

Slovakian Pupils' Knowledge of, and Attitudes toward, Birds

**Pavol Prokop*†, Milan Kubiатko* and
Jana Fančovičová***

* *Department of Biology, Faculty of Education, Trnava University, Trnava, Slovakia*

† *Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia*

Address for correspondence:

*P. Prokop, Department of
Biology, Faculty of Education,
Trnava University,
Priemyselná 4, PO Box 9,
918 43 Trnava, Slovakia.*

*E-mail:
pavol.prokop@savba.sk*

ABSTRACT As the world's biodiversity is being destroyed, costs for nature protection activities increase. One proposed way to increase people's pro-environmental attitudes is to increase their knowledge base. It has been suggested that knowledge and attitudes are related, but no consensus in this field yet exists. Thus, the investigation of the relationship between attitudes and knowledge has valuable implications for nature protection programs. In this paper, we investigated relationships between Slovakian grammar school pupils' attitudes to, and knowledge of, birds ($n = 402$ participants aged 10–19 years). We found that factual knowledge about birds was positively related to pupils' attitudes toward birds. Interestingly, younger pupils had better knowledge of birds than older pupils. Regarding attitudes, higher scores were registered for the Concern for Birds and Avoidance of Birds dimensions than the Interest in Birds dimension. Females showed more positive attitudes in the Avoidance of Birds dimension compared with males, and bird owners scored higher in the Interest in Birds dimension and lower in the Concern for Birds dimension compared with non-bird owners. Implications for nature protection programs are discussed.

Keywords: animals, attitudes, birds, knowledge



Birds are fascinating animals, numbering over 10,000 species worldwide. They are of great ecological significance due to their consumption of insects and other pests (Jones and Sieving 2006) and the role they play in the pollination of plants and trees (Klein et al. 2007), which is profitable mainly for gardeners and farmers. Additionally, many species of bird are used as food for humans (Meiklejohn 1962). Current research shows that there is a decline in bird populations all over the world (Canada 1996; Ford et al. 2001; Sekercioglu et al. 2002). In

recent years, this situation has prompted some nations to invest substantial resources in conserving biodiversity (James, Gaston and Balmford 2001; Garnett, Crowley and Balmford 2003; Bradbury and Kirby 2006; Butchart et al. 2006).

Protecting nature without increasing public awareness of environmental problems is illogical. Environmental knowledge is an essential precursor of attitude formation (Kellert and Westervelt 1984; Kaiser, Wolfing and Fuhrer 1999). However, the link between knowledge and attitudes is not always clear. First of all, it must be noted that it is unclear whether attitudes lead to increased knowledge or vice versa (Zimmermann 1996). Brossard, Lewenstein and Bonney (2005), for example, investigated the effects of an informal science education project (The Birdhouse Network) on participants' attitudes toward science and environment and their knowledge of birds. They found that participants' knowledge of bird biology increased with participation in the program. However, they failed to find any statistically significant change in participants' understanding of the scientific process, attitudes toward science, and attitudes toward the environment.

Factors Affecting Attitudes toward Animals

An attitude can be generally defined as the tendency to think, feel, or act positively or negatively toward objects in our environment (Eagly and Chaiken 1993; Petty 1995). Social psychologists have long viewed attitudes as having three components: the cognitive, the affective, and the behavioral. The cognitive component refers to knowledge about the objects—the beliefs. The affective component includes feelings about the object, and its assessment is performed using psychological indices. Finally, the behavioral component pertains to the way people act toward the object—its assessment is through direct observations (Eagly and Chaiken 1993).

Human attitudes toward animals are probably influenced by direct and indirect selection pressures (Herzog and Burghardt 1988). Direct pressures are derived from human evolutionary co-existence with animals. Indirect pressures are anthropomorphic generalizations of responses that originally evolved toward other people. The former group of attitudes comprises fear of animals, domestication, and their distribution (rare vs. common animals). The latter group refers to general attraction to “cute” animals such as infants, due to their specific features (large eyes, large cranial expanse) or awkward movements. In addition, human attraction to animals or animal treatment also depends on physiological and communicative similarity between animals and humans. For example, birds are most active during the day and they use acoustic communication which makes them “more similar” to humans compared with fish or reptiles. Physiological similarity with primates results in greater emotional attachment compared with other taxonomic groups (Herzog and Burghardt 1988).

Serpell (1986, 2004) proposed a motivational framework for human attitudes to animals based on two distinct dimensions: affection and sympathy and economic self-interest. The former dimension can be characterized as similar to indirect, anthropomorphic generalization of responses, as proposed by Herzog and Burghardt (1988). The latter dimension comprises both direct and indirect pressures (cf. Herzog and Burghardt 1988) because attitudes related to domestication are the result of direct rather than indirect pressures, but sympathy toward animals would be described as a result of indirect pressures.

This brief description of the origin of attitudes toward animals suggests that animal species plays an important role. For example, the general public was found to view most invertebrates with aversion, anxiety, and ignorance (Kellert 1993), probably because they are

small and behaviorally and morphologically dissimilar to humans (Wilson 1987; Kellert 1993; Davey 1994). Bjerke and Østdahl (2004) found that people most like small animals such as birds, squirrels, dogs, etc., and dislike bats, snails, invertebrates, and rats. This is also supported by the prevalence of keeping dogs, cats, fish, and birds as domestic pets by humans (Bjerke, Østdahl and Kleiven 2003; Prokop, Prokop and Tunnicliffe 2008). Owning pets has also been shown to result in more knowledge of animals in general (Inagaki 1990; Prokop, Prokop and Tunnicliffe 2008) and more positive attitudes toward popular animals (e.g., Bjerke, Østdahl and Kleiven 2003). Some large animals such as horses or zoo animals are also considered attractive. For example, Kellert and Westervelt (1984) found that the most popular animal-related activities among 6–18-year-olds in Connecticut were visits to a zoo. Horseback riding has been found to be attractive, especially for girls (Bjerke, Kaltenborn and Ødegårdstuen 2001).

In addition to animal species, several researchers have identified significant gender differences in attitudes to animals. Males are generally more supportive of the use of animals in medical research than females (Hagelin, Hau and Carlsson 1999) and score higher in the utilitarian, naturalistic, and dominionistic dimensions (Bjerke, Ødegårdstuen and Kaltenborn 1998; Thompson and Mintzes 2002). Recently, Taylor and Signal (2005) found better overall scores for females rather than males in the Animal Attitude Scale (AAS), which measures attitudes toward animals. A high score on this scale indicates pro-welfare attitudes. However, Herzog (2007), in his recent review, showed that gender differences are often overestimated. His calculation of effect sizes of gender differences showed that in most areas there is considerable overlap between males and females.

Another important factor that potentially may influence peoples' attitudes toward animals is their knowledge base. Scientists and members of protection communities express greater knowledge, appreciation, protection, concern, and interest toward animals than the general public (Kellert 1993; Signal and Taylor 2006a). For example, Thompson and Mintzes (2002) showed that college biology majors had higher scientific and naturalistic attitudes, and lower utilitarian/negative attitudes, toward sharks than other people. Especially, they showed statistically significant relationships among all five knowledge structures (as measured by concept maps) and three out of four attitudinal scales. Similarly, Røskaft et al. (2003) found that respondents with a higher education level reported less fear of large carnivores than did respondents with lower education.

This brief review shows that the relationship between attitudes and knowledge is still not fully understood, and several works have produced controversial findings. Despite that attitudes toward birds should be greatly influenced by both direct (domestic birds) and indirect pressures (keeping birds as pets), which may influence attitudes in various dimensions, neither attitudes toward birds specifically nor the relationship between knowledge and attitudes toward birds has ever been systematically investigated. Thus, the aim of our research was to contribute to this debate by measuring relationships between students' knowledge of, and attitudes toward, birds.

Attitudes to, and Knowledge of, Birds

There are few studies that address peoples' knowledge of, and attitudes toward, birds. Beck et al. (2001) evaluated a ten-week educational home-based program for feeding wild birds and found that knowledge about birds increased in 7–10-year-old children, but not in 10–12-year-old children. Moreover, they found neither a systematic change in environmental

attitudes nor a correlation between attitudes to birds and knowledge of birds. Bogner (1999) examined the effects of conservation programs on 10–16-year-old students' attitudes to, and knowledge of, the Common Swift, *Apus apus*. A delayed posttest, designed to examine persistence of new knowledge and attitudes, showed that participants' attitude scores changed in two of five environmental attitude dimensions. Interestingly, similar to Beck et al. (2001), Bogner also found that specific knowledge about the Common Swift increased only in younger, but not in older, students.

Jacobson et al. (2003) examined farmers' attitudes to, and knowledge of, birds and found that only a minority of them (up to 1/3 of all participants) were able to report more than 30 bird species from their farm. Younger farmers were probably more aware of a general decline in some bird populations, but there was not an overall correlation between farmers' willingness to attract birds to their farms and their knowledge on insectivorous birds or birds on their farms (Jacobson et al. 2003).

More recently, Prokop, Kubiátko and Fančovičová (2007) showed that 7–15-year-old pupils' knowledge about birds is inconsistent and that a substantial number of children have various misunderstandings about bird biology and systematics. For example, a majority (75%) of pupils thought that a penguin's body is covered with hair or just skin. About 40% of all pupils incorrectly classified a penguin as a non-bird species (see also Kellert 1985; Trowbridge and Mintzes 1985) and nearly all (89%) thought that cocks crowed to wake up people or hens (Prokop, Kubiátko and Fančovičová 2007). Other studies provide less direct evidence of human attitudes to, and knowledge of, birds. Kellert (1985), for example, showed some children's misunderstanding of bird biology and bird classification. Bjerke and Østdahl (2004) examined animal species preferences in a sample of 24 common urban animal species. They found that respondents preferred small birds (positive attitudes) but showed neutral attitudes toward other birds such as magpies, birds of prey, pigeons, or seagulls.

Current Study

This paper explores Slovakian pupils' knowledge of, and attitudes toward, birds. It was motivated by both the low knowledge base of birds found among Slovakian pupils (Prokop, Kubiátko and Fančovičová 2007) and by the poorly understood link between attitudes and knowledge. Moreover, suitable habitats for birds are often endangered and populations of several bird species have declined (Butchart et al. 2006). Thus, the understanding of pupils' attitudes can be one of the key elements in nature protection and management. We aimed to answer the following research questions:

1. What knowledge of, and attitudes toward, birds do Slovakian students have?
2. How do knowledge and attitudes change with age of pupil?
3. Is knowledge of birds related to attitudes toward birds?
4. Are there any differences in knowledge of, and attitudes toward, birds with respect to gender?
5. Are there any differences between bird owners and non-bird owners?

Methods

Construction of the Bird Attitude Questionnaire (BAQ)

Pupils' attitudes toward birds were measured by Likert-type items (Likert 1932). The original, self-constructed questionnaire consisted of 33 items that were scored by participants from 1 (strongly disagree) to 5 (strongly agree). Items were selected to examine human–bird relationships, especially in students' interest in birds, concern for birds, and their importance in nature. Items were

formulated either negatively or positively (Oppenheim 1993). Negative items were scored in reverse order. This means that the higher the score the more positive the attitude toward birds. The range of scores was 33–165. Two professors of zoology, with a specialization in ornithology from two different universities, and two biology teachers independently, and separately, checked items in order to maintain the validity of the research instrument. Their suggestions and improvements were accepted and the final version of the questionnaire was altered accordingly.

Scores were subjected to factor analysis (with varimax rotation) and four factors with eigenvalues greater than 1.5 were derived. Items with loadings lower than 0.36 were omitted, which is similar to what other researchers have done (e.g., Anastasi 1996; Palaigeorgiou et al. 2005). Three items that loaded with more than one factor were excluded from further consideration (Palaigeorgiou et al. 2005). The reliability of the remaining 28 items and of each separate dimension was measured. The Cronbach's alpha coefficient for the instrument consisting of 28 items was 0.73, which suggests appropriate reliability (Anastasi 1996). Factor analysis extracted four dimensions of students' attitudes toward birds: "Interest in Birds" ($\alpha = 0.78$) with nine items, "Avoidance of Birds" ($\alpha = 0.63$) with 7 items, "Concern for Birds" ($\alpha = 0.59$) with seven items, and "Ecology of Birds" ($\alpha = 0.43$) with five items. All dimensions showed acceptable reliability (Anastasi 1996), with the exception of the Ecology of Birds dimension. This dimension was therefore not included in further analyses. The Cronbach's alpha coefficient for the resulting instrument, consisting of 23 items, was 0.72, which indicates acceptable reliability. A subsequent factor analysis of the 23 items resulted in three independent factors. This means that the final range of scores was 23–115. The full version of the BAQ instrument with a detailed description of item loadings is shown in Table 1 (p. 226).

The Interest in Birds dimension focuses on various topics of both active and passive interests in birds. Items include having an interest in watching natural history films, an interest in ornithology, and an interest in studying birds in the future. The Avoidance of Birds dimension includes emotions toward predator and prey relationships, the problem of bird influenza, and the role of some "useless" birds in nature. The Concern for Birds dimension focuses on keeping birds in cages and human–bird relationships in the field (cutting trees) and cities (impact of pigeons on buildings).

Construction of the Bird Knowledge Questionnaire (BKQ)

Pupils' knowledge was measured by the Bird Knowledge Questionnaire, which consists of 48 true/false statements. These statements were developed following the findings of previous research based on children's responses from interviews and open-ended and multiple-choice questions (Prokop, Kubiátko and Fančovičová 2007). Items were finally submitted to a panel of ornithology and biology education experts, as mentioned above, and improved accordingly in order to maintain validity of the instrument. Each correct answer was given a score of "1" and incorrect answers were given no points. Thus, 48 points was the highest possible score. Some examples of the questions are provided below:

- Owls see better during the day than during the night (False)
- Woodpeckers feed on insects (True)
- Penguins breed live young (False)
- A cock uses crowing for protection of his territory (True)

The total score from the questionnaire was used for subsequent analyses. (The full version of the BKQ instrument is available from the corresponding author upon request.)

Table 1. Factor structure of pupils' attitudes toward birds ($n = 402$ participants). Numbers in bold represent values with greatest factor loadings.

Items	Interest in Birds	Avoidance of Birds	Concern for Birds
More time should be spent teaching ornithology in schools	0.71	-0.13	0.05
I do not like natural history films about birds	0.59	0.10	0.10
Birds have interesting life histories	0.51	0.05	0.36
I do not know how someone can be interested in bird research	0.56	0.31	0.10
I would like to go on an expedition focused on protection of an eagle	0.67	0.00	0.08
Bird ringing is interesting, similar to fishing or hunting	0.41	-0.06	0.13
Investigating biology of birds in the future would be interesting for me	0.78	-0.07	-0.07
I would like to be a falconer	0.61	-0.07	-0.13
I am not interested in why birds sing	0.42	0.12	0.05
Birds should be confined in reserves to avoid troubles in cities with them	0.17	0.56	0.21
Hawks are harmful because they kill smaller birds	-0.09	0.53	-0.07
Waterbirds should be shot in order to avoid spread of bird influenza	0.04	0.65	0.01
Even if all birds disappeared, it would not be dangerous for nature	-0.07	0.50	0.23
House sparrows are not profitable	0.26	0.48	0.13
I do not like when a powerful bird (hawk) kills a weaker bird (great tit)	-0.22	0.43	-0.16
Cuckoos should be shot because they destroy chicks of other passerine birds	0.04	0.68	0.01
Bird influenza is potentially dangerous all over the world	0.11	-0.12	0.58
Keeping birds in cages is cruel	0.01	-0.08	0.47
House swallows regulate insect gradation	-0.03	0.14	0.61
It is interesting how birds find migratory ways	0.12	0.21	0.57
Natural habitats of birds are reduced by cutting trees	0.15	0.24	0.45
Toxic substances from crop spraying are transferred from plants to birds and endanger them	0.10	0.07	0.62
Pigeons living in cities transmit diseases and endanger historical buildings	-0.27	-0.26	0.36
Eigenvalue	3.9	2.51	1.92

Participants and Procedure

A total of 402 pupils (149 males and 253 females) aged 10–19 years ($M = 15.3$, $SD = 2.95$) from grades 1 (10/11 yrs), 2 (11/12 yrs), 5 (14/15 yrs), 7 (16/17 yrs), 8 (17/18 yrs), and 9 (18/19 yrs) participated in the study. Details about sample sizes in each grade are provided in Figures 1 and 3. The selection of participants from these grades was not forced, rather it was based on teachers' willingness to administer questionnaires in selected schools. These schools, five grammar schools, were selected randomly from various parts of Slovakia.

Students were asked for basic information such as sex, grade/age, and if they kept any birds as pets at home (if yes, which species). The latter question was asked because the

administration of the questionnaire was conducted during February 2006, when bird influenza H5N1 was detected in Slovakia. Thus, we were able to control for the potential differences in attitudes among bird owners ($n = 56$) and non-bird owners ($n = 346$). Pupils were satisfied that the questionnaire was not a test, but was a non-judgmental attempt to examine their knowledge of, and attitudes toward, birds. No time limit was given for the completion of the questionnaires. To avoid social desirability bias in answering questions, the pupils were not asked to give their names and so responses were anonymous (Streiner and Norman 1989).

Results

Bird Owners and Non-Bird Owners

In total, 56 pupils (14%) reported having a bird as a pet. The distribution of bird owners and non-bird owners was similar across grade levels (7–15% of bird owners in each grade, $\chi^2 = 2.68$, $df = 5$, $p = 0.25$). Twelve percent of females and 17% of males reported keeping a bird as a pet—there was no significant gender difference ($\chi^2 = 1.6$, $df = 1$, $p = 0.21$). A majority of bird-owning pupils ($n = 47$) reported having a parrot (mostly *Melopsittacus undulatus* and *Nymphicus hollandicus*) as a pet. Six respondents reported having a canary, two had zebra finches, and one kept a turtle dove.

Pupils' Knowledge of Birds

In order to examine which factors influenced pupils' knowledge of birds, factorial analysis of variance (ANOVA) was used. Neither gender ($F_{(1,378)} = 2.58$, $p = 0.24$), nor owning birds ($F_{(1,378)} = 0.32$, $p = 0.57$), influenced pupils' BKQ scores, but grade did ($F_{(5,378)} = 7.9$, $p < 0.001$). Male bird owners had higher scores than other pupils (interaction gender \times owning birds, $F_{(1,378)} = 4.99$, $p = 0.02$). Younger pupils had higher scores than older pupils (Figure 1).

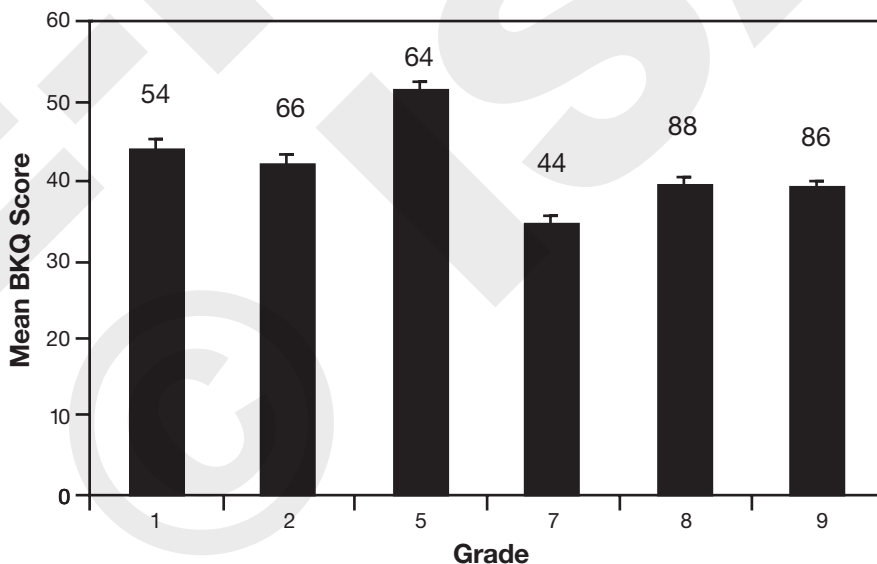


Figure 1. The mean BKQ scores with respect to grade. Error bars represent standard errors (SE). Numbers above bars are sample sizes.

Only 75 (19%) of all pupils answered more than 50% of the questions correctly. The mean score from the BKQ was 41% (range 0–77%), which suggests that these questions were very poorly understood. The best understood topics were the feeding habits of some birds and bird senses (vision and olfaction). In contrast, a substantial number of pupils showed typical anthropomorphical and teleological reasoning (Shepardson 2002) such as “Woodpecker picks grubs from trees because he is a doctor of trees” or “Cock crows because he wants to wake up people” (items with the lowest mean score). About one-third of all pupils believed that an owl’s eyes light up at night. Other questions about the owl also showed that pupils didn’t know much about their senses. For example, about half of the pupils (54%) believed that owls *only* see at night. These results fully support our previous report about problems of Slovakian children in this area (Prokop, Kubiatio and Fančovičová 2007).

Pupils' Attitudes toward Birds

Pupils' attitudes toward birds were examined by analysis of covariance (ANCOVA), whereby gender, grade, and owning birds were defined as factors, the BKQ was defined as covariate, and the BAQ dimensions were dependent variables. Greater knowledge was associated with more positive attitudes (Figure 2) to birds. Females showed more positive attitudes than males in the Avoidance of Birds dimension (ANCOVA, $F_{(1,377)} = 5.65$, $p < 0.05$). No gender differences in the Interest in Birds and Concern for Birds dimensions were found ($F_{(1,377)} = 0.22$ and 0.19 , $p = 0.64$ and 0.66 , respectively).

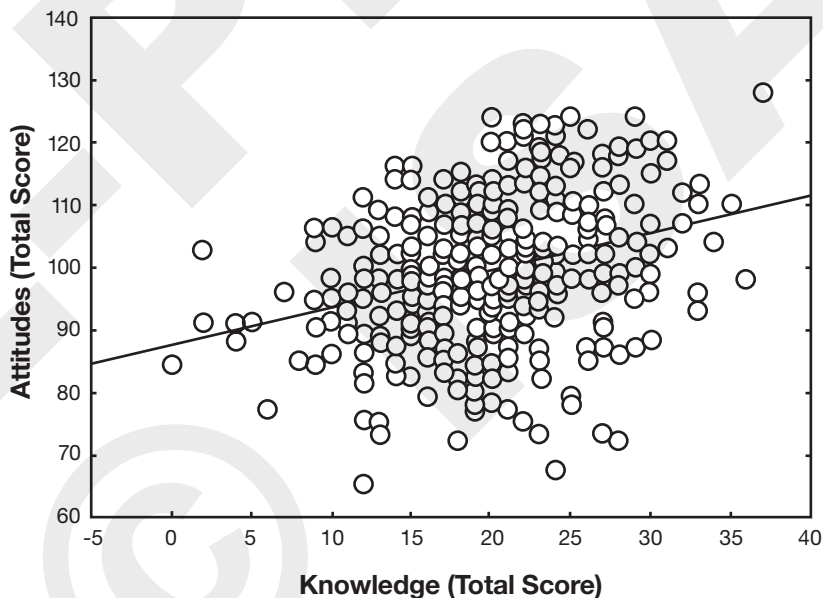


Figure 2. Relationship between knowledge of birds and attitudes toward birds found in Slovakian pupils ($r = 0.33$, $p < 0.001$, $n = 402$).

The mean scores of the Interest in Birds and Avoidance of Birds dimensions differed between pupils from various grades ($F_{(5,377)} = 6.26$, $p < 0.001$, and 9.85 , $p < 0.001$). The mean score of the Interest in Birds dimension showed a decrease from grades 1–5, then a gradual

increase from grades 5–9, but still showing rather neutral attitudes (the overall mean score was about 3.0) (Figure 3). This can be explained as a function of the low interest of Slovakian children in professional biology (Prokop, Tuncer and Fančovičová 2007). The mean score of the Avoidance of Birds dimension increased as age of pupils increased (Figure 3). Because all the negativistic items were coded in reverse order, the high mean score indicates that pupils disagreed with negative items in the Avoidance of Birds dimension. These data therefore suggest that older pupils simply “liked birds” without a deeper scientific interest in them. In contrast, there were no differences in the mean scores of the Concern for Birds dimension with respect to grade ($F_{(5,377)} = 1.22, p = 0.29$) (Figure 3).

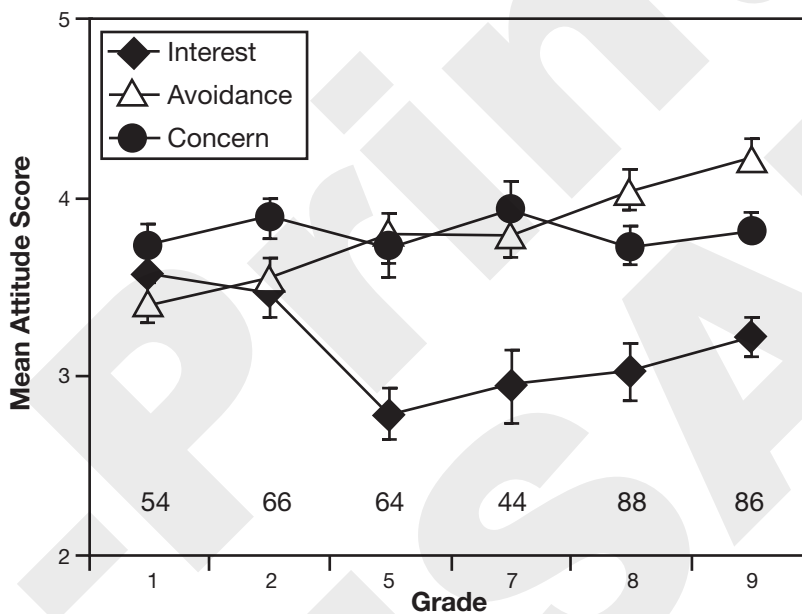


Figure 3. Interest in Birds, Avoidance of Birds and Concern for Birds dimensions in various grades. Error bars represent standard errors (SE). Numbers within the graph are the sample sizes for each grade

A comparison of bird owners and non-owners showed that owners had a higher score on the Interest in Birds dimension in comparison with non-owners, but non-owners had a higher score on the Concern for Birds dimension ($F_{(1,377)} = 4.56$ and 4.35 , both $p < 0.05$, respectively) (Figure 4, p. 230). Bird owners and non-owners did not differ on the Avoidance of Birds dimension ($F_{(1,377)} = 0.81, p = 0.13$).

Detailed Description of Items from the BAQ

The Interest in Birds Dimension: Overall, positive responses to all items in this dimension decreased as pupils' age increased. Only 30% of pupils wished to learn more about ornithology in school, but more than half of them (57%) liked watching natural history films about birds. The majority of pupils (69%) did not want to be falconers, but were interested in why birds sing (69%) and agreed that birds have interesting natural histories (64%). An expedition focused on the protection of an eagle attracted 45% of pupils, but only a minority (26%) of pupils thought

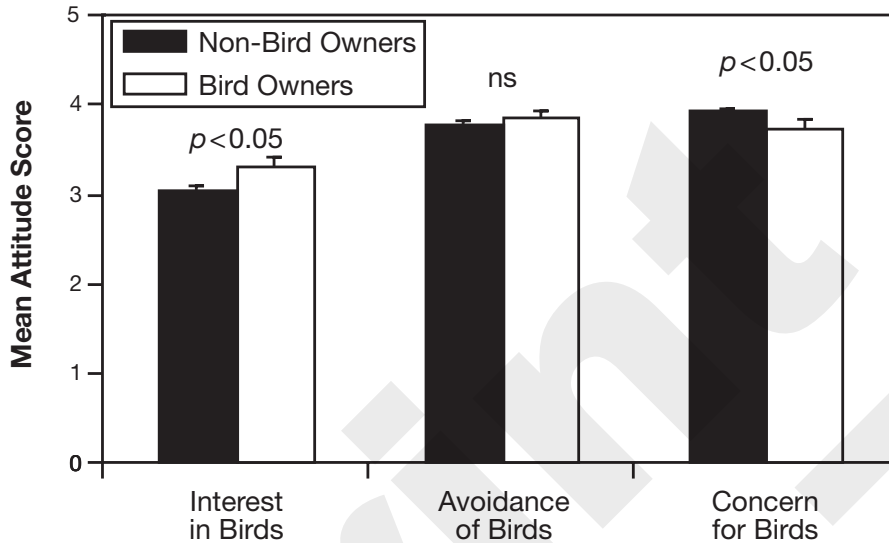


Figure 4. Comparison of attitudes toward birds between non-bird owners ($n = 346$) and bird owners ($n = 56$). Error bars represent standard errors (SE).

that investigating birds in the future would be interesting. Positive responses on these latter two items showed the most rapid decline with respect to age.

The Avoidance of Birds Dimension: Overall, positive responses to items in this dimension increased as pupils' age increased. These differences were progressive rather than fixed to a specific grade. Although the majority of pupils (74%) disagreed with a statement that hawks are harmful because they kill smaller birds, 44% did not like it when a stronger predator such as the hawk kills smaller prey such as the great tit. Only 11% of pupils (especially younger ones) stated that sparrows are not profitable. Similarly, only 9% suggested that cuckoos should be shot because they destroy the eggs of other passerine birds. About 80% of pupils disagreed with confining birds in reserves or with their unimportance in nature. The positive responses to the latter statement showed a rapid increase with respect to pupils' age, which suggests that older pupils are more aware of the role of birds in nature. About 13% of pupils agreed with shooting waterbirds in order to eliminate bird influenza while 20% were undecided. Interestingly, a significantly higher number of females (72%) disagreed with this statement compared with males (53%) (Chi-square test with "do not know" responses omitted, $\chi^2 = 5.96$, $p = 0.01$). The difference between bird owners and non-bird owners was not significant ($\chi^2 = 4.99$, $p = 0.78$).

The Concern for Birds Dimension: No apparent differences with respect to age were found with this dimension. Both males and females (80%) agreed that bird influenza is potentially dangerous all over the world. Just over half of the children (52%) agreed that keeping birds in cages is cruel. Interestingly, a higher proportion of non-bird owners than bird owners agreed with this item (65% vs. 33%, $\chi^2 = 18.32$, $p < 0.001$). More than 60% of pupils were aware of the transfer of toxic substances from crops to birds, the potential danger caused by transmission of diseases, and the threat to historical buildings by pigeons. More than

70% agreed that the natural habitats of birds have been reduced and that house swallows are important in the control of insect pests. The majority of pupils (85%) showed an interest in birds' migratory patterns.

Discussion

This study shows that Slovakian pupils' knowledge of, and attitudes toward, birds are related. Pupils showed more positive attitudes toward birds in the Concern for Birds and Avoidance of Birds dimensions relative to the Interest in Birds dimension. Bird owners showed more positive interest, but less positive concern for birds than did non-bird owners. Younger pupils had better knowledge about birds in comparison with older pupils—similar results were found by Bogner (1999) and Beck et al. (2001).

We suggest that the difference in knowledge between younger and older pupils could be explained by the Slovak biology curriculum, as many of the knowledge questions are dealt with in this curriculum. This means that pupils aged 10/11 years (Grade 2) who are learning zoology are exposed to more factual knowledge about birds than older pupils. Older pupils may have forgotten some of the information they learned when younger. This process is not surprising considering that semantic memory is suppressed by the increasing number of competing concepts that students acquire over time (Johnson and Anderson 2004). Several other knowledge items reflected information that could be obtained through the media, for example, by watching natural history films about birds.

Pupils' responses to the knowledge questions revealed several misunderstandings. For example, it is quite surprising that about one-third of all pupils believed that an owl's eyes light up at night. This supports previous research which showed that almost all 7–15-year-old children (94%) thought that owls see better at night than in the day (Prokop, Kubiátko and Fančovičová 2007).

The results suggest that environmental/science educators should pay more attention to myths about animals, and nature protection programs should show more details about the biology of birds such as owls. Myths about owls' night vision may come from natural history films, which often show an owl's eyes "lighting up" when exposed to a light in the night. If so, these myths probably can be applied to the night vision of large mammal carnivores such as lions and other animals that are frequently filmed at night.

In the present study, 12% of participants reported keeping parrots as pets. This compares well with another study of Slovakian school children, which found that about 9% of pets reared in Slovakia are parrots (Prokop, Prokop and Tunnicliffe 2008). Pet owners showed more positive attitudes in the Interest in Birds dimension and less positive attitudes in the Concern for Birds dimension than non-owners. Greater interest in birds probably reflects the greater interest of bird-owners in research and keeping birds, which may have important effects on an owner's self-esteem, social skills, and empathy (e.g., Loughlin and Dowrick 1993). Bird owners typically disagreed that keeping birds in cages is cruel, which resulted in a lower mean score on the Concern for Birds dimension. These data therefore confirm that keeping pets influences owners' attitudes toward animals (Bjerke, Ødegårdstuen and Kaltenborn 1998; Bjerke, Østdahl and Kleiven 2003). It can be suggested that these differences would be somewhat larger because the effects of keeping pets (not just birds) would influence pupils' attitudes toward animals more strongly. However, this study did not control for keeping pets other than birds. Considering that 71–90% of children live in families with various pets (Ascione 1992; Bjerke, Katelborn and Ødegårdstuen 2001; Signal and Taylor 2006b; Prokop, Prokop and

Tunncliffe 2008), keeping pets other than birds could largely camouflage the effects of keeping birds on pupils' attitudes toward birds and therefore that is why only the Interest in Birds dimension showed a significant difference between bird owners and non-bird owners.

Gender differences showed that females scored higher on the Avoidance of Birds and Interest in Birds dimensions, which probably reflects their attitudes against animal mistreatment (Hagelin et al. 1999). The highest mean scores occurred on the Avoidance of Birds and Concern for Birds dimensions, suggesting pupils are emotionally aware of the role of birds in nature and the human treatment of birds. Slovakian pupils failed to show much fear of bird influenza but, interestingly, males showed a greater fear of bird influenza than did females. This is somewhat surprising, because females generally show greater fear of various diseases than males (Koivula et al. 2001; Go et al. 2002), perhaps because they not only care for their own safety but for the safety of their children, as well (Røskaft et al. 2003). Males, however, spend more time fishing and hunting (Bjerke, Kaltenborn and Ødegårdstuen 2001), which increases their vulnerability to being infected by bird influenza from waterbirds (the Slovak media have alerted people about the risk of infection from waterbirds, P. Prokop, unpublished data).

The Interest in Birds dimension had a lower mean score than the other two dimensions. Despite middle-school students showing low overall interest in biology (Hong, Shim and Chang 1998), watching television programs about nature is one of their most frequent animal-related activities (Bjerke and Østdahl 2004). In the present study, about 57% of all participants liked watching natural history films about birds—Bjerke and Østdahl (2004) showed that 59% of participants from Norway liked the same. This indicates that at least passive pro-environmental behavior is common amongst about half of the population. The greatest weakness of pupils' responses within the Interest in Birds dimension can be explained by the low interest in a biology career in Slovakia (Prokop, Tuncer and Kvasničák 2007)—only 27% of pupils considered investigating birds in the future interesting, and the majority (69%) rejected the idea of becoming a falconer. Low interest in a biology-related career reflects Slovakian pupils' negative views of the biology profession (Prokop, Prokop and Tunncliffe 2007). Interestingly, nearly half of the pupils showed antipathy toward the killing of a great tit by a hawk, which probably reflects pupils' negative views of predators (Kellert 1985; Prokop and Kubiátko in press). Bjerke and Østdahl (2004) reported a negative association between participants' age and their attitudes toward birds of prey, which partly supports the latter idea.

Conclusions

This study showed a correlation between attitudes toward birds and knowledge of birds. The hypothesis that knowledge and attitudes are related can therefore be supported (Thompson and Mintzes 2002; Weaver 2002; Dimopoulos and Pantis 2003). As noted above, not all knowledge items were related to the Slovak biology curriculum, which reflects that both school and out-of-school experiences, gathered either by the watching of natural history films (senses) or feeding birds during winter (food), can contribute to pupils' knowledge about birds. In accordance with this idea, not only formal education, but also out-of-school experiences play an important role in building positive knowledge of (see Randler, Höllwarth and Schaal 2007), and attitudes toward, birds. This, however, needs further research.

Some experimental studies have shown that school education programs increase participants' knowledge of (Bogner 1999; Beck et al. 2001), and attitudes toward, animals (Ascione and Weber 1996). Using birds in classrooms or in out-of-school activities may enhance children's social and cognitive development and motivate them to learn more about animals

(Smith and Smith 2004). Previous studies have also revealed that humane education with animals in the classroom result in greater social integration, empathy, and lower aggression in comparison with control groups (e.g., Hergovich et al. 2002). Children should be encouraged to conduct scientific projects with pet birds kept in schools or in their home, and teachers may obtain multiple benefits from using pet birds or other animals in the classroom. Further research is necessary to determine factors influencing pupils' attitudes toward birds, the presence of birds in the classroom, and relationships between pupils' out-of-school interests and attitudes toward animals.

Acknowledgements

We would like to thank Anthony Podberscek, Gareth Davey and two anonymous referees for their insightful comments on earlier drafts of the manuscript. Scott Lamphear kindly improved the English of the paper.

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