Zoo Animal Welfare: The Human Dimension

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Standards and policies intended to safeguard nonhuman animal welfare, whether in zoos, farms, or laboratories, have tended to emphasize features of the physical environment. However, research has now made it clear that very different welfare outcomes are commonly seen in facilities using similar environments or conforming to the same animal welfare requirements. This wide variation is almost certainly due, at least in part, to the important effects of the actions of animal care staff on animal welfare. Drawing mostly on the farm animal literature, we propose that this “human dimension” of animal welfare involves seven components: (1) positive human–animal interaction, (2) consistency and familiarity of keepers, (3) treating animals as individuals and taking account of their personalities, (4) the attitudes and personalities of keepers, (5) the keepers’ knowledge and experience, (6) the keepers’ own well-being, and (7) the influence of facility design on how keepers and others interact with the animals. We suggest that attention to these human factors provides major scope for improving the welfare of animals in zoos.

Introduction

As concern about the welfare of nonhuman animals in captivity increased during the past half-century, an initial response—starting in the 1970s for animals on farms and then spreading to animals in zoos and laboratories—was to develop standards and regulations based mostly on the environments in which animals are kept. Key variables have traditionally included space allowance, air quality, noninjurious surfaces, and the availability of environmental enrichment and other features that animals use for comfort, security, or occupation. This emphasis on the environment arguably grew out of the much earlier tradition of laws that tried to protect workers in factories by requiring safer and healthier factory environments (Fraser, 2014).

However, the focus on the animals’ environment has proven to be a very incomplete response to animal welfare concerns. This is especially clear in food production where numerous studies have shown a wide variation in basic welfare outcomes even when animals are kept in similar environments or conform to the same animal welfare standards (Fraser, 2014; Main, Whay, Green, & Webster, 2003). As just a few examples, one study showed that neonatal mortality on 39 pig farms in Norway ranged from 5% to 24% even though the farms conformed to the country’s animal welfare requirement for open housing (Andersen, Tajet, Haukvik, Kongsrud, & Bøe, 2007); a study of 80 dairy farms in Austria found that the percentage of lame cows ranged from 0% to 77% even though all the animals were kept in unrestricted housing (Rouha-Mülleder et al., 2009); and a study of 114 chicken flocks, all with open-barn housing and litter floors, showed bird mortality ranging from 1.4% to 14% and impaired gait ranging from 0% to 90% of the birds (Dawkins, Donnelly, & Jones, 2004).

A few studies have pointed to comparable evidence from zoos and aquaria. One study, which recorded stereotypic behavior of African (Loxodonta africana) and Asian (Elephas maximus)
elephants in 39 zoos, all accredited by the Association of Zoos and Aquariums, found that abnormal behavior ranged from 0.5% to 68.1% of the animals’ active time (Greco et al., 2016). Similarly, a study of 55 polar bears (Ursus maritimus) housed in 20 zoos showed that stereotypic pacing varied from 0% to 49% of locomotor time (Shepherdson, Lewis, Carlstead, Bauman, & Perrin, 2013). Measures of basic health and biological functioning also have shown wide variation; in a study of black rhinoceroses (Diceros bicornis) in 19 zoos, Carlstead, Fraser, Bennett, and Kleiman (1999) found that breeding success ranged from 0% to 21% and the mortality rate ranged from 0% to 10%. Thus, what Barber (2009) called the “welfare potential” of a facility—as assessed by features of the environment—may not lead to uniformly good welfare outcomes.

Given such variability in outcomes, one response has been to develop standards that focus on “animal-based” measures rather than features of the environment (Main, Whay, Leeb, & Webster, 2007; Whitham & Wielebnowski, 2013). However, many animal-based criteria reflect basic health conditions that can be assessed readily from records or by brief inspection of the animals (e.g., Barber, 2009; Main et al., 2007), whereas other important indicators of animal welfare—such as play, affiliative behavior, and signs of contentment—are more difficult and time-consuming to monitor.

A second response has been to recognize the crucial role of keeper behavior and other human factors as major determinants of animal welfare. Indeed, thanks to the lead of Paul Hemsworth and others, human factors are becoming increasingly recognized as important determinants of animal welfare (Hemsworth, 2003; Hemsworth & Coleman, 2011).

But what exactly are the key elements in this “human dimension” of animal welfare? In this review, using mostly farm animal literature as background, we propose three clear elements, namely: (1) positive human–animal interaction, (2) consistency and familiarity, and (3) treating animals as individuals. We also highlight aspects of the human dimension that are less well established: (4) the attitudes and personalities of keepers, (5) keepers’ knowledge and experience, (6) the well-being of keepers, and (7) the influence of facility design on human–animal interaction.

The human dimension of animal welfare

Positive human–animal interaction

Any facility with animals is likely to involve frequent and often close human–animal interaction, which can range from negative to positive (Estep & Hetts, 1992; Smith, 2014; Waiblinger et al., 2006). Negative interactions, such as shouting, hitting, approaching too quickly, or simply moving in unpredictable ways, can lead to fear, avoidance, vigilance, and physiological stress responses (Smith, 2014; Waiblinger et al., 2006). In contrast, positive human–animal interactions, such as those involving affiliative behaviors or serving as a source of pleasure for the animals, are likely to result in a positive human–animal relationship (Smith, 2014; Waiblinger et al., 2006).

During the past several decades, research with farm animals has explored how negative human–animal interactions can reduce the welfare and productivity of animals (extensively reviewed by Boivin, Lensink, Tallet, & Veissier, 2003; Hemsworth, 2003; Hemsworth & Coleman, 2011; Rushen, Taylor, & De Passillé, 1999; Waiblinger et al., 2006). For example, in numerous studies with pigs, negative interactions such as slapping or the use of an electric prod consistently resulted in increased fear of humans together with physiological stress responses, often with correlated reductions in growth and reproduction (Gonyou, Hemsworth, & Barnett, 1986; Hemsworth & Barnett, 1991; Hemsworth, Barnett, & Hansen, 1981, 1986). Similar studies with dairy cattle showed that negative handling resulted in increased behavioral and physiological stress responses and reduced milk yield (Breuer, Hemsworth, Barnett, Matthews, & Coleman, 2000; Breuer, Hemsworth, & Coleman, 2003; Rushen, De Passillé, & Munksgaard, 1999). Negative handling can even be a contributing factor for lameness in cattle (Rouha-Mülleder et al., 2009). Based on these and many other studies, Hemsworth and Coleman (2011) proposed a model whereby negative human–animal interaction creates a learned fear of humans leading to a physiological stress response, which in turn affects such basic processes as growth, health, and reproduction.
Hosey (2008) applied this model to human–animal interaction in zoos, involving both keepers and visitors. Hosey (2008) proposed that as with livestock, the interactions that zoo animals experience will either augment or reduce their fear of humans and that the quality and quantity of these interactions will result in either a positive, negative, or neutral human–animal relationship. However, specific application of the model to zoos has been complicated by the wide range of species, housing, and husbandry conditions (Carlstead, 2009) and by the fact that research on deliberate negative handling, which has been a major focus of farm studies, would raise ethical concerns in a zoo setting (Ward & Melfi, 2013).

Nonetheless, substantial evidence has shown that interactions with zoo keepers do lead to human–animal relationships that range from positive to negative. In a study of the nature and frequency of their contact with animals, keepers affirmed that a positive human–animal relationship was more likely to develop if they had regular visual contact, if they spent time feeding and talking to the animal, and if aversive contact was limited (Hosey & Melfi, 2010). Behavioral evidence has also suggested that the actions of keepers can affect animals’ fear responses as well as the resulting human–animal relationship. In a study by Carlstead (2009), aversive noises made by the keeper, such as the jangling of keys or the rattling of padlocks, was associated with greater avoidance in maned wolves (Chrysocyon brachyurus) and cheetahs (Acinonyx jubatus jubatus), suggesting that this behavior increased fearfulness in these species. Ward and Melfi (2015) recorded the behavioral responses of black rhinoceroses (Diceros bicornis), Chapman’s zebras (Equus burchelli), and Sulawesi crested black macaques (Macaca nigra) to cues given by different keepers. All three species showed greater latency to respond to certain keepers, suggesting greater fearfulness toward certain individuals (Ward & Melfi, 2015). Conversely, animals that had developed a more positive relationship with certain keepers were less likely to show fear responses and performed desired behaviors more readily (Ward & Melfi, 2015).

These types of human–animal interactions are clearly important for animal welfare. For example, Carlstead and colleagues found that greater scores for the measure “fear of people” among black rhinoceroses and cheetahs were correlated with independent indicators of poor welfare. Among rhinoceroses, “fear of people” was positively correlated with higher levels of fecal glucocorticoid metabolites (Carlstead & Brown, 2005). Cheetahs showed a correlation between “fear of people” and the temperament trait “tense-fearful” (Carlstead, 2009), which was shown in other research to be linked to failed reproduction (Wielebnowski, 1999; see “Treating animals as individuals”, below) and gastric lesions (Carlstead, 2009), both of which may indicate chronic stress. Finally, in a study of felids (Felis spp.) in captivity, Mellen (1991) found that the husbandry style of the keepers was correlated with reproductive success. Specifically, a style characterized by talking and interacting with the felids beyond what was required for routine husbandry was more likely to result in successful breeding than if this did not occur (Mellen, 1991), likely because the positive human–animal relationship helped to mitigate stress.

Human–animal interaction has also been proposed as a means of enrichment for captive animals, with evidence mostly from primates (Claxton, 2011). Specifically, Claxton (2011) proposed that positive human–animal interaction has the potential to increase the performance of species-specific behavior while reducing abnormal behavior, and thus meets the criterion of enrichment. As one example, Baker (2004) found that 10 min of additional caretaker contact with chimpanzees (Pan troglodytes), in the form of playing, grooming, feeding, or talking with the animals, resulted in several positive outcomes including increased allogrooming and lower levels of regurgitation, reingestion, and other abnormal oral behaviors (Baker, 2004). A trend toward reduced agonistic displays was also detected, and interactions with an observer shifted from predominantly aggressive to affiliative in nature (Baker, 2004). Manciocco, Chiarotti, and Vitale (2009) found much the same with common marmosets (Callithrix jacchus) after a familiar caretaker spent an additional 20 min per day interacting in a similar manner. Play and other affiliative behaviors such as grooming all increased, while self-scratching decreased. A similar program with Western lowland gorillas (Gorilla gorilla), however, resulted in mixed results: although increased interaction between keepers and gorillas reduced abnormal and self-directed behavior, it also resulted in higher levels of agonistic behavior (Chelluri, Ross, & Wagner, 2013). Thus, although human interaction has the potential to improve the welfare of some primates in captivity, the results cannot be generalized across taxa and contexts (Claxton, 2011; Whitham & Wielebnowski, 2013).
Finally, positive interaction with keepers may also reduce the stressfulness of exposure to unfamiliar zoo visitors (Hosey, 2000, 2008). Zoo animals react to visitors in different ways but generally appear to find the presence and behavior of visitors to be stressful. (For reviews, see Davey, 2007; Fernandez, Tamborski, Pickens, & Timberlake, 2009; and Hosey, 2000, 2008). However, Hosey (2008, 2013) thought it plausible that positive relationships with keepers may moderate the animals’ reactions to the unfamiliar public. In support of this idea, research by Melfi and Thomas (2005) showed that when keepers started positive reinforcement training of Abyssinian colobus monkeys (Colobus guereza), animal-initiated interactions with the public significantly declined (Melfi & Thomas, 2005), suggesting that the animals found the presence of visitors less stressful or less significant. Thus, as noted by Hosey (2013), although zoos may have limited influence over visitor behavior, fostering positive relationships with zoo personnel may offset negative reactions of animals toward the public (Hosey, 2013).

Consistency and familiarity

Consistency appears to be an important element in human–animal interaction. As an example with farm animals, Hemsworth, Barnett, and Hansen (1987) found that if negative interactions (forcing a pig away upon approach) were randomly incorporated into a routine of mostly positive interactions (stroking the pig while in close proximity), the animals showed virtually the same elevated level of fear and free corticosterone concentrations as animals that received only negative interaction. Bassett and Buchanan-Smith (2007) suggested that such effects on animal welfare may be due to a reduction in an animal’s sense of predictability and control. As an example from zoo animals, a study of captive cheetahs (Acinonyx jubatus) by McKay (2003) showed that the regularity of husbandry routines was positively correlated with reproductive success.

One way to achieve consistency is to have animals attended by the same keepers so that they and their behavior become familiar. Smith (2014) studied familiarity and found that orangutans (Pongo abelii) and Western lowland gorillas (Gorilla gorilla) appeared to seek proximity to, and engaged in longer and more affiliative human-directed behaviors with, familiar keepers, whereas they were more likely to avoid, hide from, or act aggressively toward unfamiliar members of the public. Working with four species, including Brazilian tapirs (Tapirus terrestris), slender-tailed meerkats (Suricata suricatta), Rothschild’s giraffes (Giraffa camelopardalis rothschildi), and an African elephant (Loxodonta africana), Martin and Melfi (2016) compared the animals’ behavior toward familiar keepers versus participants in a “Keeper for the Day” program who performed similar husbandry tasks (Martin & Melfi, 2016). Members of all four species spent significantly more time engaged in movement toward familiar keepers (Martin & Melfi, 2016).

Other evidence has linked familiarity more directly with animal welfare. In a study of clouded leopards (Neofelis nebulosa), Wielebnowski, Fletchall, Carlstead, Busso, and Brown (2002) recorded fecal corticoid metabolites for 72 animals at 12 institutions where the number of keepers ranged from two to seven and contact time with the animals ranged from 7 hours to 32 hours per week. The results showed that corticoid metabolites, taken as a measure of stress, were lower in animals with fewer keepers and higher contact time. High adrenal activity was also associated with the presence of self-directed behaviors and a decrease in reproductive success (Wielebnowski et al., 2002). The results thus suggested that rotation of keepers and limited contact—both of which could reduce keeper familiarity—may create welfare concerns. In another study, which examined attacks by zoo animals on people, Hosey and Melfi (2015) noted seven reported attacks in which the keeper was unfamiliar to the animal, either because the animal had only been at the zoo a short time or the keeper had not previously handled the animal. The authors took these findings to suggest that attacks usually happen under unusual circumstances, in which the development of a human–animal relationship has been limited by the unfamiliarity of the keeper (Hosey & Melfi, 2015).

Treating animals as individuals

The high ratio of staff to animals in many zoos allows many keepers to know their animals individually. This situation is less common on modern farms, but many dairy farms remain small enough and involve
such close human–animal contact that staff know the animals individually. In a survey of animal
managers on dairy farms, Bertenshaw and Rowlinson (2009) found that many attached importance to
such individual knowledge. On farms where individual knowledge occurred, heifers were reported as
being easier to approach, and on farms where cows were called by name, milk yield was significantly
greater than on farms where this was not the case. Such benefits might be due to people creating a more
positive relationship with the animals and thus preventing stress caused by human contact and
husbandry procedures. Individual recognition may also allow keepers to notice subtle changes in
behavior that indicate compromises to an animal’s health and welfare (Hosey & Meli, 2010).

Recognizing and treating animals as individuals also allows keepers to recognize the individual
personalities of animals. Personality, described by Gosling (1998) as “an individual’s distinctive
pattern of behavior that is consistent across time and situations” (p. 107), has been well recognized in
a wide range of taxa including fish, reptiles, birds, and countless species of mammals (see Gosling,
2001, for an extensive review) and now plays a significant role in our understanding of animal
behavior. Indeed, of the dimensions of the five-factor model of human personality, three factors
(Extraversion, Neuroticism, and Agreeableness) generalize well to other species, while a trait similar
to Openness (reflected in animals by curiosity and playfulness) has been seen in some species, and a
trait similar to Conscientiousness has been seen in chimpanzees (Gosling & John, 1999).

Some studies of zoo animal welfare have taken animal personality into account (e.g., Gold & Maple,
1994; Wielebnowski, 1999). For instance, in Western lowland gorillas (Gorilla gorilla), individuals with
different personality traits, as determined by the Gorilla Behavior Index (GBI), showed different
behavioral responses to different-sized groups of zoo visitors (Stoinski, Jaicks, & Drayton, 2012).
Also using the GBI, Kuhar, Stoinski, Lukas, and Maple (2006) found that personality traits could
help predict behavioral patterns in male Western lowland gorillas (Gorilla gorilla), and the authors
suggested that GBI factors predictive of greater affiliative behavior and reduced aggression could be
used to identify individuals more suitable for multimale groups. In captive cheetahs (Acinonyx
jubatus), individuals scoring high for the trait “tense-fearful” were more likely to fail to breed; such
animals might benefit, both in terms of welfare and reproduction, from more secluded enclosures or
additional hiding places (Wielebnowski, 1999). As these examples suggest, attention to the personality
of individual animals could have many applications in zoo animal management and animal welfare.

Keeper attitudes and personality

In their model of human–livestock relationships, Hemsworth and colleagues also proposed that the
attitudes of stockpersons are another important determinant of animal welfare and productivity
(Hemsworth, Barnett, & Coleman, 1993; Hemsworth & Coleman, 2011). With pigs, for instance, the
attitudes of stockpersons were significantly related to the proportion of negative interactions they
initiated, the time taken for sows to approach them (as a measure of fear), and total litter size as a
reflection of reproductive success (Hemsworth, Barnett, Coleman, & Hansen, 1989). Similarly, a
study with dairy cattle showed that a positive attitude toward cows, as shown by labeling dairy cows
with terms such as “stimulating,” “entertaining,” and “intelligent,” was correlated with the use of
positive handling, which in turn was correlated with indications of lower stress (Hemsworth,
Coleman, Barnett, & Borg, 2000). Waiblinger, Menke, and Coleman (2002) observed much the
same trend: stockpersons who perceived that cows are intelligent and enjoy being stroked were more
likely to value contact with the animals and to handle them more patiently. Moreover, stockperson
attitudes were significantly correlated with the willingness of the stockperson to pursue further
training (Coleman, Hemsworth, & Hay, 1998).

There has been at least preliminary evidence that zoo keepers’ attitudes toward animals affect
their behavior. Using results obtained from self-reported attitude questionnaires, Ward and Melfi
(2015) found that keepers had large differences in attitudes that influenced their husbandry style,
and the authors concluded that “good stockmanship ability was likely if the keepers had a positive
attitude toward the animals they worked with” (p. 8).
Keeper personality has also been proposed to be an important factor for success in handling animals. In pioneering work from the 1970s, Seabrook (1980; 1984) identified personality traits of herdspersons on dairy farms with high milk yield. He characterized the ideal herdsperson for this species as a “confident introvert” who is also considerate, patient, independent, persevering, not meek, not talkative, and unsociable. He noted that these traits may not make a person agreeable to other people but were successful with cattle; specifically, these traits correlated with the cows’ willingness to enter the milking facility and with reduced restlessness during milking (Seabrook, 1984). The greater milk yield seen on farms with such stockpersons was probably due to reduced physiological stress responses in the animals. Seabrook (1980) also proposed (long before it became widely acknowledged by scientists or policymakers) that the most important factor for animal welfare is not the design of the environment but “the behavior and attitude” of the people (p. 298).

In a zoo context, a deeper understanding of keeper personality might allow for better matching of keepers with species for the benefit of both the keepers and the animals. In one interesting study of keeper personality, Phillips and Peck (2007) found that self-rated personality traits of keepers correlated with how they interacted with Bengal tigers (Panthera tigris tigris) in interactive displays. In particular, keeper “neuroticism” correlated negatively with the number of pats given to the tiger, suggesting that emotionally less stable keepers may engage in fewer positive interactions, and keepers with high self-consciousness were subject to more snarls from the tigers (Phillips & Peck, 2007).

Knowledge and experience

Hemsworth and Coleman (2011) further maintained that stockpersons should possess comprehensive understanding of the nutritional, environmental, and social requirements of animals in addition to husbandry skills. This may well be true also for zoo professionals, who arguably have to possess knowledge on a wider array of species. In the study by Ward and Melfi (2015) noted earlier, good husbandry skills, as reflected in animals’ responding quickly to the keeper, were correlated with keepers having “extensive experience and species knowledge” (p. 8). In contrast, Carlstead (2009) found that long-term keeper experience (up to 35 years) was correlated with greater scores for “fear of people” in black rhinoceroses (Diceros bicornis), cheetahs (Acinonyx jubatus), great hornbills (Buceros bicornis), and maned wolves (Chrysocyon brachyurus). She suggested that keepers with long-term experience might perform more aversive behavior, perhaps out of habit or misinformation. These intriguing findings suggest that keeper knowledge and experience and their effects on animal welfare deserve careful analysis.

Keeper well-being

In the agricultural literature, there is good evidence that human–animal relationships exert reciprocal effects on both the animals and the people (Hemsworth, 2003). Indeed, the term “one welfare,” analogous to “one health,” has been used to emphasize that animal welfare and human welfare are closely connected (García Pinillos et al., 2016). This belief has been echoed in interviews with farmers who collectively emphasized that human and animal welfare are interdependent and that if farmers are unable to manage their own well-being, they find it difficult to enhance the welfare of their animals (Kauppinen, Vainio, Valros, Rita, & Vesala, 2010). Moreover, cases of serious breakdown in farm animal care have often been associated with poor physical and mental health and with personal stress among farmers (Andrade & Anneberg, 2014; Devitt, Kelly, Blake, Hanlon, & More, 2015). In a Danish study of employed farm workers, self-reported levels of work-related stress were even found to correlate with a higher herd incidence of clinical illness including mastitis (Kolstrup & Hultgren, 2011). Such findings raise intriguing questions about stress, health, and mental health in zookeepers, including their sense of safety in dealing with potentially dangerous animals, and a possible link to the welfare of the animals.
**The influence of facility design on human–animal interaction**

One additional emerging theme in animal welfare research has been that the physical environment can influence the quality of human–animal interaction—for example, by making it difficult to move animals and thus encouraging negative handling or conversely by facilitating positive interaction. For example, Burton, Peoples, and Cooper (2012) studied 42 dairy farms and concluded that people, animals, and the physical environment interact to create a “culture” of human–animal interaction that can range from positive to negative.

In a similar vein, Coe (1999) argued that “affiliative design,” or the arrangement of enclosure features to enhance human–animal interaction, has the potential to increase affiliative behavior between humans and animals. This concept can be applied to zoo visitors. For example, Coe suggested that viewing areas be kept relatively small and dispersed so that visitors appear less threatening and do not completely surround the animals, and Fernandez et al. (2009) suggested using designs that give animals more control over their exposure to visitors.

As an example of the influence of facility design, Choo, Todd, and Li (2011) compared the effects of visitor proximity on Bornean (*Pongo pygmaeus*) and Sumatran (*Pongo abelii*) orangutans in two large, seminaturalistic exhibits. The presence of visitors in close proximity was associated with complex changes in play, regurgitation, begging, and other activities, but changes were less pronounced in the exhibit where visitors were kept well below the animals rather than at the same level (Choo et al., 2011).

The effects of facility design on keeper–animal interactions have been less studied. However, Kelling, Gaalema, and Kelling (2014) proposed using the method of “operational sequence diagrams” to map interactions in zoos, whereby the staff, visitors, and animals are treated as “interdependent coworkers,” each with specific needs that should be incorporated into the design of the physical environment.

One specific design issue for zoos is the provision of protected or unprotected contact with animals. From her study on the breeding success of captive felids, Mellen (1991) concluded that while a positive human–animal relationship was important for reproductive success, it did not necessarily require “hands-on” contact but was equally possible through protective barriers. This finding has been echoed in the views of keepers who reported “protected contact” as their preferred method of interacting with lions, tigers, and cheetahs because it was the safest option and allowed them to develop a relationship with big cats without compromising safety (Szokalski, Litchfield, & Foster, 2013). Most keepers also expressed concerns that “hands-on contact” negatively influenced species-specific behaviors of big cats and was, therefore, almost completely unwarranted.

**Conclusions**

The animal welfare science literature, especially for farm animals, suggests that human factors have major effects on animal welfare. In zoos, considerable research has shown the effects of visitors (e.g., Davey, 2007; Fernandez et al., 2009), but the influence of keepers may be even more significant. We suggest that research on keepers—their manner of interacting with animals, their attitudes, personality, knowledge, experience, and their own well-being and other factors—could provide major avenues for improving zoo animal welfare.

**References**


