears, Llamas have banana shaped ears,
(B)14	Guinea pig, rodent, big hamster, like a beaver/ rat/ otter without a tail, brown, webbed feet
(B)16	South America, Brazil, Amazon, Grasslands, Swamps
(B)17	LC – Least Concern
(B)18	Rodents
(B)19	Piranha/ fish, being eaten
(B)20	3 months, accept 2-4 months
(B)21	Master of the grass/ grassland, King of grass, Great of grass, Lord of grass
(C)14	Hare, Hare crossed with a deer, Rabbit cross
(C)16	South America, grasslands, lowland plains
(C)17	NT – Near Threatened
(C)18	Patagonian cavy
(C)19	Spring, Summer
(C)20	Their young, babies
(C)21	35mph, accept 30-40 mph
(D)14	Big bird, Large flightless bird, ostrich, emu
(D)16	South America, forests
(D)17	NT – Near Threatened
(D)18	Yes, largest birds South America, Heaviest-but not wingspan
(D)19	Male, dad, father
(D)20	Farming, food, deforestation
(D)21	Balance, change directions
(E)14	Description containing one or more of the following: mammal, snout, brown/ with stripes, hippo cross with a pig, pig body, long nose, anteater with a shorter nose
(E)16	South America, grasslands, forests
(E)17	V- Vulnerable
(E)18	Picking up fruit/food, foraging
(E)19	Smell and hearing, Ears and nose
(E)20	Preservation of rainforests, protect habitats, local conservation, reserves/ protected areas
(E)21	Malaysia

Coding used for question 23

Score	Response categories	
0	Non/ negative actions	Don't know, can't help
1	General non-specific	Stop poachers, charities (general), be more environmentally considerate, breeding, protect it
2	Personal non-specific	Donating, support specific charities, don't damage plants, don't build, visit/support zoos, adopt an animal
3	Personal specific	Conservation holidays, planting trees, educating children/grandchildren, learn about wildlife, recycling, veganism

Chapter 4: Effectiveness of entertainment-focused live animal shows at delivering information to public audiences.

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Disclosure

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Abstract:

With over 700 million visits globally each year, zoos are a popular recreational destination. Live animal shows, which combine animal facts with trained behaviours, are commonly used to engage zoo visitors and have a potential global audience of 175 million visits annually. Often these shows are dismissed as being contrary to welfare ethics and little is known about their educational effectiveness. Furthermore, the impact of tricks, used by live animal shows as attention grabbing hooks has never been investigated. We evaluated the impact of a sea lion and a mixed species bird show on audience knowledge of animal facts and conservation actions. Show audiences were questioned immediately before (n = 299) or after (n = 265) each performance about relevant show content knowledge. Additionally, audiences were questioned, as part of a general zoo visitor survey (n = 160), on what information was recalled from shows post-visit. Audiences demonstrated significantly higher animal knowledge post-show compared to pre-show. The ability to state possible conservation actions was unchanged. Crucially, the use of trick-like behaviours were found to have distracted respondents from their intended conservation messages. In order to effectively fulfil zoos' conservation education mission, live animal shows should focus on encouraging conservation and avoid using tricks to present their messages.

Keywords: Animal displays, sea lion show, bird show, visitor experience, animal training, public engagement

Introduction:

Modern zoos claim to fulfil a valuable role in society through the three pillars of education, research and conservation. These aims are prominent across zoo mission statements (Patrick et al., 2007) and are supported by international guidelines (Barongi et al., 2015; WAZA, 2005). International studies have demonstrated that zoo visits are able to raise awareness of biodiversity and knowledge of actions to help conservation (Jensen et al., 2017; A Moss & Esson, 2013; Moss et al., 2015, 2017b). Despite internationally agreed targets and many studies, the impact of individual zoo experiences, such as live animal shows, on audiences' animal and conservation awareness is relatively unknown.

Interactive animal talks and shows are a key part of the zoo experience and visitors plan their day around these interactions (Moss, Esson, & Bazley, 2010). Live animal shows are a popular feature of many zoos and are generally viewed positively by audiences (Fernandez, Tamborski, Pickens, & Timberlake, 2009). Although enjoyment can enhance learning (Clayton et al., 2009, 2017), presenting animals solely for entertainment is widely viewed as unacceptable in modern zoos (Mann-Lang, Ballantyne, & Packer, 2016). This means that live animal shows must have educational value in order to be considered a legitimate contemporary zoo experience.

Comparisons between the educational effectiveness of live animal shows, environment centres and museums found that live animal shows were best for conveying species identifications and for increasing ideas of stewardship (Kimble, 2014). Close encounters with animals can increase feelings of affiliation and emotional connections with species (Luebke et al., 2016; Povey & Rios, 2002; Sherwood, Rallis, & Stone, 1989; Skibins & Powell, 2013). Sensory encounters, such as touching animals, can also increase positive attitudes towards species (Lindemann-Matthies & Kamer, 2006; Sherwood et al., 1989). These connections are important for developing concern about environmental issues (Hotchkiss, 1991; Luebke et al., 2016).

Visitors have been shown to stay significantly longer at exhibits during a keeper talk and have a more positive view of the animals seen, compared to those who view exhibits without staff present (Anderson et al., 2003; Povey & Rios, 2002). Visitors often desire explanation as to an animal's behaviour and keeper interpretation can help visitors answer questions as they arise (Margulis, Hoyos, & Anderson, 2003). Providing interpretations of animal behaviours has been shown to be more effective than fact-only presentations at delivering animal facts to visitors (Miller et al., 2013; Visscher, Snider, & Vander-Stoep, 2009). This is supported by Jensen (2014a) who found significantly improved educational outcomes for school children visiting a zoo when they attended presentations led by zoo education staff compared to self-guided visits. Interpretation can also raise support for conservation issues. Swanagan (2000) found that when keeper talks were used at an elephant exhibit significantly more visitors signed an ‘anti-ivory’ petition.

Whilst there is evidence that interpretation of animal behaviours have a positive influence on visitor attitudes and knowledge (Anderson et al., 2003; Miller et al., 2013; Swanagan, 2000; Visscher et al., 2009), the impacts on learning of entertainment-focused live animal shows are unknown. Additionally, there is some concern that live animal shows present species as domesticated and reinforce concepts of humanity’s dominion over animals (Acampora, 2005; Finlay, James, & Maple, 1988). Research into the impact of live animal shows and their value for conservation education is needed to understand whether the concerns and hopes for these widely consumed leisure experiences are justified by evaluation evidence.

International guidelines stress that zoo animals should not perform ‘unnatural behaviours’ or ‘become humanised’ (EAZA, 2008). Nevertheless, many live animal shows still use trick-like behaviours (e.g. balancing balls, animals talking and solving puzzles) as educational hooks. Educational hooks are elements of presentations which are designed to attract and focus audience’s attention on a particular message. In the context of a live animal show these hooks are employed before explaining how the animal’s capabilities are used in the wild. There is currently no evidence to indicate whether using these trick-like hooks helps or hinders retention of educational messages. Indeed, there is limited research on the value of live-animal shows for education more generally.

This paper investigates the following research questions:

1. Are zoo audiences demonstrating positive impacts from entertainment-focused live animal shows in line with their intended learning objectives?
2. How effective are trick-like behaviours as hooks in facilitating conservation education impacts?
3. What information from shows is recalled at the end of a zoo visit?

Methods:

The research was undertaken at Flamingo Land Resort Ltd., UK, a combined zoo and theme park. Flamingo Land is privately owned and entertainment orientated (Flamingo Land Ltd., 2016) and thus, provides a genuine case for whether education is achievable in an entertainment-focused setting. The zoo is a member of the World Association of Zoos and Aquariums (WAZA) and is officially signed up to promoting biodiversity and conservation.

We examined two types of live animal show within the zoo, a sea lion show and a multi-species bird show, both of which were written and delivered by an independent entertainment and animal training team. The shows used trick-like behaviours as entertaining hooks for information. The training team felt ‘education is much more easily absorbed if delivered with a mixture of humour and entertainment’ and that shows ‘always aim for some educational content’ (APAB ltd., 2009). Interviews with the head trainer revealed the shows’ overarching objectives were to convey basic features and behaviours of animals to their audience. The secondary objective was to indicate how the audience could help in wildlife conservation. Whilst different trainers and animals performed in each show, a consistent set of facts were mentioned in every performance (Appendix B.1).

Sea lion show

The sea lion show was a 15-20 minute long, single species display featuring between one and four Californian sea lions (*Zalophus californianus*). The show took place in a combined pool and platform area in front of a seated audience (approximate capacity: 400 people). The stage area was themed to appear like a fishing and surfing bay. Although the individual sea lions varied across performances, the show always contained a sea lion balancing objects (balls, bowling pins, etc.) on its nose (Figure 4.1). This was used as a hook to teach about whisker sensitivity to movement and their use in hunting. Other behaviours included walking on land, flipper stands, catching hoops and leaps into and out of the pool, all of which were used to convey the animal’s flexibility and agility on both land and water. The differences between seals and sea lions was shown by the sea lion pretending to be a seal (sliding on the ground). Contrasts were made with a sea lion’s ability to walk, clap and shake hands because of their much larger flipper size. Show content mentioned how Californian sea lions have previously been hunted for their fur and how litter is a major threat for aquatic species. At the end of the show presenters suggested that visitors could donate to conservation charities such as the Monk Seal Trust (which had a donations box at the show).

Figure 4.1: Photograph taken from the Flamingo Land Sea Lion Show showing a sea lion balancing a ball as an educational hook for how sea lion whiskers can sense vibrations.

The bird show

The bird show was a 15-20 minute long mixed species display which presented a range of different birds both in front of and flying over a sheltered, seated audience (approximate capacity: 120 people). In every show there was as a minimum a parrot, an owl and a vulture although species and individuals varied. The parrots performed two main tasks, a shape sorting puzzle to demonstrate their ability to see in colour and a talking demonstration, to demonstrate intelligence and engage the audience. This talking demonstration included the parrot stating his name and impersonating various animals. The owl and the vulture both demonstrated flights and were taken amongst the audience for a closer experience. The presenter described each species, its features and behaviours as well as some of the threats they face in the wild including habitat loss. At the end of the show audiences were encouraged to see the animals up close. Audiences were able to hold a parrot and have a photo taken or give a coin to a parrot who would then post it into a donations box (Figure 4.2). The audience were informed that money collected would go to the Hawk and Owl Conservation Trust.

Figure 4.2: Photograph taken from the Flamingo Land Bird Show showing a parrot taking money from visitors.

Measuring the effectiveness of animal shows

The impact on the general visitor population was assessed using responses to a general visitor survey (collected 1st May- 31st October 2016) which examined the percentage of visitors who attended the shows, their satisfaction and the overall messages conveyed.

Show-level impact evaluation was conducted using pre- and post-show surveys (collected 1st May-31st October 2015) which tested audiences understanding of show-related content knowledge and ability to state conservation actions before the show and immediately after viewing.

Sample

Table 4.1 identifies sample characteristics for the show level impact evaluation and for the general visitor surveys. A total of 564 surveys (pre- and post-show) were completed for show-level impact evaluation. Only 25 respondents provided show-related comments in the general zoo visitor survey.

Table 4.1: Sample characteristics for Sea lion and Bird Show audiences for the show-level impact evaluation (pre- and post-show) and the general visitor surveys.

	Sea lion show audience	Bird show audience
Show level impact evaluation		
Sample size	188 pre-show 155 post-show (47 repeat tested)	111 pre-show 110 post-show (38 repeat tested)
Mean age (95% CI)	31.5 (29.8-33.2)	32.8 (30.7-35.0)
Gender: Percentage of females	89.1	64.8
Mean household income before taxes (£)	20,051	17,674
Modal highest education achieved	GCSE or equivalent	GCSE or equivalent
General visitor survey		
Total surveys completed	160	
No. of overall visitors who visited the zoo	134	
No. (%) of zoo visitors who attended at least one live animal show	38 (28.4%)	
No. (%) of zoo visitors who attended each live animal show	33 (24.6%)	10 (7.5%)
Number who provided comments on the show seen	18	7
Mean age (95%CI)	41.2 (35.9 – 46.4)	42 (36.1-48.7)
Gender: Percentage of females	66.7	71.4
Mean household income before taxes (£)	40,732	40,501
Modal highest education achieved	Vocational level	Vocational level

Show level impact evaluation:

Pre- and post- show surveys

Audience awareness of show-related animal facts and stated conservation actions was tested immediately before and after each show. The survey included questions based on the learning objectives of each show in addition to demographic details (Appendix B.2). It was not possible to cover all the learning objectives in the surveys, therefore objectives most relevant to the zoo mission were selected.

Pre-show responses were collected from audiences queuing to watch the show by asking every 4th adult to complete a survey. This data provided a measure of audiences' baseline knowledge (pre-show). Questionnaires were collected from respondents five minutes before the show started to ensure that no answers were completed once the show had begun.

Post-show responses were collected from audiences (every 4th adult) exiting the show. This allowed relatively even samples to be collected pre- and post-show. Where possible, respondents were repeat questioned. Due to the sampling method used more unpaired responses were collected (85 paired responses, 394 unpaired responses). This was not considered a problem as large samples from broadly similar groups have been shown to indicate the same trends as paired samples in this setting (Chapter 5)

General visitor survey

The impact of live animal shows as part of the whole zoo visit was measured using a general visitor survey. Visitors completed a short questionnaire at the entrance to the site or when booking online prior to a visit. A follow-up questionnaire was sent via email at the end of their visit. Three reminder emails were sent 10 days apart. The general visitor survey was designed primarily to collect data on overall visit experience, as part of another study (Chapter 6), but questions were added specifically to assess the impact of shows.

Included in the questionnaire were items regarding whether the individual had attended a live animal show, which show was seen, their level of satisfaction with the show and an open response for what they could remember from the show (Appendix B.3).

For the show impact evaluation and general visitor surveys respondents gave consent to be included in the study. Ethical approval was granted by the University of York, Environment Department Ethics Committee.

Data Analysis

Show level impact evaluation:

Responses to show content knowledge questions were coded either correct (1) or incorrect (0) using a pre-defined coding table based on the information given in the show (Appendix B.4) following standard content analysis methods (Jensen & Laurie, 2016).

Overall audience 'knowledge' was calculated based on the total number of correct answers given across show content knowledge questions. The impact of the show on visitor wildlife conservation awareness was measured by comparing the number of stated conservation actions pre- and post-show.

To test whether trick-like behaviours aid or distract from presented animal facts we examined one open-ended knowledge question from the sea lion show in detail: *'Why are sea lion's whiskers so important?'*. Responses were coded 'correct' if naturalistic answers including finding fish, feeling spaces and vibrations, were given. Responses were coded as 'false-learning' if responses included non-natural responses such as 'balancing' and 'balancing objects'.

General visitor survey:

Visitors who had viewed a live animal show were given an open-ended response box and asked *'What if anything can you remember from the show?'*. These responses were coded into themes with each respondent's answer having the potential to fall into multiple categories. Categories included the show being recalled as: 'educational' or 'entertaining', recall of 'tricks', 'individual animal details' and 'show conditions'. The sentiment behind the statements (whether positive, negative or neutral) was also recorded. Satisfaction with the show was coded from 'highly dissatisfied to highly satisfied' (based on a 7 point Likert scale).

Two researchers independently coded the data blind to the test condition (100% overlap). Inter-coder reliability was high (kappa = 0.83, sea lion show; kappa 0.91, bird show). Disagreements were resolved by discussion.

Statistical analysis was performed using R version 64 3.2.3 (CRAN, 2014). Data were transformed to remove skew. Transformations included: Sea lion data: no. of adults viewing [log], temperature [cube]; Bird show data: no. of adults viewing [square root]. Predictor variables were checked for inter-correlation and pairs of variables with a Pearson correlation coefficient $r = >0.7$ and Variance Inflation Factors > 2 were not included in the same model (Zuur, Ieno, & Elphick, 2010). Poisson and binomial Generalised Linear Models (GLM) were used to evaluate the effect of viewing the show against other variables as predictors of correct response to animal knowledge questions and stated conservation actions. Models were created based on an information theory approach whereby personal, show and external factors were grouped into their own models with some overlapping variables. Show characteristics included variables which could be controlled by the show such as time, presenters and audience size. Personal factors included demographic characteristics which visitors possess prior to visit; understanding the influence of these factors was important to ensure that the show did not exclude or favour particular groups. External factors included climatic variables such as cloud and temperature. Although climate variables cannot be directly controlled, understanding whether they had an impact can be important for designing show areas and determining whether weather conditions were a potential learning distraction. Unlike other stepwise approaches which create a reduced model from the full variable set, the information theoretical approach ranks whole sets of potential predictors allowing factors to be considered with a more logical approach (Burnham, Anderson, & Huyvaert, 2011; Murtaugh, 2009; Whittingham, Stephens, Bradbury, & Freckleton, 2006).

Table 4.2 shows the eight models that were applied to sea lion show data and the six models that were applied to bird show data. Models varied slightly between the bird and the sea lion shows to test the effect of individual animal ‘personalities’ used in the single species sea lion show. Akaike Information Criterion (AIC) was used to rank models and those with the lowest AIC and within two AIC of each other were selected as best representing the data (Anderson & Burnham, 2002; Thomas, 2017). Although p values are generated for each variable, they are considered less important than the effect size (% deviance explained) and model ranking, which indicates the combined factors that best explain the data (Burnham et al., 2011).

Overall audience ‘knowledge’, the number of stated conservation actions and the effect of trick-like behaviours were compared pre- and post-show using Wilcoxon signed rank tests and GLMs. The effect sizes were calculated using Cohens' d with a pooled standard deviation of pre- and post-groups (Field, 2013; Higgins et al., 2013).

Table 4.2: Models applied for a) sea lion show, and b) bird show

Sea lion models applied

Model	Variables
Personal Factors (M1)	Show seen + respondent income + visit in the last 12 months + show seen before + respondent education
Personal Factors (M2)	Show seen + respondent age + respondent income + respondent education + show seen at another zoo + gender (female)
Show factors (M3)	Show seen + number of adults viewing the show (log) + presenter + time of show + sea lion used (Miguel)
Show factors (M4)	Show seen + number of adults viewing the show (log) + presenter + sea lion used (Clive) + show seen at another zoo
Show factors (M5)	Show seen + presenter + time of show+ sea lion used (Marvin)
Show factors (M6)	Show seen + number of adults viewing the show + presenter + time of show+ sea lion used (Merlin)
External factors (M7)	Show seen + show seen before + cloud cover (0-25%, 26-50%, 51-75%, 76-100%)
External factors (M8)	Show seen + presenter + temperature

Bird show models applied

Model	Variables
Personal factors (M1)	Show seen + respondent income + visit in the last 12 months + show seen before + respondent education
Personal factors (M2)	Show seen + respondent age + respondent income + respondent education + show seen at another zoo + gender (female)
Show factors (M3)	Show seen + number of adults viewing the show (sqrt) + presenter + time of show
Show factors (M4)	Show seen + number of adults viewing the show (sqrt) + presenter + show seen at another zoo
External factors (M5)	Show seen + show seen before + cloud cover (0-25%, 26-50%, 51-75%, 76-100%)
External factors (M6)	Show seen + presenter + temperature(^3)

Results:

Over a quarter of zoo visitors (28.4%) attended at least one live animal show. Specifically, 24.6% attended the sea lion show and 7.5% attended the bird show. Given that 1.17 million visits are made to Flamingo Land each year (Chapter 6) this equates to over 332,000 visits to on-site live animal shows annually.

Are zoo audiences demonstrating positive impacts from live animal shows in line with their intended learning objectives?

Increases in the number of questions correctly answered post-show compared to pre-show were seen across all learning objectives with a 16.4% increase in the number of overall correct answers in the matched pre-post group after seeing the show (Table 4.3) (Figure 4.3).

Sea lion show

The comparison of alternative models (Appendix B.5) suggest that optimal models consistently place seeing the live animal show (show seen) as the most influential and positive predictor of correct response to animal questions explaining between 5.9 and 8.4 percent of the deviance (Table 4.4). Having seen the live animal show before was a common variable in two of the three selected models but only explained minimal deviance (< 1.0%). Other factors selected by the model were respondent's education (2.4-2.5% deviance) and increasing cloud cover (2.8% deviance).

Optimal models selected for the number of stated conservation actions for the sea lion show (Appendix B.5) place seeing the show as a factor (deviance explained 0.6-1.2%). However, none of the variables selected by the models explained more than 2% of the deviance (Table 4.5).

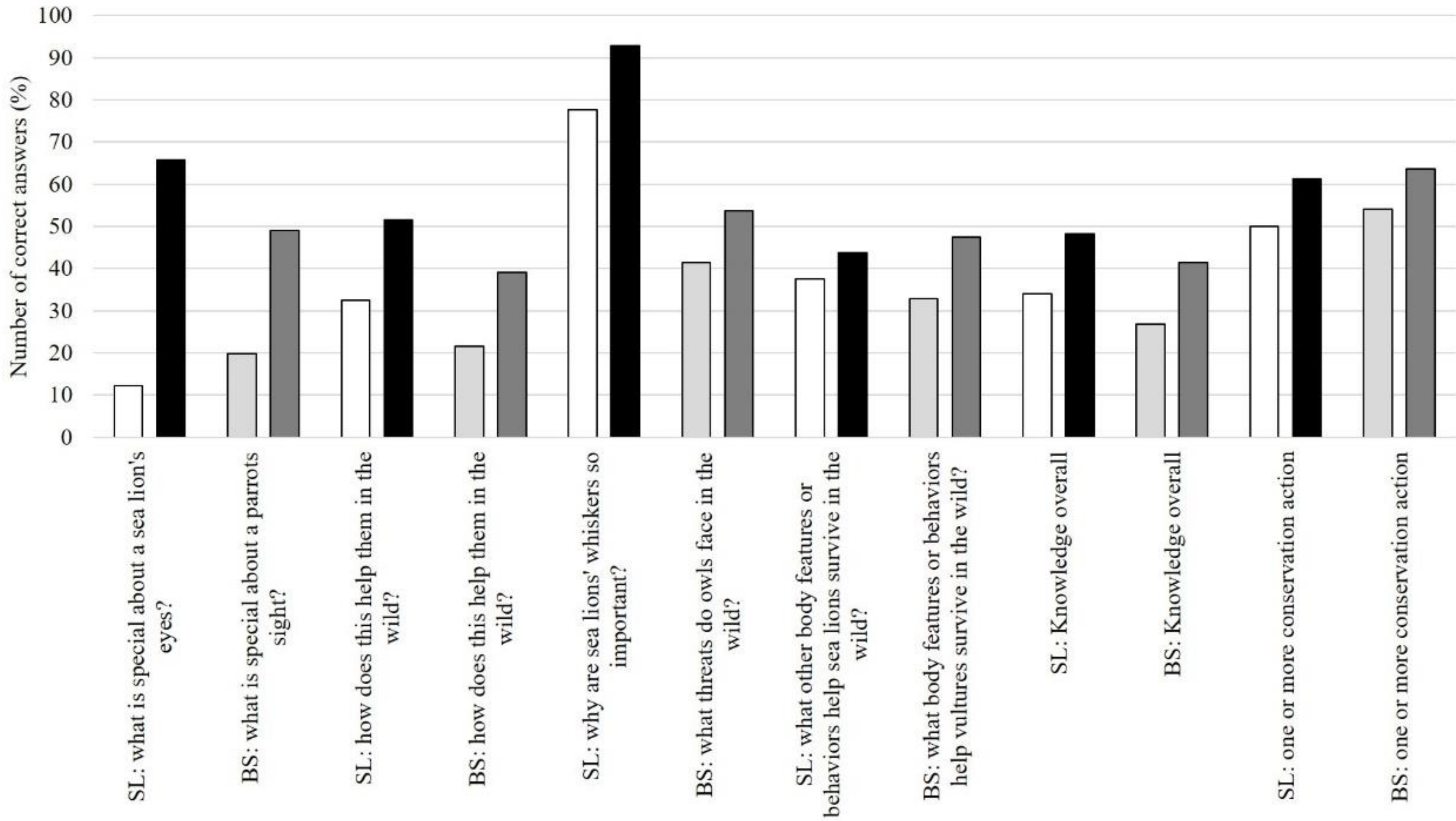

Figure 4.3: Number (%) of correct answers given for each question asked pre- and post-show. Knowledge overall (the total number of correct answers given) and stated conservation actions also shown pre- and post-show. Sea lion show (SL): pre-show responses, n = 188 (white bars), post-show responses, n = 155 (black bars); bird show (BS) pre-show responses, n = 111 (pale grey bars), post-show responses, n = 110 (dark grey bars).

Table 4.3: Comparison of learning objectives (as set by Flamingo Land Resort's animal training staff) and evidence of where these objectives have been met as demonstrated through the pre- and post-show surveys and through general visitor survey comments.

Learning outcomes:	Pre- post-show survey	General visitor survey responses
To convey basic features and behaviours of animals to their audience:		
'Audiences should recall that…'		
Sea lions have very sensitive whiskers, they act as a detection system to allow them to feel changes in the water and use these to find fish.	Correct answer: 63.3% pre-show, 69% post-show (+5.7% change) 'False learning': pre-show: 13.3%, post-show 25.8% (+12.5% change)	1 out of 18 respondents recalled '*the whisker facts*' but provided no further detail. 1 out of 18 respondents recalled '*balance balls*'
Sea lions have binocular vision which helps them judge speed and depth. This is used when hunting prey. Sea lions eyes also have a special layer of cells to protect the surface of the eye.	Correct answer: 11.2% pre-show, 68.4% post show (+57.2% change)	Not mentioned
Knowing the difference between seals and sea lions including that, seals have smaller flippers, sea lions can walk on land whilst seals slide, sea lions have visible ear flaps.	Not asked in survey	4 out of 18 respondents mentioned '*differences between seals and sea lions*' although these differences were not explained

That parrots see in colour and that this allows them to select ripe fruits and avoid poisonous ones.	Correct response: 21.6% pre-show, 50.0% post-show (+28.4% change)	Not mentioned
That parrots are intelligent and can talk.	Not asked in survey	1 out of 7 statements recalled birds as being '*intelligent*' 1 out of 7 recalled the '*parrot talking*'.
Owls have several features to help them hunt prey these include their facial disk, sharp talons and beak, ability to turn their neck three quarters of the way around and sensitive hearing.	Not asked in survey	Not mentioned
Vultures have bald heads to keep them clean when eating carcasses. *Vultures glide on thermals to conserve energy. They need to conserve energy as they scavenge for food and food sources are unreliable.*	Correct response: 39.6% pre-show, 48.9% post show (+9.3% change)	Not mentioned

To indicate how the audience could help in wildlife conservation:

'Audiences should recall that…'		
The public can help protect seals and sea lions by donating to the Monk Seal Conservation Trust and by not littering at the beach.	One or more conservation actions stated: 52.1% pre-show, 61.3% post-show (+ 9.2% change)	Not mentioned
Flamingo Land raises money for the Hawk and Owl trust to protect native species. Donations made at the bird show go to this trust.	One or more conservation actions stated: 63.1% pre-show, 66.4% post-show (+ 3.3% change)	2 out of 7 statements recalled general '*conservation efforts*' and '*the work they [the zoo] do to conserve local owls'*
Barn Owls are threatened in the UK primarily by habitat loss from barn conversions, traffic collisions, and pesticides killing prey species.	Correct response: 46.8% pre-show, 55.5% post-show (+8.7% change)	Not mentioned

Table 4.4: Estimated parameters, *p values in brackets and percentage deviance %D for each variable in the most optimal models for a) sea lion show and b) bird show audience knowledge.*

	a) Sea lion show knowledge			b) Bird show knowledge
	Personal factors M2	Personal factors M1	External factors M7	External factors M5
Show seen	0.308 (<0.001) %D = 5.9	0.307 (<0.001) %D = 5.9	0.360 (<0.001) %D = 8.4	0.465 (<0.001) %D = 10.2
Respondent's age	-0.001 (0.602) %D = 0.1	-	-	-
Respondent's income	-0.025 (0.047) %D = 0.9	-0.026 (0.039) %D = 0.1	-	-
Respondent's education	0.070 (0.001) %D = 2.4	0.072 (0.001) %D = 2.5	-	-
Gender_f	0.090 (0.161) %D = 0.5	-	-	-
Visit in the last 12 months	-	0.045 (0.505) %D = 1.0	-	-
Show seen before	-	0.038 (0.568) %D = 0.1	0.042 (0.483) %D = 0.1	0.150 (0.088) %D = 1.1
Show seen at another zoo	0.080 (0.188) %D = 0.4	-	-	-
Cloud cover	-		0.005 (<0.001) %D = 2.8	26-50%: 0.084 (0.514), 51-75%: -0.278 (0.081) 76-100%: -0.063 (0.638) %D = 2.8

Table 4.5: Estimated parameters, p values in brackets and percentage deviance %D for each variable in the most optimal models for a) sea lion show and b) bird show stated personal conservation actions.

	Sea lion conservation actions		Bird show conservation actions		
	External factors M7	Personal factors M1	External factors M6	Show factors M4	External factors M5
Show seen	0.531 (0.019) %D = 1.2	0.394 (0.084) %D = 0.6	<0.001 (0.002) %D = 2.0	0.064 (0.034) %D = 1.7	0.707 (0.020) %D = 2.1
Respondent's income		-0.095 (0.042) %D = 0.9	-	-	-
Respondent's education		0.160 (0.048) %D = 0.9	-	-	-
Visit in the last 12 months		0.334 (0.186) %D = 0.4	-	-	-
Show seen before	0.380 (0.087) %D = 0.6	0.298 (0.215) %D = 0.3	-	-	-0.201 (0.511) %D = 0.2
Show seen at another zoo	-	-	-	0.544 (0.077) %D = 1.5	-
Presenter			-0.005 (0.357) %D = 0.3	-0.229 (0.220) %D = 0.8	-
No. Of adults viewing the show	-	-	-	<0.001 (0.570) %D = 0.4	-
Cloud cover	0.015 (0.005) %D = 1.7	-	-	-	26-50%: 0.286 (0.531), 51-75%: -0.458 (0.372), 76-100%: -0.428 (0.351) %D = 1.9

Temperature	-	-	<0.001 (0.208) %D = 0.6	-	-

Bird show

A single optimal model was selected for bird show knowledge responses containing the variables: show seen, show seen before and % cloud cover (Table 4.4). Seeing the show was the main predictor of correct response explaining 10.2% of the deviance (Table 4.4). Having seen the show before explained 1.1% of the deviance.

Optimal models selected for the number of stated conservation actions for the bird show (Appendix B.5) consistently placed seeing the show as the main factor. However, seeing the show only explained between 1.7 and 2.1 % of the model deviance (Table 4.5). Other factors that were selected included: having seen the show before (0.2%D), seeing a show at another zoo (1.5%D), the presenter (0.3 – 0.8 %D), the number of adults viewing the show (0.4%D) and the percentage of cloud cover (1.9%D).

The impact of trick-like behaviours as educational hooks

The question *'Why are sea lion's whiskers so important?'* was answered correctly by 63.3% of respondents pre-show and 69.0% of respondents post-show, indicating a high level of existing knowledge. Seeing the show (which contained sea lions balancing objects on their noses) had a non-signifiant but weak, negative effect on visitors understanding of natural behaviours (ES = -0.1, w = 4309.5, p = 0.441). This led to a significant (12.5%) increase in 'false-learning' with more respondents mentioning 'balancing' or 'balancing objects' after viewing the show compared to before the show (ES = 0.29, w = 6062.5, p=0.015)(Table 4.6).

Trick behaviours were recalled post-visit in responses from general visitor surveys for both the sea lion show (22.2% of n = 18 responses) and the bird show (28.6% of n = 7 responses) (Table 4.7). Comments included "How they [sea lions] balance balls" and that the "Parrot talking was funny".

Table 4.6: Impact of watching the sea lion show on correct responses: e.g. sensing vibrations, finding fish; and 'false-learning': balancing and balancing objects

Analysis	Sample	Condition	N	Mean	S.D.	Sig. (p)	Test stat. (w)	Effect Size (d)
Responses given for the question '*why are sea lions' whiskers so important?*'	Sense vibrations, find fish, spaces	Pre	146	0.91	0.29	0.441	4309.5	-0.1
		Post	144	0.88	0.33			
	Balancing	Pre	146	0.17	0.37	0.015	6062.5	0.29
		Post	144	0.29	0.45			
	Balancing objects	Pre	146	0.01	0.08	0.007	765	0.28
		Post	144	0.06	0.25			

What information from shows is recalled at the end of a zoo visit?

Statements recalled in general visitor surveys were generally positive about both the sea lion and bird shows (Table 4.7). The most commonly recalled themes recalled post-visit were specific facts about individual animals, "Clive [sea lion] weighed 42 stone last time they weighed him" and general expressions of being entertained, "Loved it as did the children". Recalled information generally supported the shows learning objectives with visitor comments including "the whisker facts" and "conservation efforts" however, it should be noted that the responses given were very general with little specific information recalled (Table 4.3). The small sample size from general visitor surveys means that findings from post-visit comments are limited.

Table 4.7: Key themes recalled from live animal shows post-visit; example statements and the percentage of comments mentioning each theme are given.

	Sea lion show audience		**Bird show audience**	
Theme	**Example statements**	**% responses (n = 18)**	**Example statements**	**% responses (n = 7)**
Individual details	*'Clive weighed 42 stone last time they weighed him. He's the oldest sea lion they have.'* *'We absolutely loved Merlin the sea lion, such a clever sea lion.'*	33.3	*'Charlie the parrot, the wading bird and the vulture.'*	28.6
Educational	*'Great, educational and very engaging.'* *'Really informative.'*	22.2	*'Really informative and fun to watch.'*	14.3
Entertainment	*'We have seen it many times and love every minute of it.'* *'Loved it, as did the children.'*	22.2	*'It was funny.'* *'My daughter had fun and enjoyed it.'*	57.1
Tricks	*'The animals do repetitive 'tricks'.'* *'How they balance balls.'* *'The tricks that the sea lion performed.'* *'Sea lions can clap. Seals can't.'*	22.2	*'Parrot talking was funny.'* *'The tricks.'*	28.6
Show conditions	*'The volume of the trainer's microphone could have been louder to accommodate for the large, and noisy, crowd.'* *'Only people at the top could hear the attendant speaking, so we felt we wasted our time.'*	11.1	-	0
Conservation	-	0	*'Conservation efforts.'* *'The work they do to conserve local owls.'*	28.6
Positive sentiment	-	44.4	-	85.7

Neutral sentiment	-	38.9	-	14.3
Negative sentiment	-	16.7	-	0
Visitor satisfaction (somewhat satisfied to highly satisfied)	-	80% (n = 22)	-	100% (n = 8)

Discussion:

Over a quarter of zoo visitors watched at least one live animal show, highlighting their continued popularity in a modern zoo. On a global scale this equates to potentially 175 million visits to live animal shows per year.

Overall live animal shows had a positive impact on visitors' animal knowledge in line with their first intended learning outcome; to convey basic features and behaviours of animals. Significant increases in audience knowledge were found post-show compared to pre-show, and seeing the show was identified as the main predictor of knowledge change. Since active animals tend to increase engagement in learning, it is possible that seeing the animal up close and 'active' aided in knowledge transfer (Moss et al., 2010).

Live animal shows were less effective at conveying their second objective; to raise audience awareness of wildlife conservation actions. Audience ability to state conservation actions was unchanged post-show compared to pre-show. This supports findings from other zoo studies which indicate that visitors remain unsure of conservation actions which they can personally undertake (Clayton et al., 2017; Esson & Moss, 2014). Zoos must support visitors in identifying activities which they can engage with to protect the environment. In addition we only examined stated conservation actions and not audience intent to act nor actual behavioural changes. Given that several factors affect environmental behaviours (Hines et al., 1986), it is likely that the number of individuals engaging practically in conservation is lower than the number able to state conservation actions.

The learning objectives set by the shows tested were predominantly based on factual recall. Whilst factual knowledge about animals is an important precursor to broader biodiversity awareness, it has limited value. The overall zoo mission aims to raise visitor awareness of biodiversity and of actions to prevent its loss. Whilst the shows did convey knowledge, this alone is insufficient to impact behaviour (Clayton et al., 2017; Hines et al., 1986; Hughes, 2013; Myers, Saunders, & Birjulin, 2004). Understanding about biodiversity requires both a knowledge about individual species and about their importance within the ecosystem as a whole. The current learning objectives set by the shows do not align clearly with the zoo mission as they do not target overarching concepts such as biodiversity or environmental issues and are ineffective at conveying conservation actions.

The multi-species bird show was more successful than the single-species sea lion show as it introduced a variety of species and demonstrated the differences in adaptations between them. The finding that bird show audiences were able to identify and explain more adaptations, and threats facing species post-show compared to pre-show indicates that the show more successfully conveyed awareness of adaptations and about species habitats. The sea lion show also conveyed some species adaptations, although, it also introduced misconceptions about how the species use these adaptations in the wild.

Flamingo Land visitors had a high baseline knowledge of the animal facts presented in the shows. This suggests that current live animal show content is not pitched at a high enough level to fully extend audience knowledge. Factual information places a limit on the amount of learning that can occur. Studies suggest that increasing the amount of learning content does not detract from enjoyment (Mann-Lang et al., 2016). We recommend that entertainment-focused live animal shows should consider targeting their content beyond simply conveying animal facts. Allowing audiences to interact directly or ask questions to interpreters has been shown to increase learning (Povey & Rios, 2002). As seeing live animals elicits ‘learning-talk’ (Allen, 2004) encouraging audience discussions, on topics such as conservation, may enable live animal shows to extend learning beyond fact recall. Talking about conservation is known to improve perceived self-efficacy towards pro-environmental behaviours and may aid audience uptake of conservation actions (Clayton et al., 2017). As zoos increasingly aim to move beyond teaching environmental facts and instead alter public behaviour, these types of discussions, combined with live animal interaction, may become increasingly important.

The effectiveness of trick- like behaviours as educational hooks

The finding that after seeing the sea lion show audiences were more likely to mention non-naturalistic uses for animal adaptations indicates that the use of trick-like behaviours as educational hooks is ineffective and leads to ‘false-learning’. Audiences were more likely to recall educational hooks as tricks rather than remembering the explanations behind the behaviours and how the adaptations were used in the wild. This confusion over the message conveyed has been found in other zoo contexts when complex story lines were used to convey conservation and biodiversity information (Mann-Lang et al., 2016). The more removed the trick is from the natural behaviour the more likely audiences will be confused by the message conveyed. Sea lions balancing artificial objects on their noses is a tenuous link to whisker sensitivity and led to significant levels of ‘false learning’.

Visitors recalled the talking parrot post-visit. Whilst this supports notions that tricks can be recalled by visitors, the fact that wild parrots do not talk reinforces the concept that trick behaviours can mislead visitors about natural behaviour. The bird show learning objectives intended to convey parrots’ ability to talk as a fact to their audience. This indicates that currently live animal shows misdirect their learning objectives and include those which don’t support the zoo mission. It is vital that learning objectives are re-focused to avoid promoting false learning in audiences.

It is possible that the show’s environments affected how species were viewed (Patrick, 2016). Sea lions are a least concern species and were presented in an artificial pool surrounded by a fishing themed arena. This automatically created an association between the human environment and the animal and may have reinforced ideas about the animal performing stunts for humans. On the other hand the bird show arena was more neutral allowing the focus to be on the birds themselves.

Further investigations are needed to experimentally test the impact of tricks compared to naturalistic presentations of behaviour on the frequency of ‘false learning’ in audiences. Investigations are also needed to test whether the amount of time a trick is performed influences the amount of ‘false learning’. Given that ‘false learning’, in any form, is a negative outcome, our findings indicate that tricks should be avoided entirely and behaviours should be presented as naturally as possible to demonstrate animal adaptations.

We acknowledge that for some species trained behaviours fulfil an enrichment role for the animal, however, justifying the use of tricks as an educational hook is not appropriate.

Recall post-visit:

The small sample size of post-visit show audience responses limits what conclusions can be made. Live animal shows were generally viewed positively by respondents, and generated positive emotions towards species. This supports findings from other animal interaction studies (Anderson et al., 2003; Fernandez et al., 2009; Povey & Rios, 2002; Skibins & Powell, 2013). Positive experiences with animals have been demonstrated to increase pro-environmental attitudes, positive affiliations with animals and create long term memories (Clayton et al., 2009; Esson & Moss, 2014; Mann-Lang et al., 2016; Myers et al., 2004). Developing emotional bonds with an animal is necessary for engaging visitors with the conservation issues at large (Clayton et al., 2017; Myers et al., 2004; Skibins & Powell, 2013). We found that audiences recalled information about individual animals better than overall concepts post-visit. This suggests that live animal shows may be best for forming visitor connections with individual species rather than delivering conservation information as a whole.

Conclusion:

Live animal shows have a positive educational impact on their audiences by successfully conveying factual knowledge. They are less effective for conveying conservation actions. Additionally, the use of trick-like behaviours, intended as educational hooks, were found to be ineffective at conveying a clear message and increased 'false-learning' in their audience.

The current focus of live animal shows on conveying factual knowledge has limited value in supporting the overall zoo mission. In order to have a greater impact on visitor's biodiversity and conservation understanding, live animal shows should provide opportunities for visitors to engage with more complex issues such as climate change.

The continued appeal of live animal shows and their ability to convey emotional connections to species means they have an important role in the zoo. However, using trick-like behaviours as educational hooks is not justified and has negative impacts on learning. Consequently, where live animal shows are used we recommend that they present only naturalistic displays of behaviour.

This paper indicates the impact of entertainment driven live animal shows on visitor knowledge, an area currently missing from the zoo education literature. Particularly, we highlight concerns about the use of trick behaviours as an educational tool for conveying animal adaptations.

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Appendix B

B.1 Facts conveyed by each show:

In the sea lion show:

- Knowing the difference between seals and sea lions including that, seals have smaller flippers, sea lions can walk on land whilst seals slide, sea lions have visible ear flaps.
- Sea lions have very sensitive whiskers, they act as a detection system to allow them to feel changes in the water and use these to find fish.
- Sea lions have binocular vision which helps them judge speed and depth. This is used when hunting prey. Sea lions eyes also have a special layer of cells to protect the surface of the eye.
- The sea lions are trained as it reduces boredom and keeps them mentally stimulated. Training also helps during veterinary examinations.
- The public can help protect seals and sea lions by donating to the Monk Seal Conservation Trust and by not littering at the beach.

For the bird show.

- That parrots see in colour and that this allows them to select ripe fruits and avoid poisonous ones.
- That parrots are intelligent and can talk.
- Owls have several features to help them hunt prey these include their facial disk, sharp talons and beak, ability to turn their neck three quarters of the way around and sensitive hearing.
- Barn Owls are threatened in the UK primarily by habitat loss from barn conversions, traffic collisions, and pesticides killing prey species.
- Flamingo Land raises money for the Hawk and Owl trust to protect native species. Donations made at the bird show go to this trust.
- Vultures have bald heads to keep them clean when eating carcasses
- Vultures glide on thermals to conserve energy. They need to conserve energy as they scavenge for food and food sources are unreliable.

B.2 Blank example of questionnaire used to collect pre- and post-performance responses from visitors attending the sea lion or bird show at Flamingo Land Resort Ltd.

Sea lion Show Questionnaire

1. What is special about a **sea lion's** eyes:
………………………………………………

2. How does this **help** them in the wild?
………………………………………………

3. Why are **sea lion's** whiskers so important:
……………………………………………
……………………………………………
……………………………………………
………………………

4. What other **body features** or **behaviours** help **sea lions** survive in the wild?
4a. Features:
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………
4b. Behaviours:
…………………………………………………………………………………………………

5a. **What** was your **main reason** for visiting Flamingo Land today?
…………………………………………………………

5b.**Why** did you **visit the zoo**? …………………………………………………………

6. What, if anything, could **you do** personally to help conservation of seals or sea lions?
……………………………………………………………………………………………………

7. What do you think is the **role of zoos**?

……………………………………………………………………………………………………
……………………………………………………………………………………………………

8. What **words do you think of** when you think about **Flamingo Land**? (List all the words you can think of)
………………… ……………… ……………
………………… ……………… ……………
………………… ……………… …………….
………………… ……………… …………….

9. **Date of Birth**: / /

10. **Gender:**

To enable us to contact you exclusively for follow up research, please provide a contact email.

11. **Email:**……………………………………

12. **Postcode**:………………………………..

13a. Have you **visited Flamingo Land before?** Yes / No

13b. Approximate date: / /

14. Prior to today have you **seen a sea lion show before?** (Please circle)

Yes at Flamingo Land / Yes at another zoo / No

15. **What is your highest completed level of education?** (Please tick)

- ☐ No formal qualifications (no longer in education)
- ☐ GCSE, Foundation Diploma or equivalent
- ☐ A level, Advanced Diploma or equivalent
- ☐ Degree (e.g. BA)
- ☐ Postgraduate degree or equivalent (e.g. MA or MSc)
- ☐ Other (please specify):………………………………..

16. **What is your approximate annual gross disposable household income?**

- ☐ Less than £7,000
- ☐ £7,001 to £14,000
- ☐ £14,001 to £21,000
- ☐ £21,001 to £28,000
- ☐ £28,001 to £35,000
- ☐ £35,001 to £42,000
- ☐ £42,001 or more

Thank you for your help!

Bird Show Questionnaire

1. What **threats** do **owls** face in the wild?
……………………………………………
……………………………………………
……………………………………………

2. What is special about a **parrot's** sight?
……………………………………………
3. How does this **help** them in the wild?
……………………………………………

4. What **body features** or **behaviours** help **vultures** survive in the wild?
4a. Features:
……………………………………………………………………………………………
……………………………………………………………………………………………
4b. Behaviours:
……………………………………………………………………………………………
……………………………………………………………………………………………

5a. What was your **main reason** for visiting Flamingo Land today?
………………………………………………………

5b. **Why** did you **visit the zoo**? ………………………………………………………

6. What, if anything, could **you do** personally to help conservation of birds?
……………………………………………………………………………………………………

7. What do you think is the **role of zoos**?

……………………………………………………………………………………………………
……………………………………………………………………………………………………

8. What **words do you think of** when you think about **Flamingo Land**? (List all the words you can think of)

…………………	………………	……………
…………………	………………	……………
…………………	………………	…………….
…………………	………………	…………….

9. **Date of Birth**: / /

10. **Gender:**

To enable us to contact you exclusively for follow up research, please provide a contact email.

11. **Email:**…………………………………

12. **Postcode**:……………………………..

13a. **Have you visited Flamingo Land before?** Yes / No

13b. Approximate date: / /

14. **Prior to today have you seen a bird show before?** *(Please circle)*

Yes at Flamingo Land / Yes at another zoo / No

15. **What is your highest completed level of education?** (Please tick)

- ☐ No formal qualifications (no longer in education)
- ☐ GCSE, Foundation Diploma or equivalent
- ☐ A level, Advanced Diploma or equivalent
- ☐ Degree (e.g. BA)
- ☐ Postgraduate degree or equivalent (e.g. MA or MSc)
- ☐ Other (please specify):………………………………..

16. **What is your approximate annual gross disposable household income?**

- ☐ Less than £7,000
- ☐ £7,001 to £14,000
- ☐ £14,001 to £21,000
- ☐ £21,001 to £28,000
- ☐ £28,001 to £35,000
- ☐ £35,001 to £42,000
- ☐ £42,001 or more

Thank you for your help!

B.3 Selected show-related questions from general visitor survey used to collect pre- and post-visit responses from visitors to Flamingo Land Resort Ltd.

- During your visit to Flamingo Land Resort, did you attend any informational animal talk or show?
- Which of the following animal shows or talks did you attend?
    - Sea Lion Show
    - Bird show
- How satisfied were you with the [Sea Lion /Bird] Show? [Likert 7 point scale: very satisfied, satisfied, somewhat satisfied, neutral, somewhat dissatisfied, dissatisfied, very dissatisfied, no opinion/ neutral]
- What can you remember from the [Sea Lion/Bird] Show?
- What is your gender?
- What is your age?

- Which of the following qualifications do you hold? Tick all that apply
    - No formal education qualifications
    - GCSE or equivalent
    - A-level or equivalent
    - Vocational qualification
    - First Degree (Bachelor's)
    - Postgraduate degree

- Please indicate your annual household income before taxes
    - Prefer not to say
    - Under £15,000
    - £15, 001 - £25,000
    - £25,001- £35,000
    - £35,001 - £45,000
    - £45,001 - £55,000
    - Over £55,001
    - Unsure

B.4 Table used to code responses to show-related questions as correct or incorrect and false learning.

What is special about a sea lions eyes?	**Accept:** binocular vision/ forward facing /like binoculars/ like goggles underwater/ rounded lenses/ special layer of cells/protective layer can see in the dark/ dark water can survive if blind/survive without them **Reject:** Big, pretty, large, shiny (colour) 360 vision see in water/see underwater (too general) A second eyelid/ no eyelids Bifocal Are Blind
How does this help them in the wild?	**Accept:** To catch prey/fish, to hunt/to catch food To judge speed and distance/depth perception/ helps with light refraction To protect eye/ stops stuff getting into eyes To help with vision in the dark/murky water/see in low light levels **Reject:** To see predators, (although technically they have predators their eyesight is more for prey/ hunting) 360 vision/ see around To see underwater
Why are sea lions whiskers so important?	**Accept:** Sense prey/ sense vibrations/ find where fish are/ contain nerve endings/ very sensitive To feel/touch/ to feel fish To sense if go blind/hunt if murky/ detect size of space, don't bump into things **Mark as False Learning:** Balance/ Balance or touch objects/balls **Reject:** Help them feed (general) Catch food (as whiskers not involved in actually catching as not technically correct)
What body features and behaviours help sea lions survive in the wild?	0 = no features/behaviours 1 = one behaviour/feature mentioned

	2 = to or more features and behaviours listed 3 = one behaviour/feature explained 4 = two or more behaviours/featured listed with explanation of how they help survival **Accept:** Flexible body, streamline For escaping predators/ for fast swimming/ movement on land/ only go in water to hunt/ get out of water to avoid predators/sharks Live in groups/sociable Accept colour if a description of how it blends with water or camouflage is given Ears Flippers, large front flippers, accept long arms if sentiment understood Fat/blubber/ thick skin – insulation Fur – to keep them warm Loud/noisy intelligent **Reject:** whiskers as question already states other features skin smell reject colour only Answers relevant to captivity: can clap, can stick tongue out
What threats do owls face in the wild?	Cars, pesticides, drowning, lack of barns/nest sites, poisoned, deforestation, extreme weather, habitat **Reject:** hunted, eaten, bigger birds, extinction, humans (unless specific)
What is special about a parrot's sight?	See in colour, peripheral vision, see sides, side view, **Reject:** 360, binocular, telescopic, stereoscopic, see all around
How does this help them survive in the wild?	Tell ripe fruits, don't eat poisonous berries, peripheral vision, escape predators **Reject:** see food, find food [not specific enough] answer which mentions hunting or prey.
What body features or behaviours help vultures survive in the wild?	0 = no features/behaviours 1 = one behaviour/feature mentioned

	2 = two or more features and behaviours listed 3 = one behaviour/feature explained 4 = two or more behaviours/featured listed with explanation of how they help survival **Accept:** Bald head – sanitation, hygiene, keep clean Nostrils – smell food from a distance Glide on thermals – conserve energy, don’t know when they will find food Group behaviours Beak and talons sharp – ripping into flesh/ carcasses **Reject:** Answers relating to hunting as they are a scavenger species Answers relating to captivity.

B.5: comparison of alternative models for animal knowledge questions a) sea lion show knowledge, b) bird show knowledge, c) sea lion show conservation action, d) bird show conservation action. Degrees of freedom (df).

a) Sea lion knowledge questions overall correct (poisons)

model	df	AIC	AIC differences	Aiaike weights (w)
M1	6	1345.1	1.1	0.288
M2	7	1344.0	0.0	0.501
M3	8	1355.8	11.9	0.002
M4	8	1358.3	14.4	<0.001
M5	7	1356.6	12.7	<0.001
M6	8	1358.2	14.3	<0.001
M7	4	1345.7	1.8	0.207
M8	6	1355.6	11.6	0.002

b) Bird show knowledge questions overall correct (poisons)

model	df	AIC	AIC difference	Aiaike weights (w)
M1	12	745.9	4.6	0.061
M2	13	746.8	5.6	0.038
M3	5	746.7	5.4	0.042
M4	5	744.1	2.8	0.154
M5	6	741.3	0	0.619
M6	4	745.2	4.0	0.085
-	-	-	-	-
-	-	-	-	-

c) Sea lion stated conservation actions

model	df	AIC	AIC differences	Aiaike weights (w)
M1	6	464.5	0.2	0.353
M2	7	466.7	2.4	0.120
M3	8	469.7	5.4	0.026
M4	8	469.0	4.7	0.039
M5	7	469.7	5.4	0.027
M6	8	470.4	6.1	0.019
M7	4	464.3	0.0	0.397
M8	6	470.5	6.2	0.018

d) Bird show stated conservation actions

model	df	AIC	AIC differences	Aiaike weights (w)
M1	12	271.3	7.6	0.008
M2	13	274.1	10.4	0.002
M3	5	267.0	3.3	0.072
M4	5	263.8	0.1	0.353
M5	6	265.0	1.4	0.189
M6	4	263.7	0	0.375
-	-	-	-	-
-	-	-	-	-

Chapter 5: Evaluating the impacts of theatre-based wildlife and conservation education at the zoo.

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At the time of data collection Andrew R. Marshall was employed by the organisation under study (Flamingo Land Resort Ltd.) and both he and the lead author were in receipt of grant funding from the same organisation at the time of submission.

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Abstract

The experience of visiting a zoo as a child can be remembered decades later and influence future environmental attitudes. In light of steadily growing criticism of the ethics and value of live animal shows, some zoos are seeking alternative means of delivering appealing 'edutainment' to a broad audience. One such alternative is through theatre performances. Yet there is limited evidence regarding the educational impact of such theatre-based approaches. Here we examine whether a family-orientated zoo theatre performance, seen by more than 30,000 people annually, achieved animal and conservation impacts. We found significantly higher knowledge in child and adult audiences' post-performance compared to pre-performance. Puppets, characterisation and the use of popular music with altered lyrics were associated with better outcomes, especially for children. Consequently, we conclude that educational family theatre can effectively deliver animal and conservation messages within a leisure setting such as the zoo.

Keywords: children's learning, conservation theatre, environmental education, puppets, anthropomorphic

Introduction:

In order to address biodiversity loss and prevent further damage it is crucial to educate public audiences about wildlife species and conservation (Grajal et al., 2016; Moss et al., 2015). Zoos have a huge potential audience with over 700 million visits to zoos and aquariums taking place each year (Gusset & Dick, 2011) representing a wide range of demographic categories (Bruni et al., 2008). The World Association of Zoos and Aquariums (WAZA) has committed to support the global Aichi targets as part of the Convention on Biodiversity to improve public awareness of biodiversity and actions to protect it (Barongi et al., 2015; CBD, 2011; WAZA, 2005). Zoos present scientific information in settings which are more realistic and applicable to daily life than school classrooms (Braund & Reiss, 2006). Evaluation and improvement of zoo education are therefore major priorities for curbing species loss (Jensen et al., 2017; Moss et al., 2017a). Novel methods for transforming the traditional zoo experience and the potential for effectively educating visitors about animals and conservation have been little tested.

Over 80% of zoo visitors are families (Andersen, 2003) with children typically driving the decision to visit (Turley, 2001). Zoo experiences are viewed by parents as important for building connections to nature and as a family bonding experience (Fraser, 2009; Puan & Zakaria, 2007). Childhood experiences of wildlife contribute to an individual's attitudes towards the environment and have been shown to affect adult behaviour (Oreg & Katz-Gerro, 2006; Stern & Dietz, 1994). To inspire a lifelong concern for nature, and to fulfil a conservation role in the future, zoos must appeal to children.

Zoo visits can increase biodiversity literacy and awareness of conservation actions (Jensen et al., 2017; Moss et al., 2015, 2017a). Even a single zoo visit can increase children's understanding of animal species and conservation (Jensen, 2014a). Understanding how children and accompanying adults engage with zoo learning experiences is vital.

Theatre, puppet shows and other performance genres are beginning to gain popularity in zoos (Hawkey, 2003; Proffitt, 2013). We define theatre as a scripted performance intended to convey a particular message or story. Unlike traditional zoo animal shows, theatre can be performed without live animals, thus avoiding the risks of negative learning (Jensen, 2014a) or false learning (Chapter 4) from presenting species as tame or performing tricks (Acampora, 2005; Finlay et al., 1988). Theatre can also combine visual, audio and narrative elements to provide a more inclusive learning experience (Peleg & Baram-Tsabari, 2011) in ways that would not be possible with using live animals.

In non-zoo settings, educational theatre has shown promise as a method of communicating scientific concepts to school children and museum visitors. For example, visitors have been shown to be more likely to visit exhibits and stay longer during a theatre performance (Baum & Hughes, 2001; Hawkey, 2003). Theatre with participatory elements can be especially effective at challenging existing adult perceptions (Evans 2013). Educational theatre has also been found to be more effective than conventional presentations at delivering environmental conservation information to school children (Okur-Berberoglu et al., 2014).

Although theatre and puppets have long been used in zoos, there is very limited evidence of their success at educating audiences. The only zoo based peer-reviewed study on this topic showed that audiences generally enjoyed theatre performances (Penn, 2009). The study found adults indicated significant learning and children (aged 6-9) collectively recalled overall concepts whilst younger children were limited to a descriptive awareness of content. Furthermore, half of the adults questioned (52%, n = 313) stated that the performances had a positive influence on their children's pro-environmental feelings. Whilst this is admirable, we note that reporting on others' experience is prone to bias and must be viewed with caution (Donaldson & Grant-Vallone, 2002; Jensen, 2014b, 2017). Penn's (2009) study examined children's collective recall and did not consider individual knowledge changes. Penn also suggested that song is often an important element of theatre. However, there has been no investigation regarding how this aspect of zoo theatre influences learning. Songs have been found to aid in learning more generally. Setting phrases to a familiar tune reduces learning time and aids recall (Hyman et al., 2013; Rainey & Larsen, 2002). Therefore, using songs in a zoo-theatre performance may increase uptake of information, but this has not previously been tested.

This study aims to determine the effectiveness of theatre for educating zoo visitors. Our objectives are to determine whether a family-orientated puppet-based zoo-theatre performance can convey a) animal facts, and b) basic understanding of zoo conservation to both children and accompanying adults, and the influence of different techniques for effective learning.

Background:

The study was undertaken between March-October 2015 at Flamingo Land Resort Ltd., a combined theme park and zoo in the UK. The zoo was a member of WAZA, and therefore formally committed to conservation education and the Aichi biodiversity awareness targets. Although the zoo formed a significant part of the study site, marketing was strongly focused on the theme park and aimed to achieve ‘entertainment’ (Flamingo Land Ltd., 2016). Flamingo Land has had overall success at increasing visitor knowledge about animals, but previous studies indicate that animal information signs are more effective than existing live animal shows (Chapters 2, 3 and 6).

We investigated the impact of a zoo theatre performance, the ‘Mia and Mylo Show’, on children’s and adults’ knowledge of animal facts and basic understanding of conservation. Written by the theme park entertainment team in conjunction with the zoo’s education staff, the theatre performance was aimed at children aged three-nine years (Appendix C.1). The theatre performance lasted 15 minutes and was performed twice daily. During the study period, the estimated audience was 14,500 children and 16,100 adults.

The intended outcomes of the theatre performance were for the audience to be able to:

a) Describe features and behaviours of flamingos, meerkats, and lemurs (chosen for ease of recognition from the zoo), specifically:

- Flamingos eat ‘shrimp’ (this simplistic message was designed to aid understanding for a young audience);
- Flamingos are born with grey feathers which turn pink from pigments in their food (i.e. shrimp);
- Meerkats live in the African desert and stand on two feet to keep watch; and
- Lemurs are primates from Madagascar and endangered by hunting and logging.

b) State how the zoo helps conserve animals and habitats, including that Flamingo Land is:

- Doing conservation work in Africa (Tanzania) through the Udzungwa Forest Project (UFP); and
- Protecting animals and forests, educating people, and researching flamingo breeding.

The theatre performance included four actors, two dressed as meerkats and two with life-size puppets (a flamingo and a lemur) (Figure 5.1). A large digital backdrop displayed animal video footage, research photographs and maps. Screen display was timed to align with the script. Over half (52%) of the script was sung to the tune of contemporary popular songs, including Meghan Trainor's 'All About that Bass' and Mark Ronson's 'Uptown Funk'. The songs used were all upbeat and between 110 and 170 beats per minute. For most songs the altered lyrics were displayed on screen and the audience encouraged to sing along. Each time information about flamingo diet was discussed an animated cartoon shrimp appeared on screen. To ensure consistency between performances the theatre content was pre-recorded with actors miming the words.

Figure 5.1: Photograph of the 'Mia and Mylo' theatre performance at Flamingo Land. The image shows; two actors dressed as meerkats, two actors with puppets dressed as animals and a digital backdrop.

Methods:

Evaluating theatre:

We designed evaluation questionnaires based on the intended outcomes of the theatre performance. These tested whether the theatre performance had successfully conveyed its messages. Adult and child respondents were questioned at baseline (pre-performance) and directly after the theatre performance (post-performance). A quasi-experimental approach was taken comparing unpaired responses from visitors pre- (n = 81 adult, n = 120 child) and post-performance (n = 77 adult, n = 124 child). Where possible the same individuals were repeat tested (n = 15 adult, n = 29 child) in order to provide a paired control and to directly track knowledge changes.

Pre-performance questionnaires were distributed to all families within 30 metres of the stage 15 minutes prior to the performance. Children 2-17 were given the child's questionnaire and adults over 18 years given the adult questionnaire (Appendix C.2-C.3). Completed questionnaires were collected five minutes before the performance began. Many families arrived immediately before the start and could not be included in the pre-performance sample as they had no time to complete a pre-performance questionnaire.

Post-performance questionnaires were distributed to every 4th family immediately after the performance. With an approximately 25% response rate to pre-performance questionnaires, as many families left quickly at the end of the performance, this allowed the pre-and post-performance samples to be similar in size. If a respondent had completed a questionnaire both pre- and post-performance these responses were paired. The sampling method used meant there was a high proportion of unpaired respondents. Families who arrived during the performance were not asked to complete questionnaires as they may have missed information. Demographic categories were compared between pre- and post-groups to ensure that performance samples were similar (Table 5.1).

Table 5.1. Sample groups pre- and post-performance for adult and child data gathered for the Flamingo Land 'Mia and Mylo' theatre performance.

	Adult pre-unpaired	Adult post-unpaired	Adult paired	Child pre-unpaired	Child post-unpaired	Child paired
Sample size	66	62	15	91	95	29
Respondent age in years Mean (95% CI)	38 (35-42)	40 (40-45)	43 (36–49)	8 (8-9)	8 (7-8)	6 (5-7)
Adult's income (£) Mean (95% CI)	27,703 (23,906 - 31,384)	26,880 (22,680-30,940)	26,250 (18,083-33,833)	23,916 (20,533-27,416)	26,790 (22,590-30,863)	35,000 (29,272-40,409)
Adult's education Mode (% of individuals)	No formal (27.3)	GCSE or equivalent (32.3)	GCSE or equivalent (20)	GCSE or equivalent (22)	GCSE or equivalent (22.1)	GCSE or equivalent (31)
Number of female respondents (%)	40 (60.6)	46 (74.2)	13 (86.7)	41 (45.1)	61 (64.2)	19 (65.5)
Number (%) who had visited site in previous 12 months	29 (43.9)	29 (46.8)	6 (40.0)	33 (36.3)	24 (25.3)	13 (44.8)
Number (%) who had seen the theatre performance before	15 (22.7)	15 (24.2)	1 (6.7)	31 (34.1)	23 (24.2)	12 (41.4)
Mean number of days since seeing the theatre performance	–	–	–	1.3 (0.7–2.1)	0.8 (0.4–1.4)	0.7 (0.3–1.1)
Mean number of adults viewing the performance	45 (40–49)	40 (34–45)	37 (32–42)	42 (39–46)	42 (40–45)	37 (32-42)
Mean number of children viewing the performance	–	–	–	39 (35–43)	46 (42–48)	37 (32–43)

Child questionnaires:

Questions were designed to be child-friendly for completion with minimal adult assistance (Appendix C.2).

A combination of open, closed and multiple-choice questions were used to maximise responses from children of all ages. Open questions were used for more complicated concepts such as meerkat behaviour, and the role of zoos. These questions were more suited to older children and allowed us to test whether these concepts had been conveyed without prompting answers.

Adults reading questions to children were instructed to read questions exactly as they were written and to indicate if they gave any help. In cases where a child was deemed not to have understood a particular question, their response to that question was removed from analysis of that question. Their responses to other questions were included in the analysis. To determine potential covariation and bias, information about the child's age, gender and prior viewing of the performance was collected, and also the accompanying adult's income and education levels. A small token of appreciation (a medal and certificate) were given to all children who agreed to participate.

Adult questionnaires:

Adult questionnaires (Appendix C.3) were comprised of open-ended questions about information covered in the performance and closed demographic information questions. All adults in each family were given the adult questionnaire. Not all adults completed these questionnaires (91.1% response n = 14 refusals) as they were helping their children read and complete a child questionnaire. Adult questionnaires were distributed primarily to assess what they, as accompanying adults, had learned from the theatre performance and secondly, to encourage adults to focus on their own questions and not to influence children's responses.

Analysis of Theatre Performance Content:

To establish whether variation in content delivery of the performance influenced what was recalled, we analysed a video recording of the performance. We calculated the time spent conveying each learning objective and the type and duration of each medium used (spoken, song or on-screen). This enabled us to examine whether increased exposure to information for each medium (spoken, song or onscreen) influenced the percentage of correct responses given.

Data Analysis:

Adult and child responses were coded as correct (1) or incorrect (0) based on a pre-agreed coding table (Appendix C.4). If an open response included one of the pre-agreed accepted response words, the answer was marked as correct. Adult questions about flamingo adaptations and behaviours were marked out of four based on the agreed coding scheme. Two researchers coded the data, blind to the test condition (pre- or post-performance) with a 60% overlap in data coded. Inter-coder reliability was good (kappa = 0.87). Disagreements were resolved by discussion whilst still blind to test condition.

Statistical analysis was performed using R version 64: 3.2.3 (CRAN, 2014). Log transformations were applied to variables ‘the number of children viewing the performance’ and ‘number of adults viewing the performance’ to remove skew and heteroscedasticity. Predictor variables were tested for inter-correlation which can negatively affect regression modelling; where Pearson’s coefficient exceeded $r = 0.7$ and Variance Inflation Factors were > 2 these variables were not included in the same model (Zuur et al., 2010).

For each question, Binomial Generalised Linear Models (GLMs) were used to evaluate the relationships between the dependent variable (whether the question was answered correctly or incorrectly) and independent variables (Children’s response: age of respondent, gender, theatre seen, adult’s help given, adult’s income, no. of children viewing (log), number of days since last viewing theatre performance. Adults’ response: theatre seen, age, gender, highest level of education achieved, household income, number of adults viewing (log), whether respondent had visited Flamingo Land within the last 12 months ‘last-visit’, and whether they had seen the theatre performance before ‘theatre seen before’). Poisson GLMs were used to compare the total number of correct answers overall and for responses to questions on flamingo adaptations as answers were given a score rather than being correct or incorrect. Where data was over dispersed (e.g. unpaired overall correct answers) a quasi-Poisson model was used.

Minimum adequate models were produced using backwards-forwards stepwise selection and checked to ensure no deviance was lost (Murtaugh, 2009). Where the most relevant independent variable to our research question, (‘theatre seen’, i.e. whether the respondent was answering questions pre- or post-performance), was not preserved in the minimum adequate model, univariate GLMs were used to specifically model this variable against the dependent variable.

For each significant independent variable a percentage deviance was calculated (%D). This explained the impact of each independent variable on the dependant variable (response). A high percentage deviance (the maximum being 100%) meant that the variable had a major influence on the response, whilst a low percentage deviance indicated that other factors were additionally responsible. Highly significant but low deviance explained variables were possible and vice versa. This was because a variable may accurately predict a very small percentage of the response and other, potentially untested, variables explain the rest of the deviance.

Additionally, we tested the difference between the total responses (combined paired and unpaired) pre- and post-performance using Wilcoxon signed rank tests. This allowed for non-normally distributed data, for example, where unbalanced samples were used either because of being in unpaired pre-post- groups or where a child’s responses had been excluded. Effect size was calculated based on the total number of correct answers using Cohens’ d with a pooled standard deviation (Field, 2013; Higgins et al., 2013). This explained the effect of the theatre performance on overall ‘knowledge’ (total number of correct answers given). An effect size of below 0.01 was seen to have no effect on learning, 0.02-0.18 a low effect, 0.19-0.44 moderate, 0.45-0.69 high and above 0.70 a very high effect (Higgins et al., 2013)

Adjustment using False Discovery Rate (αFDR) was applied to all tests to reduce Type 1 error risk (Garcia, 2004) and 95% bootstrapped confidence were calculated using 10,000 iterations.

Ethics:

All respondents were informed that data were being collected as part of visitor experience research. Respondents were informed that completion of the questionnaire constituted consent to be included in the study. Only children with accompanying adults were given the questionnaire and verbal consent from the accompanying adult was received before the child participated in the research. The study was granted approval by the University of York, Environment Department Ethics Committee.

Results:

Learning in children

Wilcoxon signed rank tests found that the overall number of children's correct responses significantly increased from pre- to post-performance (22.1% increase, w = 4403, p = <0.001). Seeing the theatre performance had a strong effect on children's 'knowledge', i.e. the total number of correct responses given (effect size d = 0.76, mean score pre-performance = 2.2, (95%CI 1.87-2.47), n = 120, mean score post-performance = 3.5, (95%CI 3.17-3.80), n = 124; combined unpaired and paired responses) (Figure 5.2), and was the main predictor of overall correct answers (Table 5.2).

Seeing the theatre performance was also the main predictor of correct responses for both unpaired and paired groups for questions on flamingo diet (explaining 19.2 %D in paired and 23.3 %D in unpaired samples) and where Flamingo Land works outside the United Kingdom (explaining 12.2%D in paired and 5.3%D in unpaired samples) (Table 5.2).

There was no significant change in children's knowledge about meerkat habitat or behaviour post-performance compared to pre-performance. In both cases children demonstrated a relatively high level of baseline awareness pre-performance (> 50% correct responses in the pre- and post- performance conditions) (Figure 5.2).

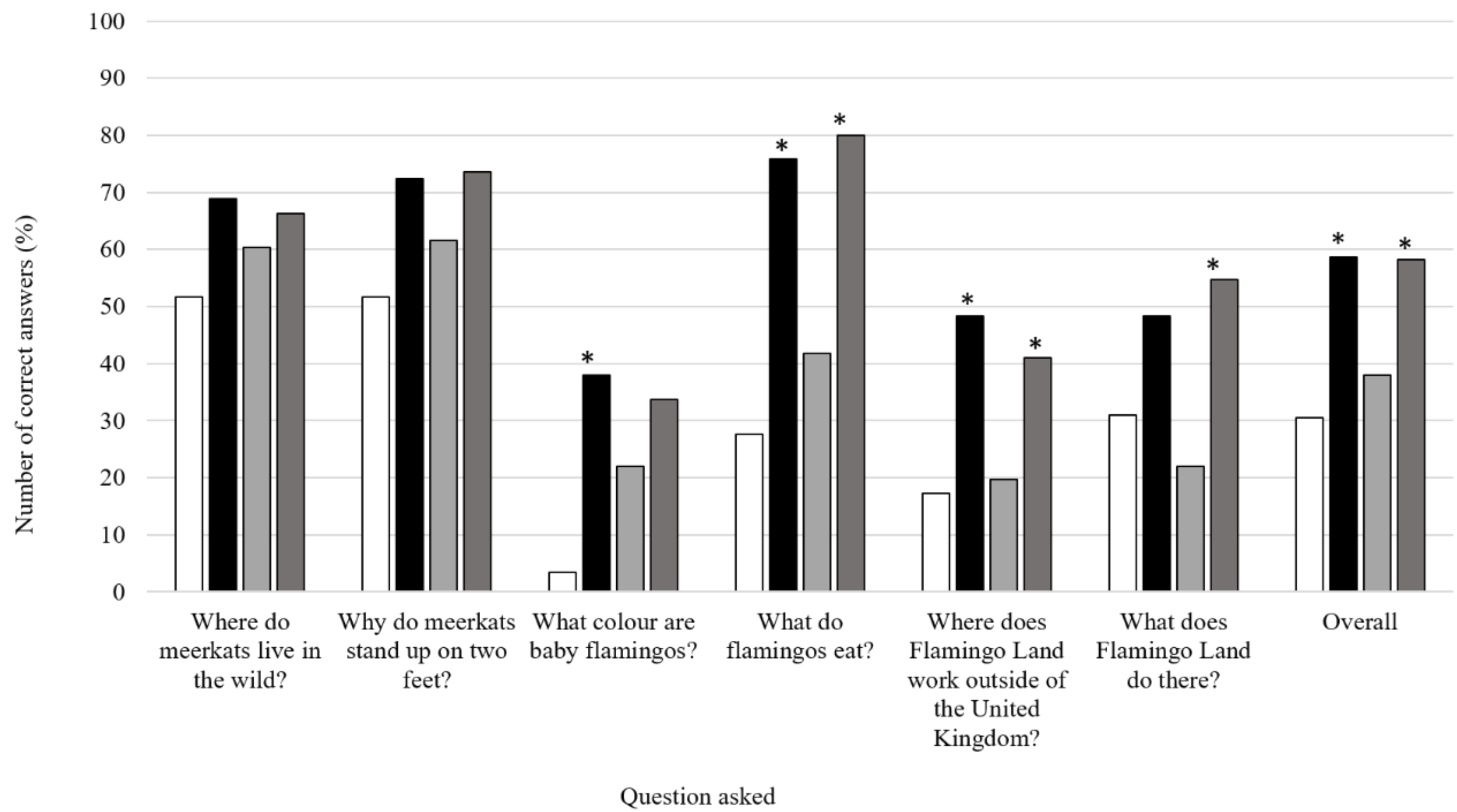

Figure 5.2: Number of correct children's responses (%) given for questions relating to content from the 'Mia and Mylo' theatre performance; comparison between paired pre-performance (white bars) and post-performance (black bars) (n = 29) and unpaired pre-performance (n = 91) (pale grey bars) and unpaired post-performance (n = 95) (dark grey bars). indicates where 'theatre seen' was a significant predictor of correct response.*

Table 5.2: Predictors of children's correct response to questions regarding animal information from the 'Mia and Mylo' theatre performance (unpaired n = 91-95, paired n = 29) from minimum adequate models (MAMs) and significant GLMs for 'theatre seen' where not preserved in the MAMs.

Model (and variables) [Binomial distribution unless otherwise stated]		**Significant variable [and model] statistics**
Q1: Where are meerkats found in the wild?	Paired MAM (b, f)	No. of children viewing[log] (+)%D = 16.6, p = 0.004; [AIC = 53.62, %D = 22.04, n = 50, α_{FDR} = 0.02]
	Unpaired MAM (b, c1, d1)	Gender [male] (+)%D = 2.90, p = 0.009; Age (+)%D = 1.01, p = <0.001; Adult's help given (+) %D = 2.40, p = 0.002; [AIC = 186.68,%D = 13.68, n = 168, α_{FDR} = 0.03)]
Q2: Why do meerkats stand on two feet?	Paired MAM (a, b, c2, d1)	No significant variables [AIC = 58.31,%D = 24.75, n = 52 α_{FDR} = 0.01]
	Unpaired MAM (a, b, d1, e1-6, f)	No significant variables [AIC = 160.62, %D = 20.60, n = 163, α_{FDR} = 0.008]
Q3: What colour are baby flamingos?	Paired MAM (a, g1-3)	Theatre seen (+) %D = 31.53, p = 0.009; [AIC = 48.47, %D = 31.53, n = 52, α_{FDR} = 0.01]
	Unpaired MAM (a,c1-2)	No significant variables [AIC = 210.46, %D = 4.93, n = 175, α_{FDR} = 0.01]
Q4: What do flamingos eat?	Paired MAM (a, e1-5, f)	Theatre seen (+) %D = 19.12, p = <0.001; [AIC = 59.32, %D = 40.2, n = 53, α_{FDR} = 0.007]
	Unpaired MAM (a, b, d1, e1-6, g1-8)	Theatre seen (+) %D = 23.27, p = <0.001; Adult's income[2](+) %D = 0.87, p = <0.00; [AIC = 184.11,%D = 34.90, n = 175, α_{FDR} = .005]
Q5: Where does Flamingo Land work outside of the United Kingdom?	Paired MAM (a, b)	Theatre seen (+)%D = 12.23, p = 0.019; Age(+) %D = 12.78, p = 0.019 [AIC = 48.52, %D = 21.30, n = 39, α_{FDR} = 0.05]
	Unpaired MAM (a, d1)	Theatre seen (+) %D = 5.27, p = 0.002; [AIC = 175.75,%D = 8.92, n = 138, α_{FDR} = 0.02]

Q6: What do they do there?	Paired MAM (b, c2, d1, f, g1-3)	No significant variables [AIC = 30.29, %D = 76.72, n = 39, α_{FDR} = 0.006]
	Unpaired MAM (a, d1)	Theatre seen (+) %D = 1.12, p = <0.001; Adult's help given (+) %D = 0.0, p = 0.001 [AIC = 181.95, %D = 8.0, n = 138, α_{FDR} = 0.05]
Overall number of correct answers	Paired MAM (a, b, c1-2, d) [Poisson]	Theatre seen (+) %D = 17.6, p = <0.001 Gender (Male)(+) %D = 2.4 p = 0.010 Adult's help given (+) %D = 0.4 , p = 0.002 [AIC = 221.22, %D = 49.3, n = 58 α_{FDR} = 0.03]
	Unpaired MAM (a, b, e1-4, 6-8) [Poisson]	Theatre seen (+) %D = 7, p = <0.001 Age (+)%D = 3.9, p = 0.004 Income (+) %D = 8.2 (1) p = <0.001, (2) p = <0.001, (3) p = <0.001 (7) p = 0.004 [AIC = 732, %D = 25.2, n = 186, α_{FDR} = 0.03]

a-h = MAM variables: a theatre seen, b age, c gender: (1) n/a, (2) male, (3) female, d adult help given e adult's income: (1) n/a, (2) < £7,000 (3) £7,001-£14,000 (4) £14,001-£21,000 (5) £21,001-£28,000 (6) £28,001 - £35,000 (7) £35,001- £42,000 (8) > £42,001, f No. of children viewing the performance [log], g days since last viewing the theatre performance: (1) <10 days ago (2) 11-20 days ago (3) 21-30 days ago (4) 31-40 days ago (5) 41-50 days ago (6) 51-60 days ago (7) >60 days ago (8) Never seen before, h adult's education level: (1) n/a, (2) no formal qualifications, (3) GCSE, foundation diploma or equivalent,(4) A level, advanced diploma or equivalent, (5) degree (e.g. BA), (6) postgraduate degree or equivalent, (7) other,
+/- = positive/negative relationship.
AIC = Akaike Information Criterion.
%D = percentage deviance explained (significant variables only).

Adult learning

Seeing the theatre performance had a strong effect on adults knowledge, i.e. the total number of correct answers given (effect size d = 0.71, mean score pre-performance = 2.27 (95%CI 1.88-2.68), n = 81, mean score post-performance = 3.69, (95%CI 3.21-4.17), n = 77; combined paired and unpaired responses). Significantly more correct answers overall were given post-performance compared to pre-performance (18% increase, w = 1931.5, p = <0.001) (Figure 5.3) and seeing the theatre performance was the main predictor of overall correct response (Table 5.3).

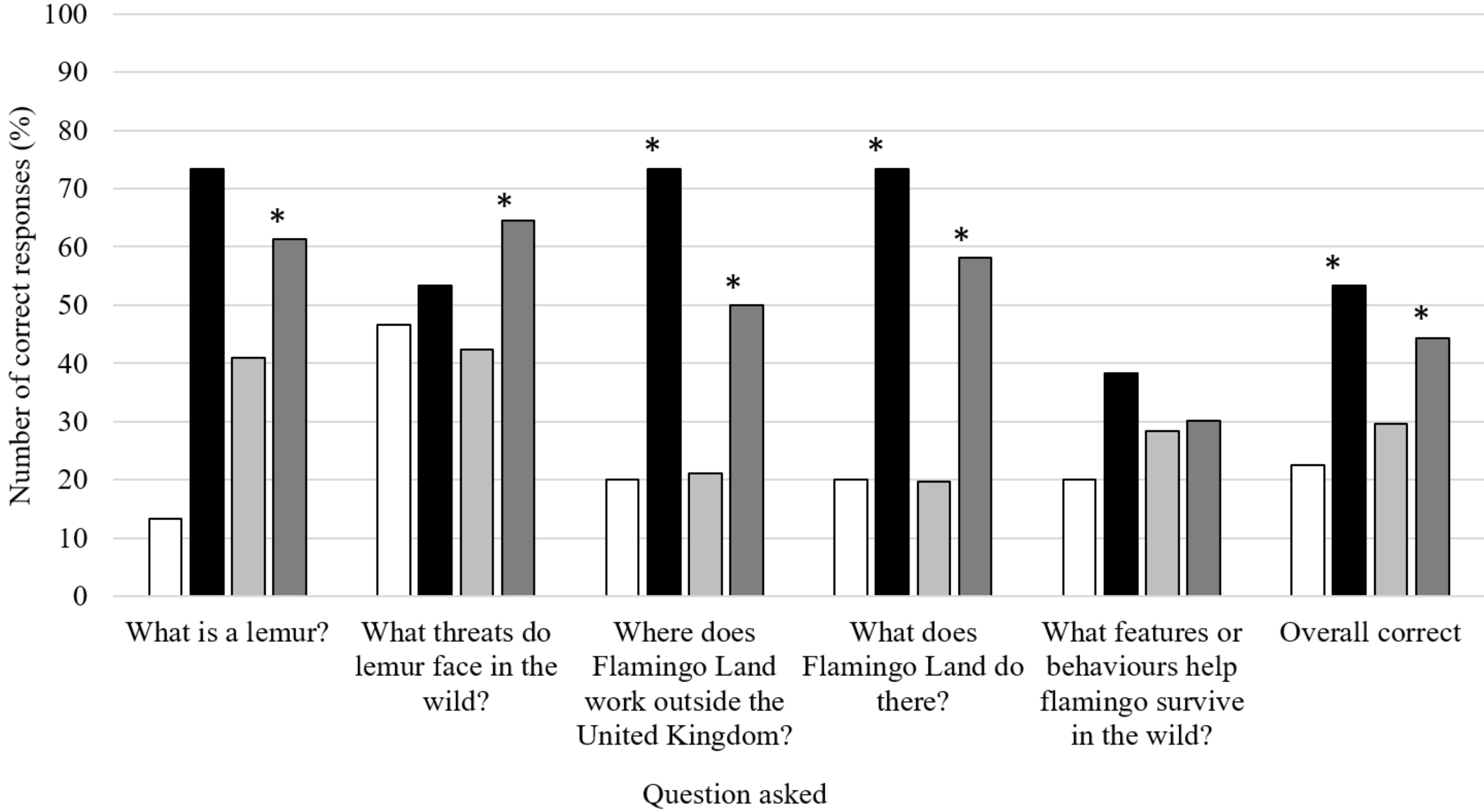

*Figure 5.3: Number of correct adult responses (%) given for questions relating to content from the 'Mia and Mylo' theatre performance. White bars = pre-performance paired (n = 15), black = post- performance paired (n = 15), pale grey = pre-performance unpaired (n = 66) dark grey = post-performance unpaired (n = 62).*indicates where 'theatre seen' was a significant predictor of correct response.*

Seeing the theatre performance also significantly predicted correct responses across both unpaired and paired groups for questions relating to where Flamingo Land works outside the United Kingdom (explaining 35.4 %D paired and 7.3 %D unpaired) and what it does there (explaining 35.4 %D paired and 15.6 %D unpaired) (Table 5.3). However, the theatre production had no effect on adult's awareness of flamingo adaptations. As this question was open ended, it is possible that visitors knew more about species than they wrote down and this could explain why no improvement was seen on this question.

Although there were differences between paired and unpaired groups in responses to specific questions, there was little discernible difference when overall correct answers were compared (adult responses paired vs. unpaired $w = 388.5$, $p = 0.2498$, children's responses paired vs. unpaired $w = 1359$, $p = 0.914$). This suggests that large sample, unpaired pre-post-groups can indicate trends in the data in the absence of repeat testing.

Using Minimum Adequate Models selected from a larger model using stepwise selection is less robust than ranking sets of models, however, it is still a reliable method of establishing which variables predict a response. This method was particularly important here as it allowed us to test which question areas were affected by seeing the performance. These could then be compared against the exposure time given to each question area within the show's content.

Table 5.3: Predictors of adult's correct response to questions regarding animal information from the 'Mia and Mylo' theatre performance (unpaired n = 128, paired n = 15) from minimum adequate model GLMs (MAMs) and significant GLMs for 'theatre seen' where not preserved in the MAMs.

Model (and variables) [Binomial distribution unless otherwise stated]		**Significant variable [and model] statistics**
What is a lemur?	Paired MAM	No significant variables [AIC = 32, %D = <0.001, n = 15, α_{FDR} = 0.05)]
	Paired 'theatre seen' (a)	Theatre seen (+) %D = 28.9, p = 0.003
	Unpaired MAM (a, f)	Theatre seen (+) %D = 14.8, p = 0.028; No. of adults viewing[log](-) %D = 0.0, p = 0.012 [AIC = 194.08, %D = 16.5, n = 128, $\alpha_{FDR\,=}$ 0.05]
What threats do lemur face in the wild?	Paired MAM	No significant variables [AIC = 32, %D = <0.00, n = 15, α_{FDR} = 0.05]
	Unpaired MAM (a)	Theatre seen (+) %D = 6.65, p = 0.013; [AIC = 193.61, %D = 17.7, n = 128, $\alpha_{FDR\,=}$ 0.05]
Where does Flamingo Land work outside the UK?	Paired MAM (g1, c2)	Theatre seen (+) %D = 35.4, p = 0.009; [AIC = 45.0, %D = 68.6 n = 15, α_{FDR} = 0.02]
	Unpaired MAM (a, c1-3)	Theatre seen (+) %D = 7.3 , p = 0.001; [AIC = 174.16, %D = 24.0 n = 128, α_{FDR} = 0.01]
What does Flamingo Land do there?	Paired MAM (a, b, d1-7, e1-7)	Theatre seen (+) %D = 35.4, p = 0.003 [AIC = 45.0, %D = 68.6, n = 15, α_{FDR} = 0.003]
	Unpaired MAM (a, f, h1-2)	Theatre seen(+) %D = 15.6, p = <0.001; Theatre seen before(+) %D = 2.7, p = 0.010; [AIC = 161.54, %D = 33.3 n = 128, α_{FDR} = 0.03]
What features or adaptations help flamingos survive in the wild?	Paired MAM [Poisson]	No significant variables [AIC = 84.6, %D = 84.79 n = 15, α_{FDR} = 0.05]
	Unpaired MAM (a-h) [Poisson]	No significant variables [AIC = 390.4, %D = 18.4 n = 128, α_{FDR} = 0.05]
Overall number of correct answers	Paired MAM (a, b, d1-7, g1) [Poisson]	Theatre seen (+)%D = 29.1 , p = <0.001; Education (+)%D = 10.3, (2) p = 0.010,(4), p = 0.007, (5) p = 0.004 [AIC = 124.0, %D = 71.3, n = 15, α_{FDR} = 0.02]
	Unpaired MAM (a-h) [Quasi-Poisson]	Theatre seen (+) %D = 16.5, p = 0.001 [AIC = NA, %D = 22.4 n = 128, α_{FDR} = 0.05]

a-h = MAM variables: a theatre seen, b age, c gender: (1) n/a, (2) male, (3) female, d education level: (1) n/a, (2) no formal qualifications, (3) GCSE, foundation diploma or equivalent,(4) A level, advanced diploma or equivalent, (5) degree (e.g. BA), (6) postgraduate degree or equivalent, (7) other, e income: (1) n/a, (2) < £7,000 (3) £7,001-£14,000 (4) £14,001-£21,000 (5) £21,001-£28,000 (6) £28,001 - £35,000 (7) £35,001- £42,000 (8) > £42,001, f No. of adults viewing the performance [log], g last-visit: (1) visited within last 12 months (2) not-visited within last 12 months, h = theatre seen before: (1) seen theatre before (2) not seen theatre before
+/- = positive/negative relationship.
AIC = Akaike Information Criterion.
%D = percentage deviance explained (significant variables only).

Media used and its impact on learning

In general longer exposure time to information in seconds led to increased recall. An 80% correct response rate for children was achieved after 200 seconds exposure, compared to a <40% correct response rate at 0 seconds (pre-performance). However, recall was dependent on the question asked and the medium used to deliver information. Whilst children's knowledge (% correct responses) continued to increase with exposure, adult knowledge (% correct responses) peaked at 110 seconds total exposure to information (Figure 5.4).

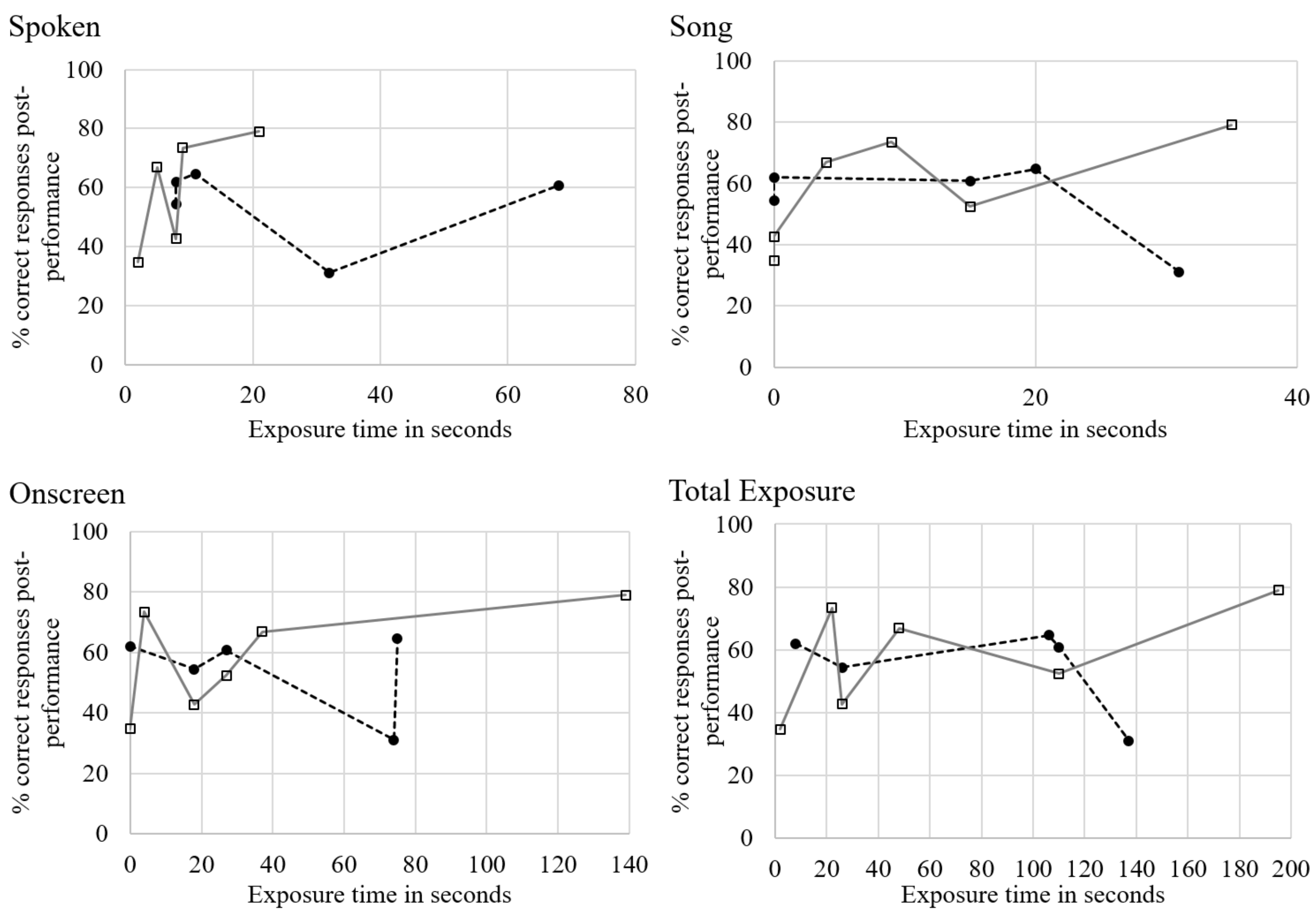

Figure 5.4: Comparison of exposure time in seconds against the percentage of correct answers for each medium used (spoken, song, on-screen and cumulative exposure). Adults: black dashed line with black data points n = 79; Children: grey solid line with black square data points n = 124.

The information that was recalled most successfully related to flamingo diet (children gave 26.7% correct answers pre-performance and 76.7% post-performance in the paired group and 41.8% correct answers pre-performance, 81.1% correct answers post-performance in the unpaired condition), and where Flamingo Land works abroad (childrens responses increased from 20.0% correct pre-performance to 50.0% correct post-performance in paired sample and 21.9% correct pre-performance to 44.2% correct post-performace unpaired sample, adults made similar improvements increasing from 20.0% correct pre-to 73.3% correct post- in paired responses and 19.4% correct pre- to 51.1% correct post- in unpaired responses)(Tables 5.2 and 5.3). Information on flamingo diet was presented for longer than any of the other learning objectives (3 minutes and 15 seconds) using a combination of song, spoken, and on-screen information. Although, 'where Flamingo Land works' was conveyed directly for a much shorter time (26 seconds through spoken and on-screen information), the topic of Africa was used throughout the performance, thus reinforcing this idea. The work that Flamingo Land undertakes outside the UK was mentioned directly for 1 minute and 50 seconds across all mediums. This information was successfully conveyed to the majority of adults (51.5-73.3% correct response post-performance) but not to all children (44.2-50.0% correct response post-performance). This suggests that the concept, although presented at length, may have been too abstract for younger age groups.

Spoken information was effective at conveying information to both adults and children and showed substantial change post-performance in knowledge even when it was the only media used (e.g. questions relating to flamingo colour demonstrated increases from 3.3% correct pre- to 36.7% correct post- in paired sample and 21.9% correct pre- and 35.8% correct post- in unpaired sample). Spoken information was conveyed the quickest with 80% correct children's responses after only 20 seconds exposure (Figure 5.4).

Songs were another effective media for conveying information, especially for children. For children, a short exposure to song increased recall and this continued to increase with song duration. Flamingo diet was presented using 35 seconds of song and children's knowledge of this information significantly increased post-performance compared to pre-performance. For adults there appeared to be a threshold when songs cease to be beneficial for learning, occurring at around 20 seconds. Information presented in short bursts of song e.g. 'what is a lemur?' (20 seconds of singing) and about zoos role in conservation (15 seconds of singing) showed significant improvements in adults' knowledge.

On-screen information (including maps, footage and text) aided children's recall with a steady increase over time. With the exception of one dip in knowledge, likely due to the question asked rather that the medium used, adults seemed relatively unaffected by the use of an on-screen presentation, neither benefiting nor detracting from their learning with increased exposure. However, adults made significant knowledge improvements for all questions which included an on-screen element in their presentation.

Discussion:

Our results show that educational zoo theatre performances effectively deliver information about animal facts and the conservation work of zoos to visitors. Although the theatre performance we tested was designed primarily for a young audience, the accompanying adults were also able to gain new animal knowledge. We showed that exposure time and performance medium both have an influence on learning impacts and have identified which mediums benefit adults and children most. If learning can be achieved in such an entertainment-driven setting, it may be that conventional zoos can achieve a similar, or greater, level of learning.

Learning in children

Our finding that children give more correct answers after watching educational theatre aligns with similar studies in museums (Baum & Hughes, 2001; Jackson & Rees Leahy, 2005) and reinforces the conclusions of previous zoo research on this topic (Penn, 2009).

Existing knowledge about meerkats (pre-performance) was much higher than for other question areas (Figure 5.2) which could explain why the magnitude of change was minimal. Furthermore, Wagoner and Jensen's (2010) study also found that children age 9-11 had a good level of knowledge about meerkats before visiting the zoo. Given that the theatre performance only provided basic knowledge about meerkat behaviour, such as 'standing on two feet', 'looking out for danger' and about where they lived, there may have been limited scope for delivering new information capable of increasing audience awareness about the species

Adult learning

We found that accompanying adults increased their knowledge about animals and the role of zoos while viewing theatre aimed at their children. This suggests that theatre can convey information to the whole family.

Zoo visits are inherently social and the 'family experience' they provide is valued by visitors (Fraser, 2009). Learning develops through social interactions (Vygotsky, 1978), rooted in families' life histories and cultural backgrounds (Dawson & Jensen, 2011). Adults have a significant role in influencing their children. Family discussions can help form understanding about the environment (Patrick & Tunnicliffe, 2013). Theatre may trigger these discussions by creating the space to consider concepts from different viewpoints (Evans, 2013). This is especially important in a combined zoo and theme park as visitors may not immediately consider their impact on nature during a visit. Providing opportunities to discuss topics such as climate change can increase confidence in tackling complex issues (Geiger et al., 2017).

Media use and its impact

Zoo learning experiences should move visitors from their existing knowledge to new understanding (Jensen, 2014a; Vygotsky, 1978). Pitching theatre content at the right level is crucial. If content is too simplistic then little learning will occur (Dove & Byrne, 2014; Penn, 2009). The information conveyed by this theatre performance was fact-based. This has limited value for extending visitor understanding beyond information recall. We suggest that the theatre could have gone further to convey more complex messages, for example, pertaining to issues such as environmental actions or prompting discussions on climate change. This is particularly important for zoos to consider as most people are unaware of how their actions connect to wider, global problems (Okur-Berberoglu et al., 2014).

Our finding that the time spent presenting a particular message correlated positively with learning supports well-established education theory (Penn, 2009). When zoo visitors are repeatedly presented with concepts across a range of presentation styles, they are more likely to remember them (Weiler & Smith, 2009). Despite finding aggregate improvements it is possible that some individuals did not gain knowledge despite the range of learning opportunities. Our findings suggest that whilst repetition benefits children's learning, adults have a threshold. If information is repeated too often adults are likely to disengage or become fatigued.

Spoken information had significant value in conveying information to both adults and children. Whilst other elements of theatre add interest to a performance and potentially make it more memorable, the value of spoken information should not be underestimated. This is supported by Calvert (2001) who argues that the spoken word is important for overall comprehension but that songs help with verbatim recall of facts.

Short bursts of song were found to be effective at conveying information. Songs are known to help in information recall and effects are strongest when familiar tunes are used (Rainey & Larsen, 2002). Hyman et al. (2013) found that songs which people know and liked were most likely to become stuck in people's heads. Pop songs are thought to have more staying power than speech alone (Murphey, 1990). As current pop songs with altered lyrics were used in the theatre performance it is likely that this familiarity aided learning.

Active participation has also been found to aid recall (Jackson & Rees Leahy, 2005). The theatre performance used sing-along on-screen lyrics and this may have reinforced messages. As memories and songs are intrinsically linked (Hyman et al., 2013) it is possible that hearing songs again may trigger memories of the theatre performance and its content, however, this was not tested.

The use of on-screen information via the digital backdrop was found to be beneficial for children and did not harm adults learning. The use of a pre-recorded script and visual display meant that information was completely aligned and reinforced the audio message presented. This was important as misalignment can cause 'visual superiority' where what is being observed takes all focus (Calvert, 2001). The use of on-screen wild animal footage provided connections between the stylised anthropomorphic character on stage and their wild counterpart. As children develop taxonomic understanding by combining knowledge of habitat, behaviour and appearance (Tunnicliffe & Reiss, 1999), a theatre performance which presents all aspects using real and exaggerated examples is likely to reinforce awareness of species.

The theatre production used characterisation to raise interest in particular species. A cartoon shrimp reinforced notions of flamingo diet and, combined with the use of song and on-screen text, may explain the significant increase in children's awareness of this information post-performance compared to pre-performance. Life size puppets of a flamingo and a lemur with anthropomorphic characterisation may have additionally contributed to recall of information about these species. Although we acknowledge that it is difficult to isolate the effect of a single theatrical element on learning.

Marketing campaigns have successfully demonstrated that anthropomorphic characters can make products more memorable and develop strong audience emotions (Balmford et al., 2002; Fournier, 1998; Patterson et al., 2013). When characters have a backstory this support is strengthened (Patterson et al., 2013). Using animal characters with human characteristics may help visitors understand environmental issues and this potentially encourages interest in conservation. According to Proffit (2013) and Hawkey (2013) audiences can find puppets easier to relate to than actors as puppets can present sensitive issues in a non-threatening way. Anthropomorphic puppets have the advantage that they convey the animal's perspective using techniques which appeal to the audience, such as songs and speech. This allows the zoo to fulfil both entertainment and educational roles without personifying the live animals themselves (Carr & Cohen, 2011).

Theatre can enable complete emersion of a visitor into a new environment which they could not otherwise access (Jackson & Rees Leahy, 2005) and can convey complex topics such as climate change (Wasserman & Friedman-Young, 2013). Whilst the theatre performance tested successfully conveyed its objectives, we note that it primarily encouraged information recall about animal facts and the zoo's conservation work. Raising awareness of the zoo's role may be beneficial for public relations, however, it has restricted value in meeting the overall zoo mission or the Aichi biodiversity targets. We suggest that zoos prioritise conveying information which raises biodiversity awareness and conservation actions and our findings indicate that theatre could be an effective tool to use.

Conclusions:

Zoo-based educational theatre successfully engages family audiences with animal facts and conservation-related information. The theatre we tested used anthropomorphic puppets to convey information. This meant that the performance could fulfil entertainment and education objectives without using live animals.

Whilst theatrical elements may add interest to a performance, spoken theatre was found to be very effective at conveying information to adults and children. The use of up-beat, popular songs with alternative, conservation-focused lyrics, were also highly successful at engaging audiences and delivering information. Short bursts of songs are likely to be most effective at aiding children's recall without losing adults' interest. Using a digital backdrop allowed information to be reinforced through on-screen text and images and this was particularly effective at aiding children's understanding.

Most importantly, zoos should consider what information they aim to impart to visitors. The theatre performance we tested successfully conveyed basic information about animals and the conservation work of the zoo. However, this factual knowledge is of limited use. Zoos should use theatre to engage family audiences with environmental issues and encourage them to develop personalised solutions. As childhood experiences can shape adult views, family-orientated theatre may help inspire future conservation action.

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Appendix C

C.1. Mia and Mylo theatre performance script used at Flamingo Land Resort Ltd. in the summer season 2015

BY ROSS PETTY
CAST:
LALAINA: A mischievous Madagascan primate who loves fruit.
FRANCESCA: A Caribbean flamingo socialite who has over 1,000 followers on ‘Pecker’.
MIA & MILO: Brother and sister meerkats who love to make new friends and teach them all about the wildlife at Flamingo Land.

MIA AND MILO ENTER AS THEIR SONG STARTS
TO THE TUNE OF ‘RATHER BE’ BY CLEAN BANDIT
Welcome to a land of comfort
You have travelled land and sea
Now that you're here at Flamingo Land
There's no place you'd rather be
I'm Mia and my name's Mylo
And it's really nice to see
All these smiling faces
New friends for you and me

With every step we take
And every song we make
Please listen carefully
We're Mia and Mylo
And we are here to show
Some of the things you'll see
If you give us a chance
We can teach you
Everything that we know about Rhino's
Meerkats, Flamingos and Lemurs
When you are with us
There's no place you'd rather be
No, no, no, no, no, no place you'd rather be
When you are with us there's no place you'd rather be.
SONG FINISHES

MIA
Hiya boys and girls, I'm Mia the meerkat
MYLO
And I'm Mylo, her handsome and talented brother
MIA
And we're here to make some new friends and learn all about some of our most interesting animals here at Flamingo Land and about how the zoo helps look after animals in the wild
MYLO
Boys and girls, would you like to make some new friends?

MIA
Great, well I've heard that we've got a bit of a celebrity with us today
MYLO
Oh really? Who is it?
MIA
Well Mylo, let's see if she's here. Boys and girls, will you help us bring out our new friend? *(KIDS CHEER)* Everybody join in with us. WE WANT FRANCESCA, WE WANT FRANCESCA

FRANCESCA FLAMINGO ENTERS

FRANCESCA
Hello everybody, I am Francesca, The most fabulous female flamingo in all the land. It's so nice to see so many of my fabulous flamingo fans here today. Hello boys and girls *(WAVES TO KIDS)*
MIA
It's great to have you here Francesca and may I just say how fabulous you look today
FRANCESCA
Of course you can, I love a compliment. Actually guys I've brought a friend of mine along with me. Would you like to meet her?
MYLO
Oh yes please, we love to make new friends
FRANCESCA
What about you boys and girls? Would you like to meet my friend? *(KIDS REACT)* Well in that case, please welcome my newest friend Lalaina the lemur, come on out Lalaina

ENTER LALAINA LEMUR

LALAINA
Hey everybody, I'm Lalaina, Lalaina the lemur
MIA & MYLO
Hello Lalaina
FRANCESCA
Isn't she fabulous? Not as fabulous as me of course, but still pretty great *(PREENS HER FEATHERS).* Did you know boys and girls that being a flamingo means you have so many friends
MIA
Really? How does that work?
FRANCESCA
Well in case you didn't know, flamingo's love to hang out in large groups. That probably explains why I've got over a 1,000 followers on ‘Pecker’.
MYLO
Woah, that's a lot of flamingo friends!!! But why do you always stand on one leg???
FRANCESCA
Good question Mylo, Well I like to stand on one leg and tuck my other foot up into my feathers, because it helps me keep warm when I'm stood in the cold water.
MIA
Seems like a pretty good idea to me Francesca. You're so interesting and beautiful, but I wondered what do flamingos eat?

FRANCESCA SONG:
TO THE TUNE OF 'ALL ABOUT THAT BASS' BY MEGHAN TRAINOR
Because you know I'm all about the shrimp bout' the shrimp, no salmon
I'm all about the shrimp 'bout the shrimp, no salmon
I'm all about the shrimp 'bout the shrimp, no salmon
I'm all about the shrimp 'bout the shrimp
PAUSE IN THE MUSIC

MYLO
Quick Mia, I have an idea! (*MIA AND MYLO LEAVE THE STAGE*)

SONG RESUMES
Yeah it's pretty clear, I'm on one leg not two
but I can shake my feathers, like I'm supposed to do
'cos I got that boom boom that all the birds chase
and I'm covered in pink in all the right places

Here at Flamingo Land, I'm a celebrity
but in reality, I'm from the Caribbean
I love to sing and dance when the beat drops
'cos every inch of me is perfect from the bottom to the top

So I'll stand on one leg as your arms sway from side to side
Did you know it took 3 years for my feathers to get so bright?
You see they started out grey but because I eat so much shrimp
It's made me beautiful, elegant and fabulously pink

That's why I'm all about the shrimp, bout the shrimp no salmon
I'm all about the shrimp 'bout the shrimp no salmon
I'm all about the shrimp 'bout the shrimp no salmon
I'm all about the shrimp 'bout the shrimp
SONG FINISHES (APPLAUSE)
MIA AND MILO RETURN CARRYING A BUCKET

MIA
WOW!!! That was incredible, I never knew flamingos are pink because of the shrimp that they eat! I feel like I know you a lot better now Francesca.
MYLO
Me too, and look at the treat we have got for you, lots of shrimp! And I bet the boys and girls would enjoy a shrimp lunch too, wouldn't you boys and girls? *(PAUSE)* Do you not like shrimp? *(PAUSE)* No?
FRANCESCA
Great! More for me! (*FRANCESCA TAKES THE BUCKET OFFSTAGE*)
MYLO
Well I'd love to learn a bit more about our new friend Lalaina too. *(TO LALAINA)* That's a very exotic name. Where do you come from?
LALAINA
Well Mylo I'm glad you asked that. I come from a small island off the coast of Africa called Madagascar
MYLO

Oooh sounds very exciting
LALAINA
It is exciting Mylo, I normally live high up in the trees of the forests and I just love to jump and climb from tree to tree
MYLO
What, you mean just like a monkey?
LALAINA
That's right, in fact I'm even a part of the primate family
MYLO
Wow, well forget primate cos now you're my mate!!! *(HIGH-FIVES LALAINA)*
MIA
Can you tell us more about you Lalaina? You're so fascinating!!!
LALAINA
Aww thanks Mia, you're sweet, just like the fruit I love to eat

LALAINA SONG:
TO THE TUNE OF AVICII, 'WAKE ME UP'
Feeling my way through the forest
Looking for a tasty treat
I don't know where this journey will end
But I'm craving something sweet

I swing myself through the branches
I stay high up in the trees
I hope I find myself some fruit, flowers or sap
Or even tree bark or leaves

So just look up as I fly over
Look behind over your shoulder
All this time I will forage for my supplies
Because I love to jump and climb
So just look up as I fly over
Look behind over your shoulder
All this time I will forage for my supplies
Because I love to jump and climb
END OF SONG
(MIA, MYLO & FRANCESCA CLAP)

MYLO
Wow!!! That was great Lalaina, I bet you have a great time up in the trees
LALAINA
Well yes that's true Mylo but because of hunters and loggers the forest can be a dangerous place for me, I'm considered to be one of the most endangered mammals on the planet.
MIA
Oh no, that's awful, my brother and I come from Africa too, but a different part called the Kalahari Desert. *(POINT TO PART OF AFRICA)* We live underground in tunnels and if we leave we always have to look out, standing on two legs, in case of any danger
MYLO

I love to be the lookout; but we live in large groups so we all take turns. Did you know that we eat fruit too? But we also love insects, small rodents and lizards *(RUBS STOMACH)* yummy!!!
LALAINA
Ew, that's gross Mylo! Ha-ha, but that's what makes Flamingo Land so amazing because not only have they given so many different animals like me, you and Francesca a safe home, they are also running and funding the Udzungwa Forest project…*(CHARACTERS LOOK CONFUSED)* or UFP for short
MYLO
Phew, thank goodness, what a tongue twister
MIA
So what does the UFP do then Lalaina?
LALAINA
Well they do some pretty awesome work in that part of Africa *(POINTS TO LOCATION)* and thanks to Flamingo Land, there are lots of people working together to protect the forests for animals like me and to provide education for little people just like all of you *(TO KIDS)*
MYLO
Gosh Lalaina that sounds brilliant!!
FRANCESA
It sure does and did you also know that there are a whole team of scientists at CIRCLE and Flamingo Land who are working hard to find the best way to breed more flamingos!!! Just imagine, more fabulous flamingos just like me
MIA
Ha-ha, there's only one Francesca though!
MYLO
I've heard some really exciting news today too guys
MIA
Well come on Mylo, spit it out
MYLO
Well there's a brand new exhibition here at Flamingo Land called Selous, named after the place in Africa that the scientists are doing all that research, and guess what we have here now?
MIA
Yes?!?...
LALAINA
Oh come on tell us Mylo
FRANCESCA
Yeah come on don't keep us in suspense
MYLO
Well here at Flamingo Land we now have black and white rhinos all the way from Africa
MIA
No way? That's awesome, rhinos are so cool
LALAINA
Yeah they're amazing, but aren't they both grey? What's the difference Mylo?
MYLO
Well spotted Lalaina, they are both grey in colour but the white rhino is a lot bigger and has a much wider mouth for eating grass and the black rhino has a more pointed narrow mouth and mostly likes to eat leaves from shrubs
LALAINA

Gosh I wouldn't wanna get too close to a rhino's mouth, they're huge!

MYLO
Yes they are, but did you know that they only use their lips to chew with because they don't have any front teeth!!!
FRANCESCSA
I really like finding out all of these cool facts about rhinos!
MYLO
Well, if you want to know more, and this goes for you boys and girls too. Then go and check out our Selous exhibit, new for 2015!
SONG:
TO THE TUNE OF 'SHAKE IT OFF' BY TAYLOR SWIFT
We are feeling great,
and we cannot wait
to see you all again mm hmm
to see you all again mm hmm
So thanks to our new mates
We think you're pretty great
So listen to us say, all of the things we've learned today
Lalaina's jumping, eating fruit and climbing foraging for food, day or night something sweet's gonna taste alright

Cos' Mia's gonna play, play, play, play, play
runnin' through the tunnels all day, day, day, day
Mylo's gonna stand up straight, straight, straight, straight, straight
looking out, looking out!
Francesca's gonna stand, stand, stand, stand, stand
up on one leg at Flamingo Land.
Give her a hand cos it's no limp
She's eating shrimp, eating shrimp!
REPEAT CHORUS
SONG ENDS
MIA
That was wicked guys, now come on let's all go and see the Selous exhibit together!
MYLO
Sounds like a great idea sis, but that means we have to say goodbye to the boys and girls
MIA
Oh, I'm afraid it does, but don't worry they'll all come back and see us again soon, won't you boys and girls?
MYLO
Ah that's great news, we love seeing all your friendly faces
MIA
We also want to say a huge thanks to all the Mum's and Dad's too for bringing all of you guys to see us today, so thank you!
FRANCESCA
Aww can we all sing one more time together before we go?
LALAINA
Yeah can we? Boys and girls shall we all sing together one last time?
MYLO

What a great idea, well don't forget to come and see us all again soon boys and girls. And remember, by visiting Flamingo Land you are helping us to continue working to protect wild animals and the places that they live.
ALL: SONG
TO THE TUNE OF 'UPTOWN FUNK' BY MARK RONSON
We wanna say
Thank you
For listening
To what we say
This one for the boys 'n' girls
Who love to learn
About all these creatures
Lemurs, Rhinos
Meerkats and Flamingos!
Listen up and we'll teach you all
Boys and Girls sing with me
We're so glad (hot damn)
That you've chosen Flamingo Land
It's so cool (hot damn)
When we teach you things you won't learn at school
You know what (hot damn)
Say the name you know who I am
I'm too hot (hot damn)
Flamingo Land we love it (break it down)
Help with conservation (woo)
All across the zoo (woo)
The science team at CIRCLE (woo)
'Cos boys and girls you're helping too
Every time you visit the zoo
We can teach you something new
Flamingo Land we in the spot
Don't believe me just watch (come on)
Don't believe me just watch
Don't believe me just watch
Don't believe me just watch
Don't believe me just watch
Before we leave
Let me tell y'all a lil' something
Uptown Funk you up, Uptown Funk you up
Uptown Funk you up, Uptown Funk you up, uh
I said Uptown Funk you up, Uptown Funk you up
Uptown Funk you up, Uptown Funk you up
SONG ENDS
MIA
Goodbye everyone!
FRANCESCA & LALAINA
BYE!!!
SONG: REPRISE OF OPENER, CLEAN BANDIT 'RATHER BE', ALL CAST ON STAGE AND WAVE GOODBYE AT THE END.

C.2. Blank example of questionnaire used to collect pre- and post-performance responses from children viewing the Mia and Mylo theatre performance at Flamingo Land Resort Ltd.

Mia and Mylo Children's Quiz

Instructions:

Read all the questions in blue to your child exactly as they are written. Questions with an * are for adults to complete

Record whether your child understood the questions and if any help was given by circling the YES/NO boxes on each question.

Please do not prompt answers.

Once finished, hand this form to our researchers to receive a goodie bag for your child.

Please Note: by completing this questionnaire you are agreeing for your child's data to be used in PhD research and associated publishable materials.

Your conversations during this questionnaire may be recorded.

---

*Child's gender: Male / Female

*Child's Age: ………… years

*Has your child seen the Mia and Mylo show before?

Yes/ No (if yes, *approximately what date?): ………/…………/…………..

Your Child's Responses

Where do meerkats live in the wild?

*TO BE COMPLETED BY THE ADULT
***Did your child understand the question/task?** YES/ NO
***Did you help your child to answer?** YES/NO

Why do meerkats stand up on two feet?

*TO BE COMPLETED BY THE ADULT
***Did your child understand the question/task?** YES/ NO
***Did you help your child to answer?** YES/NO

What colour are baby flamingos?*(please circle one colour)*

*TO BE COMPLETED BY THE ADULT
***Did your child understand the question/task?** YES/ NO
***Did you help your child to answer?** YES/NO

What do flamingos eat? (Tick all that apply)

 Grass	 Meat	 Flowers	 Fish
 Insects	 Shrimp	 Leaves	 Eggs

*TO BE COMPLETED BY THE ADULT
***Did your child understand the question/task?** YES/ NO
***Did you help your child to answer?** YES/NO

What <u>words</u> do you think of when you think about

<u>Flamingo Land</u>? (List all words you can think of)

*TO BE COMPLETED BY THE ADULT
***Did your child understand the question/task?** YES/ NO

***Did you help your child to answer?** YES/NO

<u>Where</u> does <u>Flamingo Land</u> work outside of the

United Kingdom?

………………………………………………………………

*TO BE COMPLETED BY THE ADULT
***Did your child understand the question/task?** YES/ NO

***Did you help your child to answer?** YES/NO

6a. <u>What</u> does <u>Flamingo Land</u> do there?

………………………………………………………………

………………………………………………………………

*TO BE COMPLETED BY THE ADULT

***6. How many questions did you help your child answer?**

***7. Is this your child's first visit to Flamingo Land?** Yes/ No

7a. Approximate date of last visit / /

ABOUT YOU:

***8. What is your nationality?**..

***9. What is your highest completed level of education?** Please tick

☐ No formal qualifications (still in education)
☐ No formal qualifications (no longer in education)
☐ GCSE, Foundation Diploma or equivalent
☐ A level, Advanced Diploma or equivalent
☐ Degree (e.g. BA)
☐ Postgraduate degree or equivalent (e.g. MA or MSc)
☐ Other; please specify:……………………………………….

***10. What is your approximate annual gross disposable household income?** Please tick

☐ Less than £7,000
☐ £7,001 to £14,000
☐ £14,001 to £21,000
☐ £21,001 to £28,000
☐ £28,001 to £35,000
☐ £35,001 to £42,000
☐ £42,001 or more

Thank you for helping us, Please hand your response to the researcher to receive your goodie bag!

C.3. Blank example of questionnaire used to collect pre- and post-performance responses from adults viewing the Mia and Mylo theatre performance at Flamingo Land Resort Ltd.

1. What is a **lemur**?

………………………………………………

2. What **threats** do **lemurs** face in the wild?

………………………………………………

3a. **Where** does **Flamingo Land** work outside of the United Kingdom?

…………………………………………

3b. **What** is **Flamingo Land** doing there?

…………………………………………

…………………………………………

4. What **body features** and **behaviours** help **flamingos** to survive in the wild?

4a. Features:

…………………………………………………………………………………………………

…………………………………………………………………………………………………

4b. Behaviours:

…………………………………………………………………………………………………

…………………………………………………………………………………………………

5. What was your **main reason** for visiting Flamingo Land today?

…………………………………………………………

6. What, if anything, could **you do** personally to help conservation?

……………………………………………………………………………………………………

7. What do you think is the **role of zoos**?

……………………………………………………………………………………………………

……………………………………………………………………………………………………

8. What **words do you think of** when you think about **Flamingo Land**? (List all the words you can think of)

………………… ……………… ……………

………………… ……………… ……………

………………… ……………… …………….

………………… ……………… …………….

9. **Date of Birth**: / /

10. **Gender:**

To enable us to contact you exclusively for follow up research, please provide a contact email.

11. **Email:** ………………………………

12. **Postcode**:………………………….

13a. **Have you visited Flamingo Land before?**

Yes / No

13b. Approximate date: /   /

14. **Prior to today have you seen the Mia and Mylo show before?** (please circle)

Yes at Flamingo Land / Yes at another zoo / No

15. **What is your highest completed level of education?** (Please tick)

☐ No formal qualifications (no longer in education)
☐ GCSE, Foundation Diploma or equivalent
☐ A level, Advanced Diploma or equivalent
☐ Degree (e.g. BA)
☐ Postgraduate degree or equivalent (e.g. MA or MSc)
☐ Other (please specify):………………………………..

16. **What is your approximate annual gross disposable household income?**

☐ Less than £7,000
☐ £7,001 to £14,000
☐ £14,001 to £21,000
☐ £21,001 to £28,000
☐ £28,001 to £35,000
☐ £35,001 to £42,000
☐ £42,001 or more

Thank you for your help!

C.4. Table used to code children's and adult's responses to questionnaires on the Mia and Mylo theatre performance at Flamingo Land Resort Ltd. as correct or incorrect.

Question asked	Code as correct	Code as incorrect
Where do meerkats live in the wild?	Accept in Africa, in tunnels, underground, in desserts, in sand	Reject forests, other answers not listed as correct
Why do meerkats stand up on two feet?	Accept any answer which contains the words; 'look', 'see', 'watch' or conveys that meaning, accept any answer which conveys 'looking out for predators/ danger'	Reject reasons not to do with 'looking' and /or 'predators'
What colour are baby flamingos?	Accept grey or grey selected with one additional colour	Do not accept any other colour if selected on its own, reject grey when selected with two or more additional colours as likely to be randomly chosen
What do flamingos eat?	Accept 'Shrimp' (either as only response or within three responses selected)	Reject shrimp if it is amongst more than 4 responses selected as likely to be picking at random
Where does Flamingo Land work outside the UK?	Accept 'Africa', 'UFP', 'Tanzania', 'Selous', any attempt at spelling 'Udzungwa Forest Project'	Reject 'forest' as too general, reject 'UK' or 'England' as not what question asks. Reject any other country not listed in accept list.
What does it do there?	Accept 'education', 'saving animals', 'planting forests/ trees', 'saving plants', 'conservation', 'breeding / breeding flamingos', 'helping habitats', 'research'	Reject answers relating to theme parks
What is a lemur?	Accept 'primate', 'long stripy tail', 'like a monkey', 'Madagascan animal', 'ringtail', 'King Julian of Madagascar' (cultural reference showing understanding)	Reject 'an animal', 'a mammal', 'eats fruit/lives in trees'whilst these demonstrate some understanding they are not specific enough
What threats do lemur face in the wild?	Accept: 'hunters', 'humans', 'loggers', 'deforestation',	Reject 'other animals' (non-specific), 'predators'

	'habitat loss', 'extinction/ endangered'	
What features or adaptations help flamingos survive in the wild?	Accept: 'eat shrimp', 'change colour as a result of food they eat', 'live in large groups for protection', 'have brightly coloured feathers', 'stand on one leg, to keep feet warm' Award marks as follows: 0 = no features/behaviours 1 = one behaviour/feature mentioned 2 = two or more features and behaviours listed 3 = one behaviour/feature explained i.e. 'stand on one leg to keep warm in cold water' 4 = two or more behaviours/featured listed with explanation of how they help survival	Reject generic bird features e.g. 'legs', 'beaks' without any description of specifics or of how they help survival.

Chapter 6: Can a theme park fulfil the aims of a modern zoo? A case study of Flamingo Land Resort, UK.

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Disclosure

At the time of data collection Andrew R. Marshall was employed by the organisation under study (Flamingo Land Resort Ltd.) and both he and the lead author were in receipt of grant funding from the same organisation at the time of submission.

Biographical note:

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Abstract:

The global zoo mission aims to convey conservation education and inspire pro-environmental behaviour. Zoos balance this aim with the need to generate revenue and attract visitors. Entertainment is dominant in combination attractions such as theme park zoos yet they also aim to fulfil the zoo mission. Establishing what learning is possible in these entertainment and commercial settings is crucial. We examine the impact of a theme park zoo visit on knowledge and attitudes. Pre- and post-visit surveys of theme park zoo visitors (n = 160) demonstrate significant increases in animal identification and some increase in habitat and animal endangerment awareness. Visitors recalled conservation information, mainly from signs. No significant change in visitor conservation attitudes was found as a result of a theme park zoo visit. Whilst theme park zoos partially fulfil the zoo mission in conveying facts, they may have limited impact on pro-environmental attitudes and actions. Educational methods and materials with more focus on personalised conservation actions could better encourage sustainable behaviour.

Keywords:

Theme park zoo, impact evaluation, visitor experience

Introduction:

Zoos and theme parks are both major tourist attractions and are visited by hundreds of millions of people annually (Gusset & Dick, 2011; Visit Britain & Visit England, 2015). Whilst theme parks remain predominantly entertainment driven, modern zoos have an additional emphasis on conservation education and behavioural change (Barongi et al., 2015; Patrick et al., 2007).

As human actions are now a major cause of species and habitat loss, raising public awareness of the issues and gaining support for solutions is vital (Miller et al., 2004; Moss et al., 2015). Through the World Association of Zoos and Aquariums (WAZA) the global zoo community has pledged its support for the United Nations Aichi biodiversity targets which aim to increase public understanding about biodiversity and address threats to slow its loss (Barongi et al., 2015; CBD, 2011).

Traditional zoos are increasingly demonstrating that they are fulfilling the global WAZA mission. International studies have demonstrated that a single zoo visit can increase visitor awareness about animal knowledge, biodiversity and conservation (Balmford et al., 2007; Falk et al., 2007; Khalil & Ardoin, 2011; Moss, Jensen, & Gusset, 2014; Moss et al., 2015, 2017b). Although few studies have examined the long-term impacts of a zoo visit, visitors' biodiversity knowledge is likely maintained at least two years after a visit (Jensen et al. 2017). Moreover, zoos have been shown to increase positive affiliations with animals which in-turn increases support for environmental campaigns (Clayton et al., 2017; Myers et al., 2004).

There are few studies from combination zoos such as theme park zoos. This is likely because many are privately owned and have therefore not been included in the large international studies led by WAZA organisations. In the interests of proving the educational success of zoos focus has been on traditional zoo sites and their impact. Without specific research, combination zoos face the challenge of upholding modern zoo standards using research which is less applicable to them.

The roles of theme park and zoo appear starkly contrasting and theme park zoos represent the entertainment extreme of the zoo spectrum. Entertainment is an inescapable factor of any zoo visit and is reinforced by zoos' own marketing (Carr & Cohen, 2011). In theme park zoos the entertainment driver is dominant as the zoo is combined with fast-paced rides and marketing is focused on high levels of consumption. Brand Theory and Actor Network Theory suggest that the way an institution is marketed shapes the way information is conveyed (Aaker, 1997; Fournier, 1998; Patrick, 2016). Theme park zoos create a particular atmosphere for visitors and it is important to understand how this impacts the information received.

This study aims to investigate impacts of a combination zoo on visitor's animal knowledge and conservation attitudes.

Methods:

Study site

The study was conducted at Flamingo Land Resort Ltd., North Yorkshire, UK, a 375 acre combined theme park and zoo with an average of 1.47 million visitors per annum (Visit Britain & Visit England, 2015). In addition to day visitors the site had an attached holiday village which formed an average of 20% of the daily visitors to the site during the period of the study. The zoo was a member of WAZA, ensuring formal commitment to the Aichi biodiversity targets (Barongi et al., 2015; CBD, 2011). The resort was marketed as 'wild animals, wilder rides' and as being a 'conservation zoo', demonstrating the joint focus of the site (Flamingo Land Ltd., 2016). At the time of the survey, Flamingo Land also employed a conservation director, hosted a conservation institute and funded its own tropical forest and UK biodiversity projects. Visitors paid a single fee to access both theme park and zoo and there was no barrier between the two areas. Not all visitors visited the zoo and there was a bias towards theme park only visitors during peak season (a zoo-only ticket was only available in winter season when the rides are closed).

Data collection

Research was conducted during peak season 2016 (1st May-31st October 2016). Visitors were given a short pre-visit questionnaire on arrival or at the time of booking and received a longer post-visit questionnaire at the end of their visit (Appendix D.1). Pre-visit questionnaires were administered on-site at the entrance to the holiday village, at the main site entrance and as an optional opt-in online survey at the point of booking. Post-visit questionnaires were administered via email with three reminder emails sent ten days apart. Mean completion time post-visit was 4.5 days. In asking visitors to complete a survey after their visit and not while still on-site we tested what can be remembered and assessed the impact of the visit as a whole.

Questionnaires collected basic demographic information alongside specific knowledge and attitude questions (Appendix D.1). These included: four animal knowledge questions (two animal identifications, one habitat question and one threat status question), one question about awareness of Flamingo Land's conservation work and three responses to attitude statements.

Animal 'knowledge' questions referred to species which were easily visible in the zoo and reflected different aspects of biodiversity and conservation. Each animal represented a different threat status according to the IUCN red list (IUCN, 2015). Information signs for each of the selected species followed a similar design and content. The animals chosen were the 'endangered' red panda (*Ailurus fulgens*), the 'extinct in the wild' scimitar-horned oryx (*Oryx dammah*), the 'least concern' red river hog (*Potamochoerus porcus*) and the 'critically endangered' Visayan warty pig (*Sus cebifrons*). The scimitar-horned oryx and red panda were part of species breeding programmes at the zoo. Red panda, red river hog and Visayan warty pig exhibits were all positioned centrally within the zoo area whilst the scimitar-horned oryx enclosure was at the edge of the zoo farthest from the main entrance. Knowledge questions for these species were multiple choice with three incorrect answers to each correct answer. Online surveys presented these choices in a random order to reduce selection bias.

Attitude statements asked respondent's their opinions on: the role of zoos, their self-efficacy towards conservation actions and their level of concern about species extinction. Attitude statements were measured using a seven-point Likert agreement scale. Statements included two positively phrased and one negatively phrased.

Knowledge and attitude questions were asked both before and after a visit to compare the impact of the theme park zoo.

Visit experience questions were asked in the post-visit surveys only and included questions on engagement with shows, signs and other experiences. The survey was additionally used for marketing purposes and as part of an international benchmarking study (Qualia Analytics, 2017).

Sample:

Pre-visit surveys were completed by 794 respondents (with 152 face-to-face refusals and 13 email contacts not given). There was high attrition with 160 respondents completing a post visit survey (20.2% of the original sample) (Table 6.1).

Table 6.1: Sample characteristics for pre-visit only sample (n = 794) and for the post-visit repeat survey sample (n = 160)

	Total pre-visit surveys n = 794	Pre-Post-visit n = 160
Mean age in years (95% CI)*	N/A	43 (41-46)
Gender (% of respondents)*	N/A	Female (66.8)
Nationality (% of respondents)*	N/A	UK National (91)
Mean annual household income (£) (95% CI)*	N/A	23,500 (20,953-26,062)
Highest educational qualification achieved (mode)*	N/A	GCSE
Number (%) staying in the on-site ‘Holiday Village’	57 (7.2)	24 (15)
Number (%) aware that the site has zoo animals	441 (55.5)	154 (96.3)
Number (%) who visited the zoo*	N/A	116 (72.5)
Mean number of hours reportedly spent in zoo (95% CI)*	N/A	2.1 (1.8-2.4)

*Not asked in pre-visit survey

Data Analysis:

Data were coded correct (1) or incorrect (0) for animal knowledge questions. The number of *'contributions that Flamingo Land makes to conservation'* correctly identified were calculated (with a maximum score of four). Attitude statements were coded as positive if they *'somewhat agreed'* to *'strongly agreed'* with the statements *'zoos play an important role in saving animal species from extinction'* and *'I feel personally concerned about animals going extinct'*. The self-efficacy statement *'there is nothing I can do personally to help protect animal species'* was coded as positive if respondents *'somewhat disagreed'* to *'strongly disagreed'* with the statement. Visitors who responded positively to the self-efficacy statement were deemed to have high confidence in undertaking conservation actions.

Visitors who stated that they had *'seen or heard conservation information during the visit'* were then asked the open-ended question *'What can you remember from this conservation information?'*. These responses were grouped by theme to identify key information received by visitors. Visitors were also asked *'How was this conservation information provided?'* and were required to select from a list of potential sources.

Visitors' responses to the question: *'What comes to mind when you think about Flamingo Land?'* were coded by theme and compared pre- and post-visit.

Visitor 'knowledge' was tested by the number of animal fact questions correctly answered and the number of Flamingo Land conservation activities identified. 'Attitude' was measured by the number of positive responses given to attitude statements. Group composition, who the respondent visited with, including the number of children and their ages, allowed the effect of additional independent variables to be examined. All responses were tested against potential predictor variables (Table 6.2). This allowed comparison of the effect of a theme park zoo visit against the other independent variables using Poisson and binomial Generalised Linear Models (GLM). Wilcoxon signed rank tests were used to calculate differences between responses to individual questions pre- and post-visit.

Statistical analysis was performed using R version 64 3.2.3 (CRAN, 2014). Data were log transformed to reduce skew for 5 variables: number of visits to Flamingo Land in the past 12 months, number of zoo visits in the past 12 months, number of children under 11 years old in the visiting group, number of educational shows and talks seen and, number of hours spent in the zoo. Model variables were checked for inter-correlation using the threshold Pearson’s correlation coefficient $r = <0.7$ and Variance Inflation Factors < 2 and inter-correlated variables were not modelled together (Zuur, Ieno, & Elphick, 2010).

An information theory approach was used to create a set of models which were tested on each response variable (Anderson & Burnham, 2002; Burnham et al., 2011; Quirke, O’Riordan, & Zuur, 2012; Thomas, 2017). This approach grouped variables based on whether they were personal characteristics or visit characteristics. Models with the lowest Akaike Information Criterion (AIC) and within two AIC of each other were considered equivalent (Burnham & Anderson 2011; Thomas, 2017).

Ethical approval for this study was granted by the University of York, Environment Department Ethics Committee.

Table 6.2: Models applied for 'knowledge' questions (number of correct responses to animal questions and contributions made by Flamingo Land to conservation) and attitude statements (positive sentiment towards statements on the role of zoos, concern for extinction and self-efficacy towards pro-environmental action)

Model	Predictor Variables	Response	Description
M1	Visit (post) + respondent income + respondent education + respondent age	Knowledge: Number of animal fact questions correct	Personal factors
M7	As above	Knowledge: Number of conservation activities undertaken by Flamingo Land correctly identified	
M13	As above	Attitude: positive attitude towards the role of zoos expressed	
M19	As above	Attitude: positive self-efficacy towards conservation expressed	
M25	As above	Attitude: concern about animal and plant extinction expressed	
M2	Visit (post) + respondent income + respondent education + number of children 11 years or younger	Knowledge: Number of animal fact questions correct	Personal factors
M8	As above	Knowledge: Number of conservation activities undertaken by Flamingo Land correctly identified	
M14	As above	Attitude: positive attitude towards the role of zoos expressed	
M20	As above	Attitude: positive self-efficacy towards conservation expressed	
M26	As above	Attitude: concern about animal and plant extinction expressed	
M3	Visit (post) + number of visits to Flamingo Land in past 12 months + number of visits to any zoo in the past 12 months + number of children 11 years or younger	Knowledge: Number of animal fact questions correct	Personal factors
M9	As above	Knowledge: Number of conservation activities undertaken by Flamingo Land correctly identified	
M15	As above	Attitude: positive attitude towards the role of zoos expressed	
M21	As above	Attitude: positive self-efficacy towards conservation expressed	
M27	As above	Attitude: concern about animal and plant extinction expressed	
M4	Number of hours spent in zoo + number of shows and talks seen	Knowledge: Number of animal fact questions correct	Visit experience

M10	As above	Knowledge: Number of conservation activities undertaken by Flamingo Land correctly identified	
M16	As above	Attitude: positive attitude towards the role of zoos expressed	
M22	As above	Attitude: positive self-efficacy towards conservation expressed	
M28	As above	Attitude: concern about animal and plant extinction expressed	
M5	Conservation information seen	Knowledge: Number of animal fact questions correct	Visit experience
M11	As above	Knowledge: Number of conservation activities undertaken by Flamingo Land correctly identified	
M17	As above	Attitude: positive attitude towards the role of zoos expressed	
M23	As above	Attitude: positive self-efficacy towards conservation expressed	
M29	As above	Attitude: concern about animal and plant extinction expressed	
M6	Number of hours in the zoo + live animal show was seen	Knowledge: Number of animal fact questions correct	Visit experience
M12	As above	Knowledge: Number of conservation activities undertaken by Flamingo Land correctly identified	
M18	As above	Attitude: positive attitude towards the role of zoos expressed	
M24	As above	Attitude: positive self-efficacy towards conservation expressed	
M30	As above	Attitude: concern about animal and plant extinction expressed	

Results

The majority of theme park zoo visitors (79.4%, n = 160) attended the zoo during their visit. Given annual visitor numbers to Flamingo Land, this equates to 1.17 million visits to the zoo per annum. The mean reported time spent in the zoo area was 2.1 hours.

Those who completed both pre- and post-visit surveys were found to be 40.8% more aware that the site had zoo animals and 35.7% more likely to visit the zoo during their visit compared to the total theme park zoo visitors. This means that the sample is potentially more similar to a traditional zoo audience than a theme park only audience. The pre-post-visit sample included a higher proportion of 'Holiday Village' visitors than the total sample, but this was comparable to the 20:80 ratio of 'Holiday Village' to 'day' visitors found on the site.

Knowledge

Overall visitor knowledge showed a 9.5% improvement on the number of animal knowledge questions answered correctly between the pre- and post-visit survey (effect size (es) = 0.32, p = 0.003, v = 2666, α_{FDR} 0.025). Significant improvements were made in visitors ability to identify the 'endangered' red panda (p = 0.002, v = 714) but not at identifying the 'extinct in the wild' scimitar-horned oryx (p = 0.095, v = 994) (Figure 6.1). Habitat awareness of the 'least concern' species the red river hog improved post-visit (p = 0.027, v = 804) but this was not significant. There was also no significant difference between visitors correctly identifying the Visayan warty pig as critically endangered before and after the visit (p = 0.575, v = 586).

Zoo visit was selected as a predictor of responses to animal questions and explained 4.43% of the deviance. Additional predictors included whether conservation information had been seen (6.59% deviance) (Table 6.3) (Appendix D.2-D.3).

There was no difference in visitor awareness of Flamingo Land's role in conservation post-visit compared to pre-visit (p = 0.259, v = 501.5) (Figure 6.1). The most important predictor for knowledge of Flamingo Land's conservation activities was seeing conservation information, predominantly through information signs, (22.64% deviance explained) (Table 6.3).

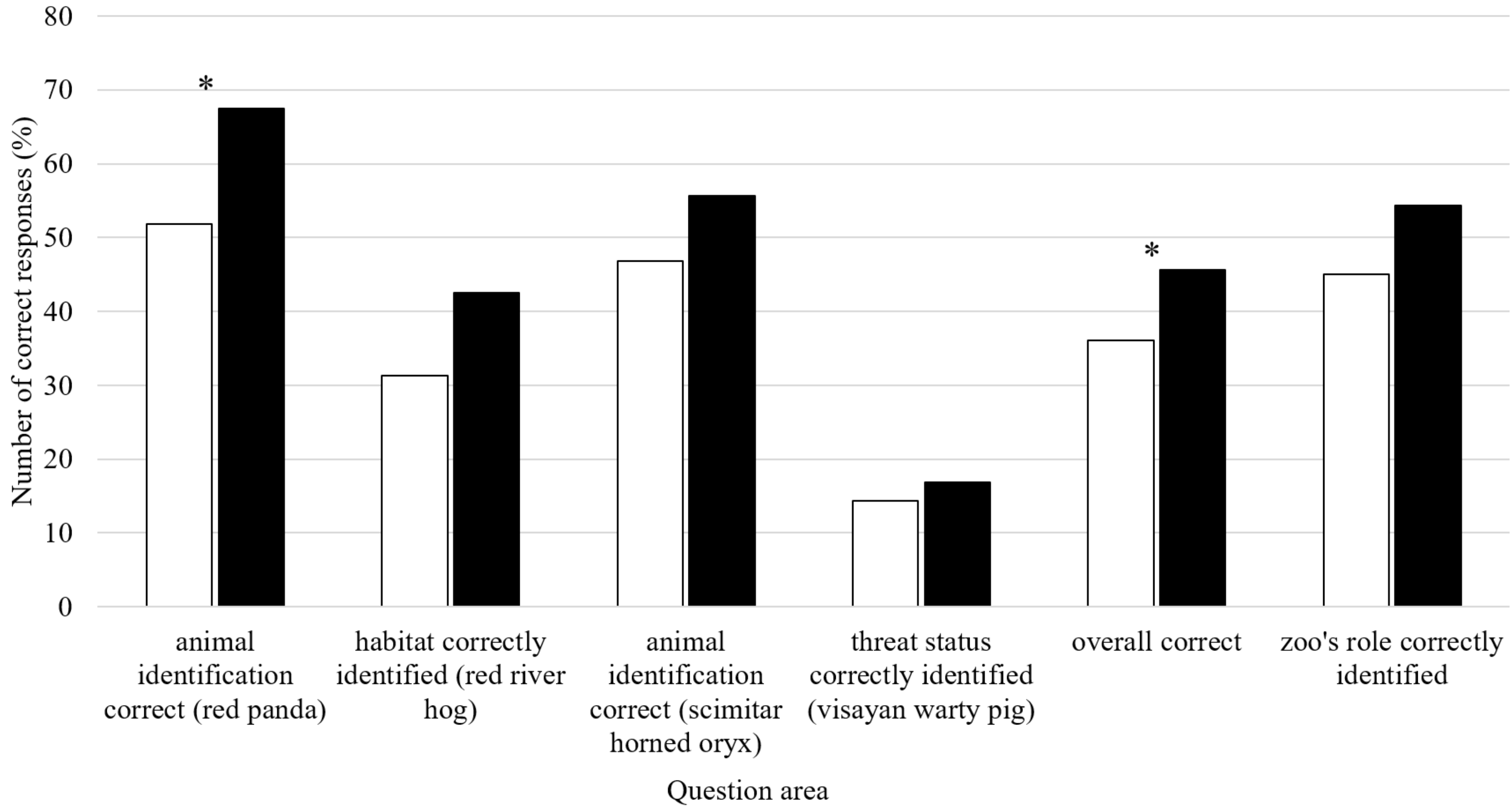

*Figure 6.1: Percentage of correct responses before (white bars) and after (black bars) a theme park zoo visit for each of the animal fact questions asked. * indicates where a significant difference between pre- and post-visit responses was found with a significance threshold of αFDR = 0.025. Overall correct response includes the four animal questions but not responses to the 'zoo's role correctly identified 'question.*

Table 6.3: Estimated parameters, p values in brackets and percentage deviance %D for each variable in the most optimal models for animal knowledge questions and number of contributions made by Flamingo Land to conservation. Other models had a difference in AIC of more than 2.

	Knowledge		FL role (contribution to conservation)		
	Personal Factors M2	Visit experience factors M5	Personal factors M9	Personal factors M8	Visit experience factors M11
Zoo visit (post)	0.367 (0.017) %D = 4.43	-	-0.223 (0.564), %D = 0.38	-0.061 (0.866) %D = 0.03	-
Respondent's income	<0.001 (0.100), %D = 3.41	-	-	<0.001 (0.795) %D = 3.98	-
Respondent's education	GCSE: 0.358 (0.428), A levels: -0.135 (0.745), Vocational: 0.072 (0.817), Bachelors: 0.152 (0.493), Postgraduate: 0.064 (0.742), %D = 1.68	-	-	GCSE : 9.038 (0.991), A levels: - 7.702 (0.991), Vocational : 4.977 (0.992), Bachelors: - 3.161 (0.990), Postgraduate: 1.115 (0.989), %D = 4.14	-
Number of children (under 11 years)	0.112 (0.771), %D = 5.36	-	-0.248 (0.798), %D = 1.94	- 0.894 (0.352) %D = 2.44	-

Conservation info seen	-	0.390 (0.028), %D = 6.59	-	-	2.089 (<0.001) %D = 22.64
Number of FL visit in last 12 months	-	-	-0.010 (0.990) %D = 3	-	-
Number of Zoo visits in the last 12 months	-	-	1.577 (0.036), %D = 4.94	-	-

Attitudes

Overall, visitors responded positively to the statements *'zoos play an important role in saving animal species from extinction'* and *'I feel personally concerned about animal species going extinct'* and disagreed that *'there is nothing I can do personally to help protect animal species'*, both before and after a theme park zoo visit (Figure 6.2). Post-visit the number of positive sentiments towards attitude statements reduced, but this reduction was not significant (ES = -0.18, V = 3001.5, p = 0.090).

For each of the attitude statements two models were selected by GLMs (Appendix D.3). Visiting the theme park zoo explained between 0.66 and 1.49% deviance across all three attitude statements (Table 6.4). The number of children under 11 years old visiting with the respondent had a significant and positive effect on feeling *'personally concerned about animal species going extinct'* (6.91% deviance explained) as did seeing conservation information during the visit (9.03% deviance explained).

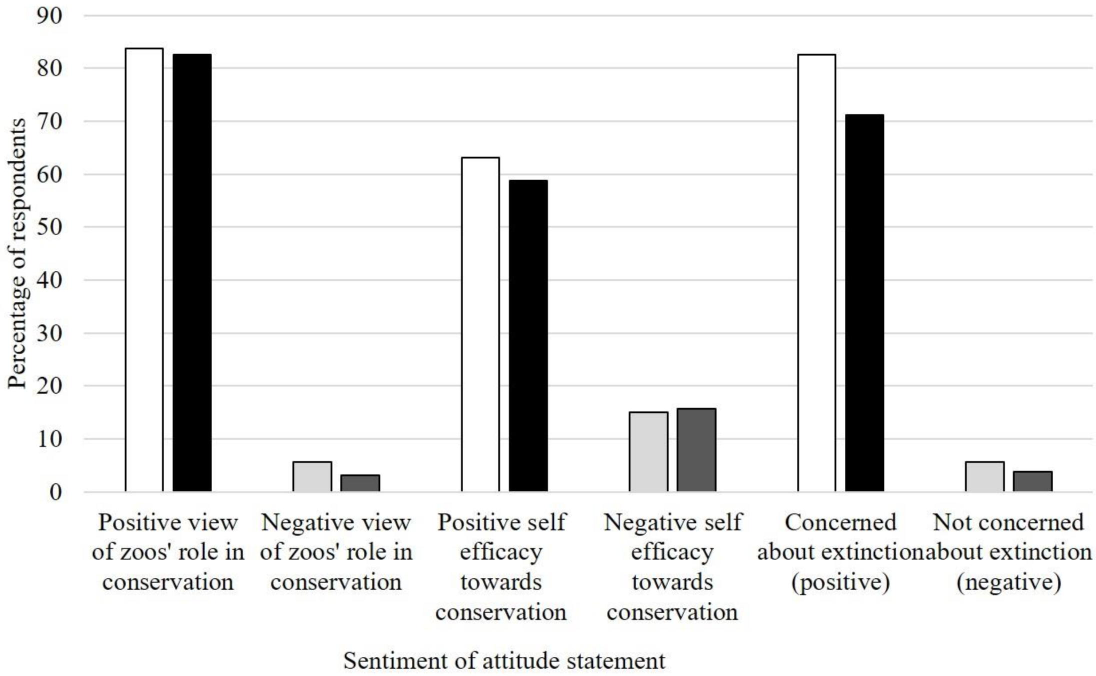

Figure 6.2: Responses to attitude statements before and after a theme park zoo visit: pre-visit positive sentiment (white bars), post-visit positive sentiment (black bars) against pre-visit negative sentiment (pale grey bars) and post-visit negative sentiment (dark grey bars). Note that neutral responses have been removed to make sentiments clearer.

Table 6.4: Estimated parameters, p values in brackets and percentage deviance %D for each variable in the most optimal models for positive sentiment towards attitude statements: Zoo role (positive response to statement 'zoos play an important role in saving animal species from extinction'), Action (measure of confidence/self-efficacy, respondents disagreed with statement 'there is nothing I can do personally to help protect animal species'), concern (agreed that 'I feel personally concerned about animals going extinct').

	Zoo role		Action		Concern	
	Personal factors M14	Visit experience factors M17	Personal factors M20	Visit experience factors M23	Personal factors M26	Visit experience factors M29
Visit (post)	-0.644 (0.206) %D = 1.45	-	-0.357 (0.393) %D = 0.66	-	-0.653 (0.182) %D = 1.49	-
Respondents income	<0.001 (0.898) %D = 5.34	-	<0.001 (0.156) %D = 6.57	-	<0.001 (0.080) %D = 5.5	-
Respondents education	GCSE: 0.109 (0.990) A levels: - 9.078 (0.991) Vocational: 4.895 (0.993) Bachelors: - 3.639 (0.989) Postgraduate: 0.769 (0.993) %D = 6.93	-	GCSE : 0.101 (0.991) A levels : - 7.863 (0.992) Vocational : 6.144 (0.991) Bachelors: - 3.138 (0.991) Postgraduate: 0.585 (0.995) %D = 3.82	-	GCSE: 9.784 (0.991) A levels : -8.914 (0.991) Vocational: 6.774 (0.990) Bachelors: -3.689 (0.989) Postgraduate 1.649 (0.986) %D = 5.49	-
Number of children (under 11 years)	-1.507 (0.249) %D = 2.97	-	2.367 (0.039) %D = 4.12	-	3.624 (0.018) %D = 9.03	-
Conservation info seen	-	0.987 (0.110) %D = 3.62	-	1.120 (0.037) %D = 4.98		1.364 (0.032) %D = 6.91

Sources of conservation information within the zoo were reportedly seen or heard by 32.5% of respondents (n = 52). The main source of conservation information was stated as being animal information signs and posters (Figure 6.3). Animal information signs were reportedly read by 41.3% of respondents (n = 160). Interactions with staff, live animal shows and keeper talks were reported as a source of conservation information by 11.9% of respondents (n = 52).

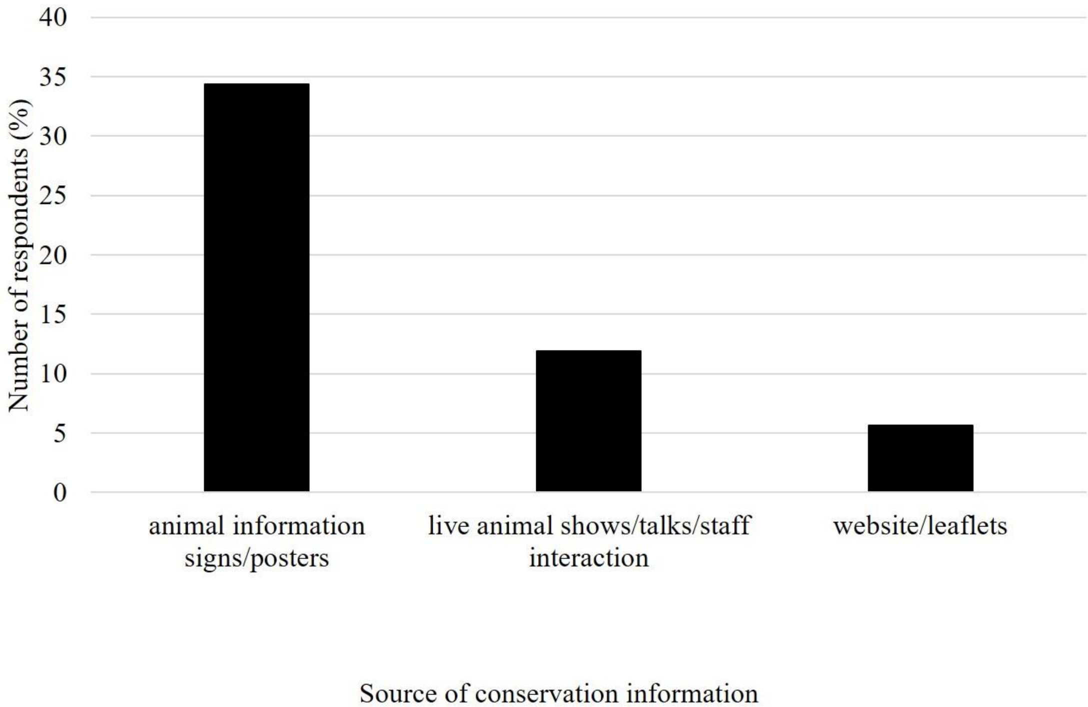

Figure 6.3: Reported sources of conservation information either seen or heard during a theme park zoo visit.

Of those who reported seeing or hearing conservation information, 61.5% (n = 32) could remember specific information (Table 6.5). More than half of recalled information (53.1% of n = 32) included themes of habitat or species loss. The zoos role, including breeding programmes and reintroductions, were mentioned in 37.5% (n = 32) statements and specific species were recalled in 34% (n = 32) of statements. Personal actions to help conservation were mentioned in only two statements out of 32 (6.3%).

The four main themes used to describe the theme park zoo both before and after a visit were ‘zoo/animals’, ‘rides/theme park’, ‘fun’ and ‘family’ (Figure 6.4). Whilst the theme of ‘rides/theme park’ increased (+2.5%) the theme of ‘zoo/animals’ decreased (-3.1%) post-visit compared to pre-visit. The themes of ‘educational/informative’ and ‘conservation’ were mentioned less frequently (7^{th} and 8^{th} most commonly reported theme), however, they both showed increases post-visit compared to pre-visit (+1.3% and +0.7% respectively)

Table 6.5: Conservation information recalled post- theme park zoo visit in response to the question 'What can you recall from this [conservation] information?' n = 32. Example statements given with respondent's gender, age and what conservation information they had reportedly seen or heard.

Habitat loss/extinction/species loss (53.1% of statements)	
'On the signs were clear indicators which told us the level that each animal was to extinction.'	Female 50, animal shows, talks and posters/ information signs
'Mainly loss of habitat.'	Male 37, posters/ information signs
'That one of the antelope type animals was extinct in the wild.'	Male, 48, posters/ information signs
Zoos role/breeding programmes (37.5% statements)	
'Something about the European breeding programme.'	Female 37, posters/information signs
'Conservation programs run in conjunction with University of York and Tanzania.'	Female 42, posters/information signs
'Lot of animals becoming extinct gradually and the ways in which they are being reintroduced.'	Female 60, animal shows, keeper talks, posters/ information signs
Specific animal information (34% statements)	
'The black rhinos are critically endangered and there is a breeding programs at Flamingo Land.'	Female (age unknown), posters/ information signs
'Tigers have dramatically reduced in numbers.'	Female, 44, shows, keeper talks & posters/information signs seen
'Oryx [scimitar-horned] was only in captivity not the wild.'	Female 46, keeper talks, posters/information signs
Public action (6.25% statements)	
'We need to care for the animals in our world.'	Male 65, posters/information signs, animal shows and talked to staff
'Support wild native birds.'	Female, 33: posters, shows, keeper talks, animal encounter & information signs seen

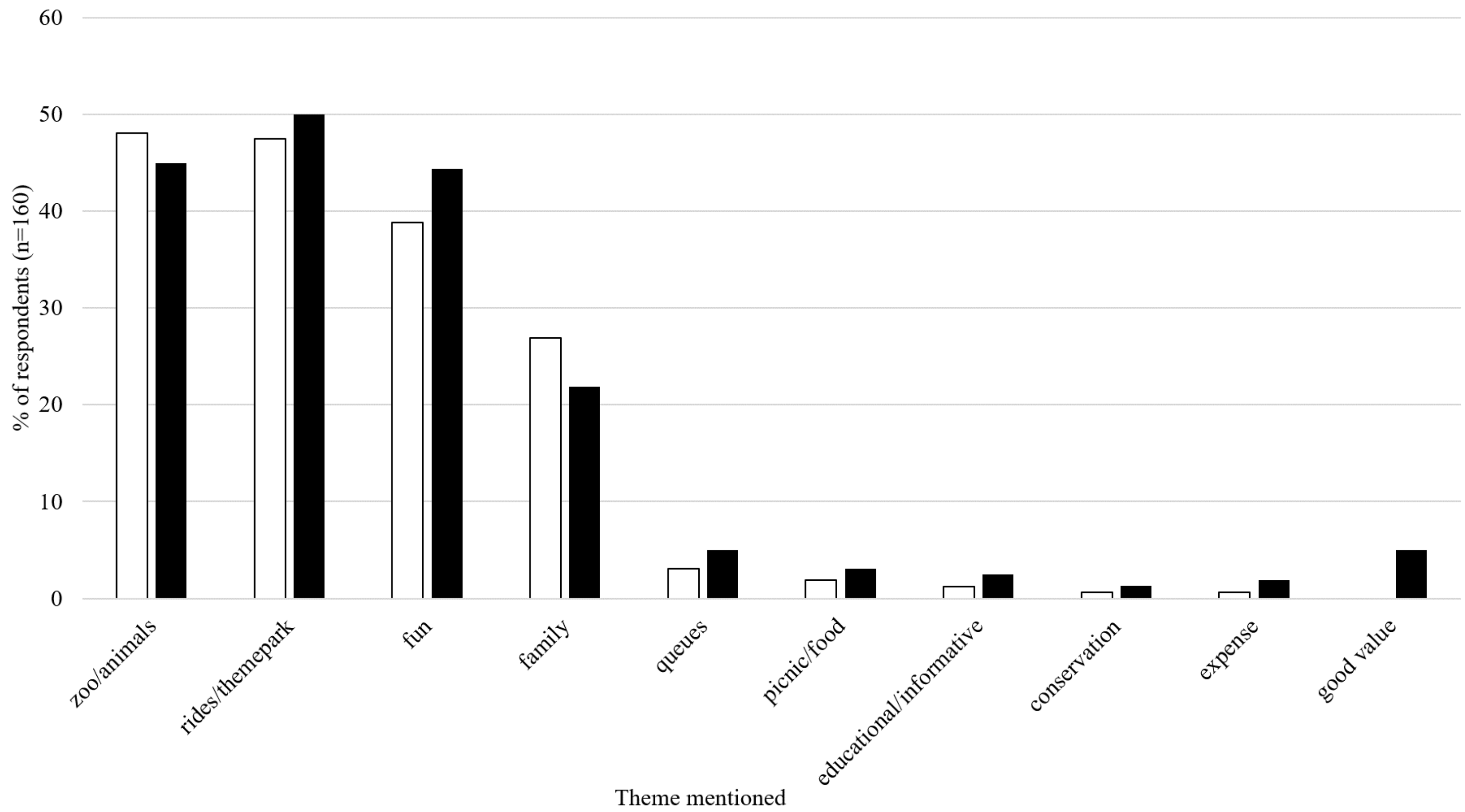

Figure 6.4: frequency of themes mentioned by respondents pre- and post-visit in response to the question 'what comes to mind when you think about Flamingo Land?'

Discussion

Our findings indicate that theme park zoos currently fulfil part of the zoo mission in conveying basic animal facts but are less successful at developing attitude changes.

A single theme park zoo visit led to significant increases in ability to identify some animal species and raised awareness of their habitats and endangerment, thereby increasing public awareness of the diversity of species (Barongi et al., 2015). However, increases were not seen across all species. Differences could be due to positioning of the exhibits within the site and the ease of viewing. Whilst animal welfare is paramount, it is important that visitors have easy access to the most endangered species in order to raise awareness as accessibility is a crucial determinant of visitor interest (Bitgood, 2006).

Understanding the role that zoos play in conservation is important for ensuring continued support. Research suggests that visitors value information about the zoo's conservation activities (Ballantyne & Packer, 2016). Theme park zoo visitors demonstrated relatively positive attitudes towards the role of zoos and concern about extinction before and after their visit. This suggests theme park zoo visitors share similar environmental attitudes to zoo-only visitors.

The impact of a theme park zoo visit on conservation attitude statements was limited in this study suggesting that they are less effective than zoo-only sites. Conservation learning can occur at multiple levels (Chapters 1 and 3). It is encouraging that theme park zoos are conveying basic animal information. Simply knowing about a species and it's threats, however, has limited effect on conservation actions (Clayton et al., 2017; Hines et al., 1986; Moss et al., 2017b). Theme park zoos must provide explicit information about public conservation actions and focus on raising environmental concern in visitors if they are to keep pace with other zoos.

Exposure to conservation information was the most important factor in predicting increases to visitor knowledge and positive sentiment to attitude statements. This supports international studies which suggest that those who saw or heard specific biodiversity information during a zoo visit scored higher on reported awareness of actions to protect it than those who did not (Moss et al., 2015, 2017a). Conservation information was reportedly seen or heard by around a third of visitors. This is lower than findings from international zoo-only studies (Moss et al., 2015). However, it suggests that basic conservation information is being conveyed in a commercial and entertainment driven theme park zoo setting.

Despite conservation information being presented throughout the site, respondents stated that they mainly found conservation information on signs. More visitors stated that they had read an animal information signs than predicted by other studies (Clayton et al., 2009). This verifies that information signs are a significant source of information during a zoo visit and their content should be carefully considered (Chapter 3).

Conservation information was also recalled from interactions with staff, keeper talks and live animal shows, however, these were less frequently reported than signs as conservation information sources. Signs are a permanent source of information for visitors, this may be why they are acknowledged by visitors as the main source of conservation information. The entertainment focus of the live animal shows may have made visitors less likely to associate them with conservation. On-site research found that live animal shows which use trick behaviours to convey educational messages cause confusion in visitor understanding (Chapter 4). This mixed messaging may be why live animal shows were not as frequently recalled by visitors as a source of conservation information. Increasing the conservation content of shows and talks is vital if visitors are to associate them with conservation.

It is encouraging that where conservation information was recalled, over half of respondents mentioned habitat and species loss. These comments included expressing concern about specific species extinction. This supports other studies that find that zoos are able to increase conservation concern in their visitors (Clayton et al., 2009, 2017). Unfortunately, only a minority of respondents provided comments. Therefore, this may not reflect the awareness of all visitors.

Conservation actions were rarely recalled and confidence in what visitors can *'do personally to help protect animal species'* marginally decreased post-visit. This may be because the zoo raised visitor's awareness of conservation threats and problems without offering sufficient solutions which potentially increases visitor anxiety about environmental issues. Individuals are most likely to engage in a pro-environmental action when they feel confident and believe that their actions will help (Geiger et al., 2017). Many visitors remain unaware of what actions they can do to protect the environment and this barrier must be addressed (Grajal et al., 2016; McKenzie-Mohr, 2000; Roe & McConney, 2015).

It is not just awareness of conservation actions which affects visitor confidence in pro-environmental behaviour. The theme park environment supports the image of a throw-away society which contrasts with the zoo message of conservation (Beardsworth & Bryman, 2001). For example, single use plastics are used in all of the food outlets, plastic toys and helium balloons are sold across all shops and there are no designated recycling facilities. Additionally, animatronics and lighting are left running continuously and theme park rides are run ‘empty’, without any passengers, as a way of advertising that the ride is active.

The way an organisation presents itself alters public perception of the site and the authority of the information it conveys (Fournier, 1998; Patrick, 2016). If theme park zoos intend to inspire conservation actions undertaken by visitors, they need to model conservation behaviours themselves (Smith et al., 2012). For example, using and promoting sustainable products and training staff to promote environmental concerns and solutions (Swim & Fraser, 2014). Changing visitors and staff personal consumption decisions is crucial for preventing further biodiversity loss (Grajal et al., 2016; McKenzie-Mohr, 2000; Moss et al., 2017b). If theme park zoos model desired behaviours, they can demonstrate how pro-environmental and sustainable choices do not limit amusement. The fact that there is no division between the theme park and zoo areas requires key concepts to be reinforced across the entire site. The lack of delineation between areas may be the reason that fewer individuals reported visiting the zoo than had intended to as some visitors may have been unsure what areas are considered as the zoo and what did not.

The presence of young children in a visiting group was a key factor in predicting attitudes, particularly *‘concern about animals going extinct’*. Zoo visits are a family event and the social aspect of a visit is important to families (Esson & Moss, 2014; Fraser, 2009; Hyson, 2004; Turley, 2001). Many adults help children engage with animal information (Esson & Moss, 2014; Patrick & Tunnicliffe, 2013; Therkelsen & Lottrup, 2015) and this potentially reminds adults that the environment needs protection for future generations. Many pro-environmental actions do not provide dramatic or instant fixes and this makes it hard to sustain interest in pro-environmental behaviours (Smith et al., 2012). Our finding that the presence of children is a strong predictor of environmental concern suggests that zoos could use this to inspire adults to act upon facts and advice they have received during their visit.

Visitors continued to hold similar views about theme park zoos both pre-and post-visit. These views aligned well with the current marketing strategy promoting ‘animals’, ‘rides’, ‘families’ and ‘fun’. Whilst it is reassuring that the themes of ‘conservation’ and ‘education’ were mentioned more frequently post-visit these increases were minimal. This suggests that further input is required on-site to raise the association between a theme park zoo visit and conservation education.

Conclusions

Theme park zoos have a vast audience and are able to convey basic animal facts to their visitors. Whilst raising general interest in animals is important, knowledge alone is insufficient for addressing conservation concerns.

Exposure to conservation information was found to be a crucial factor in predicting visitor knowledge and attitude changes. Information signs were the most effective source of information and successfully conveyed conservation need. However, limited information about conservation actions were recalled suggesting that this is an area for further development. The presence of children was also a key predictor of extinction concern and we suggest that sites could use this to encourage whole families to commit to environmental protection for the future.

Theme park zoos partially fulfil the modern zoo mission by increasing animal knowledge and encouraging some conservation concern, but they currently do not go far enough. Theme park zoos must focus on inspiring conservation attitudes and modelling sustainable practice if they are to uphold modern zoo standards and keep pace with zoo-only sites. Research within non-traditional zoo settings, such as theme park zoos, is vital to provide specific guidance and support these sites in fulfilling the modern zoo mission of conservation and education.

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Appendix D

D.1 Blank example of general visitor survey used to collect pre- and post-visit responses from visitors to Flamingo Land Resort Ltd.

Flamingo Land Resort Pre-Visit Survey

Thank you for taking part in our research on visitor experience and impact, your views are very important to us.

In addition to this short (approx. 2-3 minute) survey, you will be sent a follow up survey, via email, at the end of your visit.

Please look out for and respond to our follow up survey email as your feedback and opinions really make a difference to future visitor experiences.

The data collected is part of PhD research and a multi-institution study on visitor impacts and experience. Data will be used for this and for any subsequent publications.

You have the right to withdraw from the study at any point during the questionnaire.

The data is being collected through ZooWise, Qualia Analytics, who are registered with the UK government's Information Commissioner's Office and are fully compliant with data protection protocols and data privacy standards.

1	First Name	
	Last Name	
2	Please provide a contact email address:	
3	When do you plan to visit Flamingo Land	(linked with booking form and automated with follow up survey)
4	What comes to mind when you think about Flamingo Land? (please list all words that come to your mind)	
5	What is your main reason for visiting Flamingo Land?	For a great day out To see animals To learn about animals Were in the area To spend time with family Other (please specify)
6	Are you aware that Flamingo Land has zoo animals?	Yes, I am aware. I was unaware.

		Unsure.
7	Do you plan to visit the zoo?	Yes, visiting the zoo is part of the plan. No, visiting the zoo is not part of the plan. Unsure.
	If YES: What animals are you expecting to see during your visit? (Please note not all these animals are housed at Flamingo Land)	Data Source list: vast bank of animals allows public to state any animal including rare and endangered species
General views (Conservation, Impact):		
1		
	Please indicate your level of agreement with the statements below	
	'Zoos play an important role in saving animal species from extinction.'	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree No opinion Unsure
	'I feel personally concerned about animal species going extinct.'	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
	'There is nothing I can do personally to help protect animal species.'	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
2	Which of the following are contributions that Flamingo Land makes to conservation? (please tick all that apply) Unsure International breeding programmes Reintroducing animals into the wild Conservation projects abroad UK bird monitoring Native tree planting Anti-poaching campaigns Veterinary care for wild animals	Yes / No / Unsure [NB: randomise responses to avoid bias]

	Support for UK community wildlife projects	
3 a	In what habitat does this animal live?  	[randomised] a) Forests and swamps b) Rocky outcrops c) Deserts d) Rainforests and grasslands e) None of the above f) Unsure
3 b	What is this animal?  	a) Chinese goral b) Vicuna c) Capybara d) Scimitar-horned oryx e) None of the above f) Unsure
3 c	What is this animal?  	a) Coati b) Red panda c) Banded Mongoose d) Raccoon e) None of the above f) Unsure
3 d	Which ONE of the following animals is critically endangered?	 Vicuna  California sea lion  Visayan warty pig  Red kangaroo Unsure

Flamingo Land Resort Post Visit Survey
Thank you for agreeing to participate in our visitor impact and experience research. We are really interested in hearing about your experiences and opinions. Your answers will help us to improve future visits. We hope that you enjoyed your time at Flamingo Land.

Your Visit (Zoo Visitation)		
1.	Was this your first visit to Flamingo Land?	Yes, first visit Not my first visit Unsure
	>IF NO: How long ago was your previous visit to Flamingo Land?	Less than one year ago More than one year ago
	>IF NO: Including your most recent visit, approximately how many times have you been to Flamingo Land for any reason in the last 12 months?	1 (only my most recent visit) 2 visits 3 visits 4 visits 5 visits 6 visits 7 visits 8 visits 9 visits 10 or more visits
	>IF YES: How did you hear about Flamingo Land? (tick all that apply)	Local newspaper National newspaper On TV On the Radio Tourist Information Leaflet Digital adverts Cinema Buses Posters Social Media Recommendation / Word of Mouth Unsure Other
2	Whose idea was it to visit Flamingo Land on this trip?	My idea My children’s idea My spouse or significant other’s idea Friend or acquaintance’s idea On a tour package Other
3	Who did you visit Flamingo Land with? (tick all that apply):	I visited alone As a couple With children With friends or acquaintances With a tour group

	>If ticked: Please tell us about the children you visited with. How many children are visiting Flamingo Land with you?	1 child 2 children 3 children 4 children 5 or more children Prefer not to say > Child's gender. Child's Age
4	How many times have you visited any zoo or aquarium in the last 12 months? (Including your recent visit to Flamingo Land)	Once Twice Three times Four times Five or more times Unsure
5	How long did you travel today to get to Flamingo Land?	Less than 1 hour 1-2 hours More than 2 hours Unsure
6	About how long did you spend at Flamingo Land on this trip?	less than 1 hour 1-2 hours 2-3 hours 3-4 hours 4-5 hours 5-6 hours 6-7 hours More than 7 hours Unsure
7	What comes to mind when you think about Flamingo Land? (please list all words which come to mind)	
8	Did you spend any time in the zoo area?	Yes, I spent time in the zoo area. No, I did not visit the zoo area. Unsure
	>if Yes, About how many hours did you spend in the zoo area?	Less than 1 hour 1-2 hours 2-3 hours 3-4 hours 4-5 hours More than 5 hours Unsure
Your Experience		
1	What animals did you see during your visit? (Please tick all that apply, note not all these animals are housed at Flamingo Land)	Data source: infinite list of animals, including endangered species
2	During your visit today do you remember seeing any animal information signs?	Yes No Unsure

	>If YES, Did you read any of those signs?	Yes No Unsure
	>If YES, to what extent do you agree with the following statements	
	‘Animal information was usually available when I wanted it’	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
	‘Animal information signs were generally difficult to read’	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
	‘The animal information on the signs was mostly relevant to my interests’	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
	‘I enjoyed reading the animal information on the signs’	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
3	Did you see or hear any information about saving animals or plants from extinction during your visit to Flamingo Land?	Yes No Unsure
	>IF YES, What do you remember from this information?	
	>IF YES, How was this information provided? (please tick all that apply)	Posters Animal Shows Keeper Talks Animal Encounters Information Signs Leaflets Webpage

		Education Centre Talked to Staff Unsure Other…………………………………
4.	Which of the following are contributions that Flamingo Land makes to conservation? (please tick all that apply) Unsure International breeding programmes reintroducing animals into the wild conservation projects abroad UK bird monitoring Native tree planting Anti-poaching campaigns Veterinary care for wild animals Support for UK community wildlife projects	Yes/No/ Unsure.
5 a	In what habitat does this animal live? 	a) Forests and swamps b) Rocky outcrops c) Deserts d) Rainforests and Grasslands e) None of the above f) Unsure
5 b	What is this animal? 	a) Chinese goral b) Vicuna c) Capybara d) Scimitar-horned oryx e) None of the above f) Unsure
5 c	What is this animal? 	a) Coati b) Red panda c) Banded mongoose d) Raccoon e) None of the above f) Unsure
5 d	Which ONE of the following animals is critically endangered?	Vicuna

		 California sea lion  Visayan warty pig Red kangaroo Unsure

Please indicate how satisfied you are with the following:

6	General experience of Flamingo Land	Very satisfied Satisfied Somewhat satisfied Neutral Somewhat dissatisfied Dissatisfied Very dissatisfied No opinion/ Not applicable
	The quality of care for animals at Flamingo Land	Very satisfied Satisfied Somewhat satisfied Neutral Somewhat dissatisfied Dissatisfied Very dissatisfied No opinion/ Not applicable
	The variety of animals at Flamingo Land	Very satisfied Satisfied Somewhat satisfied Neutral Somewhat dissatisfied Dissatisfied Very dissatisfied No opinion/ Not applicable
	The value for money of your visit	Very satisfied Satisfied Somewhat satisfied Neutral Somewhat dissatisfied Dissatisfied

		Very dissatisfied No opinion/ Not applicable
7	During your visit did you attend any keeper talks or animal shows?	Yes No Unsure
	If YES. Which of the following shows or talks did you attend? (please tick all that apply)	Sea Lion Show Bird Show Tiger Talk Penguin Talk South American Talk Black Rhino Talk Giraffe and Hippo Talk Lemur Talk Baboon Talk Meet A Creature (Education Centre) Animal Encounter Pirates of Zanzibar Show Story time (Children's Planet) Unsure
General views		
1	To what extent do you agree with the following statements?	
	'Zoos play an important role in saving animal species from extinction.'	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
	'I feel personally concerned about animal species going extinct.'	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion
	'There is nothing I can do personally to help protect animal species.'	Strongly agree Agree Somewhat agree Neutral Somewhat disagree Disagree Strongly disagree Not applicable/ No opinion

About You		
1	What is your gender?	Male Female

		Other
2	What is your Age:	
3	What is your nationality?	
4	How would you describe your ethnicity?	Open response + prefer not to say tick box
5	What is your home postcode?	
6	Which of the following qualifications do you hold? Tick all that apply	No formal education qualifications GCSE or equivalent A-level or equivalent Vocational qualification First Degree (Bachelor's) Postgraduate degree
7	Please indicate your annual household income before taxes	Prefer not to say Under £15,000 £15, 001 - £25,000 £25,001- £35,000 £35,001 - £45,000 £45,001 - £55,000 Over £55,001 Unsure
8	Do you have any other comments about your zoo visit at Flamingo Land?	[open-response]

D.2: Comparison of alternative models for animal knowledge questions and number of contributions made by Flamingo Land to conservation

model	Degrees of freedom (df)	AIC	AIC differences	Akaike weights (w)
Knowledge				
M1	9	550.0	208.0	<0.001
M2	9	342.0	0.0	1
M3	5	368.2	26.1	<0.001
M4	3	451.3	196.9	<0.001
M5	2	254.4	0.0	1
M6	3	371.3	116.9	<0.001
FL role				
M7	9	382.8	123.6	<0.001
M8	9	259.9	0.7	0.41
M9	5	259.2	0.0	0.59
M10	3	288.7	106.5	<0.001
M11	2	182.2	0.0	1
M12	3	263.1	80.9	<0.001

D.3: Comparison of alternative models for positive sentiment towards conservation attitude statements: Zoo role (positive response to statement 'zoos play an important role in saving animal species from extinction'), Action (measure of confidence/self-efficacy, respondents disagreed with statement 'there is nothing I can do personally to help protect animal species'), concern (agreed that 'I feel personally concerned about animals going extinct').

model	Degrees of freedom (df)	AIC	AIC differences	Akaike weights (w)
Zoos role				
M13	9	149.4	51.0	<0.001
M14	5	98.4	0.0	0.998
M15	9	110.4	12.0	0.003
M16	3	107.8	41.7	<0.001
M17	2	66.1	0.0	1
M18	3	88.3	22.2	<0.001
action				
M19	9	202.9	72.4	<0.001
M20	9	130.5	0.0	1
M21	5	157.1	26.6	<0.001
M22	3	167.0	85.1	<0.001
M23	2	81.9	0.0	1
M24	3	126.5	44.6	<0.001
concern				
25	9	166.0	62.4	<0.001
26	9	103.7	0.0	1
27	5	118.8	15.1	<0.001
28	3	139.2	76.8	<0.001
29	2	62.4	0.0	1
30	3	111.9	49.5	<0.001

Overall Findings

This thesis used an in-depth case study conducted at Flamingo Land Resort Ltd., UK, to examine the effectiveness of current zoo education provision at delivering animal facts and conservation messages to visitors.

Chapter one set out a theoretical perspective on achieving the zoo mission (to increase public awareness of biodiversity and inspire actions to prevent its loss). I considered theories from education, psychology and behaviour. The chapter acknowledged the need to set measurable learning objectives for zoo experiences. I discussed how educators may select learning and behaviour theories in order to convey particular conservation messages. I also considered how the overall perception of an institution can influence its authority as an educator.

In chapter one I introduced a new tool for assessing the effectiveness of zoo education against the zoo mission, the ‘Zoo Learning Taxonomy’. Creation of a new taxonomy was important as existing learning and behaviour evaluations do not consider both aspects of the zoo mission. This taxonomy aids practitioners in allowing them to measure successes and identify gaps in their resource provision. It is also beneficial to the scientific community as it provides a standardised matrix to measure zoo educational effectiveness allowing comparisons between sites to be made.

Having set out the zoo mission and considered learning and behaviour theories as an important measure for educational effectiveness I then examined what methods other zoo education studies employed. These research methodologies inspired the research design in later chapters.

Chapter two highlighted the common problems found in past research including the use of retrospective pre-testing, attendance and satisfaction figures as a measure of learning, and biased survey design. I acknowledged findings from the latest robust, international zoo studies which provide evidence for zoos as educators. The chapter noted the deficit in research from non-traditional zoo settings and lack of specific education resource evaluation, particularly when considering the zoo mission and the Aichi targets. The chapter concluded that more small scale, robust studies were needed to provide practitioner focused evidence of impact.

The latest international zoo studies provide a baseline of the educational impacts of zoos. According to the evaluation cycle (Figure 2.2) the next step is to provide ‘diagnoses’, in the form of focused studies which inspire improvement. The deficit of individual experience research and the focus on traditional zoo sites, prompted my decision to undertake an in-depth study considering several educational experiences, based at a non-traditional zoo, a combined theme park and zoo. Therefore my thesis fills a gap in the zoo research literature. Given methodological shortcomings of past zoo research I designed my studies based on robust methodology to ensure the reliability of their findings.

Chapters three to five take a micro–approach to evaluation by considering the impacts of specific zoo experiences at a single study location. Viewed collectively, these studies provide a larger picture of informal zoo learning. Overall, visits to the study site had a moderate effect on increasing visitor knowledge about species and individual experiences had a high to very high effect.

The impact of zoo animal information signs on visitors’ knowledge was considered in chapter three. Signs are a commonly used educational resource in zoos yet there was a lack of robust evidence for their use in the zoo literature. I found that sign-readers demonstrated higher levels of animal knowledge compared to non-sign-readers. Information was found to be most easily recalled when presented with limited text and supporting graphics. Although my study used unpaired groups of sign-readers and non-sign-readers checks for reliability were conducted and confirm that the findings are robust.

In addition to measuring what information is conveyed by signs, my study used the Zoo Learning Taxonomy to establish how much of the zoo mission signs target. Sign content was found to be predominantly focused on conveying animal facts. This provided only a limited learning potential. Recommendations were made to include conservation actions on animal information signs in order to target more of the zoo mission.

Chapter four investigated the impact of live animal shows on their audiences’ knowledge. In particular whether the use of tricks, designed as educational hooks, were conducive to learning. The study found that live-animal shows do convey basic animal knowledge. However, the use of tricks was found to cause confusion and encouraged misconceptions to develop. The chapter suggests that future live animal shows should focus on presenting naturalistic behaviours. If tricks are used these should be closely linked to their intended objective and not excused as attention grabbing links to education. This study is a valuable contribution to the zoo literature as there is only one other study on the impact of live animal shows and this examines a conservation-orientated show. My study examined an entertainment-focused show which aimed to convey education. My study is also the first to examine the impact of trick behaviours on audience understanding.

Chapter five examined an alternative to live animal shows. It assessed the impact of a family-orientated, puppet-based, theatre performance on adults' and children's animal and conservation knowledge. Research into the impact of theatre in zoos is limited. Additionally, most zoo studies focus on adult's learning with very few testing children's knowledge. My study tested both children's and adult's knowledge change as a result of the theatre performance to assess its impact on family learning. Theatre was found to be an effective medium for conveying facts to both adults and children. Spoken messages were conveyed quickly and effectively to visitors. The use of short bursts of song with altered lyrics set to familiar tunes were also effective for conveying information, especially for children.

Given that zoos are predominantly family orientated, the finding that a single zoo educational experience can achieve whole family learning is important. Knowing this, experiences can be designed to target learning at different levels to cater for all age ranges.

When considered against our learning taxonomy the theatre performance conveyed predominantly factual knowledge. In order to meet the zoo mission theatre content needs to consider more complex concepts such as environmental issues and encourage debate.

Chapter five additionally demonstrated that there is no difference in overall findings between paired and unpaired samples of visitors, assuming that they are broadly similar in demographic and are exposed to the same conditions. This has important implications as it is not always possible to repeat test the same individuals, especially in a leisure setting. Using unpaired samples is an easier method for researchers therefore, it is reassuring that this method can be used to demonstrate the same findings as repeat testing.

Chapter six examined the impact of the theme park zoo visit as a whole on visitor knowledge and attitudes. Visitor 'knowledge' (total number of animal questions answered correctly) increased as a result of a visit. Visitors were able to identify more animal species, habitat and threat status information after the visit compared to before. Visitors were also more aware of the zoo's conservation work and could recall specific conservation information post-visit. However, visitor attitudes remained statistically unchanged by the theme park zoo visit. A slight decrease in visitor's confidence towards conservation actions was also found. This suggests that the current theme park zoo experience does not completely fulfil the zoo mission as it does not inspire or boost confidence in conservation action. While zoos do a good job at providing factual knowledge there is still a potential for improvement, especially with regard to developing conservation attitudes and actions. Some zoos will be achieving more than others. Without a standardised framework for evaluating it is hard for zoos to see what they are achieving and where resources are needed. The Zoo Learning Taxonomy fills this gap as it covers both learning and behavioural aspects of the zoo mission and provides both practitioners and researchers with a clear overview of where zoo educational experiences target.

Effect sizes across experiences

Each of study in this thesis was conducted within a different timeframe, had varying sample sizes and varying questions. Therefore, in order to standardise results and compare relative learning the effect sizes of each study on visitor 'knowledge' (total number of correct answers) were compared. For this I calculated a) effect sizes using Cohens' d with a pooled standard deviation of pre- and post- visit groups and b) statistical significance using Wilcoxon rank sum tests (Field, 2013; Higgins et al., 2013). An effect size of below 0.01 was seen to have no effect on learning, between 0.02-0.18 a low effect, 0.19-0.44 moderate, 0.45-0.69 high and above 0.70 a very high effect (Higgins et al., 2013)

All on-site experiences (signs, live animal shows and theatre) were found to have a positive, moderate to very high effect on visitor's animal fact 'knowledge' as a result of exposure, as did the effect of a theme park zoo visit overall (Table 7.1). Overall visit had a small, but negative, effect on visitor attitudes. This case study supports the hypothesis that theme park zoos effectively convey factual information but need to go further to encourage attitude change and pro-environmental actions.

Of the experiences tested, animal information signs had the greatest effect on knowledge (Table 7.1). This supports findings from chapter two that signs successfully convey information to visitors and from chapter six that conservation information was most frequently recalled from signs.

The bird show and theatre performance had a similar effect to each other on visitor knowledge (Table 7.1). In contrast, the single species sea-lion show had a much smaller, yet still significant, effect on visitor knowledge. This may be because the sea-lion show's focus on tricks to convey information caused misconceptions and because the intended learning objectives for the shows were too simplistic for many of the audience.

Table 7.1: Comparison of the effect of each zoo educational experience on visitors' knowledge.

Analysis	Sample	Condition	N	Mean	S.D.	Sig. (p)	Test stat.	Effect Size (d)
Animal Information Signs	Non-sign readers vs. sign-readers	Non-sign-reader	116	0.87	0.92	<0.001	W = 3560	0.95
		Sign-reader	118	1.86	1.15			
Live Animal Shows	Sea lion show pre- vs. post-	Pre	188	2.53	1.65	<0.001	W = 9822	0.61
		Post	155	3.55	1.69			
	Bird show pre- vs. post-	Pre	111	2.14	1.59	<0.001	W = 3697.5	0.73
		Post	110	3.32	1.69			
Educational Theatre	Child response pre- vs. post-performance	Pre	120	2.17	1.69	<0.001	W = 4403.5	0.76
		Post	124	3.49	1.79			
	Adult response pre- vs. post-performance	Pre	81	2.27	1.88	<0.001	W = 1931.5	0.71
		Post	77	3.69	2.14			
General Visitor Experience	Attitudes pre- vs. post-zoo visit	Pre	160	2.29	0.88	0.090	V = 3001.5	-0.18
		Post	160	2.13	0.94			
	Knowledge pre- vs post-zoo visit	Pre	160	1.44	1.19	0.003	V = 2666	0.32
		Post	160	1.83	1.24			

Zoo Learning Taxonomy:

The studies conducted in this thesis measured the information conveyed to visitors in relation to intended learning objectives. These objectives were set by the staff at Flamingo Land and were aimed at visitors recalling factual information. Conservation information was also conveyed as facts, e.g. identifying what conservation activities Flamingo Land undertakes or the threat status of animals. Knowledge level information has limited value, it is at the lowest end of the learning spectrum, and is not enough to impact on visitor action or provide evidence of higher order connections being made. If zoos are intending visitors to make connections between their own actions and the threats faced by species or to encourage sustainable behaviours, they need to set objectives at higher learning levels. Although the information currently presented is effectively conveyed, the value of this information, with regard to the zoo mission, is debatable.

Figure 7.1 considers the findings from this thesis in relation to the Zoo Learning Taxonomy to identify where the zoo overall mission has been met.

‘Zoo trivia’ was successfully conveyed through live animal shows. Visitors recalled specific names of animals and gave details about individual animal’s age and weight (Chapter 4). Although this information has little impact on visitors overall biodiversity awareness, it does demonstrate that the experience created memorable connections between visitors and animals. These emotional connections are potentially important in developing a drive for environmental action (Clayton et al., 2009), but in isolation they have limited value.

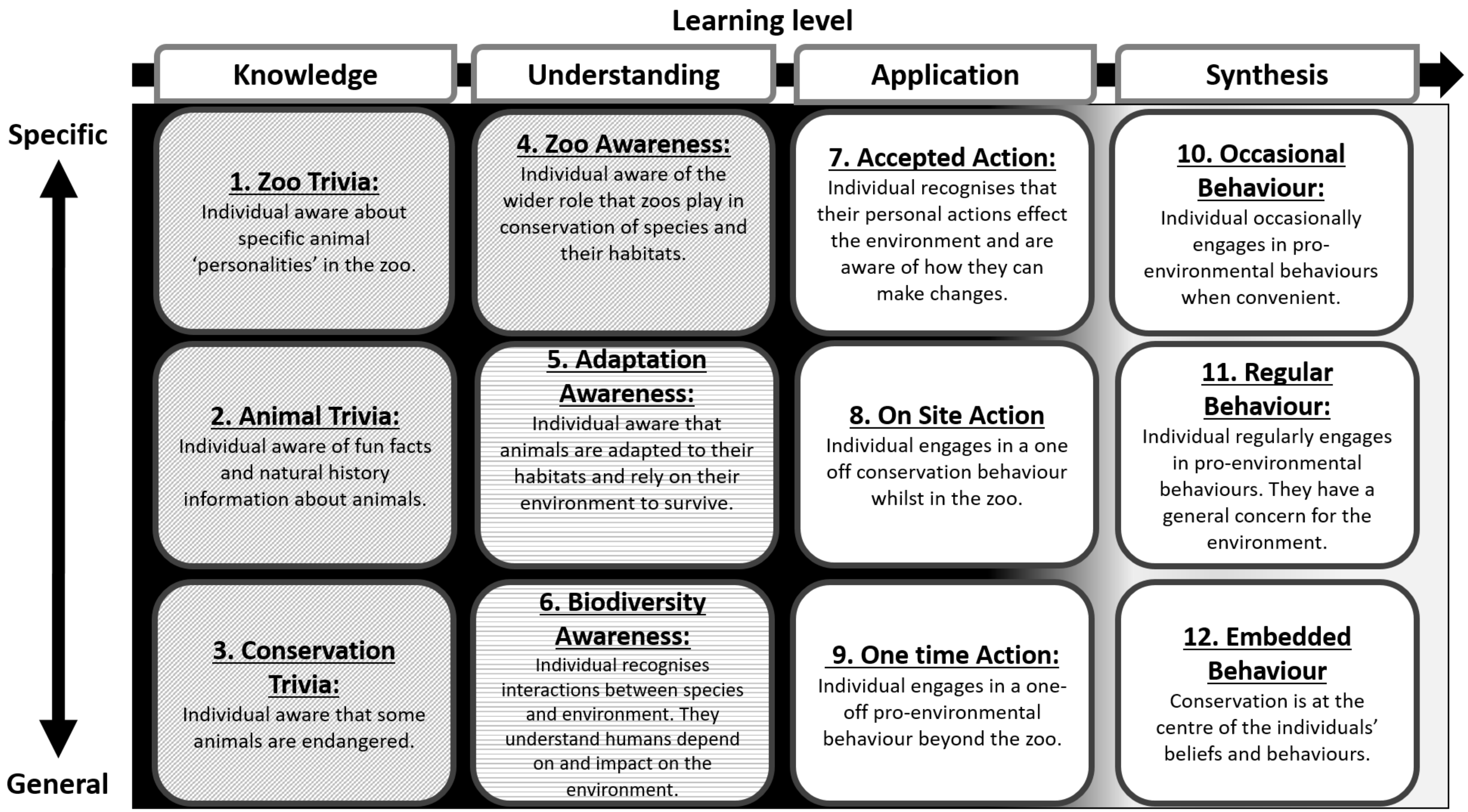

Figure 7.1: Zoo Learning Taxonomy with shaded areas reflecting where learning has been demonstrated. Darker, diagonal shading (boxes 1-4) indicates where successes have been demonstrated across studies, Paler, horizontal shading (boxes 5-6) indicates where some successes are indicated but not fully evidenced, unshaded boxes (7-12) are where learning has not yet been demonstrated.

The theme park zoo experiences predominantly conveyed ‘Animal trivia’ and ‘Conservation awareness’. Visitors who viewed signs, live animal shows or theatre performance were all able to state more facts about animals after the educational experience than before (Chapters 3, 4 & 5). The visit overall also impacted on visitor’s factual knowledge (Chapter 6). Information about the conservation work of zoos themselves was effectively conveyed through theatre performance and as a result of the visit overall, but did not inspire visitors own actions. Visitors stated that signs were the main source of conservation information, suggesting signs are important for raising visitors’ ‘Conservation awareness’. The theme park zoo experiences also impacted on visitor’s ‘Conservation trivia’, knowing that an animal is endangered. Knowledge of an animal’s threat status and causes of threats increased as a result of viewing sign information, the theatre performance, and as a result of the visit as a whole, however, not all increases were statistically significant.

‘Adaptation’ and ‘Biodiversity Awareness’ were only partially met by theme park zoo experiences. Some improvements were seen in awareness about habitats and adaptations through the theatre performance, sign information and overall visit. Biodiversity awareness was indicated through the conservation statements remembered from the overall visit as respondents mentioned habitat and species losses. As visitor awareness of conservation actions and attitudes towards conservation did not change as a result of any of the experiences tested or through the visit as a whole there is not enough evidence to suggest that the theme park zoo has made visitors more aware of their impact on the environment.

The studies undertaken in this thesis do not demonstrate learning at or above level 7 (‘Accepted action’) (Figure 7.1). Visitor confidence at undertaking conservation actions reduced after a visit indicating that the theme park zoo is not currently providing visitors with realistic solutions which they can engage with.

It is not surprising that the experiences tested have not achieved the higher levels of learning as they were aimed at achieving the lower levels (knowledge and understanding). However, it is vital that theme park zoos target the higher levels as these are the focus of the modern zoo mission.

Value for money

Of all the experiences tested, signs represent the best value for money. Signs are a constantly available information source (Hall et al., 2010) and are relatively inexpensive compared to costs of employing staff for shows or animal training teams.

This research has found that information signs are highly effective at conveying their content and are more effective than other experiences such as shows. Visitors regard signs as a prime source of conservation information even when other sources are available. This thesis has highlighted that signs are read by more people than previous studies had speculated (Clayton et al., 2009).

Visitors focus on signs for a limited period therefore information needs to be concise and carefully selected. If zoos intend to achieve outcomes across all learning levels it is important that their signage also reflects this and that signs themselves act to stimulate visitor discussion and debate in the absence of an educator.

Research implications

This thesis introduces a new evaluation framework, the Zoo Learning Taxonomy, which can be applied across zoo research to assess the impact of experiences. It is the first evaluation tool to combine both learning and behaviour outcomes based around the zoo mission. Like Bloom's Taxonomy (1956), from which the zoo taxonomy is derived, it can be applied to any zoo experience and any teaching style.

This thesis has demonstrated, through an examination of several zoo educational experiences, that a structured evaluation approach allows successes and weaknesses in provision to be identified.

In addition, the finding that unpaired pre-post samples are equivalent means that future research can confidently use unpaired samples to demonstrate knowledge changes.

Practical implications for zoos

The studies in this thesis have highlighted that theme park zoos are conveying their intended learning objectives. Still, these fall short of what is required to fulfil the zoo mission. In order to address the zoo mission, zoo experiences should consider the following key areas:

1. ***Set learning objectives across the Zoo Learning Taxonomy*****:** Zoos should consider what their current educational provisions target in relation to the overall zoo mission. Where areas are not targeted zoos should strive to address these gaps, for example offering opportunities for visitors to practice pro-environmental actions on-site. Currently, zoo educational resources and experiences are heavily focused on conveying facts. Although important, factual information is of limited value, particularly with regard to behaviour change (Ajzen, 1991; Hines et al., 1986). Zoos should consider providing experiences which encourage visitors to make connections between ideas and encourage discussions about environmental issues. This is known to increase confidence in environmental actions (Clayton et al., 2017; Grajal et al., 2016). Given our finding that theme park zoo visitors demonstrated lowered conservation confidence post-visit (Chapter 6), this is an area which must be addressed.

2. ***Importance of signs*****:** Whilst zoos continue to look for new methods of engaging visitors. We suggest that traditional information signs still have value as a constantly available information source. Sign content needs to be carefully selected to have limited text, good quality graphics and support the zoo mission.

3. ***Naturalistic versus Entertainment:*** Animals performing tricks as an educational hook were found to be ineffective and potentially detrimental to learning. Where live animals are used it is important that they convey natural behaviours to audiences or align trick behaviours closely with their intended learning outcome. Using puppets and theatre provides a successful alternative to using animals and can convey messages to whole families. Where entertainment is the focus puppets can provide information without undermining perceptions of the live animal.

4. ***Model Behaviour:*** The perception of the zoo is important for how messages are conveyed to visitors (Patrick, 2016). It is important that these behaviours are also modelled on-site if zoos intend to encourage conservation actions in their visitors. Visitors are generally unaware of conservation actions which they can undertake. Zoos must engage with visitors to develop personalised solutions and encourage visitor confidence in pro-environmental alternatives.

Limitations

This thesis was completed across a three year period with a limited budget. This meant that investigating a representative sample of zoos was not possible. Instead I chose to test a range of educational experiences within a single institutions and establish how they meet the zoo mission. This enabled me to demonstrate the Zoo Learning Taxonomy as an effective tool for evaluating zoo education against the zoo mission. Whilst research may be based on a limited sample and specific zoo experiences, collectively these show how experiences within a zoo site address the zoo mission and identify areas for improvement. The Zoo Learning Taxonomy has wider implications as a standardised tool for measuring educational effectiveness. Future research can use this taxonomy across other zoo sites to provide a more generalisable view of zoo education provision.

Given more time it would have been interesting to track visitors' long-term learning several months after their visit. I would have also liked to have experimentally tested changing the content of on-site zoo activities to investigate the impacts of fact-based versus conservation-orientated experiences.

The majority of data were collected as manually distributed surveys. This placed a limitation on sample size due to researcher availability. Data collection for chapter six 'the general visitor survey' additionally used an online survey system. Whilst this did increase sample size, the online survey was 'opt-in'. Consequently, many visitors who booked online missed the survey. There was a high attrition rate between pre-visit surveys and those who also completed a post-visit survey. Although some drop off is to be expected, providing some compensation for time or incentive to complete may have increased responses.

Future work

It is reassuring that more zoos are taking park in large scale benchmarking studies and these provide much needed evidence for the impact of zoos on visitor knowledge and attitudes. However, in order to provide institutional impact, findings need to be translated into specific guidance for practitioners. Smaller scale evaluations of specific experiences, e.g. signage and shows, are needed. These smaller studies form the 'diagnoses' part of the evaluation cycle (Figure 2.2). Regardless of the scale of the study it is crucial that zoo evaluations employ robust methodology.

Zoo research should continue to include non-traditional zoos in the literature. Without specific studies, these institutions lack insight as to how they can keep pace with modern zoo standards. It is important that large scale studies include non-traditional zoos in their sample to represent the full zoo spectrum.

Currently, there are very few zoo education studies which evaluate using learning taxonomies. Learning taxonomies can allow the impact of an experience to be considered within the wider context of the zoo mission. The Zoo Learning Taxonomy presented in this thesis is the first to be based around the zoo mission. It is hoped that it can aid practitioners in creating and evaluating on-site experiences.

Conclusions:

This thesis has demonstrated that a theme park zoo visit can lead to significant increases in visitor's animal knowledge. Information signs were found to be a valuable tool in conveying animal information to visitors, which they view as the primary source of conservation information. Live animal shows were also effective for conveying information, however the use of tricks was not conducive to learning. Alternatives to live animal shows, have potential for delivering entertainment and information to whole families.

Whilst basic knowledge is conveyed by theme park zoos, conservation attitudes and actions were not impacted. This is because current provisions are targeted at the lowest levels of learning (as described by the learning taxonomy). In order to fulfil the zoo mission completely, theme park zoos need to provide more experiences which focus on conservation and behaviour change. Using learning taxonomies in the design and evaluation of educational provisions can help ensure resources are targeted at behavioural change in addition to factual knowledge.

This thesis was limited by time and by being based at a single study site. However, it has highlighted the impact of specific zoo experiences within a non-traditional zoo setting, two areas that are missing from current literature. The studies conducted in this thesis provide robust and reliable evidence of the educational effectiveness of zoo education. They use a combination of repeat and unpaired pre-and post-testing, which we have demonstrated to be equivalent, to track knowledge changes.

To continue development of a complete body of evidence for the impact of zoos and their on-site experiences, future studies must address other non-traditional zoo settings and target specific experiences at various sites.

In addition to the findings from specific zoo experiences, which in themselves fill a gap in the zoo literature, this thesis makes a significant, novel contribution to the literature by developing an evaluation framework for both practitioners and researchers to evaluate zoo education provision against the zoo mission.

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