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Why Do Cocks Crow? Children's Concepts About Birds

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Abstract Research into children's ideas showed that children's interpretations of natural phenomena often differ from those of scientists. The aim of our study was to identify children's ideas of various age classes (7/8–14/15) about birds. A questionnaire with 31 multiple choice and open ended questions and eight photographs were administered to 495 children from 10 elementary schools in Slovakia. Children's ideas were examined in six dimensions (bird classification, food, senses, communication, migration and breeding including parental care). We found several misconceptions, some of them with both anthropomorphical and teleological reasoning of the children about birds within each dimension. In general, misconceptions were more frequently found in younger children, but several misconceptions were similarly distributed across all age classes.

Key words birds · children's ideas · classification · misconceptions

Introduction

Research on children's interpretations of natural phenomena has been initiated by the early works of Piaget (1929, 1930). Recently, Piaget's ideas have fascinated many researchers and have been the subject of numerous studies (Driver, Squires, Rushworth, & Wood-

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Robinson, 1994). Carey (1985) claimed that children before age 10 do not understand biological phenomena as ‘biological’ at all, but rather misunderstand them as ‘psychological’ and thus have an undifferentiated psychology/biology theory. Further theoretical and empirical studies showed evidence that children posses biological knowledge at much younger ages as Carey had supposed. Hatano and Inagaki (1994); Inagaki (1990); Inagaki and Hatano (1993) showed that young children’s biological knowledge is significantly affected by early experiences with live organisms or with themselves (Jaakkola & Slaughter, 2002; Teixeira, 2000).

Children’s concepts about natural phenomena often differ from those of scientists (Carey, 1985). These differing frameworks have been described as misconceptions (Fisher, 1985), the term that we use throughout the text to refer to children’s conceptions that are different from scientific conceptions. It is widely reported that misconceptions are pervasive; they serve a useful function in the everyday lives of people; they are often resistant to conventional teaching approaches; they interact with knowledge presented by teachers and result in unintended learning outcomes; they resemble the ideas of previous generations of natural philosophers; they are similar across age, abilities and gender and they are found frequently among teachers as well as students (Fisher, 1985; Wandersee, Mintzes, & Novak, 1994; Yen, Yao, & Chiu, 2004).

Research into children’s biological ideas in science include photosynthesis (e.g., Özay & Öztas 2003), diffusion and osmosis (Tekkaya, 2003), cell (Lewis, Leach, & Wood-Robinson, 2000a,b), ecology (Munson, 1994; Özkan, Tekkaya, & Geban 2004), forest (Strommen, 1995), seeds (Jewell, 2002), human body (Mintzes, 1984), digestive system (Teixeira, 2000), circulatory system (Sungur, Tekkaya, & Geban, 2001), animal classification (Bell, 1981; Braund, 1991, 1998; Kattmann, 2001; Trowbridge & Mintzes, 1988) and insects (Shepardson, 1997, 2002). It has been shown that children prefer habitat and locomotion when classifying animals (e.g., Kattmann, 2001). In addition, children’s biological explanations often reflect anthropomorphic and teleological reasoning (Leach, Driver, Scott, & Wood-Robinson, 1995; Shepardson, 2002).

Despite this, as far as we know, no study was performed to examine children’s views of birds. From the constructivistic perspective, learning is an active process, whereby learners take information from the environment and construct personal interpretations and meaning based on prior knowledge and experience (Fraser & Tobin, 1998). This implies that mental conceptions of younger children, while little affected by formal school science learning, are highly influenced by personal ideas and experiences they construct about the world. Children’s anthropomorphic reasoning (Shepardson, 2002) about birds is reflected in the incorporation of human attributes (e.g., wood-pecker picks grubs from trees, because he is a doctor of trees). Children’s teleological thinking (Shepardson, 2002) about birds would incorporate the notion that birds migration is not caused by food limitation, but birds are endangered by low temperatures (e.g., birds must migrate because they could freeze).

Purpose of the Study

The purpose of this study was to investigate children’s ideas about birds, their abilities to classify them and how these ideas change from second to ninth grade. The specific research questions for this study were: (a) What are children’s ideas about birds?; (b) Are children able to distinguish birds from animals with similar locomotion and some other features like birds?; and (c) How much do children’s ideas about birds change from second to ninth grade? The results of this study answer these three questions and provide implications for curriculum development and instructional practice for teaching children about birds.

In our study we designed our research question of bird classification into children's abilities to distinguish between birds and others animals which use similar locomotion like birds using photographs of birds and bird-like animals. Criterion of movement when classifying animals is especially important for younger children (Osborne, Wadsworth, & Black, 1992). Anatomical features of animals are, however, most important criteria for classifying and naming animals for children of all ages (Trowbridge & Mintzes, 1985, 1988; Tunnicliffe & Reiss, 1999). Based on the finding that children do not have great problems when classifying typical birds in comparison with fishes, snakes, seals or tortoises (Braund, 1998), we did not use typical birds that fly, but flightless birds that can only run and swim. Using such non-trivial examples of birds made our task more difficult but it allowed us to investigate children's classification abilities more seriously. When answering general questions about children's ideas about birds, we used examples in our questions that came from everyday life and children could have direct or indirect experiences with them.

Materials and Methods

Construction of the Questionnaire

Originally, we developed a series of open-ended questions and eight photographs of three birds and five bird-like animals that were independently submitted to two professors of ornithology from two different universities and two primary and two secondary biology teachers for comments on the questionnaire. More specifically, they were asked to evaluate: (1) Whether are questions acceptable for particular age category of children; (2) Whether wording of the questions is appropriate; and (3) Classification of the questions to six dimensions (see Table 1). All questions that were criticised were improved or excluded

Table 1 Dimensions and related targets of multiple choice items

Dimension	Target	Items
Bird classification	To determine children's abilities to recognize between bird and the bird-like animals using features related with animal locomotion. Naming of one bird species and identification of some biological features of birds.	3, 12, 30 + 8 photographs of birds and bird-like animals
Bird food	To determine children's knowledge about food of birds.	6, 11, 20
Bird senses	To determine children's knowledge and ideas about bird senses and their functioning.	8, 9, 16, 19, 26, 28
Bird communication	To determine children's knowledge and ideas about bird communication (relative importance of bird colouration and singing).	1, 5, 14, 24
Bird migration	To determine children's ideas about causes of bird migration and their knowledge about migratory ways.	2, 4, 10, 18, 23
Breeding and parental care	To determine children's knowledge and ideas about breeding and parental care in birds.	7, 13, 15, 17, 21, 22, 25, 27, 29, 31

from the final version. After comments and improvements of the first version of the questionnaire were completed, we administered the questionnaire to 110 primary and secondary children from two different schools. We simultaneously interviewed two children from grade 2–9 (7/8–14/15 years old) using questions from the questionnaire. The selection of the children was done randomly by class teacher, with instruction from the researcher that children selected be of about average intelligence and willing to participate in the research.

Scoring responses both from the interviews and open-form questions allowed us to develop a final version of the questionnaire with both multiple choice and open form questions and eight photographs with bird and bird-like animals. The full version of the questionnaire (both in English and Slovak language) is available from the corresponding author upon request. Photographs were used to examine the children's abilities to recognize birds from animals with bird-like features. More specifically, we used the New Zealand Kiwi (*Apteryx owenii*), ostrich (*Struthio camelus*) and penguin (*Aptenodytes forsteri*) as birds because they do not fly, that is, they do not have typical bird-like features. In contrast, flying squirrel (*Glaucomys volans*), pterodactyl (*Pterodactylus spectabilis*), bat (*Lasiurus borealis*) and a butterfly (*Papilio polyxenes*) can fly although they are not classified as birds. In addition, we used a photo of a platypus (*Ornithorhynchus anatinus*) because it has a bill like a bird although it cannot fly like other bird-like animals. Children were instructed to make a circle around the animals on the pictures that they thought to be a bird. Dimensions and related targets for the multiple choice items are provided in Table 1.

Administration and Analysis of the Questionnaire

A total of 495 primary and secondary children (232 boys and 263 girls) aged 7/8–14/15 (grade 2–9) from 10 Slovak elementary schools participated in the study. Usually, one of the authors visited the school and administered the questionnaire. The schools were selected randomly from various parts of Slovakia including both rural and urban environment. All these schools have been visited by 500–1,000 children, which represent typical schools in Slovakia. Children were assured that the questionnaire was not a test, but to simply see what they thought about birds. The children needed approximately 20 min for completion of the questionnaire. At the end of the questionnaire, children were asked for basic information such as sex, age and grade. Answers on open-ended questions were first discussed and coded by all authors of the study. In the few cases where our scorings differed we discussed the answers until we agreed on the category to be awarded. Because we did not detect any statistically significant gender differences, we do not mention them in the text. Age-related differences were calculated using the Pearson Chi-square test (χ^2). The Chi-square analysis may report relatively small percentage differences as being statistically significant, although such differences may not necessarily be educationally significant or of practical importance. Therefore, it was decided that age-related trends were calculated following Skamp, Boyes, and Stanisstreet (2004). If the Chi-square value was statistically significant ($p<.05$), if the direction of the trend was consistent (ether increasing or decreasing), and if there were at least three percentage points between each of the eight grade levels, the data would be described as showing an age-related trend. If the Chi-square value was not statistically significant, or if the direction of the trend was inconsistent (for example, increasing then decreasing) then the data would be described as not showing an age related trend.

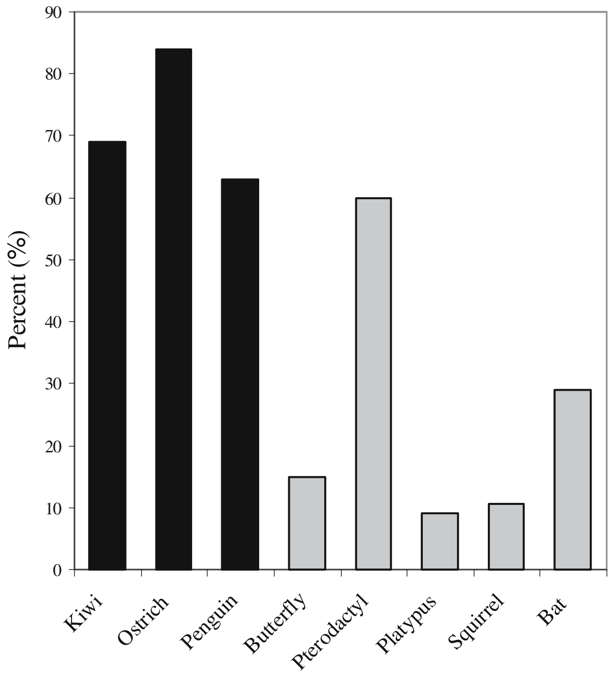

Fig. 1 Percent of responses in which children thought that an animal was a bird. Birds are represented by *black bars* and bird-like animals by *grey bars*

Results and Discussion

Bird Classification

The majority of children correctly identified three birds from a total of eight animals shown in photographs, but their knowledge was still incomplete (Fig. 1). Average inter-item correlations for bird and bird-like animals were .33 and .22, respectively. This means that children were relatively more sure when identifying birds, but less sure when they were faced with bird-like animals. This is in agreement with Kattmann's (2001) conclusion that locomotion is an important cue when children classify animals. Sixty percent of children believed that a pterodactyl is a bird. Also, one third of children thought that a bat is a bird and 37% did not know that a penguin is a bird. Correct identification was positively related with age. The Chi-square values calculated for the effect of age on the frequency of correct responses in each of eight species ranged between 22.8 and 54.4 (all p<.001, df=7) except those of platypus in which no statistically significant effect of age was detected ($\chi^2_{(7)} = 10.0$, p=.18). This means that older children were more likely to correctly recognise birds from bird-like animals relative to younger ones.

As could be predicted (Carey, 1985), most problems with bird identification occurred with the youngest children (Fig. 2). For example, 15 of 29 children (grade 2) thought that the butterfly was a bird. In addition, 60–70% of grade 2 and 3 children believed that the bat was a bird and 15–22% of older children also believed the bat was a bird. Other detailed data for bird identification are shown in Fig. 3.

The other two questions were related to the typical bird features (egg laying, item 3 and plumage on the body, item 30, both in penguins) and one on the naming of the female

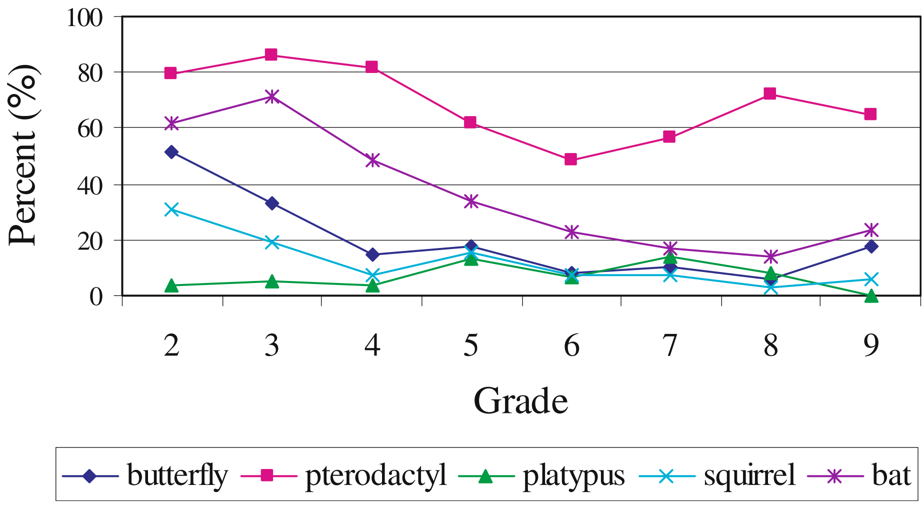

Fig. 2 The proportion of incorrect classifications of bird-like animals across several age classes

pheasant (Item 12). We found that only 25% of children knew that the penguin's body is covered by plumage, not by hair (32%) or uncovered skin (43%). In addition, 56% of children thought that a penguin does not lay eggs, but bears chicks as mammals do. Only egg laying was statistically significant with respect to age ($\chi^2_{(7)} = 26.2$, $p<.001$), while responses on the cover of the penguin body were not statistically significant with respect to age ($\chi^2_{(7)} = 13.9$, $p>.05$). The problems with classifying penguins confirm results of Trowbridge & Mintzes (1985) who found that 35% of primary children thought that a penguin is a mammal. They suggest that misclassification of penguins may lie in the penguin's inability to fly and its association with the antarctic seal. A majority of children (79%) thought that the name of the female pheasant (*Phasianus colchicus*) is partridge (*Perdix perdix*), and some of these children (8 %) thought that the name of a pheasant is

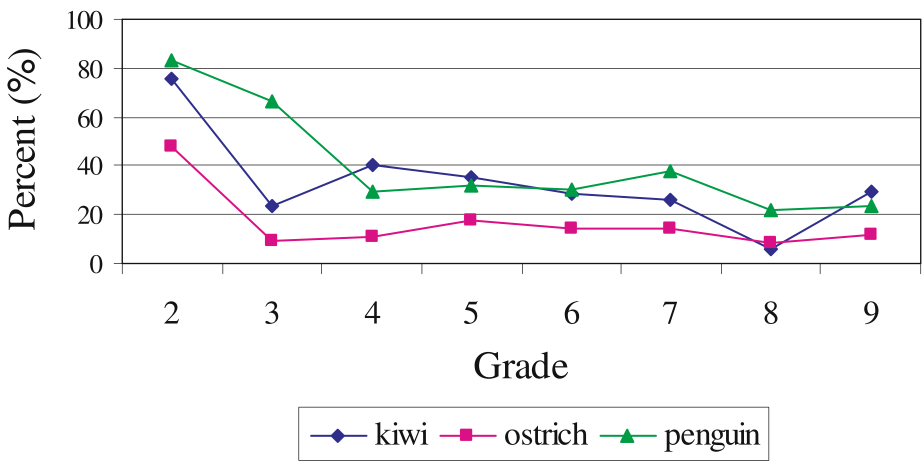

Fig. 3 The proportion of incorrect classifications of birds across several age classes

quail (*Coturnix coturnix*). The distribution of correct knowledge was statistically significant with respect to age ($\chi^2_{(7)} = 32.2$, $p<.001$), but the direction of the trend was inconsistent.

What do Birds Eat?

Three questions related to the food composition of common birds, the great tit, the wood-pecker and the pigeon, showed that about half of the children did not know what birds eat. More than half of the children (55%) thought that the great tit feeds only on bacon or oilseeds provided by people during winter. The effect of age failed to show positive or negative direction although the Pearson χ^2 test showed statistically significant differences between age categories ($\chi^2_{(7)} = 31.5$, $p<.001$). More surprisingly, a majority of children (60%) thought that pigeons feed on insects or earthworms. This indirectly supports Strommen's (1995) finding that primary age children attributed mostly insects as diet of birds inhabiting forest. Also, we found that nearly half of the children (41%) answered our question "*Why does a wood-pecker pick grubs from trees?*" anthropomorphically ("*He is a doctor of trees*"). The proportion of correct answers was significantly influenced by age (pigeon and woodpecker, $\chi^2_{(7)} = 23.9$ and 49.2, both $p<.001$, respectively).

Bird Senses

Data from children's responses showed that they knew that birds could hear (87%), but they had difficulty understanding how they hear, because 40% of them believed that birds do not have ears. The positive effect of age was statistically significant in both cases ($\chi^2_{(7)} = 74.8$ and 14.2, $p<.001$ and .05, respectively), which indirectly support the positive effect of biology lessons in secondary children.

Thirty five percent of children believe that the owl can see only during the night (with a statistically significant effect of age, $\chi^2_{(7)} = 31.7$, $p<.001$). Almost all children (94%) thought that the owl sees better at night than in the day, regardless of age category ($\chi^2_{(7)} = 12.1$, $p>.09$). Only 25% of the children knew that the owl uses hearing when foraging. This was also a statistically significant relation with age ($\chi^2_{(7)} = 41.1$, $p<.001$). Other children believe that vision is the only important sense for nocturnal foraging. Birds have chromatic vision, but the question about this topic was probably hard, because the distribution of correct and incorrect answers did not differ from random (binomial test, $p>.8$). An age effect was not apparent, because the direction of the trend was inconsistent.

Bird Communication

In the case of the significance of bird singing, we accepted answers related to bird communication in general and the role of bird song in mate attraction or territory defence in particular. About 48% (257 children) did not know the correct answer, while older children tended to be more successful ($\chi^2_{(7)} = 45.4$, $p<.001$). Incorrect answers did not show clear misconceptions because they failed to show the causes of misinterpretation. Instead children said that birds sing "Because they are birds," or "They like singing" or "Singing is their natural property." Only 33% of children answered correctly that only males bird sing, 13% thought that females sing, and a majority (54%) thought that both sexes sing. The proportion of correct answers was greater among older children ($\chi^2_{(7)} = 25.9$, $p<.001$) which probably reflects influence of other sources of information than school (Tunnicliffe

& Reiss, 1999), because bird communication is not explicitly included in biology curricula of elementary schools in Slovakia.

Two main categories were extracted from the item related to the significance of cock's crow. Firstly, only 11% of children correctly noted that crowing is an important part of communication between cocks. Secondly, a majority of children (89%) showed anthropomorphical responses because they thought that the cock crows to wake up people or hens. The positive influence of age on the distribution of correct responses was highly statistically significant ($\chi^2_{(7)} = 98.1$, $p<.001$).

Again, in the case of the question "Why a cockerel is more beautifully coloured than a hen," a majority of children (70%) had incorrect answers. Only 30% (mainly older children, $\chi^2_{(7)} = 53.1$, $p<.001$) indicated that there can be a relationship between male colour and female attraction. Interestingly, 12.5% of children thought, male colouration is caused by sexual dimorphism. Another 34% of incorrect responses simply indicated that the male is better coloured because the female must be less conspicuous and thus less vulnerable to predation.

Bird Migration

The answers on the question "How do birds know what the right way to fly during their migration is?" provided an interesting finding. While less than half of children knew that migration is a result of instinctive behaviour (44%), nearly 10% thought that birds "feel hot." A similar proportion of children (9%) thought that birds orient themselves by following the sun. A total of 75 children (15%) did not provide any response. The correct answers were more frequently distributed among older children ($\chi^2_{(7)} = 47.0$, $p<.001$). About 14% did not provide any response on our question related to the significance of bird migration. Other 35% of children showed teleological thinking (e.g., "Birds could freeze"), while only 20% being correct that birds are food limited during winter. Although Pearson χ^2 test showed a statistically significant difference ($\chi^2_{(7)} = 16.5$, $p<.05$), direction of the trend showed very inconsistent results. Other answers did not explicitly show the cause (e.g., "They [birds] could die," etc.).

A majority of children (70%) correctly knew that birds can migrate as far as 5,000 km, about 25% thought that the maximal distance for migration could be 500 km, and a minority (5%) thought only 50 km. Unexpectedly, correct answers tended to be less distributed among older children relative to younger ones ($\chi^2_{(7)} = 22.1$, $p=.01$). This result can be explained by teaching about bird migration of some selected species (stork, house swallow) among primary school children (grades 1–4), but the weak attention to this topic in secondary biology (grades 5–9).

Little more than one-third (37%) of the children correctly answered that storks visit Africa during winter. Another 37% answered more generally, because they noted that storks migrate to "hot countries" or "south countries." Many children (21%) did not provide any response. The remaining children thought that storks migrate to America or Arabia. The effect of age was statistically significant ($\chi^2_{(7)} = 45.4$, $p<.001$) probably because storks are famous examples of bird migration in natural history films.

One third of children thought that ravens are in Slovakia only during winter, although ravens are present in Slovakia throughout the year. A higher proportion of children (63%) was correct, but the answers did not show an age-related distribution, although a χ^2 tests showed statistically significant differences among grades ($\chi^2_{(7)} = 54.8$, $p<.001$). We suggest that these differences could be partly explained by regional differences with respect to the distribution of ravens in Slovakia. This species breed in colonies that are missing in many places in Slovakia. Thus, children living in close proximity to a raven colony could have more experiences with observation of this species throughout the year.

Breeding and Parental Care

Six of eleven questions regarding bird breeding and parental care were more or less related to incubation. Less than 20% knew that a pigeon lays only two eggs. A majority of children (32%) thought that pigeons lay more than five eggs. Other children (19%) thought that pigeons lay three, four or five eggs. The remaining children thought only a single egg or they simply did not know. A statistically significant effect of age was confirmed ($\chi^2_{(7)} = 73.2$, p<.001), probably because the biology of the pigeon is an important part of biology lessons (grade 6) and it is also included in the biology textbook in common use.

Responses of children on the time between egg laying and the chick hatching show that only 21% of the children correctly knew that incubation takes about three weeks. The majority of the others thought that incubation takes a longer period. The effect of age was not statistically significant ($\chi^2_{(7)} = 13.2$, p>.05).

The majority of children (43%) believed that oxygen is already inside eggs and 34% of children thought that chicks breathe only after hatching. Only 19% knew that oxygen goes through the coverings of the egg during embryonic development of the chick inside the egg. The remaining children did not provide any response. Although a statistically significant differences between age groups occurred ($\chi^2_{(7)} = 44.8$, p<.001), the direction of the trend was inconsistent. This is very interesting, because this topic is a part of the grade 6 biology curriculum. A positive effect of age could be therefore expected.

A little more than half of children (58%) knew that chicks get out from inside of the egg using their own bill. Another 15% of children believed that the egg shell simply blows out as a consequence of the chick’s growing. The remaining children did not provide any response or it was not possible to understand what they really thought (e.g., “They [chicks] get out from the egg”). The positive effect of age was statistically significant ($\chi^2_{(7)} = 53.2$, p<.001), but a clear reason of this effect remains unclear.

Sixty-nine of the children (14%) believed that the cuckoo abandons its own chicks after hatching and all other children correctly thought that the cuckoo lays its own eggs in the nests of other birds. The distribution of correct responses was statistically significant in relation with age ($\chi^2_{(7)} = 49.8$, p<.001). Another question showed that children have a general idea about female-only parental behaviour during incubation. A total of 43% of the children thought that only the female incubates the eggs of the house-sparrow. Only 7% thought that males incubate the eggs and 49% correctly knew that both male and female incubate the eggs. The effect of age was statistically significant ($\chi^2_{(7)} = 48.3$, p<.001). About 24% of the children believed that the male house sparrow has only one female mate during its lifetime and six children did not provide any response. A majority of children correctly knew that house sparrows are polygamous, with older children being more successful ($\chi^2_{(7)} = 34.6$, p<.001). Age related differences found in answers on the two latter questions probably reflect out-of-school sources of information (TV or books).

We asked which sex (mummy or daddy) takes care of chicks in two birds (in domestic fowls and house swallows). House swallows are birds with biparental care, but nearly one-third of children (28%) thought that only the female takes care of her brood. Only 5% of children thought that only the male takes care, and others did not provide a response. No statistically significant effect of age was found ($\chi^2_{(7)} = 11.2$, p>.12). Interestingly, we found that there might be difficulties for some children in understanding what a nidifugous bird is, because 75 children (15%) proposed that "Nobody takes care of chicks of fowls." Nearly half (49%) of children correctly noted that only a hen takes care of chicks and a number of children (36%) did not provide any response. A statistically significant effect of age ($\chi^2_{(7)} = 27.1$, p<.001) was found. In this case, the personal experiences of children that breed fowls can be an influence.

The last question was related to the nesting habit of sky larks, a typical ground nesting bird. Only 17% were right that larks breed on the ground, while other children thought that larks bred on trees or holes in trees. The effect of age was not statistically significant ($\chi^2_{(7)} = 10.1$, p=.18).

Conclusions and Educational Implications

The present study provides the first evidence of how children of various age groups see birds. Firstly, we showed that children from each grade have significant problems with the classification of birds, and these problems are higher among younger children. Secondly, children of all grades showed misconceptions in understanding and ideas about all investigated aspects of the biology and behaviour of birds. Previous research into children's alternative conceptions of animals and animal classification (Trowbridge & Mintzes, 1985, 1988) showed that children of all age groups have significant problems with classifying animals including birds. Because children's concepts about birds have been largely overlooked, only a few aspects of children's ideas on this topic can be compared. For example, the penguin was misclassified as a mammal by 25–55% of primary, high school and college students in the USA (Trowbridge & Mintzes, 1985). In the present study, we provided evidence as to why the penguin is misclassified and other data on children's concepts about birds in general. Other researchers confirm that similar problems with animal classification exist among different cultures (Wandersee, Mintzes, & Novak, 1994; Yen, Yao, & Chiu, 2004). We suggest that similar concepts like the misclassification of non-typical birds, bird-like animals and alternative ideas about several aspects of the biology of birds can be found in other countries, but more research in this topic is necessary. Birds are inseparable parts of each biology/science curriculum, so any information about how children consider birds can help teachers to improve their educational strategy in terms of eliminating children's misconceptions. Our study provides the first in-depth data about children's concepts of birds from which educational implications can be applied internationally. Future comparative research across different countries would provide a deeper understanding of children's concepts about birds.

From an educational perspective, birds are specific animals that cannot be easily captured or reared in a relatively small place, as arthropods or plants. Moreover, only 2% of children keep birds as pets (A. H. Kidd & R. M. Kidd, 1985). Therefore, children's experiences when learning about birds in school classes are mostly indirect although they are critical in the acquisition of an advanced biological knowledge system (Hatano & Inagaki, 1997). We therefore propose at least two ways that are not mutually exclusive on how to improve children's views of living organisms.

Firstly, Strommen (1995) pointed out that those primary children that visited a forest had a better knowledge about forest inhabitants than those that did not. Moreover, the current study of Brossard, Lewensteinb, and Bonneyb (2005), examining the impact of The

Birdhouse Network, showed that direct experiences with birds through informal science education increased the knowledge of participants about bird biology. Several other research studies on informal learning also provided evidence for the positive effects of first-hand experiences on student' knowledge and motivation in science (Dillon et al., 2006; Gibson & Chase, 2002; Knox, Moynihan & Markowitz, 2003; Salmi, 2003). Following these arguments, we propose that a child's personal experiences with birds through informal learning or, for example, bird watching can have positive effects.

Secondly, improvements of educational methods in biology lessons through problem-based learning (Barrows & Tamblyn, 1980) have been found to be advantageous because it promotes scientific thinking in students. Teachers are encouraged to engage students in inquiry-based tasks which involve the cognitive processes that scientists use when they conduct research. Participation in inquiry activities involve making predictions, gathering data and their analyses, communicating findings and so on (e.g. Chin & Chia, 2005, and references therein). Some practical recommendations for biology/science teachers are:

1. Use direct observations of the biology of common birds. It can be simply observed what pigeons or house sparrows eat. Food selection of wintering birds on feeders can be a good task for projects in biology education.
2. Try to use problem-based learning when teaching, for example about bird migration: "What are the costs and benefits for birds when they migrate? Do they have enough food during winter in our country? What is the food of non-migratory birds? How do they differ from migratory ones?" etc.
3. Avoid reductions when teaching anatomical and morphological features of birds such as "This animal is a bird because it can fly," rather say that "This animal flies, lays eggs, is covered by the feather and this is typical for birds."
4. Teach several aspects of biology about particular bird species. Children do need more information about the biology of penguins, such as incubation or morphology, when the concept of bird is developed.
5. Learn more about the potential of bird adaptations. Birds not only fly, but also swim, or live on the ground, etc. Examples should be as diverse as possible.
6. Use taxidermically prepared birds rather than image materials when teaching about birds (Randler & Bogner, 2002).
7. Take pupils to walk to the nature and show them birds and typical features of birds.

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