International Journal of Science Education
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tsed20

Factors Influencing Schoolchildren's Responses to a Questionnaire in Wildlife Conservation Education

Jean-Marie Ballouard[ab], Stephen J. Mullin[c], Rastko Ajtic[d], José Carlos Brito[e], El Hassan ElMouden[f], Mehmet Erdogan[g], Monica Feriche[h], Juan M. Pleguezuelos[h], Pavol Prokop[ij], Aida Sánchez[k], Xavier Santos[e], Tahar Slimani[f], Bogoljub Sterijovski[l], Ljiljana Tomovic[mn], Muhammet Uşak[o], Marco Zuffi[p] & Xavier Bonnet[a]

[a] Centre d'Etude Biologique de Chizé, UMR-7372, CNRS ULR, Villiers en Bois, France

[b] SOPTOM-Centre de Recherche et de Conservation des Chéloniens, Gonfaron, France

[c] Department of Biological Sciences, Eastern Illinois University, Charleston, IL, USA

[d] Institute for Nature Conservation of Serbia, Belgrade, Serbia

[e] CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos da Universidade do Porto, Instituto de Ciências Agrárias de Vairão, Vairão, Portugal

[f] Département de Biologie, Faculté des Sciences Semlalia, Marrakech, Morocco

[g] Faculty of Education, Akdeniz University, Antalya, Turkey

[h] Departamento de Biología Animal, Facultad de Ciencias, Universidad de Granada, Granada, Spain

[i] Department of Biology, Faculty of Education, University of Trnava, Trnava, Slovakia

[j] Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia

[k] Departament de Biologia Animal, Universitat de Barcelona, Barcelona, Spain

[l] Macedonian Ecological Society, Faculty of Natural Sciences, Skopje, Macedonia

[m] Faculty of Biology, University of Belgrade, Belgrade, Serbia

[n] Institute for Biological Research, "Sinisa Stankovic", University of Belgrade, Belgrade, Serbia

[o] Department of Elementary Education, Zirve University, Gaziantep, Turkey
[p] Museum Natural History and Territory, University of Pisa, Calci, Italy
Published online: 27 Jan 2015.

International Journal of Science Education, 2015
Vol. 37, No. 3, 469–483, http://dx.doi.org/10.1080/09500693.2014.993000

Factors Influencing Schoolchildren's Responses to a Questionnaire in Wildlife Conservation Education

Jean-Marie Ballouard[a,b*], Stephen J. Mullin[c], Rastko Ajtic[d], José Carlos Brito[e], El Hassan ElMouden[f], Mehmet Erdogan[g], Monica Feriche[h], Juan M. Pleguezuelos[h], Pavol Prokop[i,j], Aida Sánchez[k], Xavier Santos[e], Tahar Slimani[f], Bogoljub Sterijovski[l], Ljiljana Tomovic[m,n], Muhammet Uşak[o], Marco Zuffi[p] and Xavier Bonnet[a]

[a]*Centre d'Etude Biologique de Chizé, UMR-7372, CNRS ULR, Villiers en Bois, France;* [b]*SOPTOM-Centre de Recherche et de Conservation des Chéloniens, Gonfaron, France;* [c]*Department of Biological Sciences, Eastern Illinois University, Charleston, IL, USA;* [d]*Institute for Nature Conservation of Serbia, Belgrade, Serbia;* [e]*CIBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos da Universidade do Porto, Instituto de Ciências Agrárias de Vairão, Vairão, Portugal;* [f]*Département de Biologie, Faculté des Sciences Semlalia, Marrakech, Morocco;* [g]*Faculty of Education, Akdeniz University, Antalya, Turkey;* [h]*Departamento de Biología Animal, Facultad de Ciencias, Universidad de Granada, Granada, Spain;* [i]*Department of Biology, Faculty of Education, University of Trnava, Trnava, Slovakia;* [j]*Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia;* [k]*Departament de Biologia Animal, Universitat de Barcelona, Barcelona, Spain;* [l]*Macedonian Ecological Society, Faculty of Natural Sciences, Skopje, Macedonia;* [m]*Faculty of Biology, University of Belgrade, Belgrade, Serbia;* [n]*Institute for Biological Research,* "Sinisa Stankovic", University of Belgrade, Belgrade, Serbia; [o]*Department of Elementary Education, Zirve University, Gaziantep, Turkey;* [p]*Museum Natural History and Territory, University of Pisa, Calci, Italy*

Questionnaires are important tools for assessing attitudes regarding conservation issues. However, they are not easily comparable and their reliability has been insufficiently assessed. We examined factors influencing responses to open- and closed-ended questions about animal conservation to more than 600 schoolchildren (9 years old on average). We analysed the level of understanding,

*Corresponding author. SOPTOM-Centre de Recherche et de Conservation des Chéloniens, 83590 Gonfaron, France. Email: jmarie.ballouard@gmail.com

controllable (e.g. sample size) and less controllable factors (e.g. affectivity). Most children responded appropriately to the questions, but subtle changes in the phrasing influenced the answers. Affectivity towards endearing species and spontaneity also influenced the responses whereas small sample sizes (~50 children) provided relatively stable patterns. Overall, we suggest that standardization of questionnaires administered over large spatial and time scales is needed to accurately assess children's attitudes towards conservation issues.

Keywords: *Affectivity; Environmental education; Iconic species; Sample size; Survey methodology*

Introduction

Environmental education is essential to improve the attitude of citizens towards conservation issues (Caro, Pelkey, & Grigrione, 1994; Van Weelie & Walls, 2002). However, despite abundant media campaigns, public concerns about the biodiversity crisis tend to lose momentum (Novacek, 2008). Furthermore, public knowledge concerning biodiversity questions, or even about the term 'biodiversity' itself, is particularly low (Pilgrim, Cullen, Smith, & Pretty, 2008; Robelia & Murphy, 2012). Thus, specific education effort about biodiversity is needed to promote positive attitudes and practical conservation efforts (Lindemann-Matthies, 2006).

The efficiency of educational programmes must be evaluated to select the most appropriate approaches. Zoological exhibitions, media campaigns or animated films with strong conservationist content are assumed to stimulate positive attitudes and increase public's commitment to conservation efforts. Yet, different studies revealed that counter intuitively, portraying threatened species in popular media, animated films or zoos can negatively affect public's perception and attitude regarding biodiversity (Schroepfer, Rosati, Chartrand, & Hare, 2011; Yong, Fam, & Lum, 2011).

Most assessments in environmental education are conducted using questionnaire surveys. There is a wide range of possibilities to perform and to analyse questionnaires and many factors (e.g. cultural and socio-economic) can influence the outcomes (Fowler, 1995; Groves et al., 2009; White, Jennings, Renwick, & Barker, 2005). Various types of questionnaires have been used: postal surveys, in person interviews, telephone surveys and, to a lesser extent, individual questionnaires administered during school time (Lindemann-Matthies, Junge, & Matthies, 2010), and there is a proliferation of polls on the Internet (e.g. using searching keywords such as 'opinion', 'poll' and 'biodiversity'). Thus, a plethora of surveys based on a wide variety of methods is available.

This lack of standardization precludes comparative analyses; especially across countries, socio-economic levels, age classes and over time (Groves et al., 2009; Walsh-Daneshmandi & MacLachlan, 2006). Therefore, standard evaluations are required (Robelia & Murphy, 2012). In this context, written questionnaires offer several advantages. They provide rigorous qualitative and quantitative information by employing standardized sets of questions whereas possible impact of the observer on the respondents is minimized (Newing, Eagle, Puri, & Watson, 2011).

Furthermore, written questionnaires are well adapted to survey schoolchildren; indeed, a teacher can manage tens of paper-questionnaires simultaneously, but cannot interview more than one child at a time.

Nonetheless, the use of written questionnaires is subjected to methodological complications (Groves et al., 2009; Tourangeau, Rips, & Rasinski, 2000). We examined 50 environmental education studies based on questionnaires (Table 1). In most cases, assessment was fragmentary. For example, the influence of the sample size was not taken into account (Table 1). However, this parameter is important regarding the robustness of conclusions and to analyse the contribution of different variables. Most studies were performed in a single country, rarely two, impeding cultural comparisons. Furthermore, a major source of variation – wording and selection of words employed in the questionnaire – has not been examined (Groves et al., 2009). Thus, a key assumption associated with the use of written questionnaires remains unverified: do respondents understand the questions correctly and does their understanding correspond to the intention of the person posing the questions (Fowler, 1995). Other factors likely influence responses, such as social desirability (Richman, Kiesler, Waistband, & Drasgow, 1999), affectivity or spontaneity (Randler, Ilg, & Kern, 2005). The influence of these factors is usually detected through qualitative interviews, but most written questionnaires are not designed with that purpose in mind, limiting the possibility to perform appropriate analyses. Overall, both controllable (formulation of the questions and sample size) and other factors (impact of the media, cultural factors and

Table 1. Survey parameters in 50 studies based on survey questionnaires (1991–2009, annexe-1)

Parameters	STO	BES	EPA
Number of studies	15	13	22
Mean number of countries surveyed	1.1	1.1	1.0
Mean sample size (range)	236 (72–1,933)	430 (40–2,000)	459 (10–4,000)
Expert reviews	6	6	8
Quality interviews	1	0	1
A posteriori analyses	1	2	1
Reliability test	1	4	6
Other effects (see text)	1	1	7
Test on sample size effect	0	0	0

Notes: The studies were classified into three main types: (1) STO: Single Taxon Oriented (i.e. focusing on one species), (2) BES: Broad Environmental Survey and (3) EPA: Education Programme Assessment. Mean sample size (range) corresponds to the number of people questioned. Expert review: type and order of questions, alternative responses and instruction to interviewers were examined by a committee; Quality interviews: comparative qualitative questionnaire and cognitive interviewing were performed; A posteriori analyses: split ballot and introspective tests used, consistency of the answers examined; Reliability tests: Cronbach coefficient alpha and principal component analyses were used to assess the congruence of the answers; Other effects: for example, impact of interviewer's appearance, presence of other people, influence of a particular event have been assessed; Test on the sample size effect were not assessed.

field experiences) were not included in the survey design (Ballantyne, Packer, & Everett, 2005; Fowler, 1995).

Our study reports on a written questionnaire about conservation education administered to French primary schoolchildren (9 years old on average). Targeting children is important for conservation programmes (Rivas & Owens, 1999). Indeed, children are more receptive than adults to educational actions. Our study is oriented towards methodological issues rather than on the attitudes of the schoolchildren towards biodiversity per se; however, these two components cannot be totally separated. We focused on one conservation issue of major importance for children: Which animal species should be protected? Most analyses were based on open-ended items that all revolve around variations of a central question: 'List five animals that must be protected in priority'. We assessed the following methodological questions:

(1) Did primary schoolchildren (9 years old on average) understand the questions?
(2) If yes, did minimal modification in the wording influence the response?
(3) Do analyses reveal the influence of spontaneity and/or affectivity factors?
(4) What sample strategy (sample size, number of classes or schools surveyed) was appropriate?

Methods

Participants

The survey was conducted in France in 2007–2008, with 626 respondents completing different versions of a printed questionnaire. The mean age of the children was 9 (9.1 ± 1.3 years [SD]). The schoolchildren were drawn from 15 schools situated in the Central-West of France in rural ($N = 10$ schools, $N = 477$ schoolchildren) and urban areas ($N = 5$ schools, $N = 149$ schoolchildren). The sex ratio was equilibrated (girls 49% and boys 51%). All schools possess internet access, and probably all children had also access to various media at home and/or through friend relationships.

Questionnaire

The questionnaire is consisting of open- and closed-ended items. From a total of 28 different questions, several items (i.e. a central question Q1 +Q 5 derived questions Q2–Q6, details in the later text) were investigated in this study. The other items were used for different purposes that are not presented here (cf. Ballouard, Brischoux, & Bonnet, 2011, for example).

This study focuses on the answers to the central question 'List five animals that must be protected in priority' (Q1). We assumed that the responses reflect those species that children considered to be important. However, the question or at least the intention of the observer might not have been clearly understood. For example, the children may list the species only because they love them. Therefore, we assessed the level of understanding to a subset of 188 children (among the 626 tested). We posed the three

additional questions in a random order to limit possible influence of questions order in the answers.

- 'Why should the five animals listed be protected?' (Q2)
- 'What are the causes of the disappearance of the five animals listed?' (Q3)
- 'How can we protect the five animals listed?' (Q4)

Although superficially similar, the questions were partly divergent. In Q2, for example, the children might have included an affective factor by answering 'because I love them', something illogical to do in the response for Q3 because loving animals is not supposed to cause their disappearance. We expected that the answers to Q3 would contain more functional reasoning such as 'poaching' and that the answers to Q4 would propose practical actions such as 'building nests'. The appropriateness of the answers provided an index of understanding.

We further explored the level of understanding with the whole sample of children ($N = 626$) by including subtle changes in the formulation of the central question (Q1) in two additional ways:

- 'List five animals that you want to protect in priority' (Q5; $N = 189$).
- 'List five animals that should be saved in priority' (Q6; $N = 123$).

Overall, the central question Q1 was posed to 314 children and the slightly modified versions Q5 and Q6 (derived from Q1) to 312 children. We expected the responses associated with each variation of the main question to be different. Question 5 contains more affective element (i.e. the verb 'want' refers to personal wishes compared to the terms 'must be'), and consequently endearing species such as pets should be more represented. Question 6 is quite similar to Q1, although the terms 'should be saved' contain more affective factor compared to the very formal 'must be protected'. Q1 corresponded to the formulation where duty factor is the most prevalent.

Because we asked children to list five animals, it was possible to examine if the responses were influenced by their position in the list. The first animal listed would be more influenced by spontaneity than the next one, and more reflection by the child would have been required to add animals to the list.

Sample Size

We evaluated the importance of sample size through a random sub-sampling on the whole data set. We used a step-wise approach, starting with 100% of the data, and removed randomly an increasing proportion of the sample each time before re-running the analyses. This procedure was performed three times. For this analysis, we used the most cited animals: mammals. To visualize the influence of various sample sizes on the results, we plotted relevant practical subsamples represented by different classes ($N < 30$ children) or schools ($30 < N < 150$); thereby providing elements reflecting the level of investigations performed under a practical context.

Administration Procedures

All surveys were performed during class time by one evaluator (first author, briefly presented by the teachers to the schoolchildren) in 2008 and 2009. The questionnaire was introduced as a survey and not an exam to limit the anxiety on the schoolchildren. The evaluator explained to the schoolchildren that the main goal was to assess their perception and knowledge about biodiversity. Before giving the questionnaire individually to the schoolchildren, the observer provided preliminary explanations about global problems regarding biodiversity but carefully avoided citing any precise example of threatened group of animals, and did not cite particular species (e.g. the term 'animal' was used, not 'bear'). In other words, the observer restricted introductory explanations to the notion that animals in general are threatened. The observer also reminded the children that the term 'animal' includes organisms such as insects and worms – otherwise, many children would have overlooked invertebrates (cf. Bell, 2010).

The children required 30 minutes on average to complete the questionnaire. Children were allowed to require clarification. In most cases, individual response was provided (e.g. spelling a name), albeit frequent or general questions were explained to the class.

Data Analysis

Open-ended questions generated open and diverse answers. Consequently, we selected a limited number of categories to perform analyses. To classify the animal species listed, we referred to popular taxonomy, irrespective to phylogeny (e.g. giant panda, bear, or fish, where all considered at the same taxonomic level). For several analyses, we allocated the animals listed into six broad categories: mammals, birds, reptiles, amphibians, fishes and invertebrates. This popular classification, although scientifically inaccurate, reflects the perception of biodiversity by most people. We also distinguished pets (e.g. guinea pigs) from non-domestic animals (livestock were not considered as pets; Serpell, 1989) and from exotic animals (Ballouard et al., 2011).

To analyse the level of understanding, and affectivity factor, we classified the responses to the other open questions (Q2, Q3 and Q4) into six categories:

(1) Null or out of focus answers: not related to animal conservation.
(2) Affectivity factor predominant: children clearly introduced an affective factor. For instance using the phrase 'because they are cute'.
(3) Patrimonial factor predominant: general interest for animal conservation was revealed through sentences referring to broad patrimonial values, as in answers containing a phrase such as 'because animals are vanishing'.
(4) Direct threat: for instance, animals should be protected from hunting or poaching, or phrases such as 'people kill animals for their fur'.
(5) Indirect threat: for instance, climate change or habitat loss that can threaten species.
(6) Other: some answers were not easily classified – for instance, 'to help them'.

For the spontaneity factor assessment, we retained the most relevant (i.e. most cited) type of animals: the pets. Indeed, children were likely more prone to love and protect, and thus spontaneously select in the list, their pet compared to other animals. In practice, the pets were essentially mammals (e.g. cats). We expected a decrease in the mean frequency of pets in the five consecutive responses of the list. Consequently, we performed repeated measures ANOVA with the five consecutive responses as the repeated variable and the type of question [Q1, Q5 and Q6] as the factor.

Many statistical tests were based on proportions (e.g. exotic versus local species) using contingency table analysis. Pearson's chi-square was used to test different proportions in the type of answer to questions ($\alpha = 0.05$). We also used mean individual children score (e.g. mean value of mammal species cited in the five animals listed by each child) to perform analyses of variance. Statistics were performed with Statistica 7.1 software (®StatSoft Inc. 1984–2005). Some children did not complete the questionnaire question, thereby generating fluctuations in the sample sizes.

Results

Did Primary Schoolchildren Clearly Understand the Questions Proposed?

The three questions (Q2, Q3 and Q4) that aimed to assess the level of understanding of the children generated different frequencies of the six categories of answers (Figure 1; $\chi^2 = 305.3$, df = 10, $p < .01$). Within each question, the frequency of the response categories also differed (Figure 1; Q2: $\chi^2 = 139.2$, df = 5, $p < .01$; Q3: $\chi^2 = 351.8$, df = 5, $p < .01$; and Q4: $\chi^2 = 138.9$, df = 5, $p < .01$). Despite these variations, the proportion of out-of-focus answers remained always low (Figure 1). The affective factor was well represented in the questions where it was expected (Q2); in contrast, that factor was almost totally absent when it would have been illogical to refer to it (Q3 and Q4; Figure 1). Many answers to Q2 contained a patrimonial value, and to a lesser extent an affectivity factor. In other words, the children logically considered that it is necessary to protect animals not only because they are threatened, but also because they love them. Almost no children, however, incorrectly proposed that the cause of their disappearance is because they love them. Similarly, almost all children correctly indicated a reduction in direct and indirect threats (e.g. poaching, pollution, etc.) to better protect animals.

Did Subtle Modifications in the Wording Influence the Response?

The children responded differently to the subtle changes in the formulation of the central question (Q1 versus Q5 or Q6) (Figure 2). For example, the proportion of pets ($\chi^2 = 4.847$, df = 2, $p < .01$) or of exotic animals (exotic animals are very often cited, Authors 2011; $\chi^2 = 34.1$, df = 2, $p < .01$) in the answers was influenced by the verb used. For instance, the use of verbs 'must' versus 'want' generated differences in the proportion of answers containing an affective factor (i.e. proportion of pets cited: $\chi^2 = 68.8$, df = 1, $p < .01$; Figure 2). The meaning of the phrase 'must

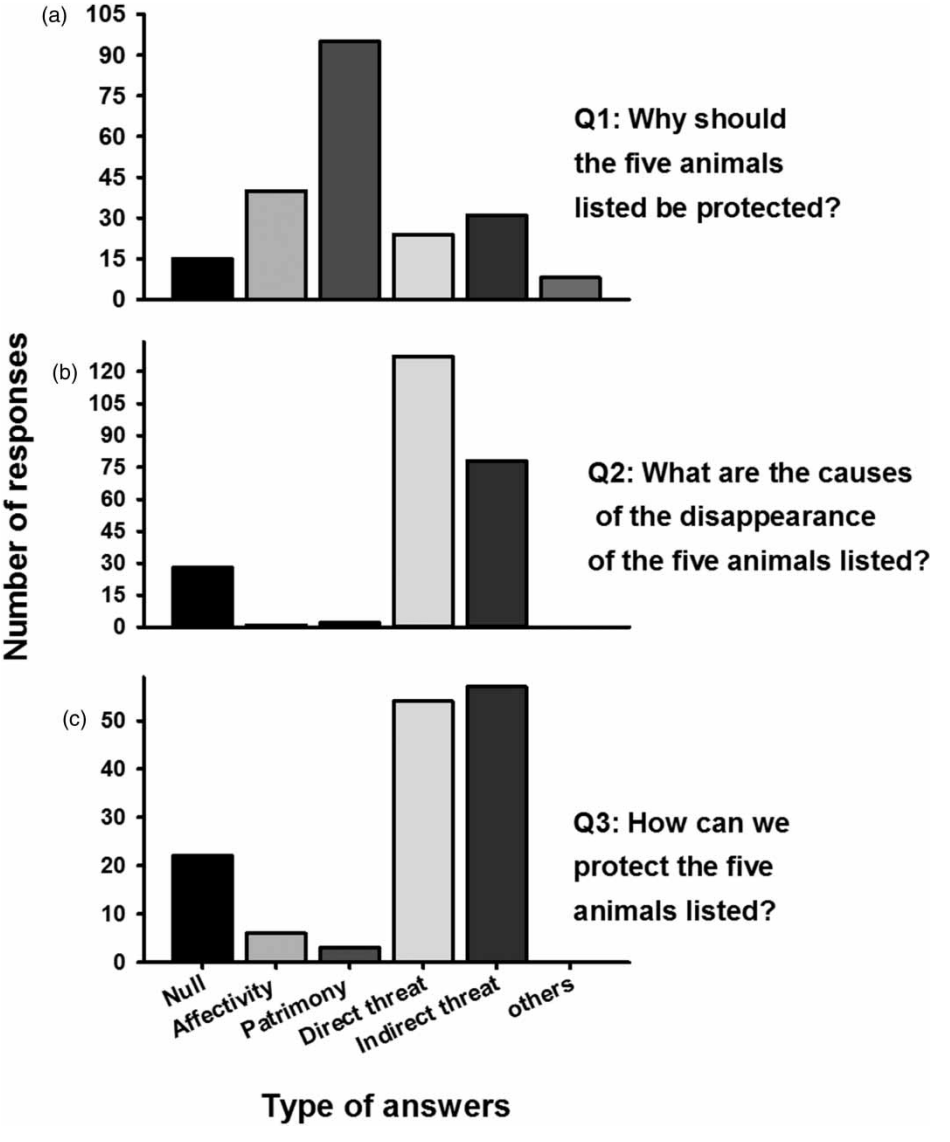

Figure 1. Numbers of responses (*Y*-axis) to three questions (Q1, Q2, Q3, respectively, panels a, b, c) posed to schoolchildren about animal conservation. The *X*-axis indicates the main types of answers: Null = out of focus; Affectivity = inclusion of affective factor; Patrimony = answer with broad patrimonial values; Direct threat = direct causes for animal disappearance; Indirect threat = indirect causes for animal disappearance; Others = unclear answers (see text for details)

be protected' was similar to 'should be saved', and the responses tended to converge. Examining the effect of proportion of exotic versus local animals generated similar trends: children proposed more exotic animal species when the question was formulated in a more formal way (Q1) and a general interest of the wildlife became more visible (Figure 2).

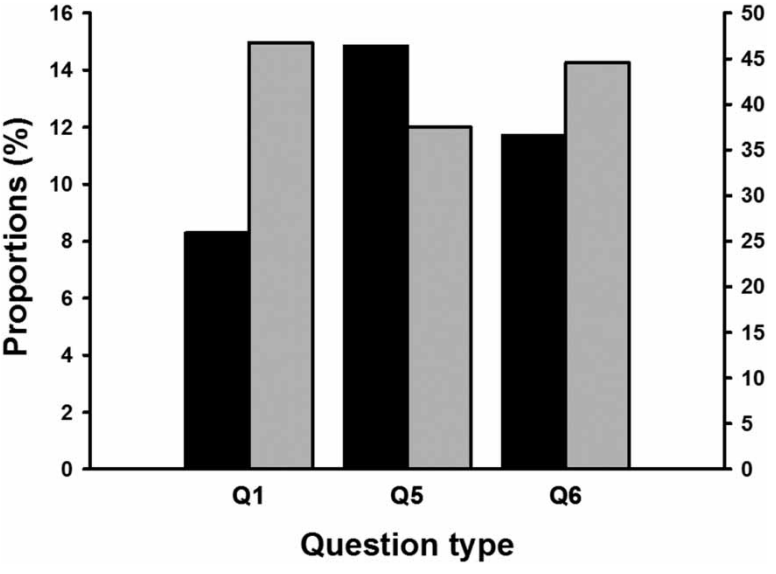

Figure 2. Proportions (*Y*-axis) of responses to three modifications (underlined below) of the formulation of the main question (*X*-axis), 'List five animals that must be protected in priority' (Q1), versus '. . . you want to protect . . . ' (Q5), or '. . . should be saved . . . ' (Q6). All the animals listed by the children tested were pooled (total number of animals cited >3,000). Black bars and left *Y*-axis correspond to the proportion of pets in the responses. Grey bars and right *Y*-axis correspond to the proportion of exotic animals in the responses

Did Spontaneity and Affectivity Factors Influence Primary Schoolchildren?

The frequency of pets in the responses decreased as the children added animals to the list (repeated measures ANOVA; specific effect of the position of the animal listed [i.e. time]: $F_{4,\ 21} = 6.7$, $p < .01$ and $F_{4,\ 21} = 5.2$, $p < .01$ for mammals and pets, respectively; Figure 3). Furthermore, an influence of the type of question (Q1, Q5 and Q6) on this trend was detected using pets in the analysis (Wilk's $\lambda = 0.94$, $F_{10,\ 10} = 3.21$, $p < .01$; interaction $F_{8,\ 212} = 1.92$, $p = .05$).

What Sample Strategy was Appropriate to Discern Differences in Survey Responses?

Mean values of most subsamples were similar to the average values obtained through the random sub-sampling procedure: the proportion of mammals did not deviate markedly from the mean value calculated on the whole sample size (Figure 4). The pattern of the average children's response was relatively stable, even with small sample sizes (i.e. $N < 50$). Focusing on classes or schools instead of using random sampling, a few outliers were apparent (Figure 4). Such a class and the related school benefited from environmental education programmes oriented towards local fauna (mostly birds) during the previous months, and were associated with a decrease in the prevalence of exotic fauna (exotic mammals mainly) and a concomitant increase in the citation rate of wild local fauna.

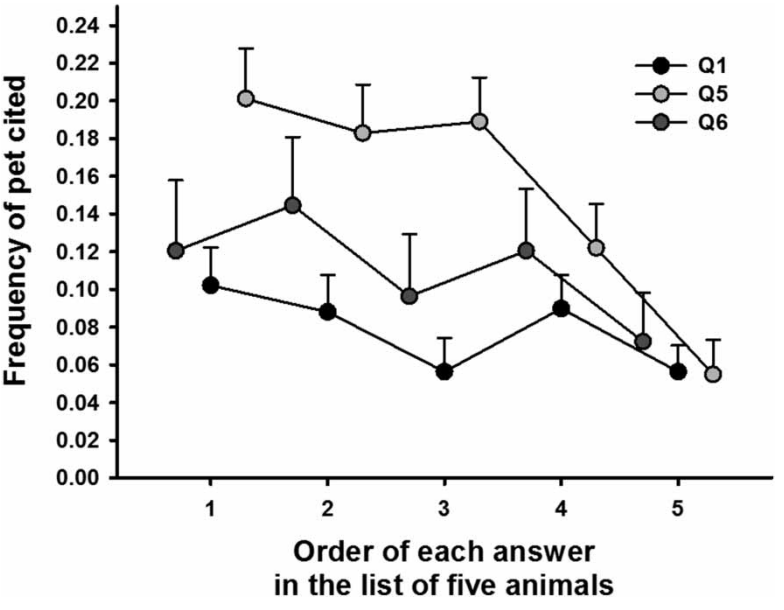

Figure 3. Effect of the questions (Q1, Q5, Q6) on the changes in the frequency of pets cited (mean proportion ± SE) in the list of five successive responses provided by French children ($N = 444$). The *X*-axis provides the order of each of the successive answers proposed by the children to elaborate a list of five animals

Discussion

Our results provide both encouraging and cautious messages for the use of written questionnaires in monitoring conservation education programmes as exposed in the later text.

Level of Understanding of the Primary Schoolchildren

The children provided accurate responses. They did not confuse the causes for animal rarefaction and the reasons why they deserve protection. For example, expressions of causality (e.g. poaching) dominated the responses when the questions were directed towards the reasons why animals disappear, showing that the schoolchildren responded in an appropriate manner. Other results indicate that the responses were reliable: (1) the detection of the influence of subtle changes in the formulation of the same question; (2) a low occurrence of out-of-focus answers and (3) the consistency of the prevalence of large animals (especially exotic mammals) in the responses. Thus, a major outcome is that using written questionnaires with schoolchildren is an accurate and simple technique for monitoring important issues in conservation education, at least in the tested age groups.

Influence of Subtle Wording Modifications in the Responses

We detected differences caused by subtle variations in the phrasing of an otherwise identical question: the verb 'want' was more often associated with affective elements

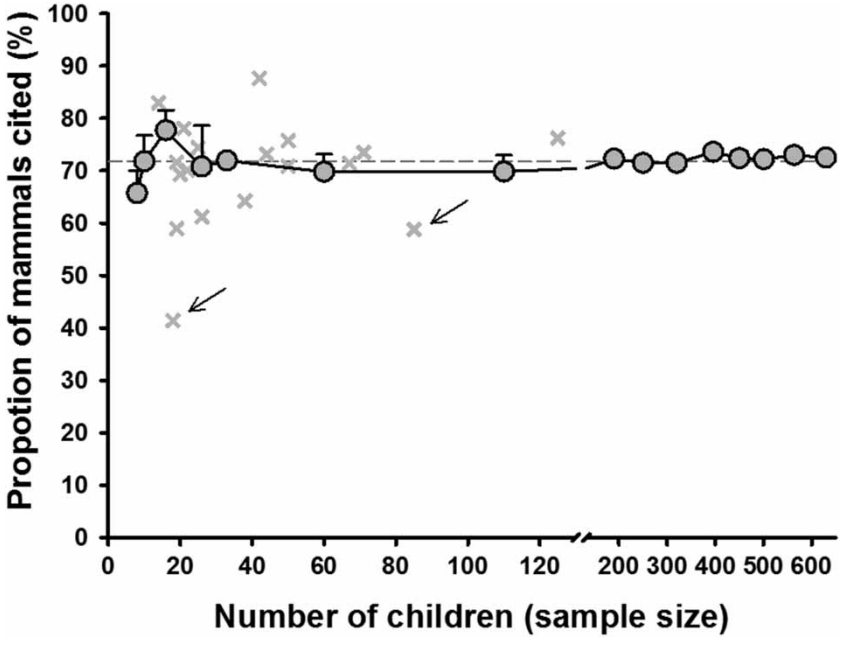

Figure 4. Influence of sample size on the mean (± SE) proportion of mammals cited. The dashed grey line indicates a mean value for comparisons. Crosses indicate values obtained for classes ($N < 30$) or schools ($N > 30$). Arrows show the class and the related school where field trips were performed two months before the survey

than the verb 'must' that involved more duty elements (Figure 2). The terms 'must be protected' involve a duty factor whilst 'you want to protect' refers more to a personal wish. Therefore, a larger proportion of familiar animals was expected, and actually observed, in the answers to the question Q5 compared to the responses to Q1. Affectivity was mostly apparent in the responses where it was logical to express, and otherwise almost absent (Figure 1). The children correctly differentiated words that might have otherwise been considered as secondary to the aim of the question. Thus, it is important to take into account these effects to use questionnaires.

Influence of Spontaneity and Affectivity Factors

The influence of spontaneity was clearly revealed, notably when considering interaction with spontaneity (Figure 3). When the order of the five animals listed was taken into account, the prevalence of pets was initially strong and decreased markedly if the question was formulated with the verb 'want', whilst the use of the verb 'must' prompted relatively stable responses with a lower initial prevalence of pets (Figure 3). Thus, the weight of the affective factor was better controlled when the question was phrased in a more neutral way (e.g. Q1 versus Q5). This result echoes psychological studies that demonstrate the importance of affective and emotional factors in children attitude and responses (D'Argembeau & Van der Linden, 2004; Iozzi, 1989; Littledyke, 2008).

The high ranks occupied by cats and dogs that are not endangered (ranking first and second among all cited animals) were somewhat inappropriate at first glance. Previous study showed that these often cited animals are also the most frequently observed in the environment by schoolchildren (Patrick & Tunnicliffe, 2011). Children exhibit clear preference for familiar species (Nates, Campos, & Lindemann-Matthies, 2010). This high frequency of not-endangered pets may reflect the fact that children wanted to protect the animals they love the most (D'Argembeau & Van der Linden, 2004; Prokop, Prokop, & Tunnicliffe, 2008; Schlegel & Rupf, 2010). Yet, perhaps young children actually considered pets to be threatened.

Influence of Sample Size

The stability of the outcome using a wide range of sample sizes suggested that large sample sizes might not be compulsory. The predominance of a limited number of iconic animals (i.e. exotic mammals) could explain such a result. Querying a large number of schoolchildren is unnecessary to ascertain whether or not tigers are often cited as animals that deserve priority protection. Considering more practical units (class and school) produced different results and the outliers were those classes that were involved in programmes oriented towards local fauna (Figure 4). Hence, basing studies on few classes or schools (the level at which most conservation education is conducted) remains tenuous.

Practical Consequences

One practical message is that the frequency of iconic animal species and pets in the responses could be used as indicators (cursors), at least with children. Using a simple cursor might be a useful monitoring and comparative tool (Schlegel & Rupf, 2010). The impact of programmes oriented to redress taxonomic bias, field trips or different methods (handling animals versus watching them) could be assessed using such a cursor. A possible increase in the rankings of local or non-popular organisms relative to the dominant exotic and iconic animals before and after the education action might reveal the effectiveness of the technique employed (Ballouard, Provost, Barré, & Bonnet, 2012; Ballouard et al., 2013).

Standardized written questionnaires represent an option to monitor the impact of environmental education over time, geographic areas and across studies. Neutral phrasing should be preferred to limit the impact of affective factor (Robelia & Murphy, 2012). Although questionnaires based on small sample sizes can provide useful patterns, they should be administered over large spatial and time scales rather than focusing on a single locality.

Limitations and Further Investigations

This study represents an early and limited examination of a rarely explored issue. However, it may prompt further tests. This investigation was not designed to

provide deep insights about how the students understood the questionnaire. Language was possibly a factor of bias, subtle changes in the wording might not easily transgress cultural and language boundaries. Furthermore, a child might cite an animal type because she/he is limited by her/his capacity to name animals (Patrick & Tunnicliffe, 2011). Nonetheless, this study can serve as a baseline for further research; improving the toolbox for conservation education is timely (Balmford, Clegg, Coulson, & Taylor, 2002). For routine surveys, simple school standard survey should be developed to better assess the efficiency of alternative methods (internet searching versus handling wildlife during field trip; Ballouard et al., 2012; Lindemann-Matthies, 2002; Zoldosova & Prokop, 2006).

Acknowledgements

We thank Dr M. Place for his help to set up the questionnaire, and the teachers and children who kindly participated in this study. R. Cambag, F. Groumpf, B. Clothaire and Wallaby Thaler were very helpful to photocopy questionnaires.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Ballantyne, R., Packer, J., & Everett. M. (2005). Measuring environmental education program impact and learning in the field/using and action research cycle to develop a tool for use with young students. *Australian Journal of Environmental Education*, *21*, 23–38.

Ballouard, J.-M., Ajtic, R., Balint, H., Brito, J. C., Crnobrnja-Isailovic, J., Desmonts, D., … Bonnet, X. (2013). Schoolchildren and one of the most unpopular animals: Are they ready to protect snakes? *Anthrozoos*, *26*, 93–109.

Ballouard, J.-M., Brischoux, F., & Bonnet, X. (2011). Children prioritize virtual exotic biodiversity over local biodiversity. *PLoS ONE*, *6*, e23152. doi:10.1371/journal.pone.0023152.

Ballouard, J.-M., Provost, G., Barré, D., & Bonnet, X. (2012). Influence of a field trip on the attitude of schoolchildren toward unpopular organisms: An experience with snakes. *Journal of Herpetology*, *46*(3), 423–428.

Balmford, A., Clegg, L., Coulson, T., & Taylor, J. (2002). Why conservationists should heed Pokémon. *Science*, *295*, 2367.

Bell, B. (2010). When an animal is not an animal? *Journal of Biological Education*, *15*, 213–218.

Caro, T., Pelkey, N., & Grigrione. M. (1994). Effect of conservation biology education on attitudes toward nature. *Conservation Biology*, *8*, 846–852.

D'Argembeau, A., & Van der Linden. M. (2004). Influence of affective meaning on memory for contextual information. *Emotion*, *4*, 173–188.

Fowler, F. (1995). *Improving survey questions: Design and evaluation*. Applied Social Research Methods Series 38. London: Sage.

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. L., Singer, E., & Tourangeau, R. (2009). *Survey methodology.* 2nd ed. New Jersey: Wiley.

Iozzi, L. A. (1989). What research says to the educator: Part two: Environmental education and the affective domain. *Journal of Environmental Education*, *20*, 6–13.

Lindemann-Matthies, P. (2002). The influence of an educational program on children's perception of biodiversity. *Journal of Environmental Education*, *33*, 22–31.

Lindemann-Matthies, P. (2006). Investigating nature on the way to school: Responses to an educational program by teachers and their pupils. *International Journal of Science Education*, *28*, 895–918.

Lindemann-Matthies, P., Junge, X., & Matthies, D. (2010). The influence of plant diversity on people's perception and aesthetic appreciation of grassland vegetation. *Biological Conservation*, *143*, 195–202.

Littledyke, M. (2008). Science education for environmental awareness: Approaches to integrating cognitive and affective domains. *Environmental Education Research*, *14*, 1–17.

Nates, J., Campos, C., & Lindemann-Matthies, P. (2010). Students perception of plant and animal species: A case study from rural Argentina. *Applied Environmental Education & Communication*, *9*, 131–141.

Newing, H., Eagle, C., Puri, R., & Watson, C. (2011). *Conducting research in conservation: Social science methods and practice*. London: Routledge.

Novacek, M. J. (2008). Engaging the public in biodiversity issues. *Proceedings of the National Academy of Sciences of the USA*, *105*, 11571–11578.

Patrick, P., & Tunnicliffe, S. D. (2011). What plants and animals Do early childhood and primary Students' name? Where Do they See them? *Journal of Science Education and Technology*, *20*, 630–642.

Pilgrim, S. E., Cullen, L. C., Smith, D. J., & Pretty, J. (2008). Ecological knowledge is lost in wealthier communities and countries. *Environmental Science & Technology*, *42*, 1004–1009.

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*, 431–449.

Randler, C., Ilg, A., & Kern, J. (2005). Cognitive and emotional evaluation of an amphibian conservation program for elementary school students. *Journal of Environmental Education*, *37*, 43–52.

Richman, W. L., Kiesler, S., Waistband, S., & Drasgow, F. (1999). A meta-analytic study of social desirability distortion in computer-administered questionnaires, traditional questionnaires, and interviews. *Journal of Applied Psychology*, *84*, 754–775.

Rivas, J. A., & Owens, R. Y. (1999). Teaching conservation effectively: A lesson from life-history strategies. *Conservation Biology*, *13*, 453–454.

Robelia, B., & Murphy, T. (2012). What do people know about key environmental issues? A review of environmental knowledge surveys. *Environmental Education Research*, *18*, 299–321.

Schlegel, J., & Rupf, R. (2010). Attitudes towards potential flagship species in nature conservation: A survey among students of different educational institutions. *Journal for Nature Conservation*, *18*, 278–290.

Serpell, James A. (1989). *Pet-keeping and animal domestication: A reappraisal*. London: Unwin Hyman.

Schroepfer, K. K., Rosati, A. G., Chartrand, T., & Hare, B. (2011). Use of "entertainment" chimpanzees in commercials distorts public perception regarding their conservation status. *PloS ONE*, *6*(10), e26048.

Tourangeau, R., Rips, L. J., & Rasinski, K. (2000). *The psychology of survey response*. New York: Cambridge University Press.

Van Weelie, D., & Wals, A. (2002). Making biodiversity meaningful through environmental education. *International Journal of Science Education*, *24*, 1143–1156.

Walsh-Daneshmandi, A., & MacLachlan, M. (2006). Toward effective evaluation of environmental education: Validity of the children's environmental attitudes and knowledge scale using data from a sample of Irish adolescents. *Journal of Environmental Education*, *37*, 13–23.

White, P. C. L., Jennings, N. V., Renwick, A. R., & Barker, N. H. L. (2005). Questionnaires in ecology: A review of past use and recommendations for best practice. *Journal of Applied Ecology*, *42*, 421–430.

Yong, D. L., Fam, S. D., & Lum, S. (2011). Reel conservation: Can big screen animations save tropical biodiversity? *Tropical Conservation Science*, *4*(3), 244–253.

Zoldosova, K., & Prokop, P. (2006). Education in the field influences children's ideas and interest toward science. *Journal of Science Education and Technology*, *15*, 304–313.