

RESEARCH ARTICLE

The role of cultural norms in shaping attitudes towards amphibians in Cape Town, South Africa

Peta Brom^{1*}, Pippin Anderson¹, Alan Channing², Leslie G. Underhill³

1 Department of Environmental and Geographic Sciences, University of Cape Town, South Africa, **2** Unit for Environmental Sciences and Management, North West University, South Africa, **3** Department of Biological Sciences, University of Cape Town, South Africa

* brompeta@gmail.com



Abstract

Urban ecosystems are increasingly viewed as an important component within strategies for wildlife conservation but are shaped as much by natural systems as they are by social and political processes. At the garden scale, attitudes and preferences govern design and maintenance choices including the decision to encourage or discourage specific faunal presence. At the global scale, charismatic taxa that are well-liked attract more conservation funding and volunteer stewardship. Amphibians are a class of animals that are both loved and loathed making them a suitable subject for comparing and unpacking the drivers of preference and attitudes towards animals. We conducted a mixed methods survey of 192 participants in three adjacent neighbourhoods in Cape Town, South Africa. The survey included both quantitative and qualitative questions which were analysed thematically and used to explain the quantitative results. The results revealed that attitudes formed during childhood tended to be retained into adulthood, were shaped by cultural norms, childhood experiences and the attitudes of primary care-givers. The findings are significant for environmental education programmes aimed at building connectedness to nature and biophilic values.

OPEN ACCESS

Citation: Brom P, Anderson P, Channing A, Underhill LG (2020) The role of cultural norms in shaping attitudes towards amphibians in Cape Town, South Africa. PLoS ONE 15(2): e0219331. <https://doi.org/10.1371/journal.pone.0219331>

Editor: Jorge Ramón López-Olvera, Universitat Autònoma de Barcelona, SPAIN

Received: June 19, 2019

Accepted: February 7, 2020

Published: February 24, 2020

Copyright: © 2020 Brom et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: The data underlying the results presented in the study are available from PLOS ONE as supporting documentation to this article.

Funding: The author(s) received no specific funding for this work.

Competing interests: The authors have declared that no competing interests exist.

Introduction

With more than half the world's human population urbanized [1], urban environments are the only place where many people will have opportunities to experience nature. As an anthropogenic environment, the quality of the nature that urbanites experience is fundamentally shaped by the choices people make, which in turn are governed by social processes, Social norms [2], individual preferences [3], attitudes [4], perceptions [5], cultural beliefs [6], and even identity [7,8] can result in different landscaping practices and a desire to cultivate and attract or remove and deter one species over another. What we like and do not like therefore matters to the future of urban nature stewardship.

Amphibians have ecological importance in many ecosystems around the world. They are an essential link in the natural food web and are important bio-indicators in determining wetland and river health whilst regulating invertebrate populations [9]. They are also the most

threatened vertebrates on earth with approximately 41% of the entire class recognised as such [10]. The most widely attributed reason for amphibian decline is habitat loss associated with land use changes and development [11], but none of the factors associated with agriculture and urbanisation can readily account for the declines that have been found in areas apparently unaffected or remote from land-use change. Declines occurring in remote areas are instead attributed to climate change, UV radiation, and diseases such as ranavirus and chytrid fungus [12]. The spread of these diseases is facilitated by species invasions and climate change [12]. Predictions indicate shifts in natural habitats 80 years hence at the hands of climate change, will occur at rates 500 times faster than current trends [13]. In short, amphibian species are threatened globally by a changing world and these changes are anthropogenic.

Cities are arguably the most altered sites of change. Urban environments are prone to urban warming, and local climate changes within cities have occurred at faster rates than surrounding areas [14] yet it was found that Australian cities consistently supported a greater number of threatened species than “all other non-urban areas on a unit-area basis” [15] and further Mark Goddard recognised that “globally declining taxa can attain high densities in urban habitats” [17] indicating the need for a reassessment of the value that urban ecosystems can contribute towards conservation. For amphibian populations, a large-scale citizen science study in North America found that although urban populations of amphibians are smaller than their wild counterparts, they appear to be declining at similar or slower rates [17], suggesting that urban environments may be able to provide refuge for some species of amphibians.

In many cities around the world, retention ponds, attenuation ponds and rain-gardens, developed as components of stormwater systems, have been colonized by amphibians as breeding habitat [18–21]. Studies which focused on urban ponds have found that natural urban wetlands and constructed habitats have similar occupation [22], but that the quality of terrestrial habitats is as important to amphibians as the in-pond conditions [23,24], highlighting the fact that amphibians rely on both aquatic and terrestrial habitats, and the need to ensure suitable terrestrial habitats are provided within urban landscaping designs.

Amphibians are both loved and loathed, making them a suitable class for unpacking human attitudes [6]. All over the world they are steeped in myths and superstitions that have been brought to us through time. Walter Rose attributed the mythologies he encountered to several typical characteristics of the class. The metamorphosis process where tadpoles visibly grow legs before leaving the pond associates them with transformation. Frogs are seemingly magical in their ability to crawl into tiny cracks and burrows. They disappear for months during aestivation and then, during a storm they can seem to appear from nowhere—leading to myths about frogs raining from the sky [25]. In Western society, frogs are associated with magic and metamorphosis such as in the image of the Frog Prince as documented by the Grimm brothers and popularized by Disney, and that of Shakespeare’s witches’ brew (Macbeth), which included “Eye of newt and toe of frog” [26]. Some of this mythology appears to stem from an inability for many people to make sense of amphibians as animals and is reflected in stories in which frogs are turned into human-like creatures with mystical powers [21].

Tarrant *et al.* noted, “That the average amphibian receives 75% less funding than the average listed mammal, bird or reptile, and 90% less funding than the average listed fish reflecting the less-popular status of amphibians in general” [2]. One of the effects of ubiquitous negative attitudes is that it translates into lower prioritisation for conservation [27]. It therefore becomes important to focus on the ways that attitudes are shaped and influenced if conservation efforts are to gain the traction required from the public to reach their targets.

Early exposure to frogs is not, on its own, a key predictor in liking frogs as an adult because children who play in nature tend to encounter them. Instead, the quality of interactions (often coupled with the attitudes of role-models facilitating those experiences) influences attitudes. On the negative end of the spectrum, behaviour modelling is a pathway to the development of (spider) phobias in children, whereby formative experiences are mediated by parents and phobias are passed on [28]. On the other hand, 75% of Canadians and 71% of Australians selected childhood experiences in nature as the number one reason for personal responsibility being felt towards the natural world [29]. Particular events during a youth's life could result in environmental values being enhanced or altered depending on the attitudes of care givers facilitating nature experiences [30].

Direct positive experiences of frogs and keeping animals as pets, whether farm animals or domestic pets, contribute to positive attitudes towards animals in later life [31,32]. Children in North America who participated in "wild" and "domesticated nature were put on a trajectory towards environmentalism [33]. Furthermore, children who engage in direct educational experience are more likely to engage in pro-environmental behaviour after an educational program has ended [32,34].

South Africa is a diverse country of many cultures and heritages and 11 official languages. Some groups hold beliefs which fuel negative response attitudes towards amphibians. For example, amphibians were documented as the second most feared animal amongst 120 Zulu respondents across various age groups (snakes were the first) and this fear often led to direct killing of amphibians [21]. There are four major ethnic divisions among black South Africans, namely the Nguni, Sotho, Shongaana-Tsonga and Venda. The Nguni is the largest and can be divided further into four groups, of which Zulu is spoken by Northern and Central Nguni, Xhosa is spoken by Southern Nguni, Swazi by those from eSwatini and Ndebele in the Northern Province and Mpumalanga. Xhosa and Zulu have a close history and share similar customs. The clear-cut distinction made today between Xhosa and Zulu originated in colonial distinctions between Natal and the Cape and later intermarrying and cultural borrowing from the Khoikhoi amongst Southern Nguni cemented these distinctions [35]. These groups share a rich oral tradition as a primary means of memory retention and heritage [36] so beliefs about animals are often passed down between generations.

This study explored the themes driving attitudes to amphibians in a neighbourhood composed of three adjacent suburbs in Cape Town, South Africa. Respondents fell predominantly within two cultural groups, namely, South African English and Xhosa. The results are discussed in terms of these two groups.

Research objectives

The aim of this study is to understand why people would be motivated to protect and conserve amphibians or to harm them.

Objectives:

1. To understand differences and drivers for attitudes and preferences towards amphibians in the study area.
2. To establish the role of life-experience as an informant of attitudes towards amphibians.
3. To explore shifts in attitude across dimensions of the preference ladder.

Methods

We took a mixed-mode approach to a social study that used qualitative data to identify themes that explained quantitative data.

Instrument design

A survey by questionnaire (S1 Fig) was developed in order to cover four areas likely to correlate to attitudes, namely: demographics, preferences, knowledge and personal childhood experiences. The initial question set was adapted from Tarrant *et al.* who aimed to test knowledge, beliefs and liking amphibians [21]. In contrast to Tarrant's [21] questions, which were measured on a 10-point Likert scale, we asked instead that respondents select from a list which best describes the feelings towards amphibians with choices between, 'I like frogs', 'frogs are ok', 'frogs are gross', 'frogs are scary' and 'I have no feelings about frogs'. This sought to address distinctions between the disgust and fear responses [27,37,38]. Although blunt, this self-identified response held valid as a position and framework throughout the cases. Cultural belief questions were used in the same format as [21]. Knowledge questions were drawn from both [21] and added to with information from [39]'s introductory section on frogs. The resulting questions asked how much respondents agree or disagree with the following statements: "Frogs / toads are considered harmless to people" and "Some frogs / toads secrete a mild toxin on their backs as a defence mechanism (e.g. when hurt)" [21,39]. Preferences questions were added based on the work of Belaire *et al.* [40], who measured residential preferences towards birds. This produced questions that asked respondents to agree or disagree on a five-point scale with the statements "I like listening to frog / toad calls when it rains" and "Frog / toad calls keep you awake at night."

In order to relate the questions to de Groot *et al.*'s preference ladder [41], questions were designed to consider behavioural responses at scales within the home by asking respondents first what they would do if they found a frog in their garden and then if they found it in their homes. Respondents were also asked if they thought amphibians should be protected in the wild and then in green spaces in the city. To test the specific levels of preference, respondents were asked to look at four images of amphibians that each represented the typology of a. rain frog, b. reed frog, c. toad and d. river frog to determine how attitudes to specific types of frogs would differ from general ideas. The frogs selected for the images are native to the City of Cape Town and could be encountered in resident's gardens (Fig 1)

Tarrant *et al.* speculated that those who had positive experiences of frogs in their childhood at an age younger than ten were more likely to have a strong affiliation towards frogs [21] and so in order to explore the relationship between childhood experiences, cultural beliefs and attitude towards frogs, respondents were asked "Do you have any strong memories of coming into contact with frogs from your childhood, or any memories of something that someone, a parent or teacher, told you about frogs that you would like to share?"

Ethics

Ethics approval was sought from the University of Cape Town for human subjects. The application was approved by the Faculty of Science Research Ethics Committee. The ethics approval number is FSREC 021–2016.

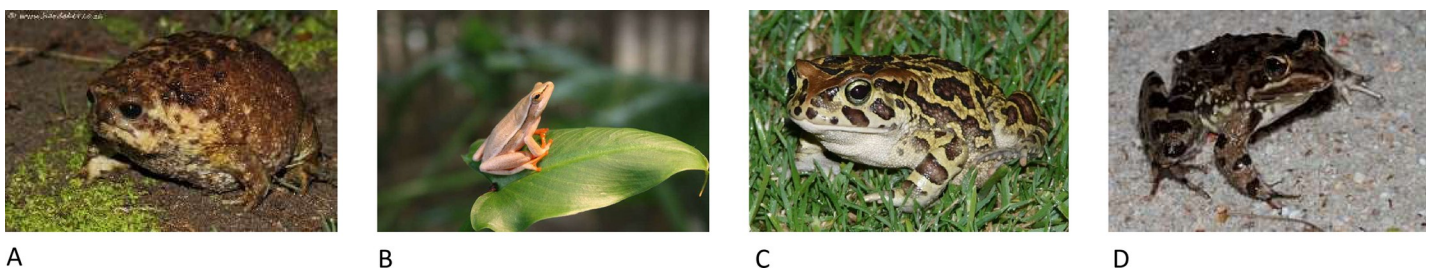


Fig 1. Flash-cards used to measure specific attitudes towards different frog types as would occur within the City of Cape Town. A: rain frog, *Breviceps gibbosus*. B: reed frog, *Hyperolius horstockii*. C: toad, *Sclerophrys pantherina*. D: river frog, *Amietia fuscigula*.

<https://doi.org/10.1371/journal.pone.0219331.g001>

Written consent was obtained from respondents who participated in the paper survey. Those who participated in the digital survey, read a disclaimer and clicked a check box acknowledging the contents before continuing. We notified respondents that participation was voluntary and that they could withdraw from the study at any time without giving reasons. We guaranteed confidentiality and explained that some quotes may be reproduced / published anonymously to exemplify the data, but that no identifying information would be published and that any personal information (such as the area where they live) would be aggregated in the data when reporting.

Sampling

A total of 188 survey responses was obtained. The respondents were predominantly between the ages of 18 and 50, with less than 5% falling below 18 years of age and above 70. The majority (57%) said that English was their mother tongue reflecting the dominant demographic of the area. Xhosa (19%) was the second language group in the respondent set, while the remainder self-identified as Afrikaans (3%), bilingual Afrikaans-English (3%), Zulu (2%), and Other (15%) which included a group of nine international languages from African and European countries.

Initially, 36 respondents were visited in their homes, and questionnaires were administered in an interview setting. Where possible both gardeners and home-owners were interviewed. During this time the questions were fine-tuned both in the phrasing and prompting. The questionnaire was then converted to a digital format using Survey Monkey [42] and a link was posted to social media groups. To ensure the inclusion of those without access to digital platforms, administration was undertaken on the street after the digital platform was made available, offering respondents a choice of platform for engagement. Posters and flyers were printed inviting respondents to find the survey questionnaire online. The posters were put up in local restaurants, bars and teahouses in the suburbs Rosebank, Little Mowbray and Observatory.

A team was assembled from Environmental and Geographical Sciences undergraduates at UCT and comprised of five women, three of whom were Xhosa first-language, one was Kenyan English first-language, and one was South African English first-language. Four members of the team stood for one weekday morning on Mowbray, Rosebank and Observatory railway station platforms between 7:45 and 9:30 am and interviewed commuters leaving the respective suburbs. Flyers were also handed out inviting commuters to logon using their phones during their train ride. On a Sunday morning two members of the team went to the village green in the centre of Observatory and interviewed 15 street dwellers who had come to take advantage of a soup kitchen that would be setting up later in the day. A team of three visited the Observatory Library on a Wednesday morning.

Recognising that street harassment and begging are problems in these areas, the team wore matching t-shirts with bold print that said “Urban Biodiversity Research” on the back, thereby announcing the team’s intention and legitimacy. Overall, the community was receptive, and we were received with a mixture of enthusiasm, curiosity and tolerance.

Analysis

Results were processed descriptively (counts, percentages, means and standard deviations) then cross-tabulated to explore the relationships between demographics and attitudes and preferences, then knowledge and beliefs, responses to amphibian presence in the garden and home. Finally the relationships between childhood memories and disposition towards frogs were assessed. Associations were evaluated using a Chi-squared test and one-way ANOVA

Table 1. Cross-tabulation of feelings towards frogs and response when found in the garden in Cape town, South Africa.

		Feelings			Total
		Like	Neutral	Dislike	
Garden Actions	Leave it alone	72	14	16	102
	Find out more	33	1	2	36
	Call someone to remove	5	1	7	13
	Kill it	1	1	10	12
	Remove it from the property	11	0	0	11
	other	6	0	0	6
	Run away	0	0	4	4
	Chase it away	1	0	1	2
Total		129	17	40	186

<https://doi.org/10.1371/journal.pone.0219331.t001>

between disposition towards amphibians and demographics, attitudes, preferences knowledge and beliefs. Correspondence analysis was performed to explore the relationship between disposition towards amphibians and themed narratives visually.

Results

The full database is available as supplementary information (S2 Fig). 69% (n = 129) of respondents liked frogs or said they were ‘OK’ whilst 10% (n = 18) had a neutral response and 21% (n = 40) had a negative response, saying they were ‘scary’ or ‘gross’. The responses to frog presence in the garden are presented in Table 1. Those that liked frogs tended to leave them alone, remove them from their houses to the garden or to a lesser extent take them to the river or nearest wetland and release them. In these instances, the reason given for removal from property was due to perceived threat from pets, or the perception that the frogs were not in their natural or preferred habitat. Those that did not like frogs were most likely to leave it alone or kill it.

The majority (89.5%, n = 162) agreed that frogs should be protected in the wild but protecting them in the city came into competition with other objectives including access for leisure and social pursuits. In this instance, respondents asked if protecting them would compromise their ability to use green spaces freely and asked for clarity on what was meant by “green spaces” expressing uncertainty. The definition given covered public open space and green corridors. 83% (n = 161) of respondents agreed that frogs should be protected in green areas within the urban edge. Respondents were more ambiguous about making it easier for frogs to move through the city, citing feasibility as the main concern and prioritized human needs within the urban and city space. When prompted with the statement that there may be simple cheap ways to improve mobility, 65.6% (n = 118) of respondents agreed or strongly agreed that we should make it easier for frogs to move through the city. Those that did not like frogs tended to express the view that frogs should stay in the “wild” and were more likely to disagree with this statement (53% of those that did not like frogs)

Language and culture

Language was used as a proxy for culture and is discussed as such. 67% (n = 24) of Xhosa, and 6% (n = 6) of English respondents disliked frogs. 89% (n = 96) of English, and 22% (n = 8) of Xhosa respondents liked frogs (Fig 2).

Of the Xhosa-speaking respondents who said they disliked frogs, a cultural belief was reported that individual frogs found on their property out of the rainy season were sent by

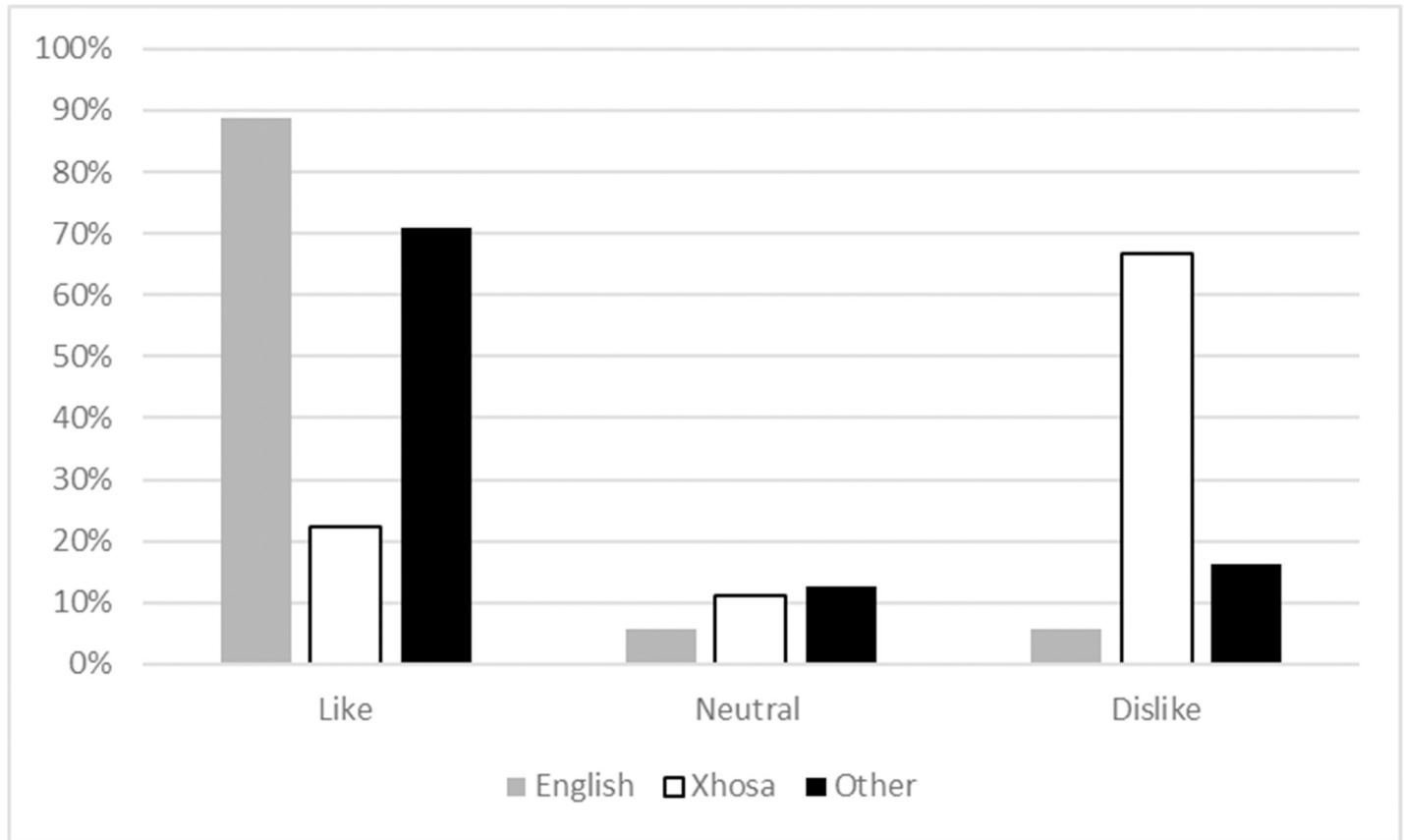


Fig 2. Feelings towards frogs split by dominant language groups.

<https://doi.org/10.1371/journal.pone.0219331.g002>

witchcraft as a curse. The remedy is to kill the frog, preferably by sprinkling salt on its back and then sweeping up the body. These qualitative responses were revealed in the coding of the “other” answers to the question “if you found a frog in your house, what would you do?” Xhosa-speakers were most likely to report being phobic of frogs to the extent that they were unable to look at the flash-cards of examples of frogs. A few respondents reported a shift in attitude with urbanisation or gaining education.

Knowledge and beliefs

Overall education levels in the sample were high. 60% ($n = 113$) of respondents had completed at least some form of higher education, reflecting both the dominant age-groups of the interviewees and the education levels of the suburbs due to their socio-economic status and proximity to tertiary educational institutions. It may also reflect a response bias of willingness to engage with research from those with higher education.

The knowledge and belief scores were cross-tabulated against attitudes (Table 2). The knowledge of those who liked frogs was significantly better (more accurate) than the knowledge of those who disliked frogs (two sample t-test $t = 5.99$, $d.f. = 161$, $P < 0.001$). This is also reflected in the knowledge means of the three groups. Knowledge means were lower in the group that were afraid of frogs. Therefore, a correlation between positive attitude towards frogs and higher knowledge scores demonstrates that those that like frogs have more accurate knowledge of them. It does not however appear to be a causal relationship because people who

Table 2. Cross-tabulation of attitudes towards frogs against knowledge and belief means.

Attitudes towards frogs	Knowledge category	Belief category	Sum of knowledge and belief scores
Like	2.93	2.56	5.49
Neutral	2.18	1.94	4.12
Dislike	2.21	1.66	3.87
Total (average)	2.71	2.31	5.02
Std. Deviation	1.05	0.886	1.636

<https://doi.org/10.1371/journal.pone.0219331.t002>

like frogs may be inclined to search out accurate knowledge about them as much as those that have more accurate knowledge about frogs may develop an interest and affinity towards them. Table 2 presents the median scores for each preference group.

Specific preferences

The most popular frog was *Hyperolius horstockii* which was reported by 76.64% of respondents as being ‘likeable’. This was followed by *Amietia fuscigula* (55.3%), *Sclerophrys pantherina* (54.8%) and finally, *Breviceps gibbosus* at (32.4%). The results are presented in Fig 3 and show specific attitudes towards individual species differs from the general conception of “frogs” as an animal.

Behaviour at spatial scales

Behaviour responses did not change significantly between the house and the garden. The exception was for those who said they would try to find out more about the frog if it was in the house (19.4%) and those who said they would leave the frog alone if it was found in the garden

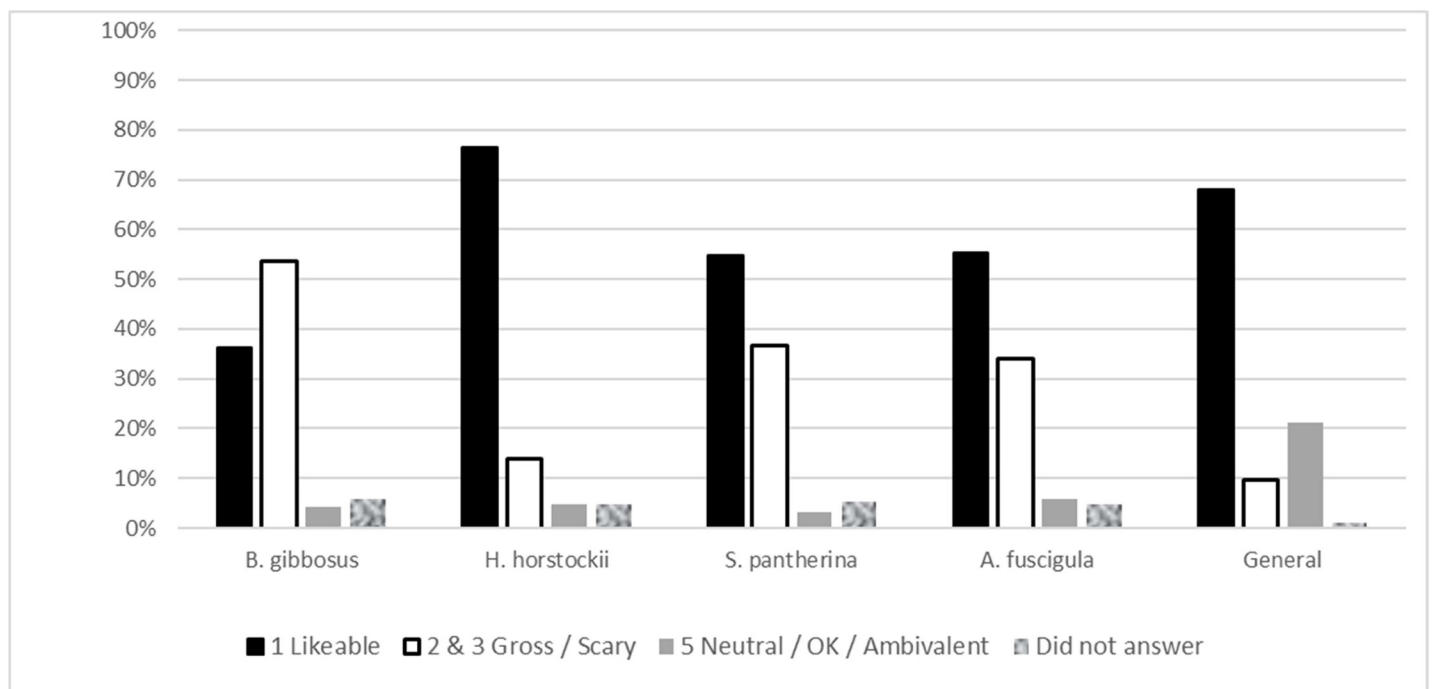


Fig 3. Frequencies of preferences towards different frogs. Comparisons of specific attitudes to *Breviceps gibbosus*, *Hyperolius horstockii*, *Sclerophrys pantherina* and *Amietia fuscigula* with general attitudes towards frogs.

<https://doi.org/10.1371/journal.pone.0219331.g003>

(55%). 60% of all respondents said that they would remove frogs from the house and put them in the garden (or call someone to do so); whilst 12.9% of the sample said that they would kill it, put salt on it or chase it away. Only 4.3% said they would leave it if it was found in the house. 12.4% of the sample would remove the frog from the property or take it to the river, either due to the perception that the river was where it belonged, out of concern for feline predation or due to fear and disgust.

Life experiences

Responses to the question “How old were you the first time you remember coming into contact with a frog?” (Fig 4), fell into the following categories; i. did not know or could not remember (n = 21); ii. under the age of five (n = 93) or iii. between the age of six and ten (n = 61). Only a few outliers within the sample did not have recollection of some contact with frogs before they were ten years old (n = 13). When the age of recollection of first contact with frogs was cross-tabulated with attitude towards frogs, the proportion of those that dislike frogs peaked in the 6–10 age category, and the proportion of those that liked frogs peaked in the 0–5 age group. Having said this, the samples have large overlapping areas indicating positive and negative outlooks within both age groups.

The thematic analysis of the narrative of a memory from childhood shows clear distinctions between those that find frogs ‘gross’ or ‘scary’ and those that find them ‘likeable’ or ‘OK’. Those that have no feelings did not reveal any clear consistency in themes, but 61% (n = 11) of them had no recollection to share. Catching tadpoles (n = 19) featured frequently as a theme amongst those that had an affinity for frogs. The second theme was childhood

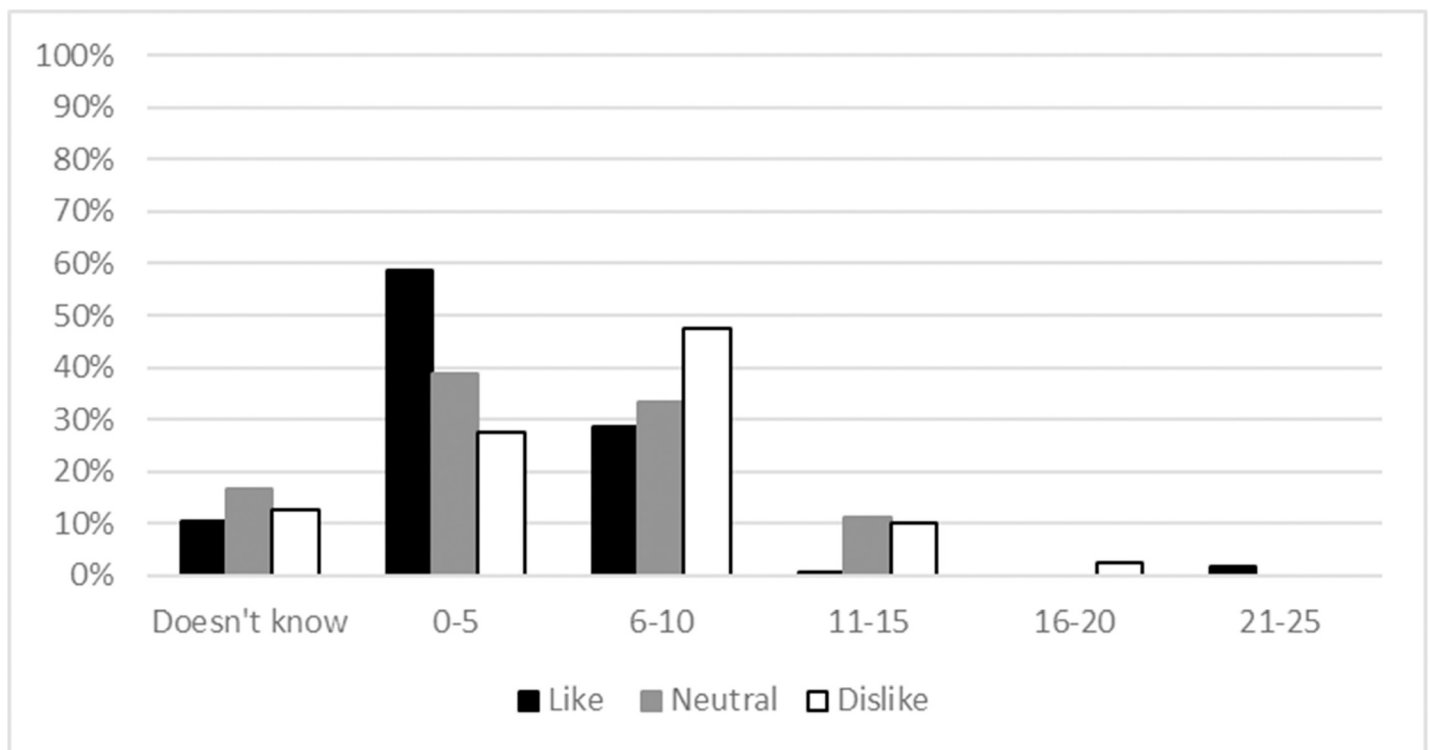


Fig 4. Respondent recollection of age when they first saw or encountered a frog.

<https://doi.org/10.1371/journal.pone.0219331.g004>

discovery (n = 14) recounting playing with and discovering frogs, seeing them or hearing them, often characterised by a sense of wonder. Respondent #129, who liked frogs said, “I remember at [place name] as a child I went to the garden, playing with water and a lot of tiny frogs popped out and I was so amazed and held them on my hands.” Respondent #93 said “looking for frogs on the sides of mountain pools (often around *Disa uniflora*) after a long hot walk on the mountain. If you could stay in the cold brown water long enough, we used to see how close we could swim to them before they jumped into the pool.”

Parental biophilia also featured among this group (n = 5), in which a primary care-giver would tell the child not to harm the animal or would be involved in facilitating the interaction, either by instruction or taking them frogging. Respondent #4 said “My dad calling us all into the garden at night to show us a leopard toad by torchlight. It happened fairly often! And then I did not see one for years until about 12 years ago in our [place name] garden . . . a long space in between!”. Some (n = 5) reported trying to keep them as pets, and some reported playing with them more destructively, or using them to play practical jokes on their friends (n = 7) “I once found a frog and put it in my sister’s room and she freaked out”, others remember listening to them during the rain or at night (n = 4), and lastly, there were those who witnessed the killing of frogs with some distress, implying that they were already familiar with them, were unafraid and held some empathy (n = 5). These themes and accounts had in common direct interaction, fond recollection and that the adults either facilitated, or allowed engagement with minimal interference or warning.

On the other hand, those who reported fear of frogs tended to hold beliefs about the ability of amphibians to harm them. Two main themes emerge. Firstly that they were told by an adult or parent, that touching them (or even looking at them in one case) can result in severe rashes or infections (n = 7) and secondly that frogs are associated with witchcraft (n = 6), Respondent #188 said “Where I come from, some people say frogs are sent by witchcraft, especially if it is not raining or it is unseasonably dry”. Additionally, those that had been chased with frogs or startled also featured (n = 6). Respondent #83 who thought frogs were ‘scary’ said “Someone put it on me and I ran away and that’s when I knew I was scared”.

Respondents across the like-dislike spectrum described frogs coming into the house, out of the ground, or out of the drains in large numbers. One respondent who liked frogs said, “I remember living on an old farm in [place name] and one very rainy, stormy night we woke up to hundreds of frogs popping up from under the floorboards and trying to put on a pair of my mom’s high heels to avoid them jumping on my feet”.

Fig 5 presents the correspondence analysis between the narrative themes and the attitude and illustrates the clustering of narratives which documented experiences, role-model attitudes and cultural beliefs with categories of attitudes and feelings towards amphibians in general. The model is statistically significant with the chi-square value at 86.295 (df = 36) and $p < 0.0001$. Dimension 1 shows the correspondence between the attitudes ‘dislike’, ‘neutral’ and ‘like’ and the themes found in the narrative. The theme ‘startled’ is an outlier on dimension 2, because respondents with a memory of being startled by a frog had varying attitudes depending on the context of the story and factors recorded in the other categories such as cultural background and parental biophilia. The close clustering of the ‘like’ and ‘dislike’ themes on both dimensions indicates the strength of the correspondence between the memories and the attitude.

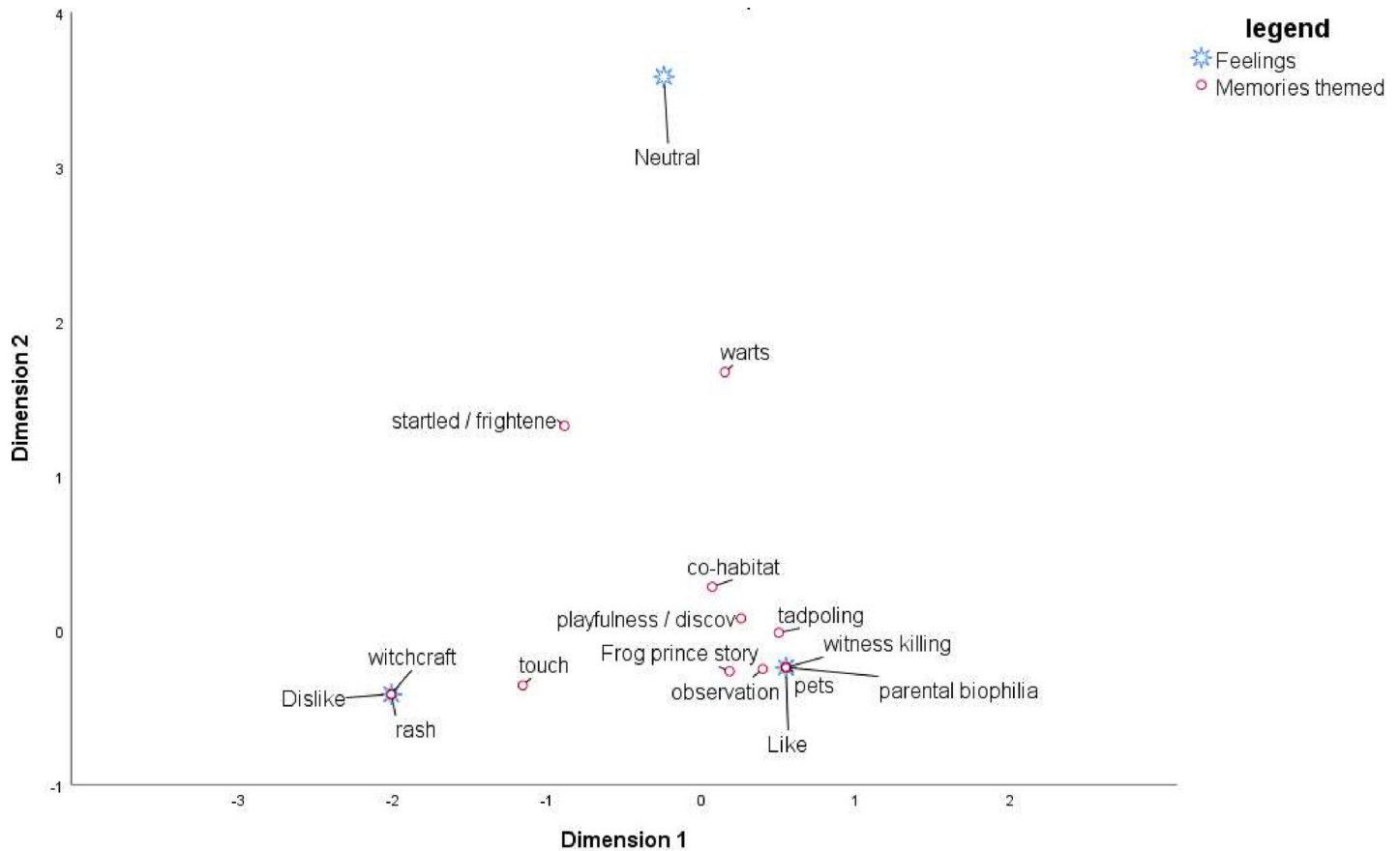


Fig 5. Correspondence analysis of narrative themes and attitude towards amphibians.

<https://doi.org/10.1371/journal.pone.0219331.g005>

Discussion

This study examined the preferences of a Cape Town community towards amphibians and explored attitudes using a composite approach drawing from several sources. De Groot’s preference ladder was used as a theoretical framework for exploring preferences. The findings of this study were consistent with those of de Groot’s in that general preferences at the broad conceptual level can be different to the specific level [41]. This study compared general preferences to specific preferences in terms of space, behaviour and individual species. When asking about individual species, the arum reed frog, *Hyperolius horstockii* was much more popular than other species and many people who were generally afraid of frogs said they thought it was ‘likeable’ and were more likely to leave it alone if they found it in their garden. This finding is consistent with other studies which found that tree frogs—visually similar to the reed frog presented here—were more popular than reptile species indicating its potential as a flagship species for conservation [27]. Knight found that people preferred animals that were ‘cute’ with more human-like proportions to their faces and proportionately larger eyes [43]. The arum lily frog is smaller than the other species presented and has a smoother pattern (as opposed to the mottles, warts and striking patterns of the other 3 species) and softer colouring to it (white, cream and beige as opposed to dark browns and kakis). It was described specifically and variously as being ‘beautiful’, ‘elegant’, ‘harmless’ and ‘it looks poisonous’. In contrast, those with strong dislike or fear of the other species often compared the appearance of the disliked species

to the skin of a snake. Humans have a faster physiological response to visual cues from snakes than other animals which is likely evolutionarily determined. The likening of the appearance of frogs to snakes in fearful individuals points to the visual cues for dangerous animals [44]. As the least popular frog, the rain frog's image was often met with dismay and exclamations of "What is that?!" and "is that even a frog?!" and it was most likely to be classified as "gross". The dislike of the rain frog is likely triggered by a strong disgust reflex which has been demonstrated as the primary driver for frog dislike amongst Slovakian respondents [37,45]. Those that liked the rain frog, tended to laugh at it and see it as 'funny' or 'grumpy', personifying its ugliness into something relatable. The results of this study suggest that reasons for liking an individual species correlate with aesthetic appreciation and anthropomorphic relatability. This is consistent with other studies that bright colours and aposematic patterns, personification, and relatability feature highly in the likelihood that individuals will like a species and respond to calls to champion a specific creature for conservation [43,46]. The findings suggest that it is easier to promote urban biodiversity using charismatic or flagship species as has been argued by others [4,27,43] however the differentiation between the specific and the general means that it may only improve attitudes towards an individual species without necessarily affecting overall attitudes to amphibians in general [16,43].

Impacting the general preference level is more complex given the multiple social influences and individual life-experiences that shape human preferences towards nature. De Groot's research closely associated a general preference for nature with a biophilic self-identity [47]. Biophilia has a number of related concepts that closely align with an affiliation with nature [48] and underpin the framework of *Connectedness To Nature* (CTN) [49]. Although CTN was not directly measured by this study, the themes that emerged within the results are consistent with the themes underpinning CTN theory [50] and thus this framework is used for discussing the results of the general preferences towards frogs.

Positive conservation efforts within the urban context would require a shift towards a culture of pro-environmental behaviour. A predictive relationship has been demonstrated between biospheric values and pro-environmental behaviour [48]. Biospheric values are held when "People judge phenomena on the basis of cost or benefits to ecosystems or the biosphere" [51] and are a result of CTN [48]. CTN is a framework which measures an individual's ability to see themselves as part of nature [48]. To harm a part of nature becomes synonymous with harming oneself. Individuals who hold biospheric values are more likely to engage in pro-environmental behaviour [49]. Klassen summarised the interrelationships of concepts and precursors of CTN in terms of four underpinning pillars, namely, "*lived experiences; encounters and conversations with passionate, caring or dedicated role models; cultural background; and prior knowledge*" [50]. This study has rendered similar findings in terms of the themes emerging from the results correlated with liking or disliking frogs in general and will be discussed below.

This research has highlighted that the attitude of the carer, or adult facilitating these activities, has a prominent role to play in this trajectory. Individuals that were actively discouraged from playing with, observing or going near to amphibians in early childhood, retained their fear into adulthood, while those who were encouraged or facilitated by their parents showed affinity. This suggests that there are elements to human attitudes which are normative, learned and intergenerational.

Role models and parental figures

The role of a parent was often mentioned in the narrative results as someone who passed on an attitude of affiliation for nature, a superstitious outlook or a set of warnings. Klassen's

summary of connectedness to nature theory gives credence to encounters with passionate role models including friends, family, teachers, community members, social movement leaders and writers [50]. Role models shape the kinds of experiences and learning about nature which takes place through facilitated nature engagement (e.g. taking the family to the beach or leading a hike) or knowledge dissemination in all its formal and informal forms. Likewise, the effective behavioural and knowledge retention of environmental impacts are more successful with direct (nature based) or vicarious (stories, plays and entertainment) learning, when compared with indirect (classroom based) learning, but the former is enhanced with in-classroom preparation [31,34,50]. Three different types of role-modelling can be identified, that of family and friends (home), that of teachers, educators and community leaders (community), and that of public figures (public). This research has highlighted the role of home-based figures in early childhood foundation years and noted that positive experiences tended to be imprinted at pre-school age, whilst negative attitudes were associated with recollection from the primary school age. CTN is influenced by multiple positive lived experiences with passionate, caring role-models [50]. When children are encouraged and facilitated by adults to explore, play and engage with nature it enables a sense of wonder and connection—a desirable precondition for establishing connection to nature [50]. This research recognises the importance of parental attitude in the formation and transfer of values and attitudes and suggests that further research is required to understand how to effectively shift whole-family attitudes by engaging both children and parents in positive nature experiences.

Cultural background

Cultural background includes cultural beliefs, values, attitudes and opinions of family and community members [50]. It is reinforced by the norms which are enforced by community members (injunctive norms) as well as what individuals observe or believe of others (descriptive norms). These find expression in community practices and role-model enforcement [2]. In this study, language was used as a proxy for cultural identity and showed differences between groups. One Xhosa-speaking male even refused to participate in the study saying “Why do you want to know that? Everybody hates frogs” thereby revealing the descriptive norm within his group. Xhosa people tend to hold the belief that frogs are dangerous and can spit a poison that causes infection in humans, therefore one should not touch them and should rather run away if you see them. Frogs are widely regarded by experts as harmless, however many frogs carry a toxin which they secrete when they are critically harmed. The banded rubber frog (*Phrynomantis bifasciatus*) is common in the north-eastern parts of South Africa and the areas where Xhosa and Zulu are widely spoken. It secretes an irritating toxin which can result in rashes or vomiting if handled extensively by sensitive individuals [39]. The presence of this frog may go some way to explaining the belief that frogs can cause a rash through spitting. This belief seems to preclude children from early encounters with frogs and discourages them from playing too close to them, so they are unlikely to have positive life experiences with frogs and the resulting phobia, or disaffiliation, is carried through into adulthood.

Recruiting community leaders or celebrities to champion pro-environmental behaviour can assist in fostering positive norms within a given society [2]. Environmentalists must be sensitized to the cultural beliefs and systems of the people that co-exist with the ecosystems they seek to conserve. Understanding the underlying suspicions, beliefs and impacts is an important step towards garnering support for conservation efforts. Further research should evaluate communities with negative outlooks on groups of animal species, e.g. snakes, vultures, mammalian predators, and explore the qualitative themes among the minority sub-groups

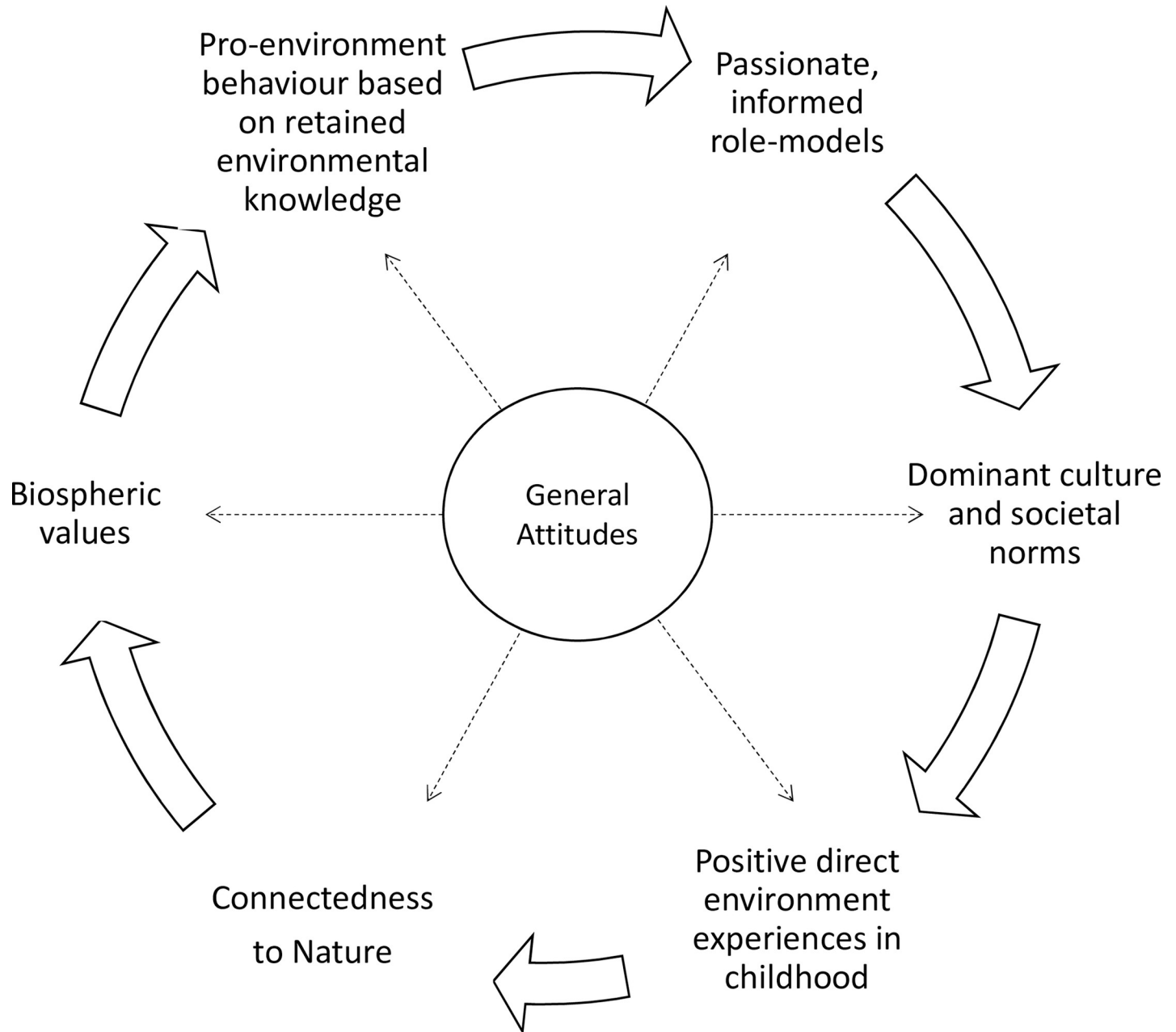


Fig 6. Cycle of knowledge, values and behaviour as the drivers of general attitudes adapted from [50].

<https://doi.org/10.1371/journal.pone.0219331.g006>

who are positively disposed. Put more specifically: what is different about the life experiences of those who like frogs within the Xhosa group?

Knowledge

The knowledge results within this study showed a correlation between accurate knowledge and liking frogs. The group that disliked frogs had a smaller mean score for knowledge and beliefs. It is not clear if lack of accurate knowledge was driven by disliking frogs or if disliking frogs meant that individuals were disinterested in accurate knowledge. Many previous studies

have determined that direct experiences of animals, pets, and nature increases the retention of knowledge about these creatures and improves attitudes [37]. Those who reported direct positive experiences with frogs in their childhood also scored higher on knowledge and beliefs and this may be a precursor to retaining accurate knowledge. Educational programmes that include components of direct experience increase knowledge retention and changes in attitudes [34].

We did not seek to measure the impacts of educational strategies but rather to determine what factors were associated with a general attitude of liking frogs. We confirmed that there is a relationship between knowledge and liking frogs, which is echoed in studies which determined that attitudes are seated in what people believe (cognitive knowledge) and how they feel about the environment (affective knowledge) [51]. We observed examples of both intergenerational knowledge and the use of knowledge in better environmental decision-making. In the first instance the knowledge of others (role-models) is a factor in driving the value-basis during the formation / deepening of CTN during childhood, while in the second instance, knowledge becomes a factor which shapes decision-making and pro-environmental actions. Therefore learning, whether formal, informal, direct or indirect is an integral foundation to fostering environmental behaviour. However it is not a factor that drives the formation of positive attitudes on its own [51]. Thus, it is important that quality information continues to be made regularly available to the public in order to facilitate appropriate pro-environmental behaviour and continue the cycle of generating experiences that drive biospheric values. The factors which shape general attitudes towards pro-environmental behaviour are interrelated and form a cycle which can be used in generating information (Fig 6).

Conclusion

This study used a traditionally unpopular group of animals to explore why people like or dislike amphibians and consequently what might motivate them to amphibian stewardship behaviours. It found that individual charismatic species can be championed amongst groups regardless of affinity towards the class of animals. However, positive general attitudes are shaped by a combination of complex social forces, most notably, cultural norms, and regular positive experiences of the species.

Supporting information

S1 Fig. Questionnaire survey instrument.

(XLSX)

S2 Fig. Database of anonymized results.

(SAV)

Author Contributions

Data curation: Peta Brom.

Formal analysis: Peta Brom.

Investigation: Peta Brom.

Methodology: Peta Brom.

Project administration: Peta Brom.

Resources: Pippin Anderson.

Supervision: Pippin Anderson, Alan Channing, Leslie G. Underhill.

Visualization: Peta Brom.

Writing – original draft: Peta Brom.

Writing – review & editing: Peta Brom, Pippin Anderson, Alan Channing, Leslie G. Underhill.

References

1. United Nations, Department of Economic and Social Affairs PD. World Urbanization Prospects: The 2018 Revision. In: Online Edition [Internet]. 2018 pp. 1–2. Available: <https://esa.un.org/unpd/wup/Publications>
2. Nassauer JI, Wang Z, Dayrell E. What will the neighbors think? Cultural norms and ecological design. *Landsc Urban Plan.* 2009; 92: 282–292. <https://doi.org/10.1016/j.landurbplan.2009.05.010>
3. Larson KL, Casagrande D, Harlan SL, Yabiku ST. Residents' yard choices and rationales in a desert city: Social priorities, ecological impacts, and decision tradeoffs. *Environ Manage.* 2009; 44: 921–937. <https://doi.org/10.1007/s00267-009-9353-1> PMID: 19777295
4. Goddard MA, Dougill AJ, Benton TG. Why garden for wildlife? Social and ecological drivers, motivations and barriers for biodiversity management in residential landscapes. *Ecol Econ.* Elsevier B.V.; 2013; 86: 258–273. <https://doi.org/10.1016/j.ecolecon.2012.07.016>
5. Clayton S. Domesticated nature: Motivations for gardening and perceptions of environmental impact. *J Environ Psychol.* 2007; 27: 215–224. <https://doi.org/10.1016/j.jenvp.2007.06.001>
6. Ceriaco LM. Human attitudes towards herpetofauna: The influence of folklore and negative values on the conservation of amphibians and reptiles in Portugal. *J Ethnobiol Ethnomed.* 2012; 8: 8. <https://doi.org/10.1186/1746-4269-8-8> PMID: 22316318
7. Kiesling FM, Manning CM. How green is your thumb? Environmental gardening identity and ecological gardening practices. *J Environ Psychol.* 2010; 30: 315–327. <https://doi.org/10.1016/j.jenvp.2010.02.004>
8. Freeman C, Dickinson KJM, Porter S, van Heezik Y. “My garden is an expression of me”: Exploring householders' relationships with their gardens. *J Environ Psychol.* 2012; 32: 135–143. <https://doi.org/10.1016/j.jenvp.2012.01.005>
9. Hocking DJ, Babbitt KJ. Amphibian contributions to ecosystem services. *Herpetol Conserv Biol.* 2014; 9: 1–17.
10. Stuart SN, Chanson JS, Cox NA, Young BE, Ana SL, Fischman DL, et al. Status and trends of amphibian declines and extinctions worldwide. *Science (80-).* 2004; 306: 1783–1786. <https://doi.org/10.1126/science.1103538> PMID: 15486254
11. Measey GJ. Ensuring a future for South Africa's frogs: a strategy for conservation research. Measey GJ, editor. Cape Town: SANBI; 2011.
12. Beebee TJC, Griffiths RA. The amphibian decline crisis: A watershed for conservation biology? *Biol Conserv.* 2005; 125: 271–285. <https://doi.org/10.1016/j.biocon.2005.04.009>
13. Mokhatla MM, Rödder D, Measey GJ. Assessing the effects of climate change on distributions of Cape Floristic Region amphibians. *S Afr J Sci.* 2015; Volume 111: 1–7. <https://doi.org/10.17159/sajs.2015/20140389>
14. Magle SB, Hunt VM, Vernon M, Crooks KR. Urban wildlife research: Past, present, and future. *Biol Conserv.* 2012; 155: 23–32.
15. Ives CD, Lentini PE, Threlfall CG, Ikin K, Shanahan DF, Garrard GE, et al. Cities are hotspots for threatened species. *Glob Ecol Biogeogr.* 2015; 25: 117–126. <https://doi.org/10.1111/geb.12404>
16. Goddard MA, Dougill AJ, Benton TG. Scaling up from gardens: biodiversity conservation in urban environments. *Trends Ecol Evol.* 2010; 25: 90–98. <https://doi.org/10.1016/j.tree.2009.07.016> PMID: 19758724
17. Westgate MJ, Scheele BC, Ikin K, Hoefer AM, Beaty RM, Evans M, et al. Citizen science program shows urban areas have lower occurrence of frog species, but not accelerated declines. *PLoS One.* 2015; 10: e0140973. <https://doi.org/10.1371/journal.pone.0140973> PMID: 26580412
18. Simon JA, Snodgrass JW, Casey RE, Sparling DW. Spatial correlates of amphibian use of constructed wetlands in an urban landscape. In: *Landscape Ecology.* 2009 pp. 361–373. <https://doi.org/10.1007/s10980-008-9311-y>

19. Le Viol I, Chiron F, Julliard R, Kerbiriou C. More amphibians than expected in highway stormwater ponds. *Ecol Eng*. 2012; 47: 146–154. <https://doi.org/10.1016/j.ecoleng.2012.06.031>
20. Scheffers BR, Paszkowski CA. The effects of urbanization on North American amphibian species: Identifying new directions for urban conservation. *Urban Ecosyst*. 2012; 15: 133–147. <https://doi.org/10.1007/s11252-011-0199-y>
21. Tarrant J, Kruger D, Preez L, du Preez L. Do public attitudes affect conservation effort? Using a questionnaire-based survey to assess perceptions, beliefs and superstitions associated with frogs in South Africa. *African Zool*. 2016; 7020: 1–26. <https://doi.org/10.1080/15627020.2015.1122554>
22. Hassall C, Anderson S. Stormwater ponds can contain comparable biodiversity to unmanaged wetlands in urban areas. *Hydrobiologia*. 2014; 745: 137–149. <https://doi.org/10.1007/s10750-014-2100-5>
23. Scheffers BR, Paszkowski CA. Amphibian use of urban stormwater wetlands: The role of natural habitat features. *Landsc Urban Plan*. 2013; 113: 139–149. <https://doi.org/10.1016/j.landurbplan.2013.01.001>
24. Kruger DJD, Hamer AJ, du Preez LH. Urbanization affects frog communities at multiple scales in a rapidly developing African city. *Urban Ecosyst*. 2015; 18: 1333–1352. <https://doi.org/10.1007/s11252-015-0443-y>
25. Rose W. Veld & Vlei. An account of South African frogs, toads, lizards, snakes, & tortoises [Internet]. Cape Town: The Specialty Press of South Africa Ltd.; 1929. Available: <file://catalog.hathitrust.org/Record/002014593>
26. Macbeth Shakespeare W.. Ninth. Rumboll FCH, editor. Cape Town: Maskew Miller Longman; 1989.
27. Schlegel J, Rupp R. Attitudes towards potential animal flagship species in nature conservation: A survey among students of different educational institutions. *J Nat Conserv*. 2017; 18: 278–290. <https://doi.org/10.1016/j.jnc.2009.12.002>
28. Merckelbach H, Muris P. The etiology of childhood spider phobia. *Behav Res Theory*. 1997; 35: 1031–1034.
29. Palmer JA, Suggate J, Robottom I, Hart P. Significant life experiences and formative influences on the development of adults' environmental awareness in the UK, Australia, and Canada. *Environ Educ Res*. 1999; 5: 181–200.
30. Hunter LM, Brehm JM. A qualitative examination of value orientations toward wildlife and biodiversity by rural residents of the intermountain region. *Hum Ecol Rev*. 2004; 11: 13–26.
31. Tomažič I. Reported experiences enhance favourable attitudes toward toads. *Eurasia J Math Sci Technol Educ*. 2011; 7: 253–262.
32. Tomažič I. Seventh graders; direct experience with, and feelings toward, amphibians and some other nonhuman animals. *Soc Anim*. 2011; 19: 225–247. <https://doi.org/10.1163/156853011X578901>
33. Wells NM, Lekies KS. Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Child Youth Environ*. 2006; 16: 1–25. Available online: www.colorado.edu/journals/cye
34. Duerden MD, Witt PA. The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. *J Environ Psychol*. Elsevier Ltd; 2010; 30: 379–392. <https://doi.org/10.1016/j.jenvp.2010.03.007>
35. Hammond-Tooke WD. Divinatory animals: Further evidence of San/Nguni borrowing? *South African Archaeol Bull*. 1999; 54: 128–132. <https://doi.org/10.2307/3889291>
36. Ownby CP. Early Nguni history: Linguistic suggestions. *South African J African Lang*. 1981; 1: 60–81. <https://doi.org/10.1080/02572117.1981.10586450>
37. Prokop P, Medina-jerez W, Coleman J, Fančovičová J, Özel M, Fedor P. Tolerance of frogs among high school students: Influences of disgust and culture. *Eurasia J Math Sci Technol Educ*. 2016; 12: 1499–1505. <https://doi.org/10.12973/eurasia.2016.1241a>
38. Randler C, Hummel E, Prokop P. Practical work at school reduces disgust and fear of unpopular animals. *Soc Anim*. 2012; 20: 61–74. <https://doi.org/10.1163/156853012X614369>
39. Du Preez LH, Carruthers V. *A Complete Guide to the Frogs of Southern Africa*. Cape Town: Struik Nature; 2009.
40. Belaire JA, Westphal LM, Minor ES. Different social drivers, including perceptions of urban wildlife, explain the ecological resources in residential landscapes. *Landsc Ecol*. 2015; 401–413. <https://doi.org/10.1007/s10980-015-0256-7>
41. de Groot WT, van den Born RJG. Visions of nature and landscape type preferences: an exploration in The Netherlands. *Landsc Urban Plan*. 2003; 63: 127–138. [https://doi.org/10.1016/S0169-2046\(02\)00184-6](https://doi.org/10.1016/S0169-2046(02)00184-6)
42. SurveyMonkey Inc. [Internet]. San Mateo, California, USA; Available: www.surveymonkey.com

43. Knight AJ. "Bats, snakes and spiders, Oh my!" How aesthetic and negativistic attitudes, and other concepts predict support for species protection. *J Environ Psychol.* 2008; 28: 94–103. <https://doi.org/10.1016/j.jenvp.2007.10.001>
44. Prokop P, Randler C. Biological predispositions and individual differences in human attitudes toward animals [Internet]. 1st ed. Alves RRN, Albuquerque UP, editors. *Ethnozology.* Elsevier Inc.; 2017. <https://doi.org/10.1016/B978-0-12-809913-1.00023-5>
45. Prokop P, Fancovicova J. Tolerance of amphibians in Slovakian people: A comparison of pond owners. *Anthrozoos.* 2014; 25: 277–288. <https://doi.org/10.2752/175303712X13403555186136>
46. Prokop P, Fanc J. Does colour matter? The influence of animal warning coloration on human emotions and willingness to protect them. 2013; 16: 458–466. <https://doi.org/10.1111/acv.12014>
47. De Groot JIM, Steg L. Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *J Environ Psychol.* Elsevier Ltd; 2010; 30: 368–378. <https://doi.org/10.1016/j.jenvp.2010.04.002>
48. Martin C, Czellar S. Where do biospheric values come from? A connectedness to nature perspective. *J Environ Psychol.* 2017; 52: 56–68. <https://doi.org/10.1016/j.jenvp.2017.04.009>
49. Mayer FS, Frantz CM. The connectedness to nature scale: A measure of individuals' feeling in community with nature. *J Environ Psychol.* 2004; 24: 503–515. <https://doi.org/10.1016/j.jenvp.2004.10.001>
50. Klassen MJ. Connectedness to nature: Comparing rural and urban youths' relationships with nature. 2010; 1–158.
51. Pooley JA, O'Connor MM. Environmental education and attitudes: Emotions and beliefs are what is needed. *Environ Behav.* 2000; 32: 711–723. <https://doi.org/10.1177/0013916500325007>