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Effects of Having Pets at Home on Children's Attitudes toward Popular and Unpopular Animals

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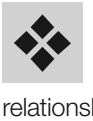
ABSTRACT Having pets at home provides various social, health, and educational benefits to children. The question of how keeping pets at home affects the attitudes of children toward wild animals still has not been answered, due to various methodological issues, such as ignorance of some attitude dimensions and/or questionnaires that include items focused on very different animals. We conducted three independent research surveys (using three independent samples) of Slovakian primary school children aged 10 to 15 years (n = 1297). These surveys focused on the effects of keeping pets on the attitudes of children towards, and knowledge of, three unpopular animals in Slovakia. These animals were pests (potato beetle) (Study 1), predators (wolf) (Study 2), and those that pose a threat of disease to humans (mouse) (Study 3). Each survey also included a popular animal (ladybird beetle, rabbit, and squirrel, respectively), which served as a "control"; these were compared by pair-wise statistics. Results consistently showed that children had better knowledge of, but less favorable attitudes towards, unpopular animals compared with popular ones. Having pets at home was associated with more positive attitudes to, and better knowledge of, both popular and unpopular animals. Girls were less favorably inclined than boys to animals that may pose a threat, danger, or disease to them. Implications for humane education are discussed, especially in terms of keeping pets, the link between knowledge and attitudes, and children's understanding of ecological adaptations.

Keywords: animals, attitudes, gender, knowledge, pets



Almost all children express the desire to have a pet (Kidd and Kidd 1985; Pagani, Robustelli and Ascione 2007). Children's attachment to pets possibly reflects the original function of relationships with animals in human evolutionary history. Serpell (1989)

proposes that pet keeping in our hunting ancestors' lives had an important educational and cultural value. Small animals, like rodents, lizards, insects, and birds, served as children's toys and provided them with valuable experience of animals and animal behavior. Such pet-keeping experiences helped children to become successful hunters in later life (Serpell 1989).

Benefits of Keeping Pets in Modern Society

Keeping a pet at home has been found by some researchers to be beneficial for the owner, from a variety of perspectives. For example, pet owners benefit from better understanding of animal physiology and behavior (Inagaki 1990; Prokop, Prokop and Tunnicliffe 2008), more positive attitudes, at least to some animals (Bjerke, Østdahl and Kleiven 2003), and better self-reported health (Serpell 1991), and may even be influential in career choices (Serpell 2005). For example, 5-year-old children who reported keeping goldfish acquired a greater amount of both factual and conceptual knowledge about goldfish, compared with children who had never raised any goldfish (Inagaki 1990). Prokop, Prokop and Tunnicliffe (2008) found that the owning of a pet by school-age children, aged 6 to 15 years, was associated with the child acquiring greater factual knowledge of various vertebrates and invertebrates. Furthermore, they found that girls in Slovakia had more pets than did boys, which may reflect greater attachment of girls to their pets (Pagani, Robustelli and Ascione 2007). Serpell (1991) found that adult cat and dog owners exhibited significant improvements in their self-reported physical and psychological health, compared with non-pet-owning controls. Paul and Serpell (1996) found that dog-owning children in the UK, aged 8 to 12 years, reported experiencing more visits from their friends and engaging in more leisure activities, compared with non-dog-owning children. Recently, Prokop, Kubiatko and Fančovičová (2008) found that 10- to 19-year-old owners of birds showed a greater interest in birds compared with non-bird owners. However, these owners failed to show any difference in their knowledge of birds, compared with non-bird owners. This lack of difference of knowledge was possibly camouflaged by the effect of owning other pets (other than birds) (Prokop, Kubiatko and Fančovičová 2008). In a sample of veterinarian students, Serpell (2005) found that more than 99% of students reported having owned or kept some kind of animal, and over 98% had owned or kept dogs and/or cats. Considering that 50 to 90% of children in various European countries live in families with various pets (Serpell 1986; Ascione 1992; Bjerke, Katelborn and Ødegårdstuen 2001; Pagani, Robustelli and Ascione 2007; Prokop, Prokop and Tunnicliffe 2008), the prevalence of pets among the veterinary students was higher than expected (Serpell 2005). Overall, previous research shows that keeping pets at home may be associated with more positive attitudes toward animals.

Does Keeping Pets Influence Attitudes toward All Animals?

Culture and society affect attitudes toward different animal species. Serpell (2004) proposed a motivational framework for understanding animal-related attitudes based on two distinct dimensions. These are 1) affection and sympathy, and 2) economic self-interest. With regard to the former, sympathies towards some animals can be the product of various evolutionary pressures (Herzog and Burghardt 1988). For example, humans tend to avoid predators that pose a serious threat to them (Ericsson and Heberlein 2003; Öhman and Mineka 2003; Røskaft et al. 2003), or animals that are associated with disease, such as cockroaches or mice (Davey et al. 1998). With regard to the latter, Kellert (1993) showed that both farmers and the general public view invertebrates associated with harmful effects on crops with fear, anxiety, and aversion.

Current research provides equivocal evidence that the owning of pets affects attitudes toward wild animals. For example, Kafer et al. (1992) found that pet owners preferred closer links to wild animals and held less favorable attitudes toward hunting, compared with people without pets. Paul and Serpell (1993) found a positive association between having a pet in childhood and later concern about the welfare of wild animals. Farmers in Norway, who reported they had pets, expressed fewer negative attitudes toward large carnivores, compared with their non-pet-owning counterparts (Vittersø, Kaltenborn and Bjerke 1998). Bjerke, Ødegårdstuen and Kaltenborn (1998) found that 9- to 15-year-olds who owned a pet had higher humanistic, moralistic, and lower utilitarian scores, compared with those without a pet. Moreover, Bjerke, Kaltenborn and Ødegårdstuen (2001) found that children and adolescents, with a pet at home, liked wild and domesticated animals more than did those children without pets. However, these differences were restricted to only some animals (Bjerke, Kaltenborn and Ødegårdstuen 2001).

Bjerke, Østdahl and Kleiven (2003) found that pet owners (adult residents in Norway) liked wild animals more than non-pet owners, but this effect was found to be significant only for popular animals such as dogs, cats, and squirrels. In contrast, unpopular animals, like rats, mosquitoes, and snails, were perceived similarly by pet owners and non-pet owners. Prokop, Özel and Usak (2009), in their research on university students in Slovakia and Turkey, found that having various pets at home was associated with less fear of snakes: the more animal species kept as pets, the lower the fear of snakes.

As described above, the association between owning a pet and attitudes toward wild animals remains unclear. Several variables could account for this. For example, the attitudes in Bjerke et al.'s (2001, 2003) research were examined just in terms of participants' sympathies, leaving other dimensions of attitudes (see, for example, Kellert 1985 for animal attitudes dimensions) unexamined. Moreover, the number of pet species kept by children, which is an important predictor of children's knowledge of animals (Prokop, Prokop and Tunnicliffe 2008), was not controlled for. In Bjerke, Ødegårdstuen and Kaltenborn's (1998) research, a greater number of dimensions of attitudes were examined, but the number of pet species kept was overlooked. More importantly, the attitude scale used in Bjerke, Ødegårdstuen and Kaltenborn (1998) in Norway was constructed from very heterogeneous statements that could result in misleading conclusions. Especially, the "negativistic scale" consisted mainly of statements that involved unpopular animals, like spiders or snakes, which logically resulted in a low mean score. In contrast, the "humanistic scale" consisted of statements involving pets, which resulted in a high mean score (see Bjerke, Ødegårdstuen and Kaltenborn 1998 for more details). These measurements failed to control for the effect of attitudes to particular animals. In other words, it is unclear whether a better knowledge of animals that potentially pose serious danger, disease, or are a harvest threat influences the attitudes of humans toward these animals. Considering the "mixed" approach in animal attitude measurement (e.g., Bjerke, Ødegårdstuen and Kaltenborn 1998), current evidence about the value of keeping pets on attitudes toward various wild animals remains unclear.

Current Study

This study focused on the effect of having various animals at home on children's knowledge of, and attitudes toward, both popular and unpopular animals in Slovakia. In order to control for the confounding effect of animal species on attitudes, we examined children's attitudes to, and knowledge of, both popular and unpopular animal species in three separate studies.

These studies examined attitudes to pests, predators, and "disgusting" animals that pose a disease threat. These three groups of animals were selected following the theoretical framework of Serpell (2004) and Herzog and Burghardt (1988) and each represents a different risk to humans (economic damage, predation, disease threat). Phylogenetically similar, but popular ("opposite"), animals were included in each group, to serve as controls. In Study 1, attitudes to, and knowledge of, a pest (potato beetle) and an "opposite" animal (ladybird beetle) were examined. Study 2 focused on attitudes to, and knowledge of, a predator (wolf) and an "opposite" animal (rabbit). Study 3 focused on an animal that poses a threat of disease to humans (mouse) and an "opposite" animal (squirrel).

The potato beetle is a typical pest of potatoes, whilst the ladybird beetle is a beetle from the same family (Coccinellidae), but is known as a beneficial insect because it kills aphids. So, the ladybird beetle in this study is an opposite (is popular) to the potato beetle. Similarly, an opposite to a predator like the wolf is its prey, the rabbit. Both these animals are mammals, so they are also phylogenetically similar. Finally, the mouse was used as a typical example of a "disgusting" animal that poses a threat of disease to humans. In that study, the squirrel was chosen as an "opposite" species, as although it is also a small mammal, unlike the mouse it is considered "cute" by many people (Bjerke, Østdahl and Kleiven 2003).

The age of the participants was 10 to 15 years. This age group was chosen because, in the USA, Kellert (1985) found that it was important in the development of cognitive abilities and the ecological awareness of the role of animals in their natural habitats. We therefore suggest that the age range of 10 to 15 years is critical to children in developing positive or negative attitudes toward animals, and that this may be utilized in humane education because the age range embraces two developmental stages and the transition from one to the other.

This paper explores the following questions: 1) What knowledge of, and attitudes toward, popular and unpopular animals do Slovakian children have? 2) Is having animals at home associated with children's knowledge of, and attitudes toward, popular and unpopular animals?

Our hypotheses were:

1. Children will have more positive attitudes toward popular animals and less positive attitudes toward less popular animals (Bjerke, Østdahl and Kleiven 2003).
2. Having pets at home will be associated with positive attitudes to, and knowledge of, both popular and unpopular animals; having more pets will result in more positive attitudes than having fewer pets (Prokop, Prokop and Tunnicliffe 2008).

Methods

Questionnaire Design

We measured students' attitudes to, and knowledge of, six animals (potato beetle, ladybird beetle, wolf, rabbit, mouse, and squirrel) using a specially designed questionnaire. For attitude measurement, we used a modified version of Prokop and Tunnicliffe's (2008) Spider Attitude Questionnaire, which is based on Kellert's (1985) attitude toward animals scale (see Appendix 1). It measures "negativistic," "ecoscientistic," and "naturalistic" attitude dimensions. Most of the negativistic items were derived and modified from the Spider Phobia Questionnaire (Kindt, Brosschot and Murit 1996). The ecoscientistic dimension measures interest in the biology, and the gathering of information of, particular animals, and concern for the role of each animal in nature and for inter-relationships between these animals and humans. The naturalistic dimension measures participants' attitudes to direct experiences with these animals in nature.

The attitude items were identical for all animals, except for the names of the animals, which allowed us to use the data in pair-wise comparisons. The order of items was random for all questionnaires. Items were scored by participants from 1 (strongly disagree) to 5 (strongly agree) and were formulated either negatively (e.g., "If I happened to find a wolf near my home, I would probably run away") or positively (e.g., "I would like to read a book about potato beetles") (Oppenheim 1993). Negative items were scored in reverse order, resulting in more positive attitudes being represented by higher mean scores.

Knowledge of the six animals was measured using self-constructed items that represented basic facts about the animals' biology and behavior. These items were focused mainly on feeding habits, reproduction, and ecological relationships of animals, and were similar for each animal species. Some examples of knowledge items (with correct answers in brackets) include: "Wolves kill only sheep." (False); "Rabbits are frequent prey of foxes and birds of prey." (True): "Mice are territorial." (True); "Female squirrels give birth to about four young in one litter." (True); "Potato beetles feed on aphids." (False); and "Ladybird beetles overwinter in soil." (True).

The overall questionnaire for measuring attitudes and knowledge comprised 26 items for attitudes and 12 items for knowledge, for each animal species. The validity of the questionnaire was established through review by two professors in the field of zoology, from two different universities, and two experts in biology education from Slovakia. All reviewers were asked whether the items in each dimension were relevant to the goal of the questionnaire. Revisions were based on their comments and suggestions.

All questionnaires showed high reliability of items (Cronbach's alphas were: 0.68 potato beetle; 0.85 ladybird beetle; 0.84 wolf; 0.87 rabbit; 0.88 mouse; and 0.89 squirrel). Although the Cronbach's alpha for the potato beetle questionnaire was somewhat low, other research on attitudes has considered similar values to be satisfactory. Fraser (1989) reported that alpha coefficients in the range of 0.58 to 0.81 indicate that the instrument has satisfactory reliability for scales containing five items each. Francis and Greer (1999) reported alpha values for three science attitude dimensions ranging from 0.64 to 0.72. Dhindsa and Chung (2003) reported alpha values for six science attitude dimensions ranging from 0.59 to 0.75.

Knowledge scores were calculated separately. The mean score from each dimension was then used in further statistical analyses.

Procedure

Questionnaires for the three studies were administered separately and simultaneously in 12 different urban and rural schools. Attitudes toward pests included items about the potato beetle and its opposite/control, the ladybird beetle (Study 1). Participants in Study 1 responded only to items about beetles. Attitudes to predators included items about the wolf and its prey (opposite), the rabbit (Study 2), but not about other animals. Attitudes to "disgusting" animals (Study 3) which pose a threat of disease included items about the mouse, as well as an opposite (popular) animal, the squirrel (Bjerke, Østdahl and Kleiven 2003).

Questionnaires were administered on two separate occasions, within 1 to 2 days, by classroom teachers. The order of administering questionnaires was random. Participants were selected randomly irrespective of their interest in biology. Children were informed that the questionnaire was not a test, but rather an attempt to examine their attitudes toward animals. The children were also asked for the following information: (1) age/grade, (2) sex, (3) if they had any animals at home, and, if yes, (4) how many animal species they had at home. No time limit was given for the completion of the questionnaire.

Participants

The study was conducted between May and June 2006. In Study 1, 307 children in grades 5 to 9 (with equal numbers of males and females), aged 10 to 15 years, attending three elementary schools, participated. In Study 2, 233 children, aged 10 to 15 years, from two different schools, participated. In Study 3, 757 children, aged 10 to 15 years, from seven schools, participated.

Results

Gender Effects: Attitudes and Knowledge

We found consistent results regarding attitudes to, and knowledge of, popular and unpopular animals. The children showed more positive attitudes to popular animals, but conversely less knowledge of popular animals (Figure 1). Attitudes to, and knowledge of, beetles were not influenced by gender ($F_{(4,294.0)} = 2.07$, $p = 0.08$, partial $\eta^2 = 0.03$, $n = 307$). Attitudes toward wolves and rabbits were influenced by gender ($F_{(4,220.0)} = 7.78$, $p < 0.001$, partial $\eta^2 = 0.12$, $n = 233$): females showed more negative attitudes toward wolves compared with males, but knowledge of both wolves and rabbits was not affected by gender. Attitudes toward mice and squirrels were influenced by gender ($F_{(4,744.0)} = 16.58$, $p < 0.001$, partial $\eta^2 = 0.08$, $n = 757$). Knowledge was not gender dependent, but attitudes toward mice were more positive among boys, and attitudes toward squirrels were more positive among girls.

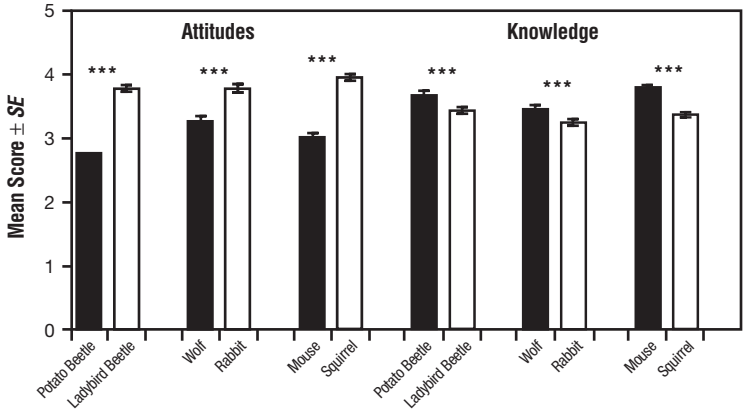


Figure 1. Mean attitude and knowledge scores for the six animals studied. The higher the score, the more positive the attitude and the greater the knowledge. Clear bars represent "control" or "opposite" animals. ***$p < 0.001$.

Gender Effects: Attitude Dimensions

The Negativistic Dimension: Attitudes to all animals were significantly influenced by gender (Figure 2). Females showed greatest preference for popular animals and least preference for unpopular animals. The largest gender differences were found in attitudes toward wolves and mice (Figure 2).

The Ecoscientistic Dimension: Females were more positive about rabbits ($F_{(1,223)} = 13.56$, $p < 0.001$) and squirrels ($F_{(1,747)} = 15.08$, $p < 0.001$) than males. There were no gender differences in attitudes toward the potato beetle and ladybird beetle ($F_{(1,297)} = 3.53$ and 0.33, $p = 0.06$ and 0.56), wolves ($F_{(1,223)} = 0.14$, $p = 0.71$) or mice ($F_{(1,747)} = 0.00$, $p = 0.98$).

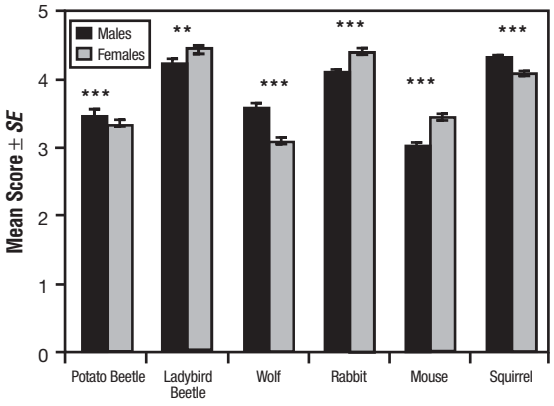


Figure 2. Mean "negativistic" attitude scores by gender, for the six animals studied. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, ns = non-significant.

The Naturalistic Dimension: We did not find any gender differences in attitudes toward potato beetles and ladybird beetles ($F_{(1,297)} = 2.27$ and 0.002, $p = 0.13$ and 0.96), or rabbits ($F_{(1,223)} = 2.72$, $p = 0.10$). However, boys showed more positive attitudes toward wolves ($F_{(1,223)} = 15.51$, $p < 0.001$) and mice ($F_{(1,747)} = 34.24$, $p < 0.001$) than did girls. Females were more favorable toward squirrels ($F_{(1,747)} = 19.97$, $p < 0.001$) than males.

Knowledge of Animals

For our analysis of children's knowledge of the species, we considered items with median split responses ≥ 4.0 as reflecting "good knowledge," and scores < 4.0 as reflecting "poor knowledge." Children showed particularly poor knowledge of the number of species, the origin of, and overwintering of potato beetles. In contrast, they were aware of the food and life cycle of the potato beetle, and knew that these beetles are important pests. Similarly, the diversity and overwintering of ladybird beetles was not well understood, as were the feeding habits of larvae and oviposition habitat. There was an incorrect belief that older ladybird beetles have more dots on their forewings.

The feeding habits of wolves were not well understood. Many children did not know that wolves also feed on small mammals like rodents or the corpses of other animals. There was also an incorrect belief that wolves howl only during a full moon and that wolves are a serious danger to humans living in the vicinity of a forest. Children were correct in that they knew that wolves do not eat only sheep and they knew the correct body mass of a wolf. Knowledge of rabbits was generally poor, especially regarding the diversity of rabbits, their activity during the evening, and running speed. The fact that rabbits are frequently the prey of foxes and other predators was known by most of the children (mean score of about 4.0; i.e., high agreement).

Some aspects of feeding habits (mice also feed on insects), territoriality, and the time that mice need to reach adolescence were least well understood. In contrast, children knew where mice live, what they look like and when they are born, and that they are the common prey of predators. Few children knew that squirrels transmit various diseases and parasites, or that they also feed on insects and bird eggs. That squirrels can live in large parks and that they make their nests inside the holes of trees was generally well known.

Having Animals at Home

Sixty-seven percent (n = 880) of the children reported having animals (a total of 1823 animals). The types of animal kept were categorized into 24 animal taxa. Eleven of them could be classified as farm animals (hens, horses, pigs, ducks, cows, goats, sheep, roe deer and deer, pigeons, and turkey-hens). These farm animals were cited less frequently than pets (322/1823 animals, 18%). Other children reported having only pets (605/1297, 47%) or both pets and farm animals (240/1297, 19%). Thirty-five children (less than 3%) reported having only farm animals (no pets). Because removing these 35 children did not change the results of subsequent statistical analyses, we did not distinguish between having pets or farm animals.

The mean number of reported animals per children was 1.40 (SE = 0.04), with a range of 0 to 9. Looking after a single animal was reported by 30% of all children, while 32% reported not looking after an animal, 18% reported keeping two animal species, 11% reported keeping three animal species, and 9% cared for four or more animal species.

The most frequently cited animals were dogs, cats, hens, parrots, hamsters, rabbits and fish (Table 1). Other animals were reported less frequently (< 5% of all animals). Only two children reported having invertebrates (a spider and a stick insect). As seen in Table 1, there is a decrease in the number of children owning an animal as age increases. This is true especially for small pets (parrot, hamster, rabbit, fish); less so for other animals (dog, cat, hen). This decrease is statistically significant (ANOVA, $F_{(4,1288)} = 3.99$, $p = 0.003$). Interestingly, females reported having more animals than boys (ANOVA, $F_{(1,1288)} = 8.78$, $p = 0.003$). There was no interaction between grade and gender ($F_{(4,1288)} = 1.34$, $p = 0.25$). These results remained unchanged even after excluding all farm animals from the analysis.

Table 1. The most reported animals reared by Slovakian children, with respect to age.

	Percentage of Children with Animal							
Grade (age: years)	Dog	Cat	Hen	Parrot	Hamster	Rabbit	Fish	No. of Children (total n = 1297)
5 (10/11)	53.5	29.8	15.4	15.7	11.4	14.4	9.0	299
6 (11/12)	40.1	18.7	14.9	11.5	13.0	9.9	11.1	262
7 (12/13)	46.4	22.2	25.6	11.4	11.8	10.0	8.3	289
8 (13/14)	43.9	21.5	20.8	9.2	7.7	6.2	5.8	260
9 (14/15)	46.5	25.7	17.7	5.4	5.9	6.4	2.7	187
% of All Animals	33	17	13	8	7	7	5	

Effect of Pets on Children's Knowledge of, and Attitudes toward, Animals

A series of one-way MANCOVAs (with having animals as the predictor and age as the covariate) was used to examine how the keeping of pets affected knowledge of, and attitudes toward, the six animal species. We found an overall statistically significant effect of animal ownership on both knowledge of, and attitudes toward, the animals. Generally, the more animals kept, the more positive attitudes to, and better knowledge of, each examined animal: potato beetle and ladybird beetle (MANCOVA, Wilk's $\lambda = 0.89$, $F_{(4,12)} = 794.01$, $p = 0.0006$, partial $\eta^2 = 0.04$, n = 307; Figure 3); wolf and rabbit (MANCOVA, Wilk's $\lambda = 0.89$, $F_{(4,12)} = 595.58$, $p = 0.02$, partial $\eta^2 = 0.04$, n = 233; Figure 4); and mouse and squirrel (MANCOVA, Wilk's $\lambda = 0.97$, $F_{(4,12)} = 1981.96$, $p = 0.03$, partial $\eta^2 = 0.01$, n = 757; Figure 5).

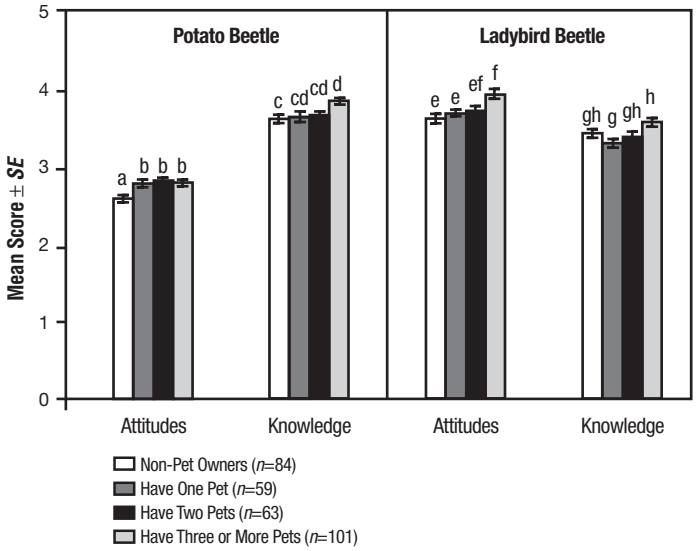


Figure 3. Mean attitude and knowledge scores for the potato beetle and the ladybird beetle, as a function of pet ownership. Letters a to h denote differences based on Tukey post-hoc tests (a vs. b, $p < 0.05$ and less; c vs. d, $p < 0.01$; cd is not different from others; e vs. f, $p < 0.05$ and less; ef is not different from others; g vs. h, p = 0.01; gh is not different from others).

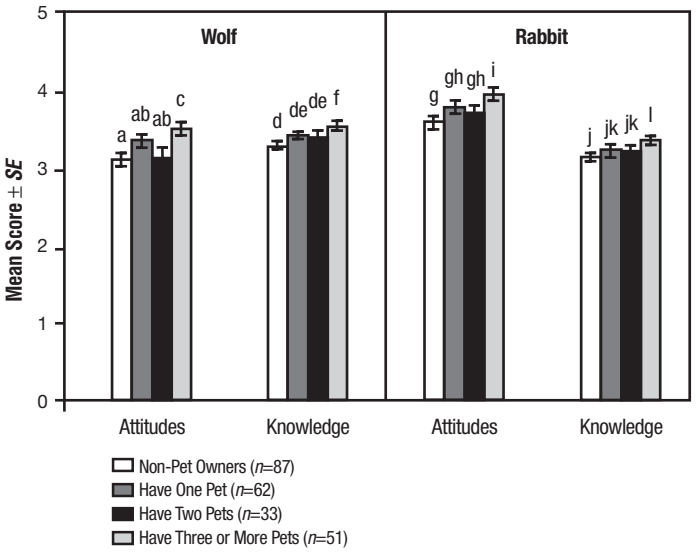


Figure 4. Mean attitude and knowledge scores for the wolf and the rabbit, as a function of pet ownership. Letters a to l denote differences based on Tukey post-hoc tests (a vs. c, p = 0.009; ab is not different from others; d vs. f, p = 0.008; de is not different from others; g vs. i, p = 0.007; gh is not different from others; j vs. l, $p = 0.03$; jk is not different from others).

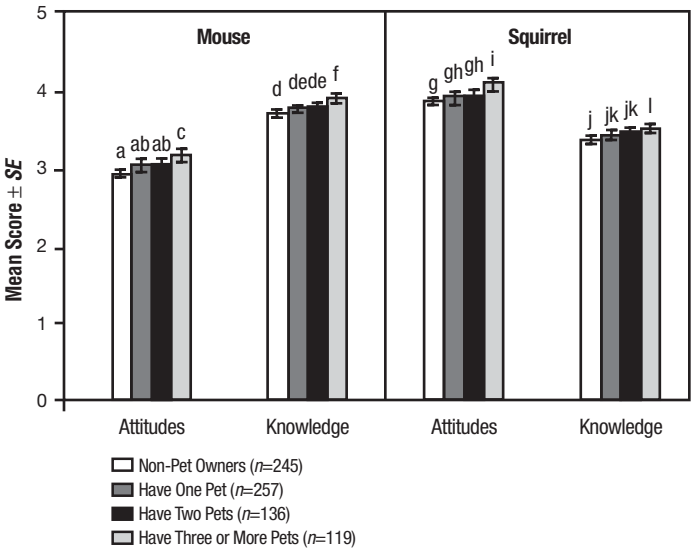


Figure 5. Mean attitude and knowledge scores for the mouse and the squirrel, as a function of pet ownership. Letters a to l denote differences based on Tukey post-hoc tests (a vs. c, $p = 0.01$; ab is not different from others; d vs. f, $p = 0.006$; de is not different from others; g vs. i, $p = 0.004$; gh is not different from others; j vs. l, $p = 0.02$; jk is not different from others).

Through examining the effects of keeping animals on each attitude dimension separately, we found that the greatest positive influence of owning animals was on naturalistic attitudes these effects were found in two out of the three unpopular animals (potato beetle: $F_{(3,303)} = 13.00$, $p < 0.001$; wolf: $F_{(3,229)} = 3.24$, $p = 0.022$; mouse: $F_{(3,753)} = 1.56$, $p = 0.19$) and all the popular animals (ladybird beetle: $F_{(3,303)} = 3.88$, $p = 0.009$; rabbit: $F_{(3,229)} = 3.12$; $p = 0.03$, squirrel: F(3,753) = 3.35, p = 0.02). The negativistic dimension was influenced only in the case of the wolf ($F_{(3,229)} = 3.44$, $p = 0.02$) and ladybird beetle ($F_{(3,303)} = 3.56$, $p = 0.015$), but not in other animals (potato beetle: $F_{(3,303)} = 1.87$, $p = 0.14$; mouse: $F_{(3,753)} = 1.46$, $p = 0.22$; rabbit: $F_{(3,229)} = 1.26$, $p = 0.29$; squirrel: $F_{(3,753)} = 0.88$, $p = 0.45$). The ecoscientistic dimension was influenced in all the popular animals (ladybird beetle: $F_{(3,303)} = 3.72$, $p = 0.012$; rabbit: $F_{(3,229)} = 5.14$, p = 0.001; squirrel: $F_{(3,753)} = 5.41$, $p = 0.001$), but just in one of the three unpopular animals (potato beetle: $F_{(3,303)} = 0.75$, $p = 0.52$; wolf: $F_{(3,229)} = 2.05$, $p = 0.11$; mouse: $F_{(3,753)} = 5.04$, $p = 0.002$).

Discussion

Having animals as pets provides various benefits for children. To date, however, no study has provided convincing evidence that having pets is related to positive attitudes toward various wild animals (that are generally considered to be more or less popular, for various reasons). The present study showed that having pets is beneficial in the development of positive attitudes toward both popular and unpopular animals. This finding contradicts the research of Bjerke, Østdahl and Kleiven (2003). In addition, the relationship between knowledge and keeping animals provides further support for the belief that having pets is linked with children's factual knowledge of animals, or vice versa (Prokop, Prokop and Tunnicliffe 2008).

Previous research in Slovakia showed that the probability of owning a pet is higher among children with better educated parents (Prokop, Prokop and Tunnicliffe 2008). One could argue therefore that the relationship between attitudes and owning pets in this study might be confounded by the educational level of the parents. Although we cannot reject this possibility, because the educational level of parents was not controlled for in this study, at least one argument supports our conclusion that having pets at home is related to more positive attitudes toward animals. The educational level of parents is responsible only for *having* versus *not having* an animal at home (Prokop, Prokop and Tunnicliffe 2008). Thus, only more positive attitudes of pet owners could be confounded by the educational level of parents, but this does not explain why children with more pets at home had better attitudes than children with fewer pets.

In addition, the same patterns are confirmed by Prokop, Özel and Usak (2009), who found an association between number of animal species at home and fear of snakes. In their research, university students from two very distinct countries (Turkey and Slovakia) who had more animals at home exhibited lower fear of snakes than students with no or fewer animals at home. Alternatively, Prokop, Prokop and Tunnicliffe (2008) examined the relationship between *knowledge* and the educational level of parents, rather than *attitudes* and the educational level of parents. Although it is clear that better educated peoples, in terms of level of education achieved, have more positive attitudes toward animals (Kellert 1993), little is known about how parents' educational level influence their child's attitudes toward animals.

In our three studies, conducted on different samples of participants, there were more positive attitudes toward popular animals, but conversely less knowledge of popular animals. It is possible that less popular animals are still attractive to children, for example, when watching natural history films. Prokop and Kubiatko (2008) found that Slovakian children held less positive attitudes towards wolves than towards rabbits, but that after they watched natural history films about wolves, these animals became more attractive to children than rabbits.

Gender differences (M > F) occurred, especially with regard to attitudes toward animals that are seen as being a physical danger (wolf) or a disease threat (mouse) to humans, but not to pests like the potato beetle.

Children's Age and the Number of Animal Species at Home

The present study showed that younger children kept pets more frequently than older children, which might reflect a greater interest by younger children in the biology of animals. In line with this, younger children have been found to be more interested in biology, compared with older children (Prokop, Prokop and Tunnicliffe 2007; Prokop, Tuncer and Chudá 2007). Thus, a decreasing interest in animals with increasing age could be either a function of differentiating interests among older children (e.g., greater effort directed to activities related to future career choice or other matters associated with adolescence). Further research is required to test whether biology-related activities, like keeping pets, decrease at the expense of other hobbies as children age.

Significance of Gender

Girls showed more negative attitudes to wolves and mice compared with boys. In contrast, there were more positive attitudes to squirrels and rabbits amongst girls, and no gender differences in attitudes toward beetles. Considering that small mammals like rabbits are frequently kept as pets, and that girls report having more pets at home than boys (Bjerke, Kaltenborn and Ødegårdstuen 2001; Lindemann-Matthies 2005; Prokop, Prokop and Tunnicliffe 2008; this study), the results suggest a greater preferences amongst females for small and less dangerous animals, compared with boys. In contrast, girls in the present study showed

less positive attitudes toward large carnivores like wolves, or animals that pose a disease threat, such as mice. This finding is in agreement with the research conducted on adult participants (e.g., Davey et al. 1998; Røskaft et al. 2003). Fredrikson et al. (1996) suggest that gender differences in animal phobias may reflect different genetic and/or environmental transmission patterns. Greater fear of large carnivores might also reflect a lower physical condition/ability of females to escape from attack by a predator (Røskaft et al. 2003). According to the "environment of evolutionary adaptedness" hypothesis, men were hunters and therefore had to deal directly with many dangerous animals (Hawkes, O'Connell and Blurton Jones 1991). Further, in-depth research which focuses on the origin of gender differences in animal fears amongst children is required.

Popular and Unpopular Animals

All three of our surveys consistently showed that the children had better knowledge, of, but more negative attitudes toward, less popular animals. We suggest that greater knowledge could either reflect personal experiences (potato beetle, see above), or information gathered from other sources such as books or natural history films (Prokop, Prokop and Tunnicliffe 2007). Importantly, differences in attitude scores between the animals in each study were more extreme in the cases of mice and squirrels and the two beetles, but relatively small in the predator/prey (wolf/rabbit) study. This might reflect the role of personal experiences with these animals and/or the risk of contact with them in real life (Kaltenborn et al. 2006). Whilst mice are both common pests and potential vectors of various diseases (Herzog, 1988), and potato beetles are a well-known pest affecting crops (e.g., Weisz, Fleischer and Smilowitz 1995), wolves are rare in Slovakia and almost non-existent in regions where our research was conducted. We therefore suggest that not only evolutionary but also regional differences could play an important role in attitudes toward animals (Herzog and Burghardt 1988). Hence, such a finding means that there are opportunities to improve attitudes, perhaps through science education lessons.

Implications for Humane Education

There are several implications from our study for humane education, especially in terms of helping improve attitudes toward unpopular animals. Firstly, keeping pets at home and/or schools should be supported by both teachers and parents. Pet-keeping can provide various benefits to children in terms of acquiring knowledge and positive attitudes toward animals. However, it is still unclear whether pet owners are simply different from non-owners (Paul and Serpell 1996) or whether owning pets influences owners' attitudes towards animals *per se*. Prokop, Prokop and Tunnicliffe (2008), for example, showed that non-pet owners come from families in which parents attained a lower educational level, which could indicate that they are of a low socio-economic status. Such a relationship merits further investigation.

Secondly, programs about nature conservation could be focused on the role of "controversial" animals like predators or invading species in nature. Martín-López, Montes and Benayas (2007) showed that an individual's understanding of the role that species play in ecosystems influences attitudes toward animals. A greater emphasis on programs focusing on the biodiversity of organisms could be beneficial to forming positive attitudes, because children have limited ideas about species diversity.

Thirdly, children should know more about the mechanisms of ecological adaptation and interspecific competition. Only a better understanding of why some harmful animals, various pests, or invasive species, are often biologically successful, might help humans with how to regulate pests in nature.

Finally, we suggest that the results reported in this paper may provide useful information in guiding curriculum development, especially for educators concerned with ecology and the behavior of animals.

To the best of our knowledge, this is the first study to have systematically investigated attitudes to the three different categories of animals we were interested in (pest, predator and "disgusting") in a sample of primary school children.

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