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How do visitors relate to biodiversity conservation? An analysis of London Zoo's 'BUGS' exhibit

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ABSTRACT

Using a case study of London Zoo's BUGS (Biodiversity Underpinning Global Survival) exhibit, this article assesses the role of experiential learning in raising biodiversity knowledge, concern and potential pro-conservation actions. Using Personal Meaning Mindmapping, a novel method in visitor research, the study examines how adult visitors relate to biodiversity conservation. Researcher priming, perceived proximity, affection, and responsibility are explored as key factors in understanding biodiversity and conservation. A mixed-method approach involving statistical, discourse and semiotic analysis finds that BUGS enables visitors to value nature by fascinating and entertaining them. However, BUGS falls short of its experiential potential as it does not resonate in visitors' everyday lives, nor does it enable them to personally contribute to conservation efforts.

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Personal Meaning Mindmapping; experiential education; biodiversity conservation; visitor studies; zoos

Introduction

Within the debate about effectively raising concern about environmental issues, experiential learning has been proposed as an important initiative to motivate people to value nature (Palmer 1998). Yet there remains a lack of understanding about how to best utilise learning experiences to engage the general public in a way that makes them aware of problems and to feel empowered to remedy them. This study seeks to narrow this gap in current understanding. It examines how visiting a particular zoo exhibit, combined with previous understanding and experience, shapes visitors' conservation knowledge, beliefs and potential pro-environmental actions. A central theme explored in the study is the extent to which contact and observation of animals within the staged setting of a zoo allows individuals to relate to biodiversity and how the experience 'connects' to visitors' everyday lives (Clayton et al. 2014).

The study makes a number of contributions. First, it advances current understanding of the role of zoos – which can be interpreted as informal learning centres for experiential and free-choice learning – in fostering, inspiring and enabling environmental knowledge, beliefs and pro-conservation actions (Esson and Moss 2013; Packer and Ballantyne 2010; Yocco et al. 2015). Second, the study makes a methodological contribution, pairing 'Personal Meaning Mindmapping' (PMM) (Falk, Moussouri, and Coulson 1998), a technique largely neglected in previous visitor studies research, with a mixed-methods analytical approach, involving statistics and semiotics to evaluate the effect of visitor priming.

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London Zoo's BUGS (Biodiversity Underpinning Global survival) exhibit

This study examines how visits to London Zoo fulfills the Zoological Society of London's (ZSL) goal of enabling '… people to adopt positive steps to support conservation and value nature' (Zoological Society of London 2013). It does not evaluate actual behavioural change. Rather, the study seeks to identify whether the corporeal experience of visiting BUGS shapes the knowledge, beliefs and intentions of its visitors by analysing emerging understandings of and feelings towards biodiversity conservation.

The BUGS exhibit, opened in 1999, is home to over 140 species of mostly invertebrates but also mammals, birds, reptiles, amphibians, and fish. It was selected as the case study because it is the Zoo's flagship educational exhibit about biodiversity and conservation. Quoting the zoo itself, 'BUGS is designed to explain what biodiversity – quite simply the variety of life on the planet – is all about, and why we need to conserve it' (ZSL 2015). The exhibit features a set path, with visitors following information panels interspersed with vivariums, aquariums, and terrariums organised in sections covering different key themes. Visitors all see the same panels in the same order, with differences to their experience being what they choose to look at or not. Multi-sensory and interactive aspects in various locations of the exhibit – live talks by zoo animators, a spider walk-through, animal sound recordings, a breeding room and nursery behind glass panels – are also part of the experience (Figures 1 and 2).

Literature review

It is difficult to mobilise people around abstract concepts such as biodiversity loss or climate change (Veloz et al. 2012). According to Clayton et al. (2014, 461), a connection to nature and animals is likely to be important in fostering an interest in, and actions towards, conservation. An ability to relate to nature may be associated with empathy, an environmental self-identity and a responsibility to protect. One potential way in which people can relate to nature is through direct contact and observation with live animals (Balmford and Cowling 2006; Packer and Ballantyne 2010; Tudge 1991).

Empirical studies which have attempted to quantify whether zoo visits change people's conservation-related knowledge, attitudes, or behaviour have led to mixed conclusions. In UK zoos sampled by Balmford et al. (2007), no evidence was found of any measurable effect on adults' conservation

Figure 1. Photograph of the 'Animal Encounter' area, where zoo animators show live specimens and invertebrate fossils to visitors. Photograph taken by researchers.

Figure 2. Photograph of the inside of the 'In With The Spiders' walk-through, featuring Australian golden orb spiders and Madagascan orb weavers. Photograph taken by researchers.

knowledge, concern or ability to act. Similar results were found in studies of Australian zoos (Kazarov 2008). However, studies on zoos in the United States have shown positive impacts on visitor connections to nature and pro-conservation behaviour change, notably where: (a) information is supplied on threats posed by humans activity on animals (Packer and Ballantyne 2010); and (b) there are identity-related motivations for visiting the zoo (Falk et al. 2007; Schultz and Joordens 2014). Smith and Broad (2008) found that zoos play an educational role mainly through reinforcement of information learnt from television.

BUGS is a space of experiential learning. In addition, a concept with particular resonance is free-choice learning (Zeppel 2008). Free-choice learning is self-motivated, voluntary and guided by the learners' needs and interests. An important theme within the literature is that free-choice learning involves active 'meaning-making' wherein individual attempt to make sense of information and other stimuli that they encounter (Ballantyne and Packer 2005). Moreover, experiential learning in free-choice environments is not an abstract experience, detached from individuals' past experiences. Rather, how a particular exhibit is interpreted, perceived and acted upon depends on interactions between previous knowledge, existing cognitions and feelings, and the visitor experience itself (Falk and Dierking 1992; Pearson, Dorrian, and Litchfield 2013).

Previous work suggests that learning is most likely to contribute to pro-conservation beliefs and actions where it relates to existing environmental knowledge. Moreover, as Ballantyne and Packer (2005) suggest, meaningful learning requires approaches which challenge environmental misconceptions and encourage individuals to rethink possible explanations. Additionally, the authors draw attention to self-efficacy, and the importance of learning experiences which increase visitors' beliefs about their ability to positively affect change. Another important theme in the literature is the significance of emotions. Experiences which are associated with an emotional response may increase individuals' level of interest, engagement and curiosity to learn (Ballantyne and Packer 2005). Evidence also suggests that they can also help to forge a connection to nature, engender a sense of personal responsibility and raise pro-environmental intentions (Clayton et al. 2014; Pearson, Dorrian, and Litchfield 2013; Schultz 2011).

Responding to this understanding, the present study uses constructivist theory to frame experiential learning as an active, continuous process whereby information is given a socially negotiated personal meaning through a dialogue with visitors' prior knowledge, attitudes and experiences (Buijs

et al. 2008; Falk, Moussouri, and Coulson 1998; Pearson, Dorrian, and Litchfield 2013). We explore this by examining how the experience of BUGS relates to existing, and contributes to new knowledge and understanding of biodiversity. Additionally, we investigate the affective properties of invertebrates at BUGS, considering how the exhibit triggers particular emotions in visitors.

The primary methodological contribution of this article is an engagement with PMM, a comparatively new analytical tool developed by Falk, Moussouri, and Coulson (1998). With a number of exceptions (das Neves and Monteiro 2014), previous studies on zoo visitors have largely been based on traditional empirical methods which might not be best suited to exploring informal learning in free-choice environments. One particular novel feature of the present application of PMM is that it explores pre-visit priming, in the sense of how initial contact, briefing and elicitation from a researcher influence visitors' subsequent experiences and learning from the exhibit. Another novel aspect is that the study combines PMM with insights from cognitive geography in order to better understand the nature, construction and representation of spatial imaginaries (Montello 2009; Watkins 2015).

Methodology

Research design, data collection and analysis

The research was based on fieldwork at the BUGS exhibit of ZSL London Zoo from March to July 2015. Primary qualitative data were collected and analysed in the following ways:

(1) Personal Meaning Mindmapping (PMM)

Adult visitors were asked to construct a mindmap of what biodiversity conservation meant to them before and after they viewed the exhibit. Participants were given a blank paper with the prompt word 'biodiversity' and were invited to write/draw freely around it. Upon exiting the exhibit, they were asked to add to or amend their PMM, as detailed in Xanthoudaki, Tickle, and Sekules (2003). Respondents were encouraged to elaborate on their mindmaps orally. If no answers were forthcoming, prompts included asking for information and understanding regarding a given concept and elaborating on their feelings about their experience. This was supplemented by a short exit questionnaire on basic demographic information, including a self-reported level of environmental concern on a 1–10 scale. After Falk, Moussouri, and Coulson (1998), PMM analysis was conducted along four dimensions of extent, breadth, depth, and mastery to determine changes in understandings of biodiversity conservation, including whether visitors felt empowered to adopt pro-conservation behaviour after their visit. Results were analysed by one researcher due to institutional requirements. An empirical guide sheet was developed for classification and assignment purposes and piloted that led to high intra-rater reliability in all dimensions.

- Range of concepts – number of concepts linked directly to biodiversity. These were derived from the PMMs and were categorised into 20 themes. Examples of concept include: symbiosis, the uncertainty of undiscovered species, habitat variety, adaptive radiation.
- Depth of understanding – number of words used to describe and elaborate on each concept. Scored on a scale of 1–6, where 1 = no elaboration and 6 = significant elaboration.
- Degree of emotion – number of emotive terms or images. The scoring does not differentiate between positive and negative emotions.
- Degree of expertise – expertise and organisation of thinking, quality of understanding and use of relevant vocabulary. Scored on a scale of 1–5, where 1 = no understanding; 2 = simple, novice-like understanding; 3 = more developed but uncertain understandings that provide examples but without conceptual linkages; 4 = detailed conceptual linkages with basic vocabulary or advanced vocabulary but lacking in conceptual linkages, 5 = highly detailed, expert-like understanding.

The PMM approach was initially piloted on 4 visitors. It was found that the pre-interview appeared to significantly affect their experience as it encouraged visitors to think more about biodiversity conservation, their relationship with nature and engage in greater depth with the exhibit than they might

have in its absence. A second pilot, conducted by asking visitors to construct a PMM after their visit only, led to noticeably sparser answers with far more limited engagement with biodiversity issues. It was decided to conduct 50% of the PMMs as pre- and post-interviews (Sample A), and the remaining 50% as post-only interviews (Sample B). This dual elicitation approach has a number of advantages, including: (a) providing insights into the cognitive and affective additionality of the exhibit; and (b) allowing a statistical comparison of the two approaches to examine the 'priming' effect of the pre-interview. A total of 100 interviews were conducted. Sample A had an even split of males and female, with an average age of 34. Sample B had 24 females and 26 males, with an average age of 32.5. The two populations were not found to be statistically different from each other (at the 95% confidence level) in terms of gender, age or geographic origin (UK/non-UK). Likewise, educational attainment and motivation for visiting the zoo had the same breadth and were not different in both samples.

(2) Cognitive world-maps

After finishing the PMM, visitors were asked to shade a contour world-map to indicate the first place(s) that come to mind when they think of biodiversity. The underlying rationale for this exercise was to examine visitors' spatial conceptions. It was made clear to respondents that this exercise was not to 'test' their geographical knowledge but to capture their perceptions – that is, their 'imagined geographies' (Power 2003) or 'place imaginaries' (Watkins 2015) – of global biodiversity. This particular exercise was extensively piloted to refine the relevant question wording such that responses could be interpreted as spatial elaborations of participants' mindmaps. Preference surfaces were produced and analysed with regards to conservation discourses and the 'exoticization' of biodiversity. If participants named a particular country or ecosystem but could not situate it on the map, it was recorded separately. In conjunction with the above, discourse and semiotic analysis of information panels and live animations were used to understand how the experience of BUGS contributed to shaping visitors' knowledge, beliefs and sense of responsibility to take pro-conservations actions.

While an assessment of how visitors engaged with the exhibit, for example through eye trackers, dwell time, and covert observation, would have enriched the data, these types of measures were difficult to justify in relation to research ethics and were logistically impossible given the resources allocated to the study.

Results and analysis

This section is divided into two parts. The first examines the results from the PMM for the two samples and uses statistical analysis to investigate the priming effect. The second deploys qualitative discourse and semiotic analysis to investigate the experience of the BUGS exhibit. It does so under three emergent themes: perceived proximity of biodiversity; affective responses to BUGS; and human responsibility and agency.

Descriptive and inferential statistical analysis of PMM

Table 1 show the results of the PMM for concept, elaboration, emotion and expertise scores, respectively. Starting with sample A, few respondents scored highly on any of the criteria, with the majority of responses lying in the bottom half of the distribution. The tables would appear to show that visitors improved their scores following their experience of BUGS and, moreover, across all four dimensions. This is confirmed by Table 2 which presents results of paired *t*-tests between the PMM responses of sample A. At a 95% confidence interval (CI), visitors significantly improved their scores in all four PMM criteria and therefore had broader, deeper, more varied, and stronger personal understandings of biodiversity. Scores of PMMs produced before entering BUGS populate sample A1 and scores of PMMs amended after exiting BUGS populate sample A2.

Turning to sample B, the overall impression from Table 1 is that the scores are generally slightly higher than pre-visit sample A1, but markedly lower than the post-visit sample A2. Samples A2 and B are not

Table 1. Number of visitors in each sample to have been assigned each score for range of concepts, elaboration, degree of emotion, and degree of expertise.

PMM score	Sample A – Before visit	Sample A – After visit	Sample B
Concept			
1	7	0	7
2	13	0	11
3	11	3	10
4	6	7	9
5	8	8	5
6	2	10	3
7	2	7	0
8	0	5	0
9	0	7	0
10	0	2	0
11	0	0	0
12	0	1	0
Elaboration			
1	16	1	13
3	9	16	19
4	2	15	5
5	3	8	2
6	1	5	1
Degree of emotion			
0	36	16	31
1	12	18	16
2	2	13	2
3	0	3	1
4	0	0	0
Degree of expertise			
1	5	0	6
2	19	3	19
3	17	13	17
4	9	25	5
5	0	9	3

Table 2. Results of paired *t*-tests between samples A1 and A2.

PMM criteria	*t*-value	*p*-value	Paired mean difference	At 95% CI, ...
Concept	14.52	<0.0001	3.3000	reject H_0
Elaboration	11.27	<0.0001	1.5800	reject H_0
Emotion	7.24	<0.0001	0.7400	reject H_0
Understanding	11.65	<0.0001	1.200	reject H_0

statistically different to each other and the key assumption is that the mean change in understanding of/emotional response to conservation would be the same in both samples had there been no researcher at all. ANOVA of the priming effect (Figure 3 and Table 3) is therefore applicable to these samples A2 and B. For each criterion, because $p < 0.05$, the null hypothesis should be rejected as mean differences between the samples is statistically significant at a 95% confidence interval. What this indicates is that differences between the scores for samples A and B (Figure 3 and Table 3) are attributable to other factors.

The low R^2 values in Table 3 are consistent with expectations of values below 50% in predicting human behaviour. The difference between the two samples is likely due to a multitude of factors, such as time spent in the BUGS exhibit; level of initial knowledge, interest, mood; and whether visitors were with people or alone. A considerable amount of all the variation in an individual's PMM is attributed to the priming effect. Researcher priming had the highest impact on concepts reported and general understanding of biodiversity suggesting that the pre-interview encouraged individuals to pay more attention to information conveyed by the exhibit. Amongst the main criteria, R^2 was lowest for emotional

response, possibly reflecting the fact that affective responses are more reactionary and therefore less strongly influenced by prior contact with the researcher.

Self-reported levels of environmental concern were affected by priming, explaining 4.91% of the variation (p-value < 0.0268). This could be due to either participants inflating their level of concern to please the researcher, or because individuals are genuinely more concerned about biodiversity after having had a discussion about it. Figures 4 and 5 show that there was more diversity in the geographical

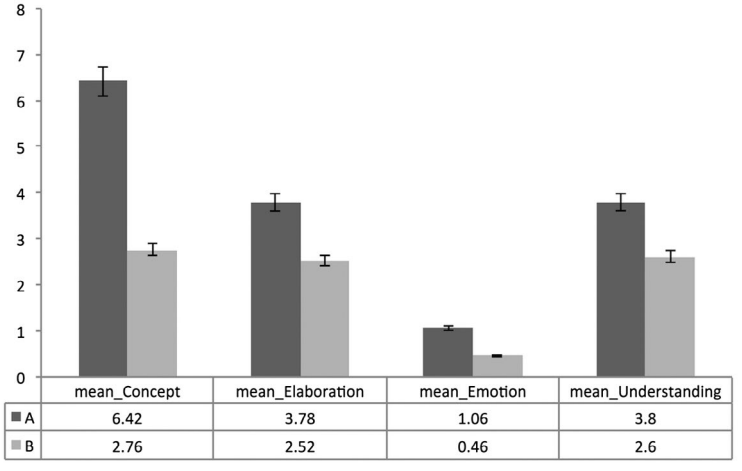

Figure 3. Bar chart of statistically different means between each PMM criteria in samples A and B, with error bars showing 95% CI.
Notes: Concepts and emotions are counts, elaboration is ranked on a scale of 1 to 6, and understanding is ranked on a scale from 1 to 4.

Table 3. One-way ANOVA results between PMM criteria in samples A and B.

PMM criteria	R^2 (%)	p-value	At 95% CI, ...
Concepts	48.95	<0.0001	reject H0
Elaboration	21.72	<0.0001	reject H0
Emotion	12.46	0.0003	reject H0
Understanding	30.00	<0.0001	reject H0

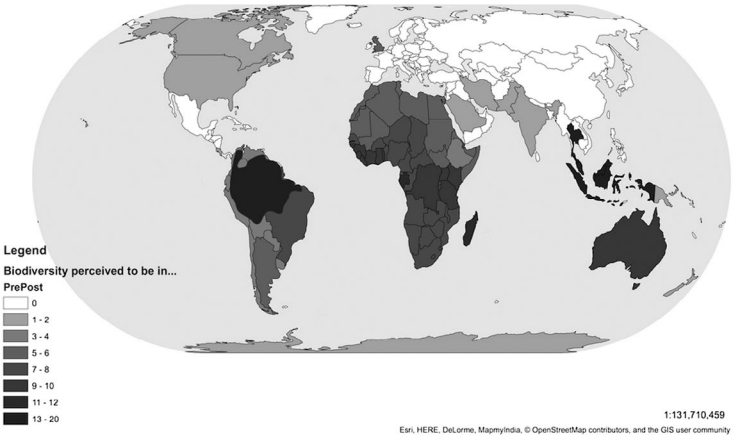

Figure 4. Map showing geographical responses of sample A.

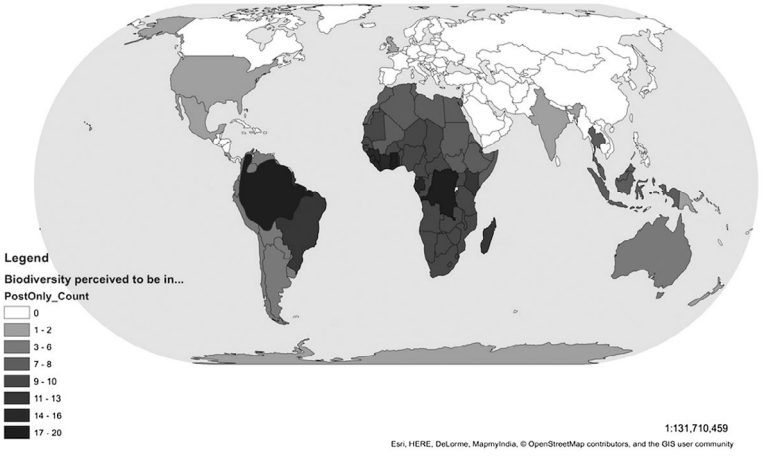

Figure 5. Map showing geographical responses of sample B.

imaginations of biodiversity in sample A than in sample B. This demonstrates that respondents in sample A had likely given more thought to the spatiality of biodiversity, such that when they were asked, they answered with greater variety than the more monolithic responses of 'South America' or 'Africa' of many respondents in sample B.

Perceived proximity and interconnectedness

In the following sections, we use direct quotations from visitors' PMMs and their oral elaborations to enrich the discourse analysis and to allow their voices to come alive in our treatment of them. The quotes were selected from their power to illustrate the themes identified from the data as a whole and from the distinct samples, and are representative examples rather than unique iterations.

Imagined geographies of conservation

The data indicated that visitors felt that biodiversity is 'exotic', to be valued from afar, and is something that does not resonate in their everyday lives, such that direct ways for them to support conservation are lacking. When asked which places first come to mind when thinking of biodiversity, the most common answers were the Amazon, South America, Africa, and Southeast Asia. The significance of these cognitive, imagined geographies of biodiversity is that perceived distance appeared to be a barrier to public engagement with biodiversity conservation (cf. Lorenzonia, Nicholson-Coleb, and Whitmarsh 2007). The exhibit panels did explicitly explain that biodiversity is a global phenomenon, detailing both species in faraway ecosystems, as well as those closer to the UK. One example is a tank that highlights the fen raft spider, threatened in the UK, by the loss of wetland habitats.

Some responses were provided based on personal experiences of forests in India or Ghana, tree coppicing programmes in Nebraska, big mammals of a South African safari, and British woodlands. Interestingly, there were also deductive responses, such as, 'I've been to China and North America; there was no biodiversity there', and, 'the UK is a desert of biodiversity'. However, most visitor responses were not based on places that people had individually experienced, but rather from hearing about them through the media, friends, and family. 'The Amazon' was the most common answer stemming from scientific reasoning that rainforests are the most biodiverse environment (14% of the Earth's surface area but home to 50% of species, according to a zoo panel referred to by some respondents), its 'sheer size', or its threatened status. Some responses were justified by documentaries (especially those of David Attenborough) and Disney films such as Finding Nemo, Madagascar and The Lion King. Five

visitors explicitly mentioned the theme song 'The Circle of Life' (from the latter) as a metaphor for the interconnectivity of biodiversity.

The majority of PMM answers comprised mental images of exotic jungles that were then contextualised by providing a concrete example of the Amazon rainforest or South America in general – sometimes without knowing where it was. Similarly, a few visitors could not locate Africa on the map, but imagined the continent to have the 'wildest' animals. Here, we turn to Shields (2007), who developed the concept of the place-myth, a sense of place that transcends the material and where the cultural is defined through discourse as appropriate or inappropriate for certain beings. This spatialisation influences visitors' relationship to and perception of biodiversity. For example, a common spatialisation of biodiversity is within protected areas as reservoirs providing ecosystem services, as well as supporting economic and social values such as nature-based recreation and tourism. Likewise, as has been demonstrated in the literature, the tropical world is a mental as well as a physical space (Driver 2004; Power 2003). The study of tropicality, alongside other geographical imaginaries such as the Orient (Said 1978), conjures in the Western imagination a singular environment.

Several islands (including Madagascar, New Zealand and the Galapagos) were cited as places of biodiversity. Islands have long captured Western imaginations of the exotic since the eighteenth century (Tuan 1974), and continue to be synonymised with nature in today's tourist brochures and travel literature. The trope of dangerous biodiversity was linked in the interviews to unfamiliar and dangerous places: Australia's venomous spiders and Africa's wild predators. One visitor declared Europe 'safe' and, therefore, lacking biodiversity but facing an influx of 'dangerous, exotic spiders'. This perhaps explains the striking absence of references to the European space, in both samples A and B. The exotic trope was certainly present, with a particularly telling remark that 'biodiversity is supposed to be exotic'. This visitor in question was surprised to learn that the giant spiny starfish in the aquarium is from coastal Britain, as it looked like 'it should be in the Great Barrier Reef or something'.

On exit, over a quarter of respondents in sample A answered that biodiversity is 'everywhere'. At times, this was expressed rather abstractly, that, scientifically, the whole planet is a container for biodiversity. A few respondents were more engaged with their answer, providing concrete examples of how there is life even in unexpected places such as Antarctica, or by relating that the whole concept of biodiversity is linked to its ubiquity and the diversity of habitats and ecosystems. Some specified that biodiversity 'is in my back garden'. Thus, depending on its conceptualisation, the place-myth of 'everywhere' signified proximity as well as distance.

Ecological interconnectedness

A sense of ecological interconnectedness was present in almost all participants' understandings of biodiversity, with more concrete or applied knowledge after exiting the exhibition. Most commonly this was between species, habitats, and ecosystems, with concepts of food chains, adaptations, evolution, natural selection often appearing. BUGS defined an ecosystem as a network of plants and animals together with the sunshine, soil, rain, habitat they depend on. It was this definition that was largely referred to by respondents in sample A, and was generally not derived from pre-existing knowledge. This was often complemented by an appreciation that invertebrates (insects specifically) underpin global survival. That is, even though they are small and seemingly inconsequential, their absence would have knock-on consequences. For example, as one visitor put it, 'trees decomposing is food for bugs, then birds eat the bugs and birds of prey eat the small birds … and that is why there are birds of prey in the UK'. Pre-existing knowledge was built on and refreshed, while examples, scientific concepts and phrasing were often a consequence of the exhibit.

There was also a significantly more deliberated understanding that humans in general and as individuals are part of this ecological interconnectedness. Therefore, despite negative consequences they engender such as disease and agricultural destruction, even humans cannot live without insects as they depend on them and the rest of biodiversity for 'food, fuel, shelter, and clothing'. One visitor expressed this by drawing small organisms connected to larger organisms and eventually humans, with links representing food chains and other ecological relationships. Indeed, size and interconnection were two of

the primary narratives of BUGS. Panels suggested that although pond life is small, it is 'just as exciting as the Serengeti fields of East Africa' and that 'life in the sea could not exist without plankton'. This was extremely well picked-up on, as almost all visitors left with the understanding that if the balance is upset through a species being taken away, the whole ecosystem can fall apart. Expectedly, sample A was more receptive to such information, and had often also thought more about the implications of ecosystem change.

Relevance to everyday life

References in the BUGS exhibit to the everyday lives of visitors include the set-up of some of the vivariums as home environments. Examples include cockroaches in kitchen cupboards, silkworms surrounded by textiles, a house-spider in a bathtub (alongside a Spiderman hanger), and jars of honey next to the beehive. There are also many references to the zoo itself – now part of the visitor's life – as an ark of biodiversity. While these did not resonate with any of the visitors apart from one in sample A who exclaimed that she '[has] spiders in [her] bath too', several other visitors in the same sample drew their own points of references. A bird-ringer recognised that 'creepy-crawlies means there'll be more birds', a frequent traveller noticed one spider was 'a stowaway on a backpack coming from West Africa', and one visitor wistfully remembered his childhood days fishing in rock-pools. The interviewer even received book, film, and documentary recommendations from respondents in sample A. Yet, for the majority of respondents, the exhibit did not appear to relate to visitors' daily lives.

Affective response

Feelings of awe enabled the majority of visitors to value nature, though anxiety and sadness at biodiversity loss were not enough to motivate visitors to adopt steps to support conservation. Fascination was the most common emotion-laden response having experienced the exhibit. This came about, firstly, because there was 'a whole building dedicated to bugs' in a zoo, and secondly, because for many it was the first time to be comfortably close enough to insects – including the more common spiders, maggots, and cockroaches – to have a good look at them. Many visitors expressed the amazement of watching leaf-cutter ants hard at work, or the thrill they got when they finally discerned all the stick and leaf insects. It was 'mind-blowing'. Referring to the acacia tree/ant symbiosis, one 'wouldn't expect insects to have relationships with other species'. The spider walk-through also elicited strong feelings of awe. Such fascination, often found in natural environments, allows visitors to think and reflect on their experience, thereby facilitating meaningful and memorable experiences. The importance of discovery, inspiration and enjoyment in facilitating learning has similarly been identified in previous studies (Packer and Ballantyne 2010).

The zoo expected and sought to quell negative emotions, with signage that 'spiders in the bath mean no harm! They have fallen in and can't climb out' or that 'there are no dangerous spiders in the UK, despite what the media sometimes say'. Feelings of disgust were expressed, especially at cockroaches, rats, and spiders, but mostly visitors expressed fear. The glass separating them from the insects was the only thing that made it 'okay', while the majority of visitors still reported feeling 'itchy' throughout the exhibit because it was 'really creepy'. One visitor reflected that she thought she was scared 'because we don't know a lot about them, it's a fear of the unknown'. However, when asked to think about biodiversity, many of these respondents conjured images of green, luxurious vegetation; a primeval world expressing harmony and synergy ('forests are peaceful, happy places'). This has always been a powerful image of collective imagination (Guarino and Pignatti 2010). Thus, while some negative emotions were provoked by the insects, respondents still contextualised biodiversity as a predominantly positive thing with which to rationalise their reactions: 'I still hate bugs but they are important'.

The aspect that frequently prevented an affective response to BUGS was the scientific modality. Introducing the concept of biodiversity by explaining Linnaean classification was a turn-off for several visitors who had 'left [their] brain at home' and who were immediately reminded of 'biology class, which is not a good thing'. Indeed, two respondents happened to be biology teachers and found that

BUGS closely mirrored the GCSE[1] syllabus and were thus thrown into their professional lives rather than having their fun day out. One example of a particularly familiar panel was that of the peppered moths, a classic example to teach natural selection. While it may cement previously-held knowledge and situate understanding, for a few visitors this was likely the cause of feeling 'like in an exam'. Perhaps because of this disaffection, the UK-based example has not displaced the aforementioned geographical trope of evolution happening in the tropics. Further emphasis on evolution, adaptations, and genetics meant that one visitor felt that biodiversity was not 'real' but a 'scientific concept that occurs in laboratories'.

Human responsibility and agency

The majority of respondents did not talk about human responsibility and agency to conserve biodiversity. The relationship that BUGS seeks to establish with visitors is to convince them that biodiversity is important, and it does this by fascinating and entertaining the visitors. The mode of address throughout BUGS is indirect, probably to avoid being patronising. Whether through the passive voice or by deflecting responsibility from individual visitors, the panels externalise blame for the causes of and solutions to biodiversity loss. The threats themselves are detailed in a passive voice that does not prioritise the human activities that cause them. About invasive species, for example, the panels state that, 'Rabbits are pests in Australia. European mammals have a devastating impact on New Zealand's wildlife' or in the Seychelles, 'rats came ashore from boats'. In contrast, any beneficial human consequences are in an active voice: 'We moved crops and improved our food … We brought potatoes from America to grow them in Britain'. On pollution, signage reads, 'during the Industrial Revolution, buildings and trees became blackened with soot from the chimneys' but now, 'we have cleaned up the air in our cities'; while on habitat fragmentation, it is noted that 'about half of all natural grasslands have disappeared'. Only in the caption of a faded photograph does it explain that 'Grassland [was] replaced by agriculture'. On the panel about past extinctions in Britain, there is no information on the causes of these extinctions. Only visitors who were already concerned about these issues established that the exhibit 'is all about destruction', as one visitor with a PhD in Zoology summarised.

When it does admit human responsibility for environmental problems, the exhibit does not place the onus of sustainability on the individual visitor. There is a list of the ways in which humans affect biodiversity: 'through the loss and fragmentation of wild habitats, overuse of forests, fisheries and wild animals, pollution, global warming'. However, it is up to governments to set fishing quotas for cod, without mentioning that visitors could have a role to play in reducing the demand for unsustainably-caught cod. Through what Butler (1999) termed as denotative transparency, BUGS obscures questions of responsibility and political power, even though these are crucial in engaging people with conservation. There is no appeal to visitors to stop being complicit in habitat destruction, as this is the job of nature trusts. According to the panels, conservation strategy involves, 'maintaining gene pools, using animals, plants, land, and water sustainably, protecting and managing habitats and ecosystems, and educating people to protect threatened species'. The average visitor who does not work in policy-making cannot contribute to any of these efforts and indeed none in either sample mentioned any feelings of individual responsibility.

Respondents that did engage with issues of human responsibility did so due to prior knowledge rather than from the experience of the BUGs exhibit. Visitors were aware that pollution is threatening biodiversity, that climate change threatens rainforests, or that some species are at risk due to invasive species. It was rare for respondents to offer any solutions, though some cited sustainability as an ideal goal. One visitor in sample B elaborated on market incentives to preserve stocks of biodiversity. People were more likely to be engaged when they felt close to the issue. One respondent from Ghana, for example, was concerned about the forests in his home country. One respondent admitted that it was hard to feel worried about the effects of extinction because 'we're so far away from it in London'. In contrast to Ballantyne and Packer's (2005) findings about the importance of visitors' beliefs about their

ability to positively affect change, the only solution that visitors themselves could take on was to 'raise awareness' and to 'change people's attitudes', without having any concrete actions to propose. The visitor who brought up the threat of palm oil plantations to biodiversity did not make the connection to the ubiquity of palm oil in everyday products. She did not realise that she had any agency on the matter, for example, through choosing sustainably-sourced palm oil. Thus, the exhibition does not seem to bring any added value to feelings of responsibility or agency but arguably helps visitors frame prior knowledge around issues of sustainability and conservation.

Conclusion

Through entry and exit PMMs, this study has examined the experiences of visitors at the BUGS exhibit at London Zoo – how they relate to biodiversity conservation, how this interacted with their prior knowledge and if the experience inspired them. By offering multiple face-to-face opportunities with (mostly) invertebrates in a controlled zoo environment, BUGS delivered messages about biodiversity and conservation. Aimed to be accessible to and informative for a broad spectrum of ages, nationalities, and education levels, communication relied on the presence of live animals. Both quantitative and qualitative evidence from the PMM suggested that the exhibit improved the knowledge, understanding and emotional resonance of biodiversity. To this end, BUGS enabled visitors to reflect on prior knowledge, and to relate to nature by fascinating and entertaining them. Yet two important caveats emerged. One is that, without pre-visit priming, the impact of the exhibit was relatively small. Indeed, a handful of respondents in the sample without pre-visit interviews emerged with no understanding of biodiversity whatsoever. Second, the experience of BUGS did not resonate in visitors' everyday lives. Further, while it may have inspired some, it did not enhance self-efficacy nor empower visitors to feel that they could adopt positive measures to support conservation. Of crucial significance, the most meaningful experiences were achieved with researcher priming, as well as the presence of perceived proximity and interconnectedness to biodiversity, an understanding of human responsibility and agency, and a mobilising affective response.

The study highlights the potential value of PMM in evaluating and understanding visitor learning in zoos. Most significantly, the open-ended nature of the elicitation methods wherein respondents are invited to record words, images, concepts, feelings, facts, appeared to be well-suited to allowing individuals to readily communicate their cognitive and affective experiences. The methods used can be transferred to additional zoos and aquariums, and limitations such as the single rater of PMMs should be addressed. Finally, the findings have practical implications. Amongst others, they highlight the importance of going beyond fascinating and entertaining visitors, which alone may be insufficient to evoke pro-conservation behaviours. Instead, there is a need to make biodiversity and conservation appear more locally-relevant, and engender self-efficacy by better elaborating on the ways in which individual actions can meaningfully contribute to conservation efforts. While important, elaborating on practical ways to address the challenge of effectively engaging visitors in local conservation is beyond the scope of the data collected. Indeed, as a proposed avenue for future research, the title question of how visitors relate to biodiversity conservation leads on to one of why certain visitors relate to biodiversity conservation and whether values and attitudes of zoo visitors impact on their experience of certain zoo exhibits and conservation messages.

Note

1. The General Certificate in Secondary Education (GCSE) is an educational qualification taken by secondary school students in England, Wales and Northern Ireland.

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No potential conflict of interest was reported by the authors.

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