



Short communication

Communicating information about the psychology of a wild carnivore, the red fox, influences perceived attitudinal changes but not overall tolerance in people

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ABSTRACT

Studies on wild animal psychology are growing in popularity due to the important role they play in understanding how wildlife is responding to human-driven environmental changes. However, communicating psychological information to the general public could undermine specific conservation objectives by encouraging greater persecution of a species (e.g., “bold” predators). Through a national-level survey ($n = 1364$ participants), we tested whether communicating information about the boldness and problem-solving abilities of a wild carnivore, the red fox (*Vulpes vulpes*), influences people's tolerance of them. Half of the participants were given information on fox psychology (either a video or a press release about fox boldness and problem-solving), the other half were given content related to basic fox ecology (either a video or a press release about fox habitat use). Afterwards, all participants completed the same 24-item questionnaire evaluating their tolerance of foxes. Although the participants given information about fox psychology were more likely to report a *perceived* attitude change due to the content they were given, this effect was relatively small and did not impact people's tolerance of foxes more than ecological information. We encourage further research to understand how communicating different types of information might influence, either positively or negatively, people's tolerance of a species as more studies on wild animal psychology are published, and the public's awareness of how animal psychology relates to human-wildlife interactions becomes more widespread.

1. Introduction

Globally, human activities are driving the mass extinction of species, commonly referred to as the “sixth mass extinction” or the “biodiversity crisis” (Ceballos et al., 2015; Western., 1992). In parallel with biodiversity decline, human societies are becoming increasingly disconnected from nature and local wildlife (Balmford et al., 2002; Cazalis and Prevot, 2019; Schuttler et al., 2019; Soga and Gaston, 2016, 2023; Soga et al., 2023). To help overcome these urgent environmental issues, conservationists and scientific communicators often use anthropomorphism (i.e., attributing human-like characteristics to non-human beings) (Epley et al., 2007) as a strategy to promote stronger pro-environmentalism within people (Williams et al., 2021). Studies have shown that anthropomorphism of nature is positively related to pro-environmental

attitudes (Apostol et al., 2013) and with the compassionate conservation movement (Manfredo et al., 2020). However, in other contexts, anthropomorphism of non-human species may hinder wider conservation efforts (Williams et al., 2021). For instance, attributing predators with perceived negative characteristics, including adjectives such as “bold”, “sly, or “cunning”, may help explain their persecution by people (Benavides Medina, 2020; Drouilly et al., 2021; Ordiz et al., 2013).

Studies on wild animal psychology are growing in popularity due to the important role that this information plays in understanding how wildlife is responding to human-driven environmental changes (Benson-Amram et al., 2022). Such research, however, often characterises animals using adjectives that could be taken out of context and/or perceived as negative when communicated to the general public (e.g., risk-taking, boldness, impulsivity, and intelligence), particularly for

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“nuisance” animal behaviour, such as bin raiding, personal attacks, and property damage. Most of what is known about the impact of communicating information about wild animal psychology on public attitudes comes from anecdotal observations (Carey, 2018). Experimental studies exist, but have focused on captive, exotic, or domestic species (Craig and Vick, 2021; Hazel et al., 2015). It remains largely unclear whether or how communicating this type of information might impact people's overall tolerance of wildlife, particularly compared to other forms of information, such as an animal's basic ecology, and for species often labelled as ‘pests’.

The current study investigated whether public tolerance of a wild carnivore, the red fox (*Vulpes vulpes*), is impacted by communicating information about their boldness and problem-solving abilities. Mammalian carnivores, such as foxes, are an example of a group of animals that display variation in boldness and problem-solving (Breck et al., 2019; Daniels et al., 2019; Morton et al., 2023; Stanton et al., 2022), which have likely enabled them to exploit a wide variety of environments (Ashish et al., 2022; Drouilly et al., 2021). Studies suggest, for example, that urban foxes may behave more boldly than rural populations (Morton et al., 2023). However, people's attitudes and beliefs about foxes may also be influenced by popular culture, which – as with other carnivore species – can be highly sensationalised and negative due to specific content or messaging (e.g., an infant being attacked by a particularly bold fox) (Bridge and Harris, 2020). There is therefore an urgent need to understand how particular types of information influence people's tolerance of foxes and other carnivores (Flemming et al., 2018).

Our study had two aims: First, to test whether providing information to the general public about boldness and problem-solving in wild foxes has a greater effect on people's tolerance of them compared to information about foxes' basic ecology. Second, to test whether any effect on public tolerance of foxes is conditional on how such information is disseminated (e.g., public press release versus YouTube videos).

2. Materials and methods

2.1. Survey design and sampling

An online survey of public attitudes and beliefs about foxes was administered to members of the UK general public between March and April 2023. To avoid priming participants by exposing them to the stimulus of “psychology”, all participants were informed upon recruitment that the survey was related to the broader theme of “public attitudes towards foxes”. A survey composed of 43 questions was organised into three parts (A, B, C) (Appendix 1). All participants, regardless of their group allocation, completed parts A and C of the survey. In Part B, participants were randomly assigned to one of four groups using a random number algorithm (Table 1). Part A included demographic questions (e.g., age, sex, and geographic location), while part C included

Table 1
Information about the online experimental and control groups.

| Group | Type | Description | Link to condition |
|-------|--------------|---|---|
| 1 | Experimental | Read a press release about a study on fox psychology. | See Fig. A in Appendix 2. |
| 2 | Control | Read a press release about a study on fox habitat use. | See Fig. B in Appendix 2. |
| 3 | Experimental | Watch a YouTube video about a study on fox psychology. | https://www.youtube.com/watch?v=Uy-ByMAUVMQ |
| 4 | Control | Watch a YouTube video about a study on fox habitat use. | https://www.youtube.com/watch?v=AZo5whONUgo |

Note. The experimental and control conditions very closely resembled each other (e.g., same length, number of words, and image quality) except the experimental group contained information about fox psychology while the control group contained information about fox habitat use.

items measured using a 7-point Likert scale to evaluate participants' overall tolerance of foxes, as well as their perceived attitudinal change due to the information they received in Part B. Most of the questions in Part C were drawn from previously validated questionnaires used to evaluate public attitudes towards carnivores, including foxes (Arbiu et al., 2019; Kimmig et al., 2020). Further details about the contents of the survey can be found in the supplementary materials.

2.2. Principal component analysis of attitudes and beliefs about foxes

To obtain a measure of participants' overall tolerance of foxes, we entered the relevant 24 items from Part C of the online survey into a Principal Component Analysis (PCA). A scree plot and parallel analysis were used to determine the number of components to extract (Horn, 1965; Morton and Altschul, 2019). Item loadings $\geq |0.4|$ were defined as salient for the PCA; items with multiple salient loadings were assigned to the component with the highest loading.

2.3. Data analysis

We used two separate linear mixed effects models (LMM) to test whether participant self-reported attitudinal change [Question 1 of Part C of the survey] or overall tolerance of foxes differed between 1) communication format (video versus written) and 2) content (fox psychology versus fox ecology). We included the interaction between format and content in each model. For all analyses, we included participant's region within Great Britain ($N = 11$: East Midlands, East of England, London, North East, North West, Scotland, South East, South West, Wales, West Midlands, Yorkshire and the Humber), and gender as random factors, as a prior study suggested that fox-related attitudes and beliefs may be different in different regions of the UK (Morton et al., 2023) and because previous studies have found gender sampling effects on fox-related attitudes (Kimmig et al., 2020). Although age and degree of urbanisation can also impact fox-related attitudes (Kimmig et al., 2020), there were no significant differences in participants' mean age ($F(3, 1369) = 0.964, P = 0.409$) and degree of urbanisation ($F(3, 1369) = 0.895, P = 0.443$) across our treatments, hence, we opted against including these variables within our models to avoid over-parameterization. We finally conducted a LMM between fox tolerance scores and self-reported attitude change. LMM analyses were performed in R version 4.3.1 (RCoreTeam, 2023) using the ‘lme4’ package (Bates et al., 2015), with Wald χ^2 values calculated using ‘car’ (Fox and Weisberg, 2019). Data for the statistical analyses of this study are provided in Dataset S1 in the supplementary materials.

3. Results

Details about the participants from this study, including a summary of the demographic data obtained from their responses to Part A of the survey, can be found in the supplementary materials. The results of our principal component analysis to measure participants' tolerance of foxes can be found in the supplementary online materials as well.

In terms of testing the main hypothesis of this study, we found no evidence that participants' overall tolerance of the species differed significantly between our experimental and control groups in terms of the content or format of information they were given (Table 2, Fig. 1). However, the first question of Part C of our survey asked participants to identify whether and to what extent the science communication materials had changed their attitudes towards foxes (referred to hereafter as “perceived attitude change”). In total, 19.9 % of people (272 out of 1364 participants) agreed that the material given to them had changed their attitude to foxes, 48.0 % of people (655 participants) neither agreed or disagreed, and 32 % of people (437 participants) disagreed that their attitude had changed. Across all participants, perceived attitude change was significantly greater among people exposed to videos versus written materials (Table 2; Fig. S3a), and among people exposed to fox

Table 2
LMM model outputs showing variable estimates (\pm SE), Walds χ^2 and *P* values.

| Model | Variable | Estimate \pm SE | Walds χ^2 | <i>P</i> |
|---------------------------|-------------------------|-------------------|----------------|----------|
| Perceived attitude change | Content | 0.25 \pm 0.12 | 10.45 | 0.001 |
| | Format | -0.20 \pm 0.12 | 5.30 | 0.021 |
| | Format \times Content | 0.03 \pm 0.17 | 0.03 | 0.869 |
| Overall tolerance | Content | 0.10 \pm 0.17 | 0.00 | 0.940 |
| | Format | -0.03 \pm 0.17 | 1.21 | 0.271 |
| | Format \times Content | -0.21 \pm 0.24 | 0.77 | 0.379 |

Note. “Perceived attitude change” is based on participants' responses to Question 1 in Part C of the survey. “Overall tolerance” is based on participants' composite scores from the 24-item survey of fox-related attitudes and beliefs in Part C of the survey.

psychology versus fox ecology materials (Table 2; Fig. S3b), but this perceived change was unaffected by the interaction between content and format (Table 2). See supplementary materials for further results.

4. Discussion

Communicating information about the psychology of wild animals has potential for influencing, either positively or negatively, public tolerance of species. In our study, participants given information about fox psychology were more likely to report a perceived attitude change compared to people given information about basic fox ecology, but people's attitudes and beliefs relating to overall fox tolerance, based on our 24-item tolerance scale, did not differ significantly between any of our experimental or control groups. These findings do not support the hypothesis that merely exposing people to information about wild animal psychology, such as their boldness and problem-solving abilities, directly impacts public tolerance of these animals, at least in the short term, more than other forms of information such as the animal's basic ecology.

Different reasons might explain why some people experienced a perceived attitude change, which is beyond the scope of the current study. For instance, there is the possibility that people's perceived attitude shifts were not reflected in our 24-item fox tolerance scale, or the possibility that participants felt or experienced something, but they misrepresented this feeling (e.g., perhaps due to the form of question).

To formally test these and other possibilities, further experimental work is required.

Despite significant attitude changes being reported by some of our participants, this perceived effect was relatively small and did not impact people's overall tolerance of foxes more than ecological information. Previous studies have reported a link between anthropomorphism and emotional attachment to nature in people (Williams et al., 2021), but our findings highlight the need for more research on this understudied topic to better understand when, where, and why people are being influenced. Giving people new information can, in some instances, influence a person's engagement with important issues after a single exposure to that information (Johnson et al., 2016; Vezich et al., 2017). However, socio-psychological research suggests that such information is only likely to be effective when framed on a personal/emotional level, especially if it aligns with people's pre-existing values or beliefs (Meadow et al., 2005; Slagle et al., 2013; Toomey, 2023; Vezich et al., 2017). Nardi et al. (2020), for instance, found a significant interaction between attention to local news about urban wildlife and political ideology for urban coyotes. Piazza and Loughnan (2016) reported that information about the psychology of a species likely loses its effect on people if their judgments impact their own livelihoods. Thus, shifting people's tolerance of a species by exposing them to information about the psychological abilities of that species may take time and effort, as it requires addressing the cognitive and emotional components to people's behaviour, especially if public tolerance is deeply entrenched by other factors.

We encourage further work to build upon the findings and ideas presented in this paper, as well as explore other possibilities, ideally using large and representative samples of participants to reduce issues with replicability and generalisability of the findings. We also urge researchers to use robust social psychology research to test their hypotheses, such as randomly controlled trials (to test for causal effects) or before-after comparisons (to test for the direction of these effects). Finally, we encourage further work to better understand how public tolerance might be impacted by the context in which information about wild animal psychology is given, such as studies of (1) other species or types of psychological abilities, (2) comparisons between psychological traits and other types of content (e.g., animal sociality and play, or content unrelated to animals), and (3) whether people's responses are conditional on how the information might impact their everyday lives, ranging from minor inconveniences (e.g., noise disturbance) to major

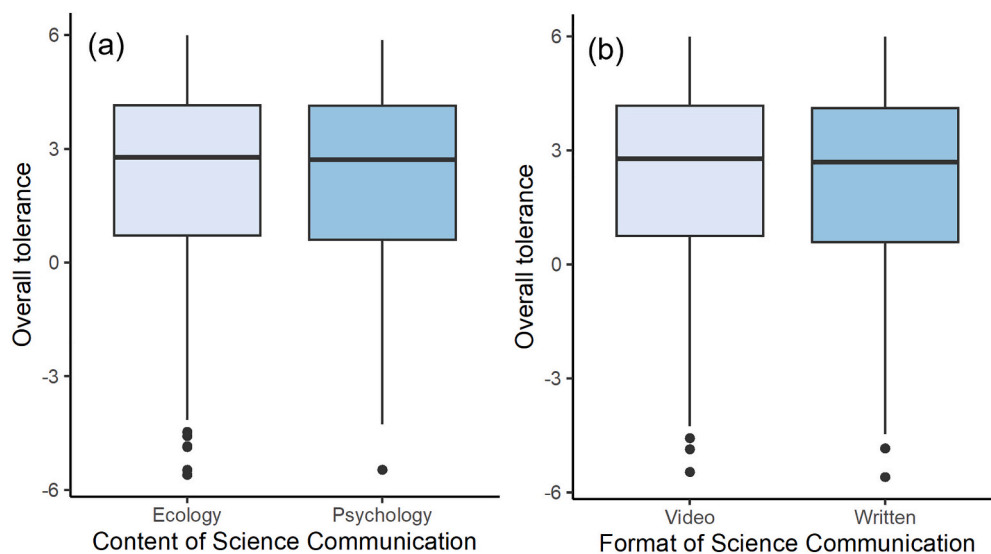


Fig. 1. Relationship between overall tolerance of foxes after people engaged with the science communication materials, which was based on participants' composite scores from the 24-item survey of fox-related attitudes and beliefs in Part C of the survey, and two experimentally relevant predictor variables: a) Content of the science communication materials ($p = 0.94$), and b) Format of the science communication materials ($p = 0.27$).

health and safety risks (e.g., attacks on livestock, children, and pets).

5. Conclusions

Despite the importance of wildlife psychology research to conservation, further research is needed to understand how best to communicate such information to the general public. Although in the current study we found no clear evidence from our red fox example that communicating information about wild animal psychology necessarily has a negative impact on public tolerance beyond information about their basic ecology, researchers' and scientific communicators' understanding of how such information shapes, either positively or negatively, people's attitudes towards wildlife is still in its infancy. Longitudinal monitoring of public attitudes is needed as more studies on wildlife psychology become published, and the public's awareness of how such information relates to human-wildlife interactions becomes more widespread.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.biocon.2024.110653>.

Ethical statement

This study was ethically approved by the Faculty of Health Sciences Ethics Committee of the University of Hull (FHS22–23.37 & FHS356).

CRediT authorship contribution statement

F. Blake Morton: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Dom Henri:** Writing – original draft, Formal analysis, Conceptualization. **Kristy A. Adaway:** Writing – original draft, Conceptualization. **Carl D. Soulsbury:** Writing – review & editing, Formal analysis. **Charlotte R. Hopkins:** Writing – original draft, Methodology, Conceptualization.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

All data used for statistical analysis can be found in the online supplementary materials associated with this paper.

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