CHAPTER

23

Biological Predispositions and Individual Differences in Human Attitudes Toward Animals

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Animals play inseparable roles in human life. Everywhere around us animals are presented in clips, books, movies, or on symbols of various cultures since ancient times (Walsh, 2009). Animals are also significant sources of human foods for at least the past two million years (Ungar and Teaford, 2002). Cultures without any doubt play an important role in perception of animals, although our biological predispositions seems to be more than significant (Herzog and Burghardt, 1988). The focus here will be specifically on the biological influences of human attitudes to animals, as well as on the role of education in forming children's attitudes and their perception of living creatures.

HOW DOES EVOLUTION SHAPE HUMAN ATTITUDES TO ANIMALS?

Although the genus *Homo* exists from roughly about 2.8 million years (Villmoare et al., 2015), the history of interactions with animals that could have influenced the evolution of the human brain is much older. Approximately 150 million years ago, snakes hunted for small placental mammals, from which the order Primates originated around 85 million years later (Zhang et al., 2008). It is reasonable to assume that individuals who were able to detect and escape snakes could have a survival advantage because they were able to reproduce and transfer their genes to the following generation. It is believed that the origin of certain emotions, such as the emotion of fear, which plays an important role in human attitudes to animals, lies somewhere in these early interactions with snakes (Isbell, 2006, 2009; Öhman and Mineka, 2001, 2003). Indeed, the amygdala, the ancient part of the brain located deep and medially within the temporal lobes of the brain, could have evolved under pressure from snakes on small mammals. A number of studies have shown that the amygdala is involved in fear conditioning in a variety of mammals, including rats, mice, rabbits, and monkeys (see LeDoux, 2012 for a review) providing evidence for the origin

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of fear in our evolutionary past. About 60 million years ago, snakes introduced venom, as a new powerful weapon in the coevolutionary arms race with their mammalian prey. Although actual estimates suggest that human mortality caused by snake bite is relatively low (roughly about 20,000–125,000 deaths worldwide, see Chippaux, 1998; Kasturiratne et al., 2008), it is argued that these estimates are based on incomplete data (Warrell, 2010), partly because reporting is not mandatory in many regions in the world. In contrast to modern humans living in cities, however, our ancestors were in daily contact with the natural environment, making the likelihood of snake bite quite high. Moreover, a lack of medical help necessarily led to higher mortality rates than at present.

COEVOLUTION WITH SNAKES ENHANCES VISUAL ATTENTION TO DANGEROUS STIMULI

In light of the deadly threat represented by snakes on their prey, it is reasonable to assume that visual attention providing self-protection should have evolved in mammals (Öhman et al., 2001a). Neurobiological evidence supports this idea because amygdala tunes visual brain areas for rapid perception of fear-related stimuli (Phelps et al., 2006). In current research, Van Le et al. (2013) implanted electrodes in the individual neurons of the brains of three macaque monkeys (*Macaca fuscata*) and then made recordings from the neurons where the monkeys were exposed to four sets of pictures: snakes, angry monkey faces, monkey hands, and other geometrical shapes, such as circles. Researchers have hypothesized that the neurons placed in a specific part of the brain, unique in primates, will respond particularly quickly to images of snakes. Of the 91 neurons tested with all stimuli, 37 were more sensitive to snake images, 26 to angry face images, 17 to hand images, and 11 to shapes images. In line with their hypothesis, the neurons that responded specifically to snakes were more numerous and more sensitive to the relevant stimuli than neurons in the other three groups. Interestingly, the abundance of neurons sensitive to angry faces was in the second place suggesting that recognition of emotions by other members of the social group is advantageous in terms of enhanced survival and reproduction. Humans, similar to nonhuman primates, are also sensitive to detection of visual cues in the faces of conspecifics. In all probability, accurate recognition of the presence of anger, fear, disgust, and other emotions is necessary since significant parts of violent deaths can be attributed to conflicts between conspecifics (Daly and Wilson, 1988)—similarly as with chimpanzees (Wrangham and Peterson, 1996). Threatening faces are actually detected by humans more quickly than neutral or friendly faces (for a review see LoBue and Rakison, 2013; Öhman, 2009; Öhman et al., 2001a,b).

Snakes promote rapid visual detection by humans and this innate ability was in all probability shaped by the predator (the snake)–prey coevolution. In a series of experiments, Öhman et al. (2001a) compared the detection of a fear-relevant target (a snake or a spider) among eight fear-irrelevant distractors (flowers or mushrooms) with that of a fear-irrelevant target (a flower or a mushroom) among fear-relevant distractors (snakes or spiders). Snakes and spiders were detected more quickly than fear-irrelevant targets. These experiments were successfully replicated several times (reviewed by LoBue and Rakison, 2013), including children (LoBue and DeLoache, 2008) who also detect snakes sooner than, for example, flowers, albeit children's detection time is longer than that of adults. In addition, infants at 5 months of age look longer at a schematic image of a spider than a partly or completely scrambled image of a spider but do not do so for schematic and scrambled images of a flower (Rakison and Derringer, 2008).

Previous neurobiological evidence clearly suggests that nonhuman primates should be afraid of snakes. Indeed, wild monkeys are still attacked by snakes and do manifest strong fearful responses to them (Cook and Mineka, 1991). These responses seem to be learned, rather than innate, because laboratory reared monkeys lacking any experience with snakes show no fear (Mineka et al., 1980). Now classic experiments performed by Cook and Mineka (1990, 1991) determined that monkeys were able to quickly acquire fear of a predator by observing other monkeys expressing fear in interaction with the predator. When laboratory reared monkeys observed a wild-reared monkey displaying fear of a live and toy snake, they were rapidly conditioned to fear snakes (Cook and Mineka, 1990). Additional experiments with toy snakes and crocodiles as predators, and flowers and rabbits as harmless objects, provided further evidence for a predisposition to quickly learn fearful responses in dangerous situations: fear responses were conditioned only to predators, but not to harmless stimuli (Cook and Mineka, 1991). Research on humans also revealed exciting findings: 7 to 18-month-old infants looked longer at clips of snakes paired with a frightened human voice than at clips of snakes paired with a happy human voice (DeLoache and LoBue, 2009). In light of the fact that attention enhances learning (Shirey and Reynolds, 1988), children would learn from stories with frightened voices, which are typical for stories with predators, more than from other stories. Clearly, learned avoidance of snakes could have an adaptive advantage, because children could more easily avoid potential predators. These results are in agreement with earlier suggestions by Martin Seligman (1971) who predicted that common fears reflect evolutionarily prepared learning to fear events and situations that have provided survival threats in our evolutionary past. These results also highlight evolutionary significance in the development of fear of prototypical predators such as snakes.

AESTHETIC PREFERENCES FOR ANIMALS

Everyday life is accompanied by spontaneous ratings of common things as "beautiful" or "ugly." We rate almost everything around us: buildings, flowers, landscapes, works of art, other humans, as well as nonhuman animals. Visual perception of beautiful objects activates the prefrontal cortex (Cela-Conde et al., 2004), providing neurobiological evidence that ugly objects are perceived differently from beautiful objects. From an evolutionary perspective, a preference for beauty is advantageous, because beauty is associated with fitness-enhancing traits (for a review, see Rusch and Voland, 2013; Voland and Grammer, 2003). Colorfulness can be associated, for example, with parasite avoidance in birds (Hamilton and Zuk, 1982). A peacock's train can be a costly signal of a male quality (Zahavi and Zahavi, 1997) and female barn swallows (*Hirundo rustica*) have an esthetic preference for male tail feathers that are symmetrical (Møller, 1992). Similarly, people have an esthetic preference for symmetrical faces (Thornhill and Gangestad, 1999) and more physically attractive people have a higher reproductive success (Jokela, 2009; Pawlowski et al., 2000; Prokop and Fedor, 2011). Perceived beauty influences feeding preferences—what is beautiful should taste good (Prokop and Fančovičová, 2012a), suggesting that these preferences also work in nonsexual contexts. Esthetic preferences of animals may also have a possible fitness-relevant value, by favoring harmless animals over dangerous ones.

WHY ARE SOME ANIMALS UGLY?

Research suggests that phylogenetically and behaviorally distant or dissimilar animals are often perceived negatively (Batt, 2009; Bjerke and Østdahl, 2004; Kellert, 1984, 1993). Negative perception is associated with ugliness. Ugly animals receive lower preference scores compared with cute animals (Driscoll, 1995; Prokop et al., 2010a,b). Specifically, rats, snakes, cockroaches, mosquitoes, spiders, slugs, earthworms, bats, frogs, crocodiles, or hyenas received lower preference scores than, for example, birds, squirrels, butterflies, horses, hedgehogs, zebras, or gazelles (Almeida et al., 2014; Batt, 2009; Bennett-Levy and Marteau, 1984; Bjerke and Østdahl, 2004; de Pinho et al., 2014; Driscoll, 1995; Kaltenborn et al., 2006b; Knight, 2008; Schlegel and Rupf, 2010). These preferences can be seen among kindergarten children suggesting that the predisposition to have a preference for animals sharing certain similarities (phylogenetic or behavioral) with humans emerges early in childhood (Borgi and Cirulli, 2015). As concerns invertebrates, parasites clearly show the lowest scores compared with nonparasitic species (Prokop et al., 2010a,b) with spiders always scoring the lowest while butterflies receive the top rankings (Batt, 2009; Schlegel and Rupf, 2010; Schlegel et al., 2015).

The ultimate explanation of the role of perceived beauty in the ranking of animals can be partly explained by the potential threat that ugly animals possess to humans. Rats, cockroaches, and mosquitoes transmit certain serious diseases to humans such as plague, leptospirosis, malaria, or salmonella (Baumholtz et al., 1997; Morelli et al., 2010; Murray et al., 2012). It can therefore be argued that people are more prone to consider these harmful animals as disgusting and/or ugly thereby reducing the risk of contamination (Prokop et al., 2010a,b). It may be that we are able to associate these animals with danger more easily than with other animals (prepared learning, Seligman, 1971). To support this idea, it was repeatedly found that people who are more vulnerable to diseases consider vectors/reservoirs of diseases as more dangerous than those who are healthier and/or less vulnerable to diseases (Prokop et al., 2010a,b,c). Negative attitudes to spiders are still disputable. Although spider phobia is one of the most common phobias in the world (about 3.5% of US people, Fredrikson et al., 1997); mortality rates caused by spiders are extremely small (99 deaths over 20 years in the United States, Forrester and Stanley, 2004). Despite this fact, spiders, similar to snakes, meet with the strong attention of both children and adults (LoBue, 2010; Öhman et al., 2001a). The possibility that spiders caused danger to humans in our evolutionary past cannot be excluded, of course, which may be the reason why South African students living in places where early humans originated and where the diversity of spiders is high, manifest a stronger fear of spiders than Slovak students living in Europe where the diversity of spiders is much lower (Prokop et al., 2010d). Furthermore, it appears that humans do not misidentify spiders with other arthropods, but the fear of spiders is very specific (Gerdes et al., 2009). There are also cultural explanations suggesting, of course, that spiders are associated with disgust, illness, and infection (Davey, 1994a) by Europeans from the Middle Ages onward. Van Strien et al. (2014) recently found that pictures of snakes received earlier visual attention than pictures of spiders suggesting that neural circuitry for defense behavior was initially designed to deal with snakes, as dangerous predators of mammals (Isbell, 2006). This evidence suggests that the origin of spider fear is still unexplored and no firm conclusions can be made as yet.

Terrestrial predators such as hyenas receive low attractiveness/high fear scores, while lions (de Pinho et al., 2014; Kaltenborn et al., 2006b) or leopards (Batt, 2009) are much more valued by people. These predators obviously do not cause phobias (in contrast to snakes), despite being dangerous for humans (Treves and Naughton-Treves, 1999). This apparent inconsistency can be explained by an evolutionary perspective. While carnivore predators occurred only about 40–60 million years ago (Heinrich et al., 2008; Polly et al., 2006), snakes are phylogenetically much older. It may be that the coevolution between humans and our predecessors with carnivore predators is too short for developing specific phobias. It does not mean, however, that carnivores do not enhance attention. By recording eye movements, Yorzinski et al. (2014), for example, determined that participants visually detected dangerous animals (snakes and lions) faster than nondangerous animals (lizards and impalas). Similarly as it was found in detecting snakes by LoBue and DeLoache (2008), the participants were slower to locate nondangerous animals because they spent more time looking at dangerous distractors, a process known as delayed disengagement, and looked at a larger number of dangerous distractors. In summary, dangerous animals capture and maintain attention in humans, suggesting that coevolution with predators shaped the evolution of neural architecture and visual abilities in modern humans.

Evolutionary forces underlying the (dis)liking of certain animals are further strengthened by cultural beliefs. Traditional beliefs are passed on from generation to generation and designate specific attitudes and behaviors toward certain groups of animals (Herzog and Burghardt, 1988). Cultural beliefs about animals often include fear, respect, and abhorrence (Costa Rego et al., 2015; Davey et al., 1998; Fredrikson et al., 1997; Herzog and Burghardt, 1988). Mofu people in Africa, for example, treat ants in genus *Dorylus* with respect and fear, by bending over and touching their chest when they encounter them, because they are considered the prince of the insect fauna (Santos and Antonini, 2008). Ugly animals such as reptiles, frogs, bats, or spiders are often emblazoned with myths (Ceríaco, 2012; Costa Rego et al., 2015; Prokop et al., 2009a,b; Tarrant et al., 2016), which can itself be extremely dangerous for the survival of the particular species. First, unpopular animals receive less funding for conservation than more popular animals (Tarrant et al., 2016 and references therein). Second, the killing of ugly animals such as frogs or reptiles by people has been documented by various researchers (e.g., Alves et al., 2012; Ballouard et al., 2013; Ceríaco, 2012; Pagani et al., 2007; Prokop and Fančovičová, 2012b; Whitaker and Shine, 2000). It is not actually apparent how education is associated with beliefs concerning myths about animals since the results are mixed. In certain cases less educated people hold more beliefs about myths (Tarrant et al., 2016), while others found opposite patterns (Ceríaco, 2012) or that there was no difference in beliefs between biology majors and nonmajors (Prokop et al., 2009a). According to certain authors, less educated people engage in direct persecution of animals more than people with a higher education level (Ceríaco, 2012; but see Prokop and Fančovičová, 2012b) suggesting that education is associated with positive behavior toward animals. It seems that belief in myths also has an adaptive context, because more disease-vulnerable children manifest stronger beliefs for untrue myths than less disease-vulnerable children (Prokop and Kubiatko, 2014), which can be explained by the stronger avoidance of potentially dangerous animals by those people who are more vulnerable to contamination or injury from animals.

WHY CERTAIN HARMLESS ANIMALS ARE CONSIDERED UGLY?

A number of researchers have observed that harmless snakes (Arrindell et al., 2003; Bennett-Levy and Marteau, 1984) or worm-like invertebrates (Batt, 2009; Prokop and Fančovičová, 2010a; Prokop et al., 2010a,b; Schlegel et al., 2015) receive low attractiveness/high fear scores despite not being dangerous to humans. In a similar vein, Rozin et al. (1986) demonstrated that if a heat sterilized dead cockroach was briefly dipped into a glass containing a previously desirable beverage, that beverage became psychologically contaminated and hence unacceptable. This suggests that some cues of contamination significantly influence people's behavior. Superficial perception of potentially harmful stimuli is favored by natural selection in order to minimize the likelihood of failing to register the presence of actual danger (smoke detector principle, Nesse, 2005). Although the avoidance of a worm-like invertebrates could be perceived as "erroneous" (a false positive error), it is still less risky than the erroneous detection of a truly harmful snake (a false negative error). The smoke detector principle is helpful in understanding negative attitudes to certain harmless animals, particularly if they superficially resemble certain harmful animals.

WHY CERTAIN ANIMALS ARE CONSIDERED CUTE?

Humans have an innate propensity to affiliate with other organisms (biophilia hypothesis, see Wilson, 1984). Although the biophilia hypothesis is not restricted to animals (also to plants and habitats), the focus of this chapter will be on the animal domain.

From early life children are introduced to animals through cartoons, books, and everyday experiences. Their preferences for animals seem to be innate, rather than taught (Jacobs, 2009). Simion et al. (2008) found, for example, that 2-day-old babies had a preference for looking at biological motion as opposed to nonbiological motion. One film clip shown to the babies depicted a dozen spotlights representing the joints and contours of a walking hen. Another clip depicting a dozen spotlights that moved with the same characteristics (in terms of angles and speed) was generated randomly. As expected, most babies had a preference for the clip representing the walking hen. Similar results were obtained with 11- to 40-month-old children. By allowing children (and their parents) to freely interact with various toys and certain live animals, Lobue et al. (2013) found that children, as well as their parents interacted with the animals more often than with the toys. Children also talked about the animals more than the toys and asked more questions about them. These examples clearly support the idea that humans have an innate tendency to interact with live animals more than with attractive toys. Interestingly, animals are helpful to children with autistic-spectrum disorders (Katcher, 2002; O'Haire et al., 2013).

Phylogenetic and behavioral similarity is not the only mechanism that can explain human affinity to certain animals (Herzog and Burghardt, 1988; Serpell, 2004). Some anthropometric features, particularly big eyes, a round face and a small nose and mouth, are morphological traits associated with "cuteness." Lorenz (1943) was the first to recognize that these traits (baby schema) enhance parental care over infants. Innate responses to baby faces are adaptive because caregiving enhances infant survival. Interestingly, positive responses to infantile facial configurations emerge early during development (evidence come from 3- to 6-year-old children, see Borgi and Cirulli, 2013; Borgi et al., 2014).

In line with the original suggestions of Lorenz (1943), positive responses to infantile conspecifics are not restricted to conspecifics. Several empirical works repeatedly demonstrated that humans show a cute response to nonhuman animals with these responses being measured by showing real animals, representations of animals in cartoons, as well as with stuffed or toy animals (for a review, see Borgi and Cirulli, 2016). By comparing various bird species, Lišková et al. (2015) found that shorter necks and bigger eyes were associated with a higher attractiveness ranking, once again suggesting the prominent role of baby schema in perceived attractiveness. Furthermore, esthetic perception of animals correlates with an individual's willingness to protect them (Gunnthorsdottir, 2001; Knight, 2008; Martín-López et al., 2007; Prokop and Fančovičová, 2013a). Martín-López et al. (2008) in their metaanalysis of 60 recent papers on the economic valuation of biodiversity showed that a willingness to pay for biodiversity conservation increases in favor of conservation species with anthropomorphic and anthropocentric (e.g., larger eyes and weight) characteristics instead of more relevant, scientific factors.

Another interesting example is the story of pets (Hinde and Barden, 1985). These authors measured toy teddy bears between 1900 and 1980. From the beginning, the snout became shorter, this being measured by the distance between the tip of the snout and the back of the head. This "evolutionary" change was nearly complete by the 1930s. A larger forehead also developed over time. Although teddy bears do not reproduce themselves, this kind of evolution of traits can be seen as a form of selection because the cuter teddy bears sell better.

Positive responses to infantile cues on nonhuman animals could be by-products of parental care originally focused on their own infants and can be particularly strong in humans, since parental care is prolonged as compared with other nonhuman primates (Kramer, 2011). Apart from mechanisms underlying positive perception of infantile cues in humans, baby schema is helpful in understanding why certain animals receive high likability ratings and why some animals are more frequently kept as pets compared with others. Prokop et al. (2008) found, for example, with a large sample of Slovak children that about 30%–40% of children of various age groups reported having a dog at home, whereas less than 1% of children reported having an invertebrate as a pet. Clearly, the baby schema cannot be applied to the perception of the majority of invertebrates.

Mammalian facial traits fit with positive rankings of cuteness. Mammals are generally highly ranked by people (Prokop and Fančovičová, 2013a) and are frequently used as flagship species in nature protection (Clucas et al., 2008). Being a mammal can also be an advantage because mammals are phylogenetically similar to humans and humans tend to be more prosocial toward others who are more similar to them (e.g., Allen et al., 2002a,b; Stephan and Finlay, 1999). A similar expression of emotions can be observed in nonhuman mammals (Darwin, 1872), which in all probability allow humans to better recognize them, thus promoting human–animal bonds. Russell (2003) found, for example, that humans are able to recognize the emotional expressions of horses. Correct recognition of animal emotions could be advantageous for hunters who have to actively plan their strategies for capturing animal prey. Moreover, the tendency to anthropomorphize animals (that is, assigning human traits and states to animals) can be at least partly explained by the ability to recognize the same emotions in animals (Jacobs, 2009). Anthropomorphism could have later enabled the domestication of companion and agricultural animals (Serpell, 2003). In summary, successful encoding of animal emotions along with anthropomorphism provides a meaningful basis for why humans have a preference for animals similar to them.

THE ROLE OF COLORS IN ATTITUDES TOWARD ANIMALS

Colors play important roles in human life (Elliot and Maier, 2014); it is therefore reasonable to suggest that they can influence human perception and attitudes toward animals. Evidence suggests that red and black colors are associated with aggression, dominance (Hill and Barton, 2005; Little and Hill, 2007), and physical attractiveness (Elliot and Niesta, 2008; Roberts et al., 2010) in humans. Certain animals have aposematic, warning coloration by means of which they advertise defensive mechanisms to predators, while others are inconspicuous and cryptic (Ruxton et al., 2004). Although experimental data are scarce, humans seem to perceive warning coloration as more highly conspicuous, than (confusing) natural predators (Bohlin et al., 2012). Aposematically colored species (Marešová et al., 2009b; Prokop and Fančovičová, 2013a), brightly colored butterflies (Barua et al., 2012), and penguins with a warm color (Stokes, 2007) are perceived as more beautiful than other species. These preferences seem to be cross-culturally universal (Frynta et al., 2011; Marešová et al., 2009a). Frynta and his colleagues (2010; Lišková and Frynta, 2013; Lišková et al., 2015) have determined that, apart from body shape and body mass, blue and yellow colors in particular make birds more attractive than other colors. The green color, in contrast, was perceived negatively, which can be explained by its cryptic function at least in certain birds. Interestingly, the color red only played an important role in esthetic preferences of snakes (Marešová et al., 2009b), not of birds (Lišková et al., 2015). It is probable that colorful objects capture human attention thereby increasing its esthetic value. Preferences for certain colors can be derived from preferences for ripe fruits (Prokop and Fančovičová, 2012a); consider, for example, low preferences for green fruits (a parallel with green birds, see above) can be explained by their low edibility (Prokop and Fančovičová, 2014). These observations have implications for the selection of flagship species (Prokop and Fančovičová, 2013a), individual willingness to protect animals (Knight, 2008; Prokop and Fančovičová, 2013a), and their being kept in zoo populations (Frynta et al., 2010; Marešová and Frynta, 2008).

RARITY AND ATTITUDES TOWARD ANIMALS

Humans manifest a tendency to favor rare animals over common ones (Herzog and Burghardt, 1988). Being rare and endemic are often viewed as the most important species attributes (Morse-Jones et al., 2012; Takahashi et al., 2012; Veríssimo et al., 2009). Endangerment and rarity have been significantly associated with an individual's reported willingness to pay for species preservation (DeKay and McClelland, 1996; Samples et al., 1986) with one study determining that endemic species were ranked as the highest conservation priority, followed by species with declining numbers and species of economic importance (Meuser et al., 2009). Certain additional factors such as, for example, age (Frew et al., 2017) and education can moderate preferences for endangered species (Kellert, 1984/1985). Species rarity may also be a factor utilized by zoos, which tend to keep and breed rare species preferentially in their collections (Frynta et al., 2010).

The origin of individual preferences for endangered species has received, however, limited attention. Herzog and Burghardt (1988) have speculated about certain evolutionary components underlying these preferences although evidence demonstrating that rare species played a role in the rituals of traditional societies still does not explain their ultimate origin. One can speculate that preferences for rare species can be a product of frequency-dependent sexual selection. This process suggests that the fitness of a phenotype increases as it becomes rarer (Allen and Clarke, 1984). Janif et al. (2014), for example, found that clean shaven male faces were the least attractive for females when clean shaven faces were the most common compared with males with full beards. It may be that preferences for rare phenotypes influence our preferences for gems, gold, pearls, or exceptional clothes, as well as for rare animals. Although this idea is currently purely speculative, further research may provide some empirical or experimental tests concerning its validity.

GENDER DIFFERENCES IN PREFERENCES FOR ANIMALS

Preferences for animals are gender specific (Kellert and Berry, 1987). The differences, however, might only be small and may be generally overstated (see for discussion: Herzog, 2007). In most large-scale studies, females have higher scores in pro-animal attitudes than males (e.g., Herzog, 2007; Herzog et al., 1991; Kellert and Berry, 1987; Pagani et al., 2007; Stanisstreet et al., 1993). Females manifest stronger preferences for cute, popular animals such as common pets while males obviously score higher in preferences for less attractive, unpopular animals (Bjerke et al., 2001; de Pinho et al., 2014; Lindemann-Matthies, 2005; Prokop and Tunnicliffe, 2010). Preferences for cute animals can stem from higher parental investment of human females compared with males, thereby enhancing preferences for baby-like faces. In contrast, females' low preferences for unpopular animals could be influenced by their potential danger. Females show a higher fear of predators, for example, compared with males (Alves et al., 2014; de Pinho et al., 2014; Kaltenborn et al., 2006a; Prokop and Fančovičová, 2013b). These fears possibly result from their lower exposure to predators (de Pinho et al., 2014) which can have a long-lasting evolutionary history considering that females were more sedentary and males as hunters were more frequently exposed to various predators (Prokop and Fančovičová, 2010b; Røskaft et al., 2003).

Certain researchers have suggested that a higher fear of large carnivore predators in females can be explained by females' lower physical condition compared with the physical condition of males (Prokop and Fančovičová, 2010b, 2013b; Røskaft et al., 2003). Indeed, females and children who are physically weaker than males are less likely to survive predatory attacks of large carnivores (Treves and Naughton-Treves, 1999). The disease avoidance hypothesis suggests that vulnerability to infectious diseases makes people more sensitive to potential danger. Indeed, females are more disease-vulnerable than males and more disease-vulnerable people perceive animals as more dangerous than less disease-vulnerable people (Prokop and Fančovičová, 2013b). These two hypotheses can be viewed as compatible, because disease vulnerability is associated with a poorer perceived physical condition (Prokop and Fančovičová, 2013b). The parental investment hypothesis proposes that females take care of children and have to be more sensitive to danger in order to protect their offspring (Røskaft et al., 2003). This hypothesis has not received empirical support as yet (Prokop and Fančovičová, 2010b).

Another domain explaining certain gender differences in attitudes toward animals is empathy. Females score higher on measures of empathy (Alterman et al., 2003) and are able to encode and decode facial emotions (McLure, 2000) better than males. These abilities were possibly favored by natural selection more in females, considering their higher vulnerability to attacks by predators (see above) or by other people (particularly by males). Apart from the evolutionary origins of gender differences in socioemotional behavior, it is reasonable to predict that females will be more sensitive to animals' needs. Females actually scored higher in attitudes on the Animal Attitudes Scale (AAS) (Herzog, 2011; Mathews and Herzog, 1997) and empathy scores positively correlated with the AAS scores, particularly in females (Taylor and Signal, 2005). Dogs, similar to humans, are able to discriminate between the emotional expressions of human faces (Müller et al., 2015) and thus their affinity to socially support owners is predictable (Wedl et al., 2010).

DEVELOPMENTAL ASPECTS AND CORRELATES WITH ANIMAL ATTITUDES

During adolescence, young people experience strong changes in their attitudes and behavior, with this also being related to animal attitudes. Vegetarianism usually develops, for example, during adolescence. Starting with primary school children, Kellert (1983) reported increasing respect toward animals with increasing age. In contrast, positive attitudes toward animals decreases, once again, during adolescence (Binngießer et al., 2013; Bjerke et al., 1998;

Randler et al., 2017; Stanisstreet et al., 1993). Similarly, younger children were more opposed to animals in zoos/circuses, while they manifested a more negative attitude toward hunting (Pagani et al., 2007).

Concerning personality, there is only scarce evidence for a relationship between animal attitudes and personality. Mathews and Herzog (1997) based their study on the 16 Personality Factor Inventory and their AAS. Two personality factors, sensitivity and imaginativeness, were significantly correlated with attitudes toward animals. Their sample was based, however, on 99 college students, which is fairly small for correlational studies. Studies based on the Big Five personality measures are slightly different. The Big Five ranks among the most frequently used instruments in order to assess personality of late. It is based on five factors: extraversion, agreeableness, conscientiousness, neuroticism (or emotional instability), and openness to new experiences. Furnham et al. (2003) found that agreeableness was the most consistent predictor of animal welfare attitudes, followed by extraversion and openness. Hanna et al. (2009) assessed the animal attitudes of 311 dairy stock people and found that agreeableness and conscientiousness most strongly correlated with positive attitudes toward working with dairy cows. Randler et al. (2017) reported significant correlations between agreeableness and conscientiousness on the one hand and pro-animal attitudes on the other hand. Although it is difficult to draw general conclusions from these studies, it seems a general result that people who are more agreeable to other people also seem to have a higher pro-animal attitude.

COMPANION ANIMALS

Certain studies have demonstrated that adolescents with companion animals have higher pro-animal attitudes (Binngießer et al., 2013; Prokop and Tunnicliffe, 2010). In adults, however, Signal and Taylor (2006) failed to find the significant effect of companion animals on animal respect in a community sample while Taylor and Signal (2005) found a significant difference for current people with companion animals but not when they had companion animals in childhood. This unequivocal pattern requires further research. It also seems unclear whether people have basically a higher pro-animal attitude and in consequence, opt for a companion animal or if the companion animal itself provides higher attitude scores. This could be investigated in a long-term prospective study and would seem to be rewarding.

INFLUENCES OF KEEPING ANIMALS AS PETS ON ATTITUDES TOWARD ANIMALS

Pet ownership correlates with certain positive physiological measures, such as lower blood pressure, serum triglycerides, and cholesterol levels (Walsh, 2009), which ameliorate the cardiovascular effects of stress (Allen et al., 2002a,b). Furthermore, close relationships with pets positively influence oxytocin release which is one of the body's "feel good" chemicals and also plays a role in social bonding. In particular, oxytocin is boosted in both the dog and the human when a dog owner stares into the eyes of the dog (Nagasawa et al., 2015). Oxytocin physically facilitates childbirth and nursing for women, and this is probably the reason why it was found to be associated with increased caregiving, displays of affection, and empathy even toward members of other species (Handlin et al., 2012; Odendaal and Meintjes, 2003). This suggests that humans coevolved in their relationships with their pets and that these relationships are beneficial for both of them.

It is suggested that physical interactions with pets (Fig. 23.1) and the resulting improvement of attitudes to animals are generalized

FIGURE 23.1 Children playing with the rabbit.

to concerns for a broader species of animals (Amiot and Bastian, 2015). Based on this view, pets may act as ambassadors for other animals (Serpell, 1995, 2000; Serpell and Paul, 1994). Certain studies have provided support for the generalizing effect. In a large study of Slovak school children aged between 10 and 15 years, Prokop and Tunnicliffe (2010) compared children's knowledge and attitudes toward popular animals (i.e., ladybird, beetle, rabbit, and squirrel) with unpopular animals that are considered pests, predators, or those posing a disease threat to humans (i.e., potato beetle, wolf, and mouse, respectively). The results showed that children with pets at home were associated with more positive attitudes to, and a better knowledge of, both popular and unpopular animals. Bowd (1984) demonstrated that children who had pets had less negative attitudes toward nonpets such as lions, pigs, chickens, and snakes compared with non–pet owners. Keeping a pet was found to be associated with more empathic feeling for animals used in the fur and leather industry and for zoo animals (Pagani et al., 2007). Children with pets at home read more animal-related stories and reported enjoying animal-related films, visits to zoos and wildlife parks, and television programs to a greater extent than children who did not have pets (Kidd and Kidd, 1990). Conversely, school children who more frequently watched natural history films and walked in the outdoors were less fearful of wolves (Prokop et al., 2011) suggesting that attitudes to animals can be influenced by various activities supporting a connection with the outdoors among children.

INFLUENCES OF MEAT CONSUMPTION ON ATTITUDES TOWARD ANIMALS

Meat consumption evolved around 2.6 million years ago (Domínguez-Rodrigo et al., 2005) and humans are seen as omnivores. Vegetarianism is consequently a new development (ancient India, Greece, and Italy, see Spencer, 1993). Certain studies have reported that meat consumption as measured on the Likert scale is related to animal attitudes in adolescents (Binngießer et al., 2013; Randler et al., 2017) and adults (Schröder and McEachern, 2004). People that score high on pro-animal attitudes report lower meat consumption. Based on the dichotomous classification, vegetarians had a more positive attitude toward animal welfare than nonvegetarians (Furnham et al., 2003; Herzog and Golden, 2009). These studies do not reveal cause and effect; however, it could be possible that high pro-animal attitudes lead to vegetarianism or vice versa, or even that they develop in a parallel fashion. This could be investigated in a prospective study.

HUMAN EMOTIONS AND ANIMAL CONSERVATION

Research has highlighted the role of certain emotions (traditionally labeled as "negative") in solving environmental issues. Disgust is mainly related to avoidance of certain animals, ill humans, feces, vomit, sexual substances, and other harmful events (Rozin et al., 2000). Tybur et al. (2009, 2013) have demonstrated that there are at least three distinct types of disgust: *pathogen*, *sexual disgust*, and *moral* disgust. Pathogen disgust refers to disgust elicitors caused by the sources of various pathogens (e.g., stepping in dog excrement). Moral disgust refers to disgust that pertains to social transgressions (e.g., deceiving a friend). These social transgressions broadly include nonnormative, often antisocial activities, such as cheating, stealing, etc. Sexual disgust refers to disgust, which motivates sexual avoidance of an unsuitable mating partner or other reproductively costly behavior (e.g., performing anal sex or being in a situation with a high probability of having sex with a stranger). Research on animals is centered particularly on the pathogen domain of disgust.

Disgust is an adaptive (rather than "negative") emotion because it reduces the probability of transmission of infectious diseases (Curtis and Biran, 2001; Curtis et al., 2004; Navarrete et al., 2007; Oaten et al., 2009; Prokop et al., 2010a,b,c; Stevenson et al., 2009; Tybur et al., 2009). Interestingly, disgust is easily conditioned and it often takes only one single event to condition it. It is also, however, rigid and resistant to conventional changes (see Curtis and Biran, 2001 for discussion).

Certain animals are considered ugly and ugliness is associated with the emotion of disgust and fear. Indeed, the physical appearance of animals and attitudes toward them have received increasing attention from researchers (e.g., de Pinho et al., 2014; Gunnthorsdottir, 2001; Jimenez and Lindemann-Matthies, 2015a,b; Knight, 2008; Prokop et al., 2016). Jacobs et al. (2014), for example, found that disgust for wolves was consistently and significantly associated with the acceptability of lethal control of wolves both among Dutch and Canadian University students. Prokop and Fančovičová (2012b) and Prokop et al. (2016) found that the emotion of disgust was negatively related to tolerance for frogs. In another study, higher fear of bears correlated with the willingness of participants to exterminate bears by shooting (Prokop and Fančovičová, 2010b). All this evidence strongly highlight the role of human emotions in conservation efforts.

ATTITUDE CHANGE: THE ROLE OF EDUCATION

Higher educated people have more positive attitudes toward animals (Kellert, 1993); thus, education is viewed as one of the primary tools in influencing attitude change (Kellert, 1996). The emotion of disgust, for example, influences learning and retention among school pupils and students (Holstermann et al., 2012; Randler et al., 2012a; Štefaniková and Prokop, 2013). It is believed that physical contact with animals may inhibit disgust/fear thereby positively influencing attitudes toward animals (Ballouard et al., 2012; Johansson et al., 2016; Morgan and Gramann, 1989; Tomažič, 2008, 2011a,b; Randler et al., 2005, 2012b). During an intervention using live animals (wood lice, snails, and mice), for example, disgust for these animals was reduced compared to a control group, suggesting that educational programs are a means of reducing disgust (Randler et al., 2012b). 11- to 13-year-old children who interacted with unpopular live animals (i.e., wood louse, snail, mouse) became less disgusted and fearful of these animals after interacting with them compared to those who did not have such contact (Randler et al., 2012b). In a study with snails, as examples of slimy, disgusting animals (Davey et al., 1998), Prokop and Fančovičová (2017) demonstrated that hands-on experience with snails not only reduces specific disgust of snails but also a tendency to inhibit disgust from the other, unfamiliar but disgusting animals (Fig. 23.2). Though the drop of disgust scores was not clearly significant ($P = .09$), it provides some preliminary evidence about the possible positive influence of hands-on activities with disgusting animals on attitudes toward other unpopular animals.

In a farm animal education research, adolescents learned about chicken biology, welfare, and food labeling. Both knowledge of and positive behaviors toward poultry species increased immediately after the intervention, although then tended to diminish 3 months following the event (Jamieson et al., 2012).

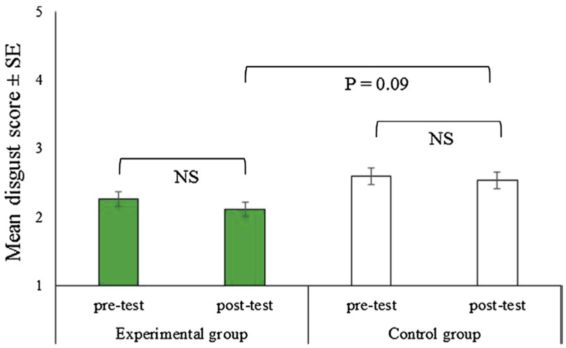

FIGURE 23.2 Disgust for animals dropped down after hands-on activities in the experimental group more than in the control group. *NS*, not statistically significant.

Although a great deal of work is needed before definite conclusions can be reached, these research reports reveal promising results suggesting that physical contact with animals has the potential to improve human–animal relationships in a more general sense. Schools, as well as conservation organizations, have the potential to apply these findings to intervention programs in order to improve children's attitudes toward animals in particular and environmental attitudes in general (Binngießer and Randler, 2015; Prokop and Kubiatko, 2014).

CONCLUSION

Increasing environmental problems have forced people to take active steps in saving biodiversity. Research on human–animal relationships may therefore provide certain helpful recommendations as to how perception of certain animals by people can be improved. Science helps us understand the nature of our own sympathies and antipathies toward animals around us. Animal appearance, particularly colors, genetic closeness to humans, its abundance in nature, potential threats from animals, and a number of other variables make human–animal relationships extremely complicated, but important to investigate. Research findings cannot be, however, used as a justification of our negative attitudes toward unpopular animals. Instead, an understanding of those evolutionary processes that have favored our fear and disgust of snakes or slimy animals should help us better control our behavior and future decisions. An improved understanding of the role of biological predispositions in individual attitudes toward animals may help us protect animals and finally save the biodiversity of the earth.

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