

## Cross-Cultural Comparison of Student Attitudes toward Snakes

Pavol Prokop,<sup>a</sup> Murat Özel<sup>b</sup> & Muhammet Uşak<sup>c</sup>

a) University of Trnava, Trnava, Slovakia  
Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia  
pavol.prokop@savba.sk

b) Gazi University, Ankara, Turkey  
muratozel@gazi.edu.tr

c) Dumlupinar University, Kutahya, Turkey  
musaktr@dumlupinar.edu.tr

---

### Abstract

There is an increasing amount of research focusing on the origin of the human fear of animals. However, other dimensions of human views of frightening animals have been largely neglected. This study investigated attitudes toward snakes. The Snake Attitude Questionnaire (SAQ), which consisted of 58 Likert-type items (Cronbach's  $\alpha = 0.91$ ), was administered in a sample of students from two countries (Turkey and Slovakia). Students showed negative attitudes toward snakes, especially within the *Negativistic* and *Naturalistic* dimensions. Turkish students showed more positive *Scientific* and *Naturalistic* attitudes than Slovakian students, and females showed more negative attitudes toward snakes than males. Although biology majors had more positive attitudes, compared with nonbiology majors, knowledge of snakes and beliefs about untrue myths were similar between these two subgroups. Our research indicates that fear of snakes negatively influences other attitudinal dimensions (especially naturalistic and scientific attitudes) although no students had been injured by a snake. Keeping various pets at home was associated with less fear of snakes. Nature protection actions should combine direct contact with these controversial animals with interventions against belief in untrue myths about snakes.

### Keywords

animals, attitudes, keeping pets, myths, snakes

### Introduction

Snakes, which comprise more than 1800 species, are important, although often neglected, components of terrestrial and aquatic ecosystems (Campbell & Campbell, 2001). They are predators and prey of vertebrates and invertebrates. Their unique life histories make them crucial in many ecological processes.

Many snake species are listed as threatened or endangered. Besides their use as food (Zhou & Jiang, 2004, 2005), snakes are exploited in a variety of ways, such as being used in traditional medicine and magic/religious rituals, especially in Afro-Brazilian religions (Alves & Pereira, 2007). Snake populations are being significantly reduced throughout the world. Factors responsible for the observed declines are thought to include the alteration, destruction, or fragmentation of habitat; climate change; disease; as well as impacts from non-indigenous species, ultraviolet radiation, and xenobiotic chemicals (Gibbons et al., 2000).

All over the world and throughout recorded history, snakes have been the source of fascination and fear; they have been both worshipped and despised (Pough et al., 1998). Depending on the cultural bias to which people are exposed, they develop a positive or negative attitude about snakes. Cultural bias might affect whether these animals are considered worthy of protection (Campbell & Campbell, 2001).

The controversial reputation of snakes makes this group of animals more problematic—compared with charismatic animals like eagles or large carnivores—when planning snake protection activities (Martín-López, Montes, & Benayas, 2007). Snakes do not get much legal protection because of public prejudices such as hate, fear, or incorrect assumptions about their danger, as well as ignorance of the fact that many snakes *are* of good use (e.g., in controlling rodents in ecosystems) (Kaltenborn, Bjerke, Nyahongo, & Williams, 2006). Snakes are in one of the most frequently cited fear categories (Pagani, Robustelli, & Ascione, 2007; Robins & Regier, 1991). This high prevalence of snake fear in humans, as well as in our primate relatives, suggests that it is a result of an ancient evolutionary history (Öhman & Mineka, 2003). People who encounter snakes in the wild may report that they first froze in fear, realizing that they were about to step on a snake (Öhman & Mineka, 2003). Fear is generally greater in females, probably because they have lesser physical abilities to escape from a predatory attack (Røskoft, Bjerke, Kaltenborn, Linnell, & Andersen, 2003). Because reptiles have been associated with danger throughout evolution, Öhman and Mineka (2003) propose that it is likely that snakes represent a prototypical stimulus for activating the fear response. This is in agreement with Herzog and Burghardt (1988), who propose that evolutionary pressures are responsible for human attitudes to animals. In addition, these authors propose that human attitudes are also influenced by rarity and population distribution of animals, being more favorable toward rare animals.

The evolutionary predisposition for avoiding animals associated with danger (or disease risk) is consequently in conflict with the human tendency to

favor rare animals (Prokop, Fančovičová, & Kubiátko, 2009). This is probably why Prokop and Tunnicliffe (2008) found a positive association between knowledge of, and attitudes toward, animals less associated with people's phobias (such as bats), but no similar relationship between knowledge of, and attitudes toward, animals more associated with phobias (such as spiders). These authors speculate that public awareness is simply unable to improve attitudes toward animals associated with danger. Similarly, Morgan and Gramann (1989) reported that increasing knowledge of snakes failed, by itself, to improve children's attitudes toward them.

Several research reports have showed that keeping pets is associated with better knowledge of animals (Prokop, Prokop, & Tunnicliffe, 2008), positive attitudes toward animals, better social interactions with friends, leisure activities (Paul & Serpell, 1996), and better health (Serpell, 1991). Moreover, some researchers propose that pet-keeping in childhood may have important effects on children's self-esteem, social skills, and empathy (Covert, Whiren, Keith, & Nelson, 1985; Poresky & Hendrix, 1990). Bjerke, Østdahl, and Kleiven (2003) showed, however, that keeping pets positively influenced attitudes to more popular animals such as small birds, squirrels, and dogs but found no effects of keeping pets on attitudes to less popular animals like rats, mosquitoes, or beetles (snakes were unfortunately not examined). The attitudes in Bjerke, Østdahl, and Kleiven's (2003) research were examined just in terms of participants' sympathies, leaving other dimensions of their attitudes (see, for example, Kellert, 1985) unexplored. Pagani, Robustelli, and Ascione (2007) found only a weak association between pet guardianship and empathic attitudes toward animals. Although these authors found that snakes were common objects of irrational fears on the part of Italian pupils, they did not examine the attitudes of pet caretakers toward snakes or less popular animals in general. These examples suggest that the relationship between keeping pets and attitudes toward less popular animals is not clear.

In Slovakia, there are five species of snakes belonging to two families (four species from *Colubridae* and one from *Viperidae*) (see <http://www.korytnacky.szm.sk/Pdf/99-93p4.pdf> for a full list of species). In Turkey, there are 33 species from *Colubridae*, 8 from *Viperidae*, and 1 species each from *Typhlopidae*, *Leptotyphlopidae*, and *Boidae* (see [www.cevreorman.gov.tr/belgeler3/mak2006.doc](http://www.cevreorman.gov.tr/belgeler3/mak2006.doc) for a full list of species). The decline in snake populations prompted governments in Slovakia and Turkey to protect all snakes by law.

Surprisingly, there is no research that seriously investigates attitudes to snakes, with the exception of the fear dimension (e.g. Arrindell, 2000; Öhman & Mineka, 2003). Does fear of snakes influence peoples' attitudes to snakes? Do beliefs about untrue myths and level of knowledge about snakes influence

other dimensions of people's attitude toward snakes? Does the higher occurrence of venomous snakes in a particular country influence people's attitudes toward snakes? Does keeping pets influence human attitudes toward animals associated with people's phobias, like snakes? These and many other basic questions that contribute to understanding the relationship between humans and snakes have not been studied. Moreover, better understanding of attitudes toward snakes might help better planning for environmental education programs focusing on snake conservation.

### **Current Study**

This study examined university students' attitudes toward snakes. We have chosen a sample of participants from two different continents (Asia and Europe), considering that "in Asia and Africa, where early humans evolved, there are no simple rules for discriminating poisonous from non-poisonous species as there are in the USA and Europe" (Herzog & Burghardt, 1988, p. 215). The aims of this investigation were threefold:

- To quantitatively assess university students' attitudes toward snakes as a function of their origin (Turkey [Asia] and Slovakia [Europe]).
- To compare such attitudes as a function of students' majors (biology majors and nonmajors) and gender.
- To compare pet-keepers' and non-pet-keepers' attitudes toward snakes.

### **Methods**

#### *Construction of the Snake Attitude Questionnaire (SAQ)*

Students' attitudes, belief in myths, and knowledge of snakes were measured by a five-point Likert-type questionnaire (Likert, 1932). Most of the negative items were adopted from the Spider Phobia Questionnaire (Kindt, Brosschot, & Murit, 1996). Items from this questionnaire were modified by simply changing the term "spider" to "snake." Knowledge of snakes was measured by the items that represent basic facts about the biology of snakes. Myths about snakes were collected from online Web pages (putting "snake" + "myths" into Google) and our own experiences with peoples' beliefs. Other attitude items were modified following the Bat Attitude Questionnaire (Prokop, Fančovičová, & Kubiato, 2009) available at [www.zoo.sav.sk/prokop](http://www.zoo.sav.sk/prokop) and in similar research studies (e.g. Thompson & Mintzes, 2002). The *Negativistic* dimension was

designed specifically to measure active avoidance of snakes as a result of dislike or fear. The *Scientistic* dimension measures interest in biology and in gathering information about snakes. The *Naturalistic* dimension was designed to investigate participants' interest in direct experience with snakes and exploration of Nature. The *Ecologistic* dimension was designed to investigate participants' concern about the role of snakes in Nature and interrelationships between snakes and humans.

The original instruments were developed in English and later translated into Slovak and Turkish by the authors of this paper. SAQ was independently translated by two researchers who were bilingual (Turkish/English or Slovak/English) and knowledgeable about zoology. These translated instruments were reviewed by another researcher to investigate the gaps between the translations.

The original, self-constructed questionnaire consists of 58 items that were scored by participants from 1 (strongly disagree) to 5 (strongly agree). Items were formulated either negatively or positively (Oppenheim, 1999). Negative items were scored in the reverse order. Summed scores provide a composite index of attitude toward snakes. Low scores reflect relatively negative attitudes and high scores reflect positive attitudes toward snakes. This is also true for the *Negativistic* dimension, where low scores mean agreement with negative statements (i.e., negative attitude) and high scores mean disagreement with negative statements (i.e., positive attitude).

The validity of the questionnaire was established through review by two professors in the field of zoology from two different universities, as well as by two experts in biology education. All were asked to evaluate whether the items in each dimension were relevant to the goal of the questionnaire. Revisions were based on their comments and suggestions. The results of a pilot study in which 55 Slovakian university students participated were carefully reviewed. All items that did not correlate with other items at the level of Pearson correlation  $r = 0.20$  or more were excluded, according to Prokop, Fančovičová, and Kubiátko (2009). Data from the pilot study were omitted from future analyses.

A factor analysis (PCA with Varimax rotation) was performed on scores from the final study, and seven factors with eigenvalues greater than 1.5 were found. The seven factors represented in the rotation matrix were termed: *Negativistic* (13 items), *Scientistic* (13 items), *Naturalistic* (7 items), *Knowledge* (5 items) and *Ecologistic* (5 items). Two independent dimensions contained items subjected on *Myths* (8 and 7 items). These seven factors explained 42% of total variance. Most of this variance was explained by the *Negativistic* and *Scientistic* dimension (18.6% and 6.7 %, respectively). Finally, we measured the reliability of all remaining items and also the reliability of each dimension separately. The Cronbach's alpha coefficient for the whole instrument was

0.91, which indicates the high reliability of the questionnaire (Nunnally, 1978). Because of space limitations, we have included the full version of the SAQ with detailed information about the reliability of each dimension on the Web site of the first author ([www.zoo.sav.sk/prokop](http://www.zoo.sav.sk/prokop)).

The values of alpha coefficients for the scales ranged from 0.58 to 0.89, which indicate acceptable reliability (Nunnally, 1978). The alpha for the *Ecologicistic* dimension, however, which explained only 2.7 % of total variance, was somewhat lower ( $\alpha = 0.51$ ). We therefore excluded the *Ecologicistic* dimension from further analyses. The meaning of items from two myth dimensions that loaded to two different factors was not distinguishable, even after having them considered by an independent professor of zoology. Means of these two dimensions significantly correlated ( $r = 0.4$ ,  $p < 0.001$ ) and showed very similar trends in each country. We therefore pooled data from these two dimensions and present them as a single dimension: "Myths."

Values of discriminant validity and the mean of correlation values (controlled for the effect of country) of a subscale with other scales, are ranged from 0.10 to 0.39. These results support that the instrument was internally consistent and reliable for interpreting the data reported in the study.

### *Participants*

The study was conducted between October and November 2007. A total of 204 Turkish (120 females and 84 males) and 234 Slovakian (190 females and 44 males) first-year college students aged 17-24 years ( $M = 19.5$ ,  $SE = 0.08$ ) and attending two different universities participated in the study. Students were studying toward their primary or secondary school teaching degree. They were studying various disciplines, while a significant part of the group (41 of 204 in Turkey and 115 of 234 in Slovakia) were enrolled in a biology course. A homogeneity-of-slopes general linear model analysis did not reveal significant interaction between independent variables (country, gender, keeping pets, or enrollment in biology courses) on dependent variables, which suggests that differences in means showed similar trends among biology majors and nonmajors, boys and girls, or pet-keepers and non-pet-keepers in both Turkey and Slovakia.

Because only first-year students were selected for this study, they had experience mainly with general biology courses, and not with a general zoology or a vertebrate zoology course in either of the two countries. The remaining 278 students were enrolled mostly in humanities disciplines. This allows us to compare biology majors (presumably more interested in snakes) and students enrolling in humanities (presumably less interested/educated in snakes) in terms of their attitudes toward, and knowledge about, myths about snakes.

Students were satisfied that the questionnaire was not a test, but rather a research attempt to examine their attitudes toward snakes. No time limit was given for completion of the questionnaire. Participants were asked for personal information in the questionnaire related to (1) their age/grade, (2) gender, (3) whether they had pets, and, if yes, (4) what animal species they had as pets and (5) whether they had ever been bitten by a snake.

## Results

### *Venomous Snakes in Turkey and Slovakia*

Twelve of 44 known species of snakes (27%) in Turkey are venomous and 1 of 5 known species of snakes (20%) in Slovakia are venomous. This could mean that Turks might encounter venomous snakes more commonly than Slovaks. The proportion of poisonous snakes, however, is similar between the two countries (Fisher exact test,  $p = 1.0$ ). The adder, *Vipera berus*, is the only poisonous species in Slovakia. Similarly, other species of the family *Viperidae* are also the most common venomous species in Turkey. No student, however, reported having been bitten by a snake.

### *Having Pets*

Slovakian students (59%, 139/234) reported having animals as pets more frequently than did Turkish students (37%, 76/204) ( $\chi^2 = 21.3$ ,  $df = 1$ ,  $p < 0.0001$ ). Females (54%, 166/310) kept pets more frequently than did males (38%, 49/128) ( $\chi^2 = 8.45$ ,  $df = 1$ ,  $p = 0.003$ ), but biology majors (50%, 80/160) reported keeping pets as frequently as nonmajors (49%, 135/278) ( $\chi^2 = 0.08$ ,  $df = 1$ ,  $p = 0.77$ ).

The types of animal kept were categorized into 17 animal taxa. Most of these animals could be considered as pets and fewer as farm animals. Only five Turkish students, and no Slovakian one, reported having only farm animals (typically chickens and pigeons), but other animal keepers reported having pets besides farm animals. Because removing these five Turkish students did not change the results of subsequent statistical analyses, we consider pets and farm animals the same. Moreover, it is often hard to distinguish between pets and farm animals because, for example, a dog can be viewed only as a "house guarder" and a cat as a "mouse consumer," without greater emotional attachment on the part of the keeper. In contrast, the same animals could be considered exclusively as pets without any utilitarian attitudes toward them.

The most frequently cited animals are listed in Table 1. Other animals such as hens, hamsters, tortoises, and rabbits have less frequency (fewer than 10% of all animals).

Slovakian students reported having 16 species, but Turkish students reported only 9 species. Turkish students did not cite having small mammals like hamsters, rats, or guinea pigs, in contrast to Slovakian students. Fish and cats were cited with almost identical frequency in both countries. Interestingly, bird pets were cited more frequently in Turkey, compared with Slovakia, but having dogs was more common in Slovakia (Table 1). Only two Slovakian female students reported having snakes.

**Table 1. Comparison of most frequently cited animals as pets in Turkey and Slovakia. Total number of pets cited by students was 111 in Turkey and 240 in Slovakia.**

	Dog % (n)	Cat % (n)	Fish % (n)	Bird % (n)
Turkey	18 (20)	23 (25)	11 (12)	26 (29)
Slovakia	38 (92)	16 (38)	10 (24)	9 (21)
$\chi^2$	14.42	2.69	0.05	18.8
p	0.001	0.1	0.82	0.001

#### *Attitudes toward Snakes*

It was found that differences with respect to country (MANOVA, Wilk's lambda = 0.75,  $F(5,426) = 28.57$ ,  $p < 0.0001$ ,  $n^2 = 0.25$ ), gender (Wilk's lambda = 0.96,  $F(5,426) = 3.68$ ,  $p = 0.002$ ,  $n^2 = 0.04$ ) and study specialization (Wilk's lambda = 0.95,  $F(5,426) = 4.78$ ,  $p = 0.0003$ ,  $n^2 = 0.05$ ) significantly influenced students' five dimensions of attitudes toward snakes. Interactions between variables were not significant (all  $p > 0.16$ ). Interestingly, even after Bonferroni adjustments, the effect of keeping animals on students' attitudes toward snakes showed significant effect on attitudes (MANOVA, Wilk's lambda = 0.94,  $F(6,431) = 4.08$ ,  $p = 0.0005$ ,  $\alpha = 0.012$ ,  $n^2 = 0.05$ ).

As shown in Fig. 1, there is an evident fear of snakes in terms of the *Negativistic* and *Naturalistic* dimension (mean scores below 3.0). This means that students from both countries do not like snakes and show concern about encountering snakes in Nature. There were no differences in the *Negativistic* attitudes toward snakes with respect to country. Interestingly, Turkish students showed greater interest in the biology of snakes (the *Scientistic* dimension) and

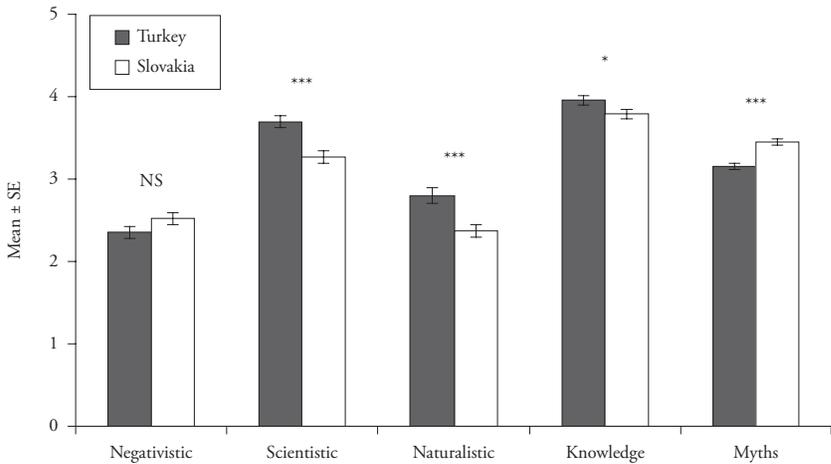


Figure 1. Differences in attitudes toward snakes between Turkish and Slovakian students. Low mean scores within the *Negativistic* and *Naturalistic* dimension indicate great fear of snakes. Asterisks denote statistically significant differences (\*\*\*)  $p < 0.001$ ; \*  $p < 0.05$ ; NS = not significant).

less concern about encountering a snake in Nature. Nevertheless, Turkish students showed greater belief in untrue myths about snakes. The difference in knowledge score was significant, favoring Turkish students, but weak.

Fig. 2 shows that males had generally more positive attitudes, as compared with females. There were no differences in the *Scientistic* dimension and in *Knowledge*, which suggests that interest in the biology of snakes and knowledge about snakes is not influenced by gender. Females show greater fear of snakes and concern about encountering a snake in Nature. Females also displayed somewhat greater belief in untrue myths about snakes, compared to males.

Biology majors showed more positive attitudes about snakes, compared with nonmajors (Fig. 3). Biology majors showed less fear of snakes, compared with nonmajors, but there were no differences in knowledge or belief in myths about snakes.

After dividing participants into three groups according to number of pets (0 pets, 1 pet, and 2 or more pets; see Prokop, Prokop, & Tunnicliffe, 2008), it was found that having more pets was associated with more positive attitudes toward snakes. Although statistical significance was reached only in the *Negativistic* dimension, similar trends are visually distinguishable as well in the *Scientistic* and *Naturalistic* dimensions (Fig. 4). This result suggests that

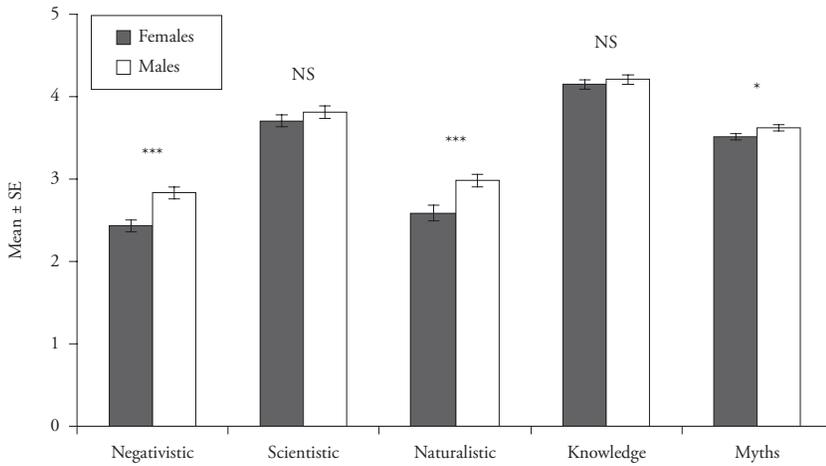


Figure 2. Differences between male and female students in attitudes toward snakes. Low mean scores within the *Negativistic* and *Naturalistic* dimension indicate great fear of snakes. Asterisks denote statistically significant differences (\*\* $p < 0.001$ ; \* $p < 0.01$ ; \* $p < 0.05$ ; NS = not significant).

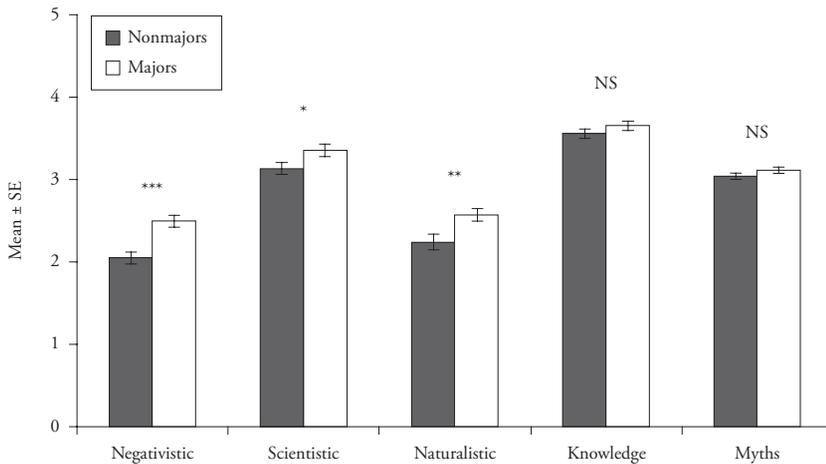


Figure 3. Differences between biology majors and nonmajors in attitudes toward snakes. Low mean scores within the *Negativistic* and *Naturalistic* dimension indicate great fear of snakes. Asterisks denote statistically significant differences (\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ ; NS = not significant).

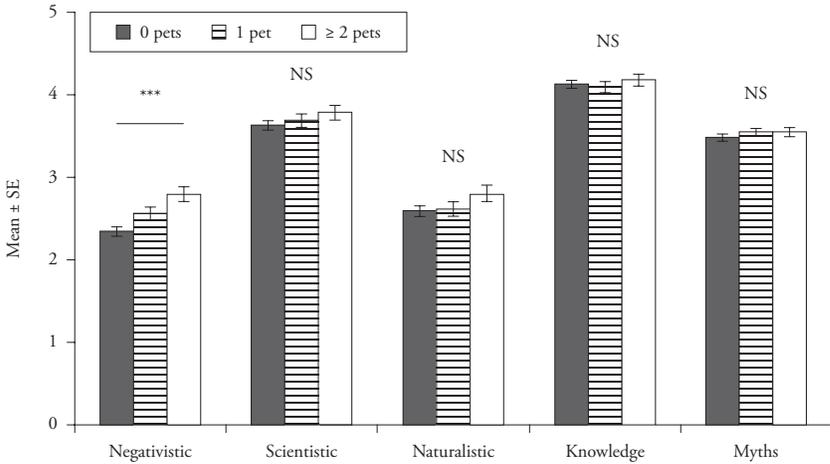


Figure 4. Differences in attitudes toward snakes with respect to number of reported pets at home. Low mean scores within the *Negativistic* and *Naturalistic* dimensions indicate great fear of snakes. Asterisks denote statistically significant differences based on Tukey HSD posthoc test (\*\* $p < 0.001$ ; NS = not significant).

students having more pets show less fear of snakes compared with students with fewer or no pets.

#### *The Relationships between Attitudes and Knowledge*

A series of partial correlations (controlled for the effect of country, gender, study specialization, and pet-keeping) between knowledge and attitudes showed that knowledge score significantly correlated only with the *Scientistic* dimension (Table 2). The *Negativistic* dimension strongly correlated with the *Scientistic* and *Naturalistic* dimension.

**Table 2. Relationships between SAQ dimensions. Numbers are partial correlation coefficients. Asterisks indicate that the correlations are statistically significant (\*\* $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ , NS = not significant)**

	Scientistic	Naturalistic	Knowledge	Myths
Negativistic	0.56***	0.70***	0.07 <sup>NS</sup>	0.09*
Scientistic	–	0.44***	0.27***	0.17***
Naturalistic	–	–	–0.07 <sup>NS</sup>	0.15**
Knowledge	–	–	–	0.03 <sup>NS</sup>

## Discussion

Attitudes toward snakes have been studied, especially in the context of human fear of snakes (e.g., Arrindell, 2000; Öhman & Mineka, 2003), but this is the first comparative study that has examined several dimensions of human attitudes toward snakes in two countries.

This study shows that attitudes toward snakes, based on a sample of university students from two different continents, varies with respect to country, gender, study combination, and keeping animals as pets. Students from Turkey and Slovakia showed fear of snakes as indicated by low mean score (below 3.0) within the *Negativistic* and *Naturalistic* dimension. Interestingly, Turkish students showed greater interest in the biology of snakes (the *Scientific* dimension) and better naturalistic attitudes, but they also showed greater beliefs in untrue myths about snakes compared with Slovakian students. As expected, females showed greater fear of snakes as compared with males. Attitudes to snakes were more positive in biology majors, compared with nonmajors, and keeping pets at home positively influenced attitudes toward snakes, especially in the *Negativistic* dimension.

### *The Effect of Country*

The dislike of snakes seems to be a cross-cultural universal, since they rank lowest on the preference scale in reports from other countries (Africa: Kaltenborn et al., 2006; USA: Kellert & Westerveld, 1983; the Netherlands: Arrindell, 2000; Italy: Pagani, Robustelli, & Ascione, 2007; Spain: Martín-López, Montes, & Benayas, 2007). The present study failed to reveal significant differences in the *Negativistic* dimension between Turkish and Slovakian students, supporting the universality of fear of snakes. The lack of this difference also indicates that the greater number of venomous species of snakes in Turkey does not contribute to negative attitudes toward them. It is not clear, however, how many students lived in areas containing venomous (or nonvenomous) snakes; this variable could explain some of the variance of attitudes toward animals (Røskaft et al., 2003). The adder *Vipera berus* is rare in Slovakia, and other *Vipera* species are similarly rare in Middle Anatolia (Turkey), where the research was carried out. This is also confirmed by the fact that no student in any country was bitten by a snake. The importance of whether there are snakes in the vicinity therefore requires further attention.

Another possibility for low differences in the *Negativistic* dimension between Slovakian and Turkish students is as a result of greater propaganda about snakes in the media and/or in popular books about snakes in Turkey (e.g., Baran, 2005). This would increase scientific attitudes toward snakes that

eliminate negativistic attitudes (correlation between *Scientistic* and *Negativistic* dimension is high; see Table 1). This question requires greater attention.

### *The Effect of Gender*

Gender is perhaps the most important demographic variable affecting attitudes toward animals (Arrindell et al., 2003; Kaltenborn et al., 2006). Females more than males have been found to express negative attitudes toward predators (Røskaft et al., 2003), which would explain why female students expressed greater fear of snakes in the present study. Røskaft et al. (2003) suggest that males' greater ability to escape from the attacks of large carnivores may be responsible for greater fear of predators in females. However, no study examined this possibility in the context of snake attacks, so the origin of the different expression of fear in males and females remains to be studied.

Males generally like wild animals, whereas females tend to prefer exotic animals (Lindemann-Matthies, 2005), and they are also more emotionally attached to their pets, compared with males (Pagani, Robustelli, & Ascione, 2007). In a large survey of pet-keeping among Slovakian children (Prokop, Prokop, & Tunnickliffe, 2008), 8 of 791 males reported having snakes as pets. In contrast, not one of 753 females reported having a snake (P. Prokop, unpublished data). This difference is statistically significant ( $\chi^2 = 7.66$ ,  $df = 1$ ,  $p = 0.006$ ) and would be interpreted as a greater dislike of snakes among females as shown by preferences in domestic pets. Lack of similar support regarding keeping snakes as pets—especially for boys—in the present study (two females, and no males, reported having a snake at home) can be explained by the relatively low number of male participants. Another explanation is that there was a relatively low number of pet-keepers among university students, which would reflect lower interest in keeping animals among older students (Bjerke & Østdahl, 2004).

### *Keeping Animals*

Our results suggest that keeping pets was linked to less negative attitudes toward snakes. In addition, having more pets at home was associated with more positive attitudes, compared with having fewer pets. We suggest that there could be an association between pet attachment and the number of reported pets in the home, but a more detailed approach is necessary to confirm this prediction. We propose several mechanisms that are not mutually exclusive that might explain the effects of keeping pets on participants' attitudes toward snakes. First, keeping pets (at least dogs) is associated with more recreational walks (Serpell, 1991), which can result in more contact with

Nature and more experiences with wild animals. Røskaft et al. (2003) showed that more visits in Nature resulted in more positive attitudes toward large carnivores in Norway. This means that keeping pets would have an indirect effect on (positive) attitudes toward snakes. Second, pet-keepers—at least in Slovakia—have more educated parents compared to their non-pet-keeping counterparts (Prokop, Prokop, & Tunnicliffe, 2008). Higher education level is consequently linked to more positive attitudes toward less popular animals such as insects (Kellert, 1993), which would influence children's attitudes toward animals. This explanation therefore suggests that participants' attitudes toward snakes were influenced by parent upbringing and/or by an interaction between parent upbringing and keeping pets. Third, keeping pets results in more empathy with (Poresky & Hendrix, 1990), and practical skills in, maintaining animals. Emotional and cognitive experiences with keeping pets would therefore be transformed and generalized to other animals, regardless of whether or not they are associated with people's phobias. Fourth, people who decided to keep a pet could simply be individuals who like animals more than did non-pet-keepers. The latter explanation seems less likely, considering that virtually every child (99%) wants to have a pet (Kidd & Kidd, 1985).

#### *The Effect of Enrolling in Biology Courses*

More positive attitudes toward snakes have been found to be associated with enrolling in biology courses, especially within the *Negativistic* and *Naturalistic* dimension, and in the *Scientistic* dimension. Biology majors are expected to be more knowledgeable about animals, including snakes, but we failed to find any difference in the *Knowledge* dimension and *Myths*. We suggest that the better attitude score of biology majors could be caused by greater individual interest in animals as compared with nonmajors, who probably incline toward the humanities. Prokop, Fančovičová, and Kubiátko (2009) also did not find any difference in beliefs in untrue myths about bats when comparing biology majors and nonmajors in the same age group of university students. These results should be of interest to environmental educators who should be aware that human beliefs about untrue myths are distributed randomly in the population irrespective of age, culture, gender (Mintzes & Wandersee, 1998), or area of study specialization (Prokop, Fančovičová, & Kubiátko, 2009; this study).

#### *Relationship between Knowledge, Myths, and Attitude Dimensions*

Knowledge score showed no correlation with attitude dimensions except for the *Scientistic* dimension. These data should be interpreted very cautiously,

however, considering that there were just five items that loaded to the knowledge dimension. Interestingly, Prokop, Kubiátko, and Fančovičová (2008) and Prokop, Fančovičová, and Kubiátko (2009), using a similar approach, reported correlations between attitude and knowledge about  $r = 0.30$  and more. These differences can be interpreted in the context of evolutionary pressures that influence human attitudes toward animals (Herzog & Burghardt, 1988). Prokop and Tunnicliffe (2008) and Prokop, Fančovičová, and Kubiátko (2009) propose that avoiding animals associated with danger is consequently in conflict with the human tendency to favor rare animals. This hypothesis suggests that acquiring factual knowledge of animals will result in more positive attitudes only if this animal is not perceived as dangerous in terms of physical attack or disease risk. Previous research by Prokop and colleagues focused on less dangerous animals like birds and bats and showed a greater association between attitude and knowledge, but this association seems to be much lower with more dangerous animals like spiders (Prokop & Tunnicliffe, 2008) and snakes (this study), thus supporting our hypothesis. More research in this field would shed more light on patterns of attitude-knowledge relationships.

Absence of correlations between the *Myths* and other attitude dimensions found in other studies (Prokop & Tunnicliffe, 2008; Prokop, Fančovičová, & Kubiátko, 2009) was probably caused by using myths that are quite geographically specific and especially American. Rattlesnakes, milk snakes, and other snake species are not found in Europe.

## Conclusion

Planning environmental protection programs should take into account that attitudes to some frightening animals such as snakes who possess more or less serious danger cannot be influenced only by increasing public awareness. Instead, understanding the structure of peoples' beliefs in untrue myths and fears would result in more successful proenvironmental actions. The bad reputation of snakes rooted in untrue stories and myths is associated with all other attitude dimensions toward snakes; thus, interventions eliminating myths would result in effective attitude improvements. These interventions should also include science/biology teachers or students enrolling in biology courses because their beliefs in untrue myths are similar to those of nonbiology students (Prokop, Fančovičová, & Kubiátko, 2009; this study). People have poor experiences with snakes, considering their low interest in keeping snakes as pets. Greater physical contact with snakes contributes to building more positive attitudes toward them (Morgan & Gramann, 1989). Keeping pets at

home also has various benefits, including reduced fear of snakes (this study). Proenvironmental programs should take into account physical contact with snakes that can be provided by visiting zoos or snake breeders/specialists. Increasing interest in snakes would result in less fear (this study), but enhancing dull, factual knowledge cannot improve complicated relationships between humans and frightening animals.

## Acknowledgment

We would like to thank two anonymous reviewers for helpful comments on earlier drafts of this manuscript.

## References

- Alves, R. R. N., & Pereira, G. A. (2007). Commercialization and use of snakes in North and Northeastern Brazil: Implications for conservation and management. *Biodiversity and Conservation*, *16* (4), 969-985.
- Arrindell, W. A. (2000). Phobic dimensions: IV. The structure of animal fears. *Behaviour Research & Therapy*, *38* (5), 509-530.
- Arrindell, W. A., Eisemann, M., Richter J., Tian, P. S., Oei, T. P. S., Caballo, V. E., et al. (2003). Phobic anxiety in 11 nations, Part I: Dimensional constancy of the five-factor model. *Behaviour Research & Therapy*, *41* (4), 461-479.
- Baran, I. (2005). *The reptiles and amphibians of Turkey*. Popular Scientific Books Series, no. 207. Ankara, Turkey: TUBITAK Publications.
- Bjerke, T., & Østdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoös*, *17* (2), 109-129.
- Bjerke, T., Østdahl, T., & Kleiven, J. (2003). Attitudes and activities related to urban wildlife: Pet owners and non-owners. *Anthrozoös*, *16* (3), 252-262.
- Campbell, K. R., & Campbell, T. S. (2001). The accumulation and effects of environmental contaminants on snakes: A review. *Environmental Monitoring and Assessment*, *70* (3), 253-301.
- Covert, A. M., Whiren, A. P., Keith, J., & Nelson, C. (1985). Pets, early adolescence and families. *Marriage and Family Review*, *8* (3-4), 95-108.
- Gibbons, J. W., Scott, D. E., Ryan, T. J., Buhlmann, K. A., Tuberville, T. D., Metts, B. S., et al. (2000). The global decline of reptiles, déjà vu amphibians. *BioScience* *50* (8), 653-666.
- Herzog, H., & Burghardt, G. M. (1988). Attitudes toward animals: Origins and diversity. *Anthrozoös*, *1* (4), 214-222.
- Kaltenborn, B. P., Bjerke, T., Nyahongo, J. W., & Williams, D. R. (2006). Animal preferences and acceptability of wildlife management actions around Serengeti National Park, Tanzania. *Biodiversity and Conservation*, *15* (14), 4633-4649.
- Kellert, S. R. (1985). Attitudes toward animals: Age-related development among children. *Journal of Environmental Education*, *16* (3), 29-39.
- (1993). Values and perceptions of invertebrates. *Conservation Biology*, *7* (4), 845-855.
- Kellert, S. R., & Westervelt, M. O. (1983). *Children's attitudes, knowledge and behaviors toward animals*. Phase V. U.S. Fish and Wildlife Service. (No. 024-010-00641-2). Washington, DC: U.S. Government Printing Office.

- Kidd, A. H., & Kidd, R. M. (1985). Children's attitudes toward their pets. *Psychological Reports*, 57 (1), 15-31.
- Kindt, M., Brosschot, J. F., & Murit, P. (1996). Spider phobia questionnaire for children (SPQ-C): A psychometric study and normative data. *Behaviour Research and Therapy*, 34 (2), 277-282.
- Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology* 140, 1-55.
- Lindemann-Matthies, P. (2005). 'Loveable' mammals and 'lifeless' plants: how children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education*, 27 (6), 655-677.
- Martín-López, B., Montes, C., & Benayas, J. (2007). The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological Conservation*, 139, 67-82.
- Mintzes, J. J., & Wandersee, J. H. (1998). Research in science teaching and learning: A human constructivistic view. In Mintzes, J. J., Wandersee, J. H., and Novak, J. D. (Eds.), *Teaching Science for Understanding*, pp. 60-94. Orlando, FL: Academic Press.
- Morgan, J. M., & Gramann, J. H. (1989). Predicting effectiveness of wildlife education programs: A study of students' attitudes and knowledge toward snakes. *Wildlife Society Bulletin*, 17 (4), 501-509.
- Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.
- Öhman, A., & Mineka, S. (2003). The malicious serpent: Snakes as a prototypical stimulus for an evolved module of fear. *Current Directions in Psychological Science*, 12 (1), 5-9.
- Oppenheim, A. N. (1999). *Questionnaire design, interviewing and attitude measurement*. (Rev. ed.). London: Continuum International Publishing Group.
- Pagani, C., Robustelli, F., & Ascione, F. R. (2007). Italian youths' attitudes toward, and concern for, animals. *Anthrozoös*, 20 (3), 275-293.
- Paul, E. S., & Serpell, J. A. (1996). Obtaining a new pet dog: Effects on middle school children and their families. *Applied Animal Behaviour Science*, 47 (1-2), 17-29.
- Poresky, R. H., & Hendrix, C. (1990). Differential effects of pet presence and pet bonding in young children. *Psychological Reports*, 67 (1), 51-54.
- Pough, F. H., Andrews, R. M., Cadle, J. E., Crump, M. L., Savitzky, A. H., & Wells, K. D. (1998). *Herpetology*. New Jersey: Prentice-Hall.
- Prokop, P., Fančovičová, J., & Kubiátko, M. (2009). Vampires are still alive: Slovakian students' attitudes toward bats. *Anthrozoös*, 22 (1), 19-30.
- Prokop, P., Prokop, M., & Tunnicliffe, S. D. (2008). Effects of keeping animals as pets on children's concepts of vertebrates and invertebrates. *International Journal of Science Education*, 30 (4), 431-449.
- Prokop, P., & Tunnicliffe, S.D. (2008). "Disgusting" animals: Primary school children's attitudes and myths of bats and spiders. *Eurasia Journal of Mathematics, Science and Technology Education*, 4 (2), 87-97.
- Robins, L. N., & Regier, D. A. (Eds.). (1991). *Psychiatric disorders in America: The epidemiologic catchment area study*. New York: Free Press.
- Røskaft, E., Bjerke, T., Kaltenborn, B. P., Linnell, J. D. C., & Andersen, R. (2003). Patterns of self-reported fear towards large carnivores among the Norwegian public. *Evolution & Human Behavior*, 24 (3), 184-198.
- Serpell, J. A. (1991). Beneficial effects of pet ownership on some aspects of human health and behaviour. *Journal of the Royal Society of Medicine*, 84 (12), 717-720.
- Thompson, T. L., & Mintzes, J. J. (2002). Cognitive structure and the affective domain: on knowing and feeling in biology. *International Journal of Science Education*, 24 (6), 645-660.
- Zhou, Z., & Jiang, Z. (2004). International trade status and crisis for snake species in China. *Conservation Biology*, 18 (5), 1386-1394.
- Zhou, Z., & Jiang, Z. (2005). Identifying snake species threatened by economic exploitation and international trade in China. *Biodiversity and Conservation*, 14 (14), 3525-3536.