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Zookeepers – The most important animal in the zoo?

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ABSTRACT

Education to improve knowledge of animal welfare is not a universal component of training for zoo staff, and little is reported about the perspectives of zoo staff on the need for such education. This paper reports results from structured telephone interviews of a diverse sample of eight Chinese and eight European zoo staff about aspects of zoological animal welfare, education and zoological practices. These qualitative data were thematically analyzed and key themes generated. Similar themes emerged across regions: Zoo staff consider professional attributes including motivation and enthusiasm to be important alongside formal training, zoo staff value learning opportunities but don't always feel supported, and contextual information including wild animal ecology was considered important content in zoo animal welfare education.

KEYWORDS

Zoo; welfare; education; China; europe

Introduction

The role of zoos in delivering conservation education has become an increasingly significant part of their role in society (Mellish, Ryan, Mcleod, Tuckey, & Pearson, 2021; Nygren & Ojalammi, 2017, Patrick & Caplow, 2018) and the importance of good animal welfare and modern husbandry practices has been recognized in supporting this aim (Whitehouse-Tedd, Spooner, & Whitehouse-Tedd, Whitehouse-Tedd, et al., 2019). Additionally the keeper–animal relationship is increasingly recognized as a factor that may significantly influence the welfare of zoo animals (Birke, Hosey, & Melfi, 2019; Carlstead, Paris, & Brown, 2019; Hosey, Birke, Shaw, & Melfi, 2018; Hosey & Melfi, 2014). In order to effectively achieve the goals of zoos, it follows that staff responsible for animal care should be knowledgeable about advances in animal welfare and husbandry practices. Despite this, formal education in animal welfare has not always formed part of zookeeper training, e.g. ethics, and welfare was only introduced to the UK zookeeper training programme in 2017 (Biaza, 2018) and no formal training of zookeepers exists in China. Barriers including the English language literature bias (Goulart et al., 2009a) and a lack of knowledge (Melfi & Hosey, 2011) have been suggested to limit zoo staff education in other parts of the world. Whilst concepts of animal welfare may be well understood by zoo professionals from different countries, the application of good standards of husbandry to achieve welfare does not always occur (Agoramoorthy & Harrison, 2002; Bacon et al., 2021; Blackett, Mckenna, Kavanagh, & Morgan, 2017) and the relationship between knowledge of a subject and workplace behavior remains complex (Ajzen, 1991; White & Rogers, 2017).

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Zoo animal welfare education

Most zoo staff training relies on 'on-the-job' training, even though it may not be more effective than formal training at increasing knowledge or interest in zoo animals (Johnson, 2018). Thus, it may be important that vocational on-the-job-experience is supported by more formal education in order to ensure sufficient knowledge of, and positive attitudes toward, zoo animals (Bacon et al., 2021; Ward, Melfi, & Pritchett-Corning, 2015). In other animal use industries, such as the laboratory animal community, improvements or "refinements" in animal care have been introduced through a comprehensive and holistic educational approach, including training programmes in animal welfare (Prescott & Lidster, 2017). In Europe, animal research institutions have adopted a "culture of care" philosophy underpinned by five key areas of activity: Company values, strategic approach in the establishment, implementation structures, staff support, and animal care (Robinson et al., 2020). International zoo associations have developed some initiatives and policies to encourage the implementation of ethical zoo practices and good standards of zoo animal welfare (Chinese Association of Zoological Gardens, 2012; European Association of Zoos and Aquaria, 2020; Mellor, Hunt, & Gusset, 2015), but such guidance is not always supported by on-the-ground education of zoo staff. Increasingly, however, zoological associations are developing educational resources, e.g. the European professional zookeeper qualification framework was developed as an initiative to standardize zookeeper training across a range of subject areas including animal behavior, animal welfare and aspects of animal housing and husbandry (European Professional Zookeeper Qualification Framework, 2018).

Workplace learning in adults

The art and science of helping adults learn is the definition of andragogy or adult learning theory (Fidishun, 2012). Developed by Knowles, the theory of adult learning comprises six principles (Knowles, Holton, Swanson, & Robinson, 2020) comprising the purpose of learning, acknowledgment of previous experience, control over learning, real-life problem-solving, goal-oriented and internally motivated. The primary drawback of Knowles' theory of andragogy is that it overlooks the contextual, experiential and cultural factors which may influence learning. The relevance of the learning environment to the learning experiences is something which has been described as situated learning or situativity theory (Durning & Artino, 2011), and it is of particular importance to workplace learning in adults. Situated learning occurs when the learning process is embedded in a context that strongly resembles real-life applications (O'brien & Battista, 2020). As most zoo staff learn on-the-job from colleagues and within their own zoo's "cultural norms", their learning is often situational and thus likely dependent upon zoo-specific socio-cultural factors, as well as andragogy (Burton, Peoples, & Cooper, 2012; Durning & Artino, 2011; Fenwick & Tennant, 2004). This has also been demonstrated in animal industries where industry-specific culture may act as a barrier to improved animal welfare (Burton et al., 2012; Coleman & Hemsworth, 2014). Thus, understanding the need and context for zoo staff education is a necessary first step in developing effective education (Knowles et al., 2020).

Zoos and their staff exist around the world in a variety of geographic and cultural contexts. To evaluate similarities and differences in training needs of zoo staff, a diverse international sample was selected comprising zoo staff from two culturally, linguistically and geographically different regions (China and Europe). The regions were selected as each has its own structured regional zoo membership association that has developed policies supporting zoo animal welfare but each represents different cultural contexts. China is more uniform in terms of language and culture, and remains linguistically and politically isolated from animal welfare literature (Goulart et al., 2009a) and the international zoo animal welfare community. In contrast, Europe is linguistically and ethnically diverse, and generates significant zoo animal welfare literature (Binding, Farmer, Krusin, & Cronin, 2020) with close connections to other regional zoo

associations. This study aimed to investigate the opinions of zoo staff from a range of job roles in zoos to animal welfare educational opportunities and barriers.

Materials and methods

Ethical approval for this project was obtained from the Royal (Dick) School of Veterinary Studies student survey group, at the University of Edinburgh. This paper reports results from a larger mixed methods research project aiming to characterize the perceptions of zoo staff in Europe and China on zoo animal behavior, welfare and educational practices.

Qualitative research is multifaceted and attempts to capture the richness of data through the experiences of people (Braun & Clarke, 2013). The critical realism ontology seeks to understand the causal entities of real-world events and specifically, examines the relationship between human agency and societal structures (Houston, 2010). It considers that true reality sits behind the subjective and variable perspective of the researcher. The "reality" will be nuanced by the perspective of each researcher, but that this perspective allows the researcher to access part of that reality (Braun & Clarke, 2013). It emphasizes the importance of diverse viewpoints through the belief that viewpoints on reality are partial (Peggy, 2015) and that the world cannot be changed rationally unless it is interpreted adequately (Corson, 1991). With this in mind, a sampling matrix was used to ensure a maximum purposive sample and interviewees comprising living collection zoo employees working in zoos in Europe (EU1-EU8), or zoos in the People's Republic of China (CN1-CN8). Interviewees were recruited through professional networks, e.g. via contacts on zoological committees, or through connections made during professional activities, such as CPD delivery and were only invited for interview (voluntary) if they fit within the sampling frame of staff currently working in or with zoos (i.e. as zoo-focussed consultants/technical experts or vets), in China or Europe that were able to influence through their daily duties or through line management structure, for animal management decisions, or animal health or husbandry activities. A maximum purposive sample of job roles including keepers, senior keepers and curatorial staff, veterinarians and biologists/consultants/industry experts, and zoo directors were selected for interview in each region to ensure that perspectives across a range of zoo staff were captured.

Interviews

Structured interviews were selected to minimize the potential for confusion in terminology or context of questions in a diverse international sample. The interview script was structured in three sections: 1. Demographics and zoo perceptions, 2. animal welfare knowledge and education, and 3. controversial zoo practices.

All interviewees gave informed consent to participate in the project. The Chinese interview script was back-translated and the script was piloted with a Chinese and a European zookeeper. Piloting ensured the script was clear and covered the topics of interest. Based on piloting, the interview scripts were refined to reduce question numbers as the interview duration was over 40 minutes long, and minor edits in were made to the script to reduce the need for any verbal clarification of questions, but the content of the interview script was not substantively changed after piloting.

The interviews with European participants were delivered by telephone in English and the responses recorded in English for direct transcription. Chinese interviews were also conducted on the telephone via a translator who read from a Chinese script to the Chinese interviewee and verbally back translated their responses into English, which was also recorded. The recorded interview responses were transcribed professionally (University Transcriptions). These responses were cleaned, with contextual information added in square brackets to ensure clarity of meaning. At no time was the meaning of the text changed, nor were any errors in grammar or syntax corrected. Transcribed interview data were cross-checked against the original audio recordings for accuracy.

Eight European and eight Chinese zoo staff from a range of job roles (Keeper to director) and from a range of places (UK, Denmark, Greece, Latvia, Romania, Spain, Jiangsu, Sichuan, Shangxi, Beijing, Fujian and Qinghai). Interviewees were interviewed for a period of 25–45 minutes. Interviews were continued until saturation of coding occurred. Interviews were conducted as described above and whilst the script was followed, interviewees were encouraged to expand on points of interest. Recorded interview responses were transcribed professionally (University Transcriptions) and responses were cleaned, with contextual information added in square brackets to ensure clarity of meaning. At no time was the meaning of the text changed, nor were any errors in grammar or syntax corrected. Transcribed interview data were cross-checked against the original audio recordings for accuracy.

The interviews were divided into European and Chinese data sets and analysis conducted within these datasets. Each dataset was thematically analyzed by coding for emergent themes arising from each interview script and coding for *a priori* codes derived from research questions. Thematic analysis reduces and analyses data through the segmentation, categorization, summarization, and reconstruction of qualitative data, focussing on capturing the important concepts from the data set (Given, 2008). Coding was computer assisted using NVIVO 11 (QSR International (UK) Limited) for coding of each interview script (within-case) and one script from each region was cross-coded to ensure consensus on emergent nodes. Each dataset was then manually coded by interview question (across-case) to assess any similar and differing spontaneous responses arising from the interview prompts. At the end of this analysis the pilot interview data were found to be consistent with their datasets and were included within the sample. The coded data were then grouped into themes and the themes emerging from each geographic region compared.

Results

The themes relating to interviewees' perceptions of the skills and attributes that are important to zoo staff, their training needs and barriers are reported below with illustrative quotes. The themes were common to both study regions.

Theme 1. Zookeepers – the most important animal in the zoo

A primary theme that emerged from the interviews regardless of their own job role was that of zookeeper attributes. Interviewees from both regions discussed "soft skills" or attributes that they thought were necessary to being a successful zookeeper and in ensuring good zoo animal welfare. One European interviewee outlined his thoughts on the important characteristics of zookeepers, including practical skills, knowledge and empathy:

> "the best animal keepers, if you like, combine two things. One is the compassion and care for animals and an understanding of their needs, so there's a degree of biological scientific training, but also that magical stock-manship thing. But also practical common sense, self-organisation built in as well. … the key thing is a genuine vocation for caring, looking after animals and the requisite knowledge." (EU7)

However the "stockmanship" was not considered to be ubiquitous in European zookeepers, and in fact one European interviewee suggested that keeper–animal interactions should be a training priority, as not many keepers understood the impact that their own behavior could have on their animals. This suggests that whilst the characteristics of good zookeepers might be well understood, they aren't necessarily inherent within the zookeeping community and could thus form a useful part of zookeeper education:

> "I think priority is human-animal interaction because a lot of keepers that you talk to, they understand the terms enrichment and training … Whereas not many people you speak to actually think about how they are around their animals and how their behaviour affects their animals and what they could do to improve that." (EU6)

Within the Chinese interviewee cohort, professional knowledge and personal characteristics were also important. It was suggested that staff motivation was an important element alongside professional or technical knowledge, indicating that in China, maintaining the enthusiasm of keeping staff may be a challenge.

> "I think the most [important] is the professional knowledge of their own job, but I don't know how to keep passion and enthusiasm of staff" (CN5)

> "Motivating keeper's activity is the most important. We do not lack methods of doing something, we need keepers' activity and motivation to do it." (CN7)

And one interviewee even suggested that a sense of responsibility was more important than knowledge of animals, as perhaps it is easier to train technical knowledge than cultivate personal attributes.

> "Responsibility should be the first priority, then professional skills such as how to keep animals" (CN6)

The empowerment and motivation of zookeeping staff may not be a problem that is unique to China. One European interviewee also indicated that the role and value placed upon zookeepers across Europe may vary, something that could in turn influence their motivation for their work. Another European interviewee stated that the professionalizing and ongoing development of zookeepers was important, and that not all would have the right attitudes, or be valued in their roles, indicating similar concerns to those raised by Chinese interviewees.

> "From what I've heard over in Eastern Europe it's kind of seen as somebody who has absolutely no academic ability. It's like, what do I do, let's go and muck out animals. I think it's very different across Europe" (EU4)

> "to be honest, ongoing and professionalising, if you like, of zoo keepers is really important. So recognising in every sense the skills that they have and providing career development. The counter point to making sure that those who don't have the right attitude or standards don't continue." (EU7)

Interviewees from both Europe and China also indicated that they themselves valued self-directed learning and knowledge-seeking as important attributes of themselves and as important in supporting colleagues and providing good animal care. Several interviewees noted ways in which they had engaged in self-directed learning to enable them to provide better zoo animal welfare.

> "I'm trying to learn as many things and as much as I can, so I'm planning for example to visit the Barcelona Zoo for a week and to work with the curator and then to go again to Chester to work with the curator and maybe to Edinburgh, but we'll see." (EU8)

> "one of the animal welfare courses I put myself through, as part of the training for my job, I think that would have been very beneficial but I sort of had to go out and find it myself. So, I think probably most people wouldn't necessarily do that or have the money to do that." (EU6)

> "We have some internal training, such as our colleagues who have been to other workshops and conferences sharing their experience, the content includes behaviour observation, enrichment, training, animal talks. Possessing relevant knowledge can help improve our work, and is good to animals, too." (CN8)

> "It [education] may extend knowledge, deepen understanding, and increase awareness. I have to know something before I can guide others" (CN7)

Overall, this theme indicates that in addition to technical knowledge and skills, zookeepers are expected to demonstrate a range of attributes including enthusiasm for their work, positive attitudes toward animals, and a desire for continuing education.

Theme 2: The structure and context of education matters

This theme explores zoo staff's perspectives on who within the zoo might benefit from future education/training to improve animal welfare, and what sort of content the interviewees feel is

important to include. Interviewees also reflected on their own training and discussed what might have been useful to them at the start of their zoo career.

Interviewees from both regions felt it was important that all staff responsible for animal care received training in zoo animal welfare, both to generate support from across the institution in improving welfare, and to ensure that everyone had an evidence-based rather than intuitive idea of what animal welfare is.

> "I do think we all should be targeted with specific continuing education for animal welfare, because even in those areas where you're supposed to be doing this stuff, most of it has not been formatted in a proper formal way and we're dealing with it more in an intuitive way, than actually scientific." (EU3)

> "All staff should be targeted at, for management level, they need new ideas, and for the front-line staff, they need new technique, or skills." (CN7)

Another commonality between the Chinese and European reflections on their early careers was the need to have to learn "on the job" and a lack of structure during those experiences.

> "Definitely general stuff about working in a zoo, because I have no idea and my director and chief have no idea, and they used to ask me what I'm there for because they only hire me because the law require it but they have no idea why they need it" (EU1)

> "Training, there's sort of induction, orientation, background, and training has connotations of more of a formal or structured training thing, whereas a lot of what I did was having to learn on the job." (EU7)

> "No formal training, only simple orientation. When I came here, I was led by older staff to my post. I think the training should be omnidirectional, such as understanding of the post and animals. There are so much content, and so many things we need to learn by ourselves" (CN8)

Responses differed between regions on these reflections. European interviewees each provided ideas that were relevant and specific to their own job role rather than making general recommendations about training for work within the zoo – this perhaps reflects the more specific and distinct roles that staff within European zoos may hold.

> "Well some kind of training school, I mean where I learn all of the learning terminology and how to train the animals, I mean, how the learning theory is" (EU2)

> "Veterinary residency, zoo vet residency programme. That's actually what we're trying to set up now" (EU3)

> "Basic biology, and of course in terms of ornithology basic biology of birds and bird behaviour and animal behaviour in other aspects. Some breeding or incubation basic things, how to handle your chicks and how to incubate and how to have protocols and work with protocols" (EU8)

By contrast, in China, responses often suggested more general animal care skills, and focused on a need for practical skills. This may reflect the more basic animal husbandry educational needs within Chinese zoos and a need for practical skills.

> "First of all is Daily wildlife keeping management, including how to observe, animal behaviours, how to distinguish normal and abnormal, how to manage animals diet or nutrition and enrichment" (CN1)

> "I think the best one is the one I participated in at AAF bear centre training in 2011, hands-on training" (CN5)

> "The most important training would be practice such as observing how to deal with animals step by step" (CN6)

Staff from all job roles and across both regions (5/8 European and 5/8 Chinese interviewees) had similar viewpoints on the importance of including animal ecology/natural history in any future training to improve the welfare and husbandry of zoo animals. This perhaps reflects the disconnect that is sometimes seen where zoo animals are considered distinct from their wild counterparts, and so zoo staff may focus on providing captive care without perhaps understanding the importance of the animal's natural history in effectively providing for its needs.

> "I think the most important is the basic knowledge about all animals, not limited to the animal you are responsible for, not all the staff are very familiar with all types of animals so this is the biggest problem" (CN2)

> "For me the first is animal biology and behaviour." (EU8)

This was echoed to some extent in the suggested training need of understanding and providing for zoo animal welfare needs. Different respondents across both regions phrased this training need differently, with some focusing more on understanding the ecology/natural history of the animal, whilst others focussed more on providing resources or learning about husbandry activities. These slightly different approaches show that whilst the core information important to training is similar across both regions, the interviewee perception of how this is framed may vary within each region. Some zoo staff appear to be looking at animal husbandry through a more human-centric lens of "provisioning," e.g. of enrichment, food, enclosures etc. whilst other zoo staff are looking through a more animal-centric lens of "providing for animal needs" by accommodating natural behaviors, ecologically appropriate nutrition and environments etc.

> "I would say teaching them about the natural behaviours. But again, not the natural environment that the animal's necessarily in but again pulling out those behaviours. Yeah, I would think the main thing would be, so what are these animals actually doing in the wild." (EU4)

> "The most important is training in their natural behaviour such as their habits and natural environment" (CN3)

> "let's say, in zoo system, in enclosures, in feeding, in training, in enrichment, in capturing and in transporting and well, all these subjects" (EU5)

> "Behaviour observation is the most important, how to make enrichment tools, safety training, zoonotic disease control" (CN1)

In this theme, both Chinese and European interviewees felt that all animal care staff would benefit from animal welfare education, and that there had been a lack of structure or specific training in preparing them for their own careers in the zoo. When making recommendations for training, interviewees from both regions felt that an understanding of animal ecology was important in improving animal welfare, though European interviewees focussed more on job-role specific training whilst Chinese interviewees discussed more general animal husbandry techniques. Interviewees from both regions discussed animal husbandry education in terms of either animal-centric or human-centric perspectives.

Theme 3: Barriers to zoo staff education in animal welfare

Interviewees from both Europe and China raised challenges of finances and time to support training. Additionally, obtaining management support for education in animal welfare education for zoo staff was raised as a barrier by interviewees from both regions. Regardless of whether this lack of management support is real or perceived, these responses indicate that there is not a clear institutional culture of placing value on animal welfare training for zoo staff in either region.

> "Staff, money, actually being allowed into the zoo to do the training in the first place. So actually persuading management in some cases that it is a valued use of their staff time, I think is really important." (EU4)

> "If the management do not recognize animal welfare, then the animal welfare can not be improved, and only everyone reaches agreement, can we do things well" (CN8)

Alongside money, one of the Chinese interviewees also suggested that staff motivation to engage in education was a barrier to delivering zoo animal welfare education. This echoes some of the Chinese interviewee responses described above about motivation and responsibility being important elements of staff training.

> "The first barrier would be the funding limit, we do not have enough funds, besides the passion or activity of staff is a problem, not all staff will accept animal welfare ideas and so animal welfare work will take more time, and some staff will also have no willingness to participate in any kind of training" (CN6)

In addition keeper time was also raised by interviewees from both regions as being a barrier to delivering animal welfare education to keepers, keepers were considered busy and with limited time for ongoing education, and European responses indicated that continuing education was something that keepers have to sacrifice their free time for – something which echoes the keeper attributes described above.

> "Time, this is the main reason, the workload for keepers is comparatively large" (CN1)

> "Pobably the online would be the most cost effective way of doing it, but you've still got the limitation of keepers don't have a lot of free time in their day. With the animal courses, for example, they have to do it at home in the evenings or on their days off. So they're not necessarily in the right frame of mind to want to sit down and study hard." (EU6)

An additional barrier was raised by an Eastern European interviewee was that of access to educational resources, with the English language bias being cited as a barrier to zoo staff education. This highlights the requirement either for greater translation of existing materials, or for education and empowerment to develop regional/national resources in local languages. This lack of resource also echoes one of the comments made in the previous theme about the differing societal values placed upon the role of zookeepers in different countries across Europe.

> "the keepers they don't understand English, because of this the internet is kind of useless for them, because on Romanian websites you cannot find anything about zoo caring stuff so they cannot learn in Romanian, and because they cannot understand English, all the information on the internet is useless for them." (EU1)

Overall the barriers to delivering animal welfare training to zoo staff appear to be a mixture of resources (time, money, language-appropriate resources) and human characteristics (interest, motivation). The human barriers mentioned triangulate with the theme one on desirable attributes of zoo staff and so it may be that staff selection as well as educational opportunities and resources need to be considered when developing zoo staff training.

Discussion

This paper reports the three themes relating to education and attributes that emerged from structured interviews with a sample of European and Chinese zoo staff. The staff interviewed across both regions demonstrated the characteristics outlined in the theory of adult learning (Knowles et al., 2020): All interviewees thought that animal welfare education was relevant and important to the work of staff within zoos and all were keen for further training with several motivated to undertake self-directed education outside of their workplace. Several interviewees from both regions reported a lack of structure in their training for their jobs, and despite their commitment to self-directed learning, it was clear that the interviewees did not necessarily feel supported by their institutions in furthering animal welfare institutionally. Similar challenges are recognized in the laboratory animal industry where developing a "culture of care" has been suggested as being important in supporting good animal welfare and staff morale. Culture of care has been described by (Norecopa, 2020) as: "A Culture of Care is one that demonstrates caring and respectful attitudes and behaviour towards animals and encourages acceptance of responsibility and accountability in all aspects of animal care and use. This should go beyond simply having animal facilities and resources that meet the minimum requirements of the legislation."

A similar approach has been suggested in the zoo community with a universal framework for animal welfare including organizational culture proposed (Kagan, Carter, & Allard, 2015; Mellor et al., 2015). However, it is clear that global challenges in providing a culture of care in zoos, including understanding of animal behavior, providing for positive mental states and safeguarding human well-being still exists (Ward, Williams, Groves, Marsh, & Morgan, 2020). Additionally, a previous study highlighted the lack of senior leadership knowledge of and support for good animal welfare in China (Bacon et al., 2021) and this challenge may also exist in other locations. This study

suggests that management support for animal welfare education in zoo staff may be one barrier to progressing education and a culture of positive animal welfare in zoos, alongside other barriers, such as time, language, and finances, that were discussed in this study and that have also been suggested in other countries (Ward et al., 2020).

In particular, the personal attributes including enthusiasm, a sense of responsibility, a desire for information-seeking, and professionalization of keeping staff were discussed by interviewees. Many of these attributes were apparent in the staff interviewed, but clearly did not exist across all zoo staff, as reflected in comments made about zoo staff with the wrong attitudes or a lack of motivation for the job. It has been suggested that zookeepers in the USA feel a strong sense of "calling" or moral duty toward their work (Allen, 2015; Bunderson & Thompson, 2009). However, this characteristic was not statistically related to how meaningful they found their work, perhaps indicating a disconnect between aspiration/emotional connection and the practical reality in the daily work of zookeepers (Allen, 2015). This sense of moral duty may also result in zookeepers feeling obligated to sacrifice personal time for their jobs (Bunderson & Thompson, 2009) – something that was reflected in the commitment to self-directed learning shown by the zoo staff across both regions in this study. Zoo staff across both regions appear to value positive human-animal relationships, enthusiasm for their work, knowledge-seeking, and a sense of responsibility and professionalization. Stockpersonship has been described comprehensively by Hemsworth in the farm animal literature as comprising capacity, willingness and opportunity. This study explores capacity, which includes the skills, abilities and knowledge that are important in stockpersonship, and willingness including motivations and attitude (Coleman & Hemsworth, 2014). In the zoo context, stockpersonship has been described as comprising just species knowledge, and a positive attitude toward animals (Ward et al., 2015), and whilst these elements were also echoed in the interview responses in this study, the themes that emerged aligned more closely with those described by Hemsworth and Coleman as willingness (zoo staff attributes), capacity (content and delivery of education) and opportunity (barriers institutional support, time and money).

The natural history or ecology of zoo animals was suggested as an important part of animal welfare training by interviewees from both regions. This is interesting as wild animal ecology and behavior is not something that always forms part of the primary training of zookeeper, and even in the new framework, it's inclusion is limited only to a single learning outcome (European Professional Zookeeper Qualification Framework, 2018). The consensus of the importance of ecology of zoo animals to animal welfare reinforces the common understanding of animal welfare that appears to be shared within this community (Bacon et al., 2021).

Whilst species-specific behavior is usually incorporated into animal welfare curricula, wider natural history and ecology is often not – perhaps because most of these curricula are designed to focus on domestic animals (Boo & Knight, 2005; Lord et al., 2017). The importance of ecology to animal behavior and welfare is clear when considering non-domesticated animal needs (and is also important to domesticated animals), and has been raised over the years as an essential component of good zoo animal husbandry and welfare (Hediger, 1955, 2013; Kroshko et al., 2016). More recently, the importance of evolved behavioral drives and the neurobiological basis for affective states has been incorporated into animal welfare models (Mellor, 2012, 2015; Panksepp, 2011). There is increasing recognition of the role of chronic behavioral frustration, and failure to cope with captive environments, in negatively influencing zoo animal health and welfare. For example, carnivores with larger home range sizes are at greater risk of developing pathological behaviors, and increased neonatal mortality, whilst Asian elephants are at risk of decreased longevity when held in a captive setting (Clubb & Mason, 2003; Clubb et al., 2008; Kroshko et al., 2016). A study by (Ward et al., 2020) supports these findings, by showing that in zoo welfare assessments, many zoos scored poorly in the "animal behaviour" metric and this was also highlighted by another recent international study on welfare assessment in zoo bears where scores in the "behaviour" section of the assessment were lower than in the physical or environmental sections (Maher, Gibson, Dixon, & Bacon, 2021). Thus, it seems sensible that animal welfare training of zoo staff should also incorporate

elements of species-specific ecology and natural behaviors that impact on zoo animal welfare. The prevalence of animal welfare challenges relating to ecology and behavior in zoo animals and the need for training on this topic identified by interviewees highlights the importance of the workplace context in education, and the value of situativity and application of knowledge to address real-world problems in adult education of zoo staff.

When describing specific topics for inclusion in zookeeper education, interviewees responded in one of the two ways – either listing subjects that are categorized in relation to the human viewpoint of captive management, e.g. enrichment, training, transport, enclosure design, or describing animal-focused behaviors and needs, e.g. species-specific behaviors, natural habits etc. This latter perspective aligns with the focus on the importance of understanding ecology to zoo animal welfare, whilst the former likely reflects a greater focus on the tasks and responsibilities that zookeepers are engaged in. The latter perspective has been described as "behavioural husbandry" (Poulsen *pers comm*. 2011) where the animal is the primary focus and the daily, weekly and seasonal husbandry routines are built around the animal's natural habits and behaviors (Bacon, 2018). This differs to the more traditional approach to zoo animal husbandry, which focuses on the zookeeper's activities during the working day. An example illustrating these two perspectives is that of environmental enrichment. Traditionally, environmental enrichment for zoo animals has been categorized according to human-defined parameters, e.g. shapes of five categories of enrichment (The Shape of Enrichment, 2011). These categories aim to add variety to enrichment programmes for zoo animals and may be successful at doing so (Swaisgood et al., 2001), but the categories are really only meaningful from the human perspective – they do not reflect the value that different species may place upon different types of enrichment. For example, surface swimming "toys" are commonly provided to cetaceans and appear to comply with an anthropocentric view of enrichment, but are actually unlikely to be effective for the enrichment of highly cognitive cetaceans (Brando, Broom, Acasuso-Rivero, & Clark, 2018; Clark, 2013). Goal-based enrichment that provides for species-specific behavioral needs (Hamilton, Fuller, & Allard, 2020) may be more successful than simple novelty. Whilst selecting an enrichment technique from each human-defined enrichment category may add variety and novelty, it does not always consider whether this variety is behaviorally or ecologically meaningful to that particular species. For example, maned wolves benefit more from foraging enrichment than novel object enrichment (Cummings, Brown, Rodden, & Songsasen, 2007). As zoo animals have a need to exhibit highly motivated and evolutionarily conserved behaviors that are linked to neurobiological reward systems (Mellor, 2015), it follows that enrichment which provides opportunities for these behaviors (animal-centric) may be more successful than simply the provision of human-centric categories that offer variety and novelty (Bacon, 2018). These interviews indicate that both animal-centric and human-centric perspectives occur across a variety of zoo staff in relation to zoo animal husbandry activities and so both of these perspectives should be accommodated and explored in zoo staff education.

This study has several limitations. As European interviews were conducted in English, only interviewees with good spoken English comprehension could be interviewed and so may be influenced by the educational attainment of this sample. Chinese interviews were translated and whilst efforts were made to limit any misunderstanding or misinterpretations (by translating and back translating the interview script, and using experienced translators in the interviews), the possibility of translational errors cannot be entirely eliminated. Whilst these limitations may limit the generalizability of the findings reported in this paper, e.g. to more well-educated zoo staff working in Europe, they still provide valuable insight into the educational needs of international zoo staff on the subject of zoo animal welfare.

Conclusions

This study fills a gap in the published evidence and provides useful insight into the characteristics and perspectives of zoo staff across Europe and in China for animal welfare education. Zoo staff

valued professional attitudes including motivation and enthusiasm, and engaged in self-directed learning, but raised concerns about a lack of management support for education, time and money, as well as language barriers as challenges to effective animal welfare education for zoo staff. Staff working in zoos support a more structured and situative approach to zoo animal welfare education including animal behavior and ecological aspects, highlighting the importance of the context in which animal welfare education is applied in the zoo. We recommend zoo leadership engage and appropriately resource animal behavior and welfare training for their staff, and that professional education for zoo staff includes comprehensive information on ecology and behavior of zoo species alongside more traditional animal welfare education.

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