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Pre-Service Biology Teachers' and Primary School Students' Attitudes Toward and Knowledge about Snakes

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Snakes are controversial animals emblazoned by legends, but also endangered as a result of human prejudice and fear. The author investigated gender and age-related differences in attitudes to and knowledge of snakes comparing samples of school children and pre-service teachers. It was found that although pre-service teachers had better knowledge of and more positive scientistic and moralistic attitudes toward snakes fear of snakes and willingness to pay for snake conservation was no statistically different between these two groups of participants. These results support the idea that better factual knowledge is not a sufficient precursor of attitudes toward harmful animals.

Keywords: Animals, Attitude, Knowledge, Pre-Service Teachers, Snakes, Students

INTRODUCTION

There are 11 known species of snake in Slovenia of which three are poisonous (the horned viper, *Vipera ammodytes*; the European asp, *Vipera aspis* and the common European adder, *Vipera berus*) and potentially dangerous to humans. All Slovenian snake species are included in the Red List of Threatened Species (Ur. l. RS, n. 82/2002) and are also protected by law. Habitat loss and degradation, introduced invasive species, environmental pollution, disease and parasitism, unsustainable land use and global climate change are several known or suspected causes for the worldwide decline of reptile species summed up by Gibbons et al. (2000). Some of these, e.g. the loss and degradation of reptile habitats, also threaten Slovenian species of reptiles (Mršić, 1996).

Throughout history, snakes have been exploited in various ways. In some countries, they are used as food, in traditional medicine and religious rituals (Alves & Pereira, 2007). They have been a source of fascination and fear or worship and despise (Pough et al., 1998). People in Slovenia are generally afraid of and prejudicial toward snakes. They have many misconceptions about snakes and believe in different myths about them (Ocepek, 2001). The famous Slovenian polymath, Janez Vajkard Valvasor, writes about snakes in his most celebrated natural history volume on Slovenia, *The Glory of the Duchy of Carniola* (1689). He says that Slovenia has 'snakes and vipers' in abundance, and that they cause numerous injuries each year. 'This despicable nuisance', he refers to them, 'is quick to sting both people and beasts and thus bring death upon them'. The author then proposes the following remedy for protection against snake bite. To avoid being bitten by a snake, a person should tear out the serpent's heart first thing in the morning, swallow it while it is still beating, and wash it down with a spoonful of spring water. This would not only serve as an antidote, but also keep any poor soul safe from future snake bites. Lastly, Valvasor says that this also applies to vipers, and goes as far as to claim that whoever follows his instructions can handle live snakes without any harm.

Snakes are also of great interest to psychologists who study the affective domain since excessive negative emotions can cause serious distress and interfere with

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State of the literature

- Studies of people's attitudes toward and knowledge of different organisms until recently focused on larger and/or 'charismatic' animals, such as sharks, dolphins, primates and on invertebrates.
- In recent years, such studies are also turning to animals such as bats, spiders, snakes and amphibians.
- Education plays a crucial role in informing people about organisms and the environment, helping them develop responsible attitudes and behaviors.

Contribution of this paper to the literature

- In this study the author compares pre-service biology teachers' and primary school students knowledge about and their attitude toward snakes.
- Although a person becomes more knowledgeable about animals through schooling, his or hers willingness to act pro-environmentally does not necessarily change accordingly for animals that are potentially harmful.
- Comparing student teachers and primary school students attitudes and knowledge about animals gives us guidelines for preparing adequate teaching/learning materials for both.

people's daily lives (Merckelbach & Muris, 2001). Fears can be described as normal responses to real or imagined situations. When fears become excessive and irrational, they are called phobias (King et al., 1994). Animal phobias are one of the most common phobias and can be treated relatively easily (Merckelbach & Muris, 2001). In a research conducted by Muris et al. (2002a), 12 out of 49 fears reported by children referred to animals, with snakes and spiders topping the list.

Fear development and acquisition are until today widely researched topics and debated extensively. Some psychologists propose that fear of snakes is genetically fixed, because our mammalian ancestors were targeted by large predators, and therefore natural selection favoured only individuals who were able to recognise the danger posed by large reptiles and escape in time (reviewed by Öhman & Mineka, 2001). These evolutionary assumptions are very important – yet continue to be neglected in educational practices – as they suggest that standard teaching methods need not necessarily succeed in influencing human prejudice and fear of these controversial animals. Some studies support this idea by identifying drawbacks of conservation activities aimed at protecting snakes (Martín-López et al., 2007). On the other hand, not all psychologists agree with the above evolutionary (non-associative) account. While they do not completely disregard genetic predispositions, they propose their own multifactorial model on the etiology of (childhood) specific phobias (Muris et al., 2002b). We should not overlook the fact that fear (including fear of animals) can be acquired either through direct experience, modelling, or negative information (see Davey et al., 2003; and Muris et al., 2002b).

Emotions represent an important dimension of attitude research. Attitudes have been extensively researched in recent decades. One of the first researchers to tackle the attitude of the general public toward animals and the environment was Kellert (1985) who defined a set of attitudinal dimensions and formed a special typology. This typology is briefly presented in Tab. 1. People's attitudes toward animals differ from one animal group to another and from species to species. For example, charismatic animals such as dolphins are perceived as lovable (Barney et al., 2005), while snakes or sharks are perceived as dangerous (Prokop et al., 2009b; Thompson & Mintzes, 2002). Martín-López et al. (2007) identify five clusters of biodiversity preferences: (1) charismatic fauna; (2) species that are familiar or useful for people; (3) species that usually cause phobias; (4) aquatic organisms; and (5) plant species. Their results indicate that scientific considerations are relatively less important than anthropomorphic and anthropocentric factors in determining both human attitudes towards species and the WTP (willingness to pay) to support biodiversity conservation, which can be seen from preferences categorisation (e.g. affectionate, utilitarian and prototypical view of organisms).

Studies of people's attitudes toward and knowledge of different organisms until recently focused on larger and/or 'charismatic' animals, such as sharks (Thompson & Mintzes, 2002), dolphins (Barney et al., 2005) and primates (Lukas & Ross, 2005), and on invertebrates (Kellert, 1993; Killermann, 1996). But in recent years, such studies are also turning to animals such as bats, spiders, snakes (Prokop & Tunnicliffe, 2008, 2010; Prokop et al., 2009a,b) and amphibians (Randler et al. 2005, Tomažič, 2008). All of the mentioned studies encompass both formal and informal aspects of education as their integral feature.

According to Kellert (1996), education plays a crucial role in informing people about organisms and the environment, helping them develop responsible attitudes and behaviours. For example, better educated people have more favourable attitudes toward insects than less educated people (Kellert, 1993). Snakes can easily be obtained as pets, or children can encounter them in several types of institutions (e.g. zoos).

Table 1. Kellert's (1985, 1996) typology of attitudes.

Attitude dimension	Description
Aesthetic	Interest in the artistic and symbolic characteristics of animals.
Dominionistic	Interest in the mastery and control of animals, generally in sporting activities.
Ecologistic	Concern for the environment as a system and for interrelationships of wildlife species and the natural habitats.
Humanistic	Interest and strong affection for animals, especially pets.
Moralistic	Concern for the right and wrong treatment of animals, with strong opposition to exploitation or cruelty toward animals.
Naturalistic	Interest and affection for wildlife and the outdoors.
Negativistic	An active avoidance of animals as a result of dislike or fear. Indifference (passive avoidance; proposed neutralistic dimension)
Scientistic	Interest in the physical attributes and biological functioning of animals.
Utilitarian	Concern for the practical and material value of animals or their habitats.

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). The authors speculate that public awareness is simply unable to improve attitudes toward animals that were associated with danger in human evolutionary history. To support this view, Morgan (1992) reports that better knowledge of snakes failed, by itself, to improve children's attitudes toward them. Prokop et al. (2009b) argue that "*pro-environmental programs should take into account physical contact with live snakes that can be provided by visiting zoos or snake breeders/specialists. Increasing interest in snakes would result in less fear, but enhancing dull, factual knowledge cannot improve complicated relationships between humans and frightening animals.*"

To date, few studies examined attitudes toward snakes systematically (Prokop et al., 2009b). This means that there are no valid research instruments allowing educators and/or researchers to easily and quickly identify the various dimensions of learners' attitudes toward snakes. Moreover, to the best of the author's knowledge, no study assessed whether attitudes to and knowledge of snakes differ between school children and adult students. Although this task may seem trivial at first glance, recent research showed that school children have surprisingly similar animal identification skills to those of university pre-service biology teachers (Prokop & Rodák, 2009). What is more, myths and knowledge about controversial animals such as bats or snakes exhibit remarkable similarities even between biology majors and non-majors (Prokop et al., 2009a).

Present study

In the present study, the author constructed the questionnaire that would be psychometrically appropriate for measuring attitudes toward and knowledge about snakes of Slovenian general public. The questionnaire was first tested on a group of future biology teachers and a group of primary school pupils. The aim was to use the questionnaire later to assess the effectiveness of snake workshops at a local zoo.

The author set out to:

(1) modify and test SAQ (snakes attitude questionnaire), which was initially developed by Prokop et al. (2009b), that would be appropriate for the Slovenian general public;

(2) identify differences in students' ratings on different attitudinal dimensions according to gender (primary school only), education status, reported fear and direct experience of snakes;

(3) identify differences in students' knowledge about snakes according to gender (primary school only), education status, reported fear and direct experience of snakes;

(4) identify differences in student ratings for willingness to act pro-environmentally according to gender (primary school only, because our sample contains only one adult male), education status, reported fear and direct experience of snakes;

(5) identify relationships between different attitude dimensions, knowledge and willingness to act pro-environmentally.

Methods

Questionnaire

The questionnaire consisted of three parts. The first part included questions about the respondent's age, gender, education, experience of snakes, possible fear of snakes, type of fear acquisition, and sources of information about snakes. The second part was constructed to measure students' willingness to act pro-

environmentally, and different attitude dimensions toward snakes. In this part statements were used that, according to Kellert (1985), define *scientistic*, *negativistic* and *moralistic* (*utilitarian*) attitudinal types. Statements used were similar to those used in several other studies (Prokop et al., 2009b; Tompson & Mintzes, 2002; Barney et al., 2005). Items in the second part of the questionnaire were of the Likert type (Likert, 1932). The third part of the questionnaire contained 28 knowledge and myth-based statements. Students were required to identify them as true, as false or they could remain undecided.

Detailed psychometric properties of the questionnaire are presented in the statistical analysis section.

Participants

The sample included a total of 120 primary school pupils and university (pre-service biology teachers) students. Pre-service biology teachers were in their second (N=32) and third (N=42) academic year. Primary school pupils were in the seventh (N=25) and ninth grades (N=21) of compulsory school.

The age structure of the sample was the following: seventh grade pupils (M=12.4; SD=0.57), ninth grade pupils (M=14.4; SD=0.50), second year university students (M=20.5; SD=0.95), and third year university students (M=22.5; SD=1.49). 114 (95%) students responded to the question about their age. When analysing data according to this independent variable, students who had not provide their age were excluded.

Among 74 university students there was only one male student. Primary school pupils were more equally distributed gender-wise, with 27 boys and 19 girls filling in the questionnaire.

Because the author was aware of the fact that the majority of pre-service teachers already had direct experience of live non-poisonous snakes (e.g. cornsnake; *Elaphe guttata*), a group of primary school pupils with approximately the same amount of direct experience of snakes was selected. Past direct experience was expressed as: "*I've already touched or handled a live snake*". Seven out of 46 primary school pupils and six out of 74 university students did not report previous direct experience of snakes (χ^2=1.442; df=1; p=0.230). The sample, therefore, had not been randomly selected. Pre-service teachers acquired direct experience of live snakes within the course of biology didactics in their first and second academic years, while primary school pupils were introduced to live snakes as a part of regular instruction. Primary school teachers who help to train pre-service teachers at their schools can in exchange take their pupils to the faculty where they can experience live animals that are kept there or the animals are brought to schools.

Statistical analysis

Basic descriptive statistics was used to obtain the average values and frequencies of students' ratings and responses. After factor analysis, four meaningful factors were extracted. Eigenvalue above 1.2 was used for the final factor solution. The Kaiser-Meyer-Olkin (KMO) measure of the sampling adequacy test (0.780) and Bartlett's test for sphericity (χ^2 = 1111.47; df = 276; p < 0.001) suggested that factor analysis was appropriate for this data set, because the value of KMO exceeded the critical value of 0.7 (Leech et al., 2005). The first factor explained 27.8% of total variance and all four factors explained 52.6% of variance. Researchers disagree about the minimum loading that warrants item retention (Sharma, 1996; Tabachnick & Fidell, 2007). A liberal assignment criterion of at least 0.44, a similar value as other researchers was used (cf. Thompson & Mintzes, 2002; McKibbin et al., 2009). Factor 1 was termed "*scientistic*", factor 2 "*negativistic*", factor 3 "*willingness*" and factor 4 "*moralistic*". Cronbach α for total scale was 0.87. Also, Cronbach α's were satisfactory for all four factors (factor 1 = 0.86; factor 2 = 0.83; factor 3 = 0.71 and factor 4 = 0.58). Cronbach α's of this range had been used in some other studies and were therefore treated as satisfactory (Prokop et al., 2009b). Factors that were extracted and knowledge score served as dependent variables that were analysed according to education level of students, gender of primary school students, reported fear of snakes and reported direct experience of snakes. Nonparametric tests and stepwise correlations were calculated to reveal statistically significant differences and correlations according to the above-mentioned independent variables. Nonparametric tests were chosen because of the non-Gaussian distribution of some results. General linear model statistics was used to determine the level of significance of individual independent variables.

Results

Results are presented in four sections. First, an analysis of knowledge scores is presented, followed by inference statistics of individual attitudinal and knowledge ratings and scores. Next, a multivariate analysis of independent variables effect on attitude and knowledge is presented, complete with a presentation of relationships between the individual attitude dimension and knowledge.

Knowledge

A detailed distribution of students' answers to each statement according to education level is presented in Table 2. This shows that primary school pupils were more frequently undecided about the statements than university students, who were more confident in their

Table 2. Frequency distributions (%) and inference statistics of answers on knowledge statements about snakes

N	Item	Primary school			Faculty			Sig.		
		T	F	U	T	F	U	χ^2	*df*	*p*
1	There are 3 species of poisonous snakes living in Slovenia.	**24**	17	57	**45**	38	18	20.60	2	<0.001
2	Our poisonous snakes grow bigger than non-poisonous snakes.	37	**24**	39	8	**57**	34	19.41	2	<0.001
3	Snakes are endangered because of human actions on their habitats.	**87**	4	9	**96**	1	3	3.20	2	0.202*
4	All snake species are dangerous to humans.	7	**93**	0	0	**100**	0	5.88	1	0.015*
5	All snakes of Slovenia lay eggs.	35	**9**	57	47	**20**	32	7.40	2	0.025*
6	There are 6 species of snakes living in Slovenia.	17	**9**	74	7	**22**	72	6.00	2	0.050*
7	Viper has a round pupil.	13	**11**	74	18	**32**	50	8.60	2	0.014
8	All vipers living in Slovenia have a horned nose.	2	**54**	43	5	**70**	23	5.66	2	0.059*
9	Some species of snakes in Slovenia can be found in rivers and streams.	**65**	7	26	**76**	4	19	1.43	2	0.489*
10	All Slovenian snakes eat only rodents.	17	**28**	54	14	**54**	32	7.89	2	0.019
11	Non-poisonous snakes suffocate their prey and eat it whole.	**59**	9	30	**80**	5	15	5.42	2	0.067*
12	All snakes of Slovenia are protected by law.	**28**	33	39	**8**	53	38	9.80	2	0.007
13	Snakes are able to discriminate between the preys' temperature and colder environment.	**61**	7	33	**86**	0	12	13.97	2	0.001*
14	Snakes smell with their tongues.	57	**9**	33	65	**16**	19	3.73	2	0.155
15	Snakes cannot hear.	20	**26**	54	39	**34**	27	9.64	2	0.008
16	Poisonous snakes have 2 teeth and non-poisonous snakes have none.	22	**43**	35	14	**62**	24	4.05	2	0.132
17	Snakes can hypnotise their prey.	9	**33**	59	16	**45**	39	4.54	2	0.104
18	Poisonous snakes have triangular heads.	13	**33**	54	24	**39**	36	4.23	2	0.121
19	All snakes are more or less poisonous.	17	**57**	24	9	**84**	7	10.61	2	0.005
20	Injured snakes die only after sunset.	4	**39**	57	1	**74**	24	14.86	2	0.001*
21	Snake skin is moist.	52	**20**	26	11	**88**	1	60.01	2	<0.001*
22	Snakes are cold.	72	**11**	13	78	**22**	0	13.62	2	0.001*
23	A snake's tail is poisonous.	7	**70**	24	3	**84**	14	3.40	2	0.183
24	Snakes bite (sting) with their tongue.	35	**46**	20	12	**85**	3	22.19	2	<0.001*
25	Some snakes suck milk from livestock and sheep.	11	**30**	59	4	**72**	24	19.92	2	<0.001
26	Snakes travel in pairs.	0	**48**	48	0	**88**	12	20.40	1	<0.001
27	If threatened, a snake coils into a circle and rolls toward the attacker.	30	**30**	39	5	**78**	16	28.67	2	<0.001
28	Snakes collect (pick) poison from forest plants.	11	**35**	54	0	**82**	18	32.24	2	<0.001*

*Note: T-true, F-false, U-undecided; Correct responses are printed in bold type; Sig.-Chi-square test; *-Likelihood ratio*

knowledge. There were no statistically significant differences in knowledge scores between second and third year university students (Mann-Whitney U: Z=-1.05; p=0.097) and between seventh and eighth grade primary school pupils (Mann-Whitney U: Z=-1.66; p=0.293). The average knowledge score was 60.7% (SD=12.84) for university students and 38.6% (SD=14.97) for primary school pupils. Statistically significant differences were found between these two groups of students (Mann-Whitney U: Z= 6.75; p<0.001).

Knowledge, attitude and behavioural intent according to education level

Results show that pre-service teachers are more knowledgeable about snakes than primary school pupils. They were also prepared to learn more about snakes than primary school pupils and were more sensitive about the right or wrong treatment of animals (Fig. 1). In order to eliminate gender effect, only the scores and ratings of females from both groups were compared, although there were no statistically significant differences between ratings of primary school boys and girls on any of the measured components (all $p > 0.05$). This analysis gave the same results as are shown in Fig. 1 for primary school boys and girls pooled. The only difference was the significance level on the *scientistic* attitude dimension, which was 0.01 and not 0.001 as Fig. 1 indicates (Mann-Whitney U test).

The differences on attitude dimensions and knowledge scores according to reported fear were similar for both primary school pupils and pre-service teachers (Fig. 2). Differences were found for both groups on the *scientistic* and *negativistic* attitude ratings, while for the *moralistic* attitude dimension, differences were found only for pre-service teachers. There were no statistically significant differences found in knowledge scores of both groups of students.

In contrast to reported fear, according to direct experience of snakes, statistically significant differences were found only within the pre-service teachers group (Fig. 3). Differences were again found for the *scientistic*, *negativistic* and *moralistic* attitude dimensions. To eliminate gender effect, only the responses of girls with and without direct experience of snakes across different education levels were analysed. Only four primary school girls and six female pre-service teachers did not have any direct experience of snakes. Statistics produced almost the same results as are presented in Fig. 3. The only difference compared to Fig. 3, chart A, was in ratings for the negativistic attitudinal dimension, where primary school girls with direct experience of snakes reported less fear than girls with no direct experience (Mann-Whitney U: Z=-2.06; $p = 0.037$). Results of the pre-service teachers group differed only slightly when male respondents were ignored, but the difference was not statistically significant (Fig. 3, chart B).

No statistically significant differences within any independent variables (direct experience, education level and the level of fear) were found for *willingness* (behavioural intent category), (cf. Fig. 1, Fig. 2 and Fig. 3).

Multivariate analysis of independent variables effect on attitude and knowledge

Results of multivariate analysis show that among all three independent variables, the strongest effect can be contributed to student education level (Tab. 3). Fear of snakes also significantly contributed to the model, while direct experience of snakes did not significantly influence this model. In this model, the author was not able to use gender as an independent variable because there was only one male student in the pre-service teachers group. For that reason the pooled sample of primary school boys and girls was used, because according to inference statistics, their ratings and scores did not produce any statistically significant differences.

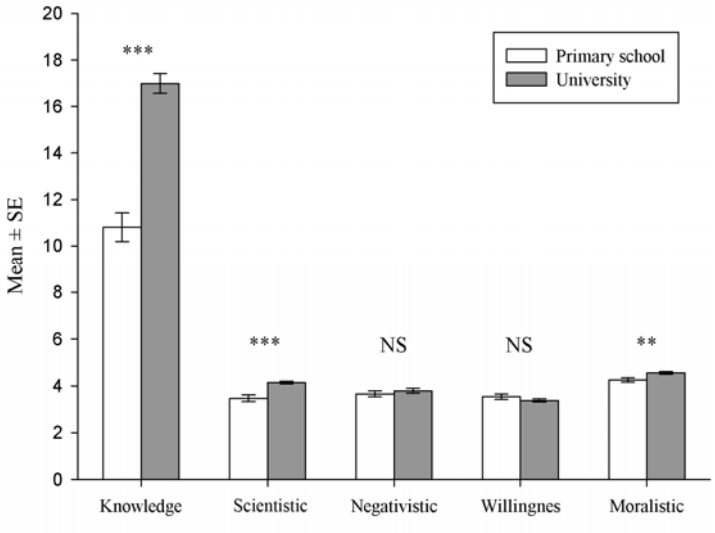
Table 3. GLM analysis of the effect of independent variables on attitude

Effect	Wilks' Λ	*F*	Hypothesis df	Error df	*p*	Partial η^2
Education level	**0.681**	**9.909**	**5**	**106**	**0.000**	**0.319**
Expressed fear	0.855	3.610	5	106	**0.005**	0.145
Direct experience	0.913	2.015	5	106	0.082	0.087

Table 4. Relationships between questionnaire dimensions (partial correlation coefficients)

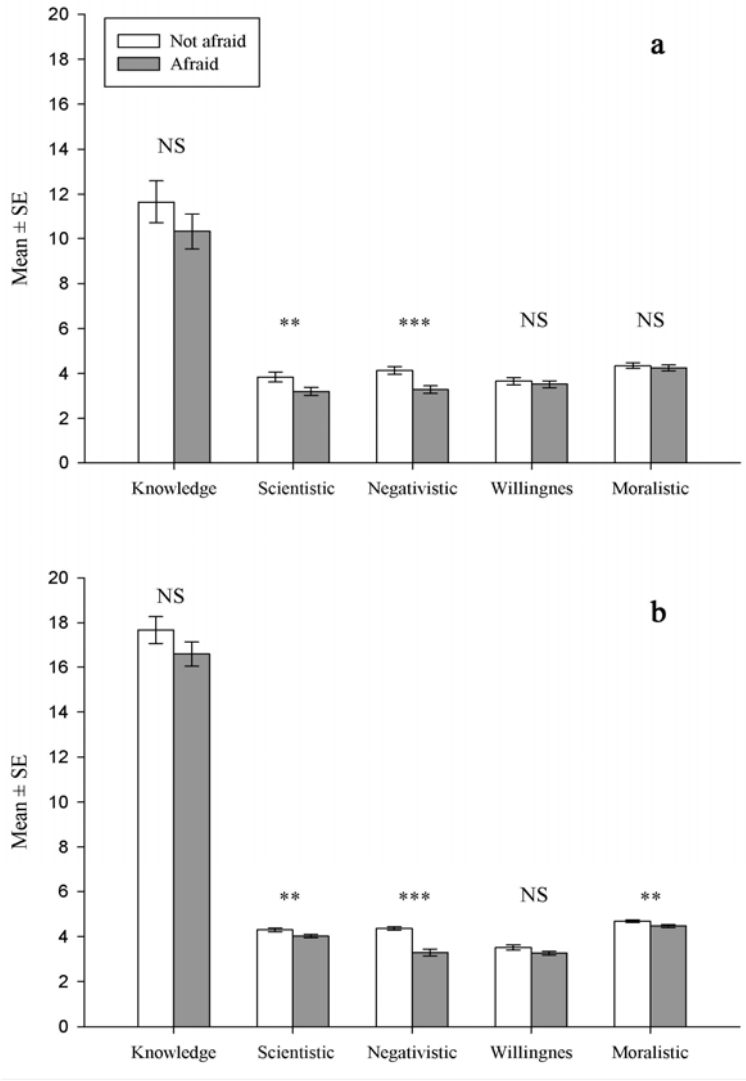
	Scientistic	Negativistic	Willingness	Moralistic
Knowledge	0.277**	0.251**	0.149^{NS}	0.113^{NS}
Scientistic	-	0.334***	0.341***	0.250**
Negativistic	-	-	0.343***	0.387***
Willingness	-	-	-	0.371***

**** p < 0.001; ** p < 0.01; NS = not significant*



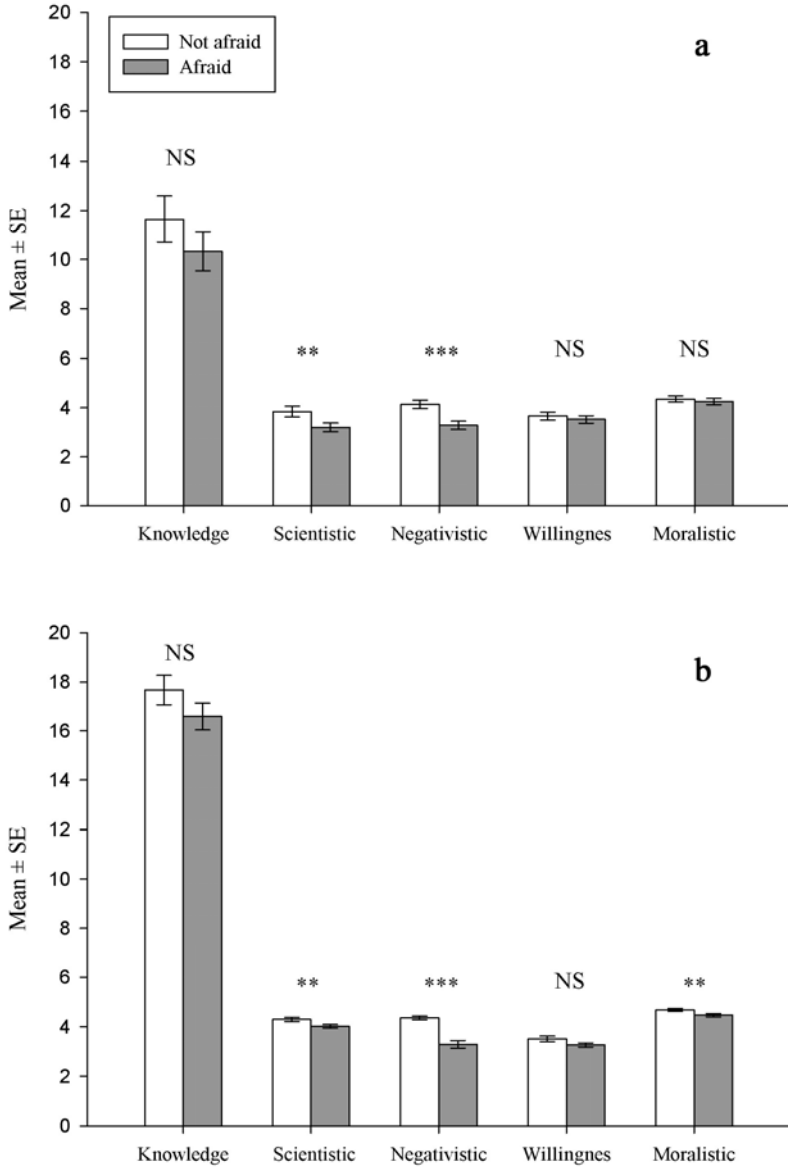
**** $p < 0.001$; ** $p < 0.01$; NS = not significant.*

Figure 1. Differences in attitudes toward and knowledge about snakes between primary school pupils and pre-service teachers. Lower score on the negativistic scale means greater fear of snakes.



**** $p < 0.01$; ** $p < 0.05$; NS = not significant.*

Figure 2. Differences in attitudes toward and knowledge about snakes between (a) - primary school pupils and (b) - pre-service teachers according to reported fear of snakes. Lower score on the negativistic scale means greater fear of snakes.



**** $p < 0.001$; ** $p < 0.05$; NS = not significant.*

Figure 3. Differences in attitudes toward and knowledge about snakes between (a) - primary school pupils and (b) - pre-service teachers according to reported direct experience with snakes. Lower score on the negativistic scale means greater fear of snakes.

Relationships between attitudes and knowledge

The highest relationships were found between the moralistic–negativistic and moralistic–willingness dimensions. Correlations of the knowledge dimension with other dimensions were generally lower than correlations between other attitudinal dimensions (Table 4).

DISCUSSION AND CONCLUSIONS

The present study found that (1), according to factor analysis, the questionnaire is suitable for use on larger sample of Slovenian general public. (2) While pre-service biology teachers' knowledge about snakes is better than the knowledge of primary school pupils, it could be improved further. (3) Although pre-service teachers were more knowledgeable about snakes, their willingness to act pro-environmentally and the negativistic attitudinal dimension did not significantly differ from the ratings of primary school pupils, which implies that factual knowledge *per se* does not improve attitudes toward animals that pose a risk to humans (Prokop et al., 2009a,b). (4) The ratings of both groups, when controlled for the fear variable, produced statistically significant differences on two attitudinal dimensions, but not on the knowledge dimension and on the dimension of willingness to act pro-environmentally. (5) When controlled for direct experience, primary school pupils did not rate any dimension significantly differently, while pre-service

teachers rated the three dimensions, *scientistic*, *negativistic* and *moralistic* significantly differently. (6) The highest influence of the observed independent variables can be contributed to the education level of respondents. (7) The moral (utilitarian) dimension showed the strongest link with negative attitude and the willingness to act pro-environmentally.

The effects of education level, fear and direct experience

Students who are studying to become primary school biology teachers encountered or worked with live snakes at least three times during their studies, and had opportunities to come in direct contact with the animals. These students were not yet learning about different species of snakes. The main purpose was to learn about one species of non-poisonous snakes and their body structure, and observe feeding behaviour. The amount of time spent with the snakes accounted for the difference between students, who, according to their direct experience, rated several dimensions differently than their counterparts who only had brief exposure to snakes in the course of their instruction. It would also be of interest to see how students of similar academic courses (future life science teachers), but without an opportunity to experience live animals, would rate such the statements of this questionnaire (e.g. students from other teacher training institutions).

Interestingly, as some studies also suggest, females generally report greater fear of animals than males (Arrindell et al., 2003; Roskaft et al., 2003, Prokop et al., 2009a,b). Primary school girls and boys did not rate any dimension significantly different from each other. Although the reasons for these patterns are not clear, the author speculates that less fear of animals in males would be expressed later in life, when males become sexually active, because males risk more than females (Byrnes et al., 1999) and these risks in adult males would be interpreted as costly signals by which males advertise their physical abilities to females (see e.g. Hawkes, 1991 for discussion about costly signals in humans). Additional research involving males and females of various age groups is necessary to test this idea.

Another positive conclusion is that future teachers show greater concern for snake wellbeing, but on the other hand are not willing to engage in conservation activities any more than primary school pupils. These activities are of greatest interest to conservation biology (Martin-Lopez et al., 2007). Higher *scientistic* and *moral* attitudes and grater *knowledge* are simply not enough to protect animals in the wild. Life science teachers have an important role in educating environmentally responsible citizens, who would be prepared to take action when the environment is threatened.

Since pre-service teachers who took part in our study had up to that point not attended any vertebrate zoology or ecology classes, they would hopefully improve other attitudinal dimensions later, as they progress with their studies and their exposure to wildlife increases.

Knowing students' (and later, the general public's) attitudes toward and familiarity with different animals (in this case snakes) is necessary in order to improve or maintain educational activities that include working with live animals in schools and/or in life science teacher education. In the light of increasing environment destruction the development of strategies that help conserve organisms and nature are crucial.

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Appendix: Factor analysis of attitude and behavioural intent items

	Factor			
Item	**Scientistic**	**Negativistic**	**Willingness**	**Moralistic**
I would like to learn about snake habitats.	*0.901*			
I would like to know how snakes eat, smell and hear.	*0.841*			
I would like to learn about different snake species.	*0.823*			
I would like to study snakes in nature.	*0.687*			
I like to read about snakes.	*0.659*			
I am bored when biologists talk about snakes. (R)	*0.466*			
I am afraid of snakes. (R)		*0.786*		
Snakes are disgusting. (R)		*0.773*		
Snakes are ugly. (R)		*0.720*		
I would rather watch a movie about snakes than observe them in nature. (R)		*0.694*		
When I walk through the woods, I do not particularly wish to stumble upon a snake. (R)		*0.669*		
I would like to hold a snake in my hands.		*0.629*		
I would report it to the authorities if I was aware that someone was destroying snake habitats.			*0.806*	
I would be willing to inform the public about people destroying snake habitats.			*0.719*	
I would notify the authorities if I saw someone killing snakes.			*0.618*	
Keeping snakes in captivity is cruel.			*0.484*	
I would be willing to donate some money to protect certain snake species.			*0.466*	
I would be willing to inform the public about the wrong treatment of snakes.			*0.448*	
I would not buy snake products, because I would like to protect snakes.				*0.627*
Snakes are of value as they kill mice and other rodents.				*0.583*
Snakes should have rights too.				*0.491*
It would be for the best if all snakes were killed. (R)				*0.486*
Killing snakes for fun is cruel.				*0.473*
We should not legally protect snakes because there are a lot of snakes elsewhere. (R)	-	-	-	-
Crombach α	0.86	0.83	0.71	0.58