ANTHROZOÖS
2022, AHEAD-OF-PRINT, 1-18
https://doi.org/10.1080/08927936.2022.2051934

Understanding the Human–Reptile Bond: An Exploratory Mixed-Methods Study

Alexandre Azevedo[a,b,c], Leonor Guimarães[d,e], Joel Ferraz[f], Martin Whiting[a,b], and Manuel Magalhães-Sant'Ana[a,b]

[a] CIISA – Centro de Investigação Interdisciplinar em Sanidade Animal, Faculdade de Medicina Veterinária, Universidade de Lisboa, Lisbon, Portugal [b] Laboratório Associado para Ciência Animal e Veterinária (AL4AnimalS) [c] Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto, Porto, Portugal [d] Escola Universitária Vasco da Gama, Coimbra, Portugal [e] Clínica Veterinária Exoclinic, Lisbon, Portugal [f] Centro Veterinário de Exóticos do Porto, Porto, Portugal

ABSTRACT

Owning reptiles (e.g., chelonians, lizards, and snakes) poses a great deal of challenges in terms of welfare and care, as well as conservation and environmental concerns. However, despite the large scale of the reptile trade, little is known about the motives for acquiring and keeping these animals. This research provides the first empirical investigation on the motives for owning reptiles as pets in Portugal as well as on the nature of the human–reptile bond. Using a mixed-methods approach, an online survey was used to gather the views and opinions of 220 reptile owners. Respondents described their affection toward reptiles using terms that denote affective states of increasing intensity: "to like", "to love," "fascination," and "passion." Four main categories of motivations for the long-term keeping of pet reptiles were identified: convenience, entertainment, companionship, and duty of care. Respondents perceived their pets as family members (64%) and as sentient beings, including the ability to feel "stress or fear" (≥ 80%) and "pain or discomfort" (≥74%). Snakes differed from lizards and chelonians in the sense that they were less frequently considered a "family member" ($\chi^2_{(2)} = 7.14$, $p = 0.03$) and were perceived as less able to communicate ($\chi^2_{(2)} = 9.91$, $p < 0.01$). Results suggest that human–reptile relations are driven by the same feelings as those previously reported for mammalian pets, although they are more diverse and nuanced by a sense of admiration and fascination for their mysterious nature and unusual behaviors. Building on these strong emotional bonds, promoting early education about wildlife conservation, and responsible pet keeping could play a crucial role in improving captive-reptile welfare.

KEYWORDS

Human–animal bond, human–animal interaction, ownership, pets, Portugal, reptiles

CONTACT Manuel Magalhães-Sant'Ana mdsantana@fmv.ulisboa.pt CIISA – Centro de Investigação Interdisciplinar em Sanidade Animal, Faculdade de Medicina Veterinária, Universidade de Lisboa, 1300-477 Lisbon, Portugal

Supplemental data for this article can be accessed online at https://doi.org/10.1080/08927936.2022.2051934

Millions of reptiles are traded and kept in households as pets worldwide. In the European Union alone, over 500 reptile species have been identified in trade (Warwick et al., 2018), and an estimated 8 million reptiles are kept as household pets (Toland et al., 2020). Despite the challenges posed by limited available information on reptile husbandry for prospective owners and the high cost of enclosures, the scale of the reptile pet trade suggests it is driven by strong motivations to acquire and keep reptiles as pets.

The pet-keeping or cross-species adoption hypothesis first proposed by Francis Galton (1865) suggests that domestication was driven by the keeping and nurturing of young animals in hunter-gatherer communities, resulting in the selection of traits that favored co-habitation with humans (Serpell, 2021). While the relationships between humans and common mammalian pets have been extensively researched (Bradshaw, 2016; Hare et al., 2002; Johnson et al., 1992; Riedel et al., 2008; Templer et al., 1981; Zasloff, 1996), it is not clear whether the results extrapolate to reptiles, which seem less fit to fulfill the human need for the expression of nurturing behavior. Attitudes of humans toward reptiles appear to depend on the type of reptile, with turtles and tortoises ranking among the most liked animals, and snakes among the most disliked species (Almeida et al., 2014; George et al., 2016). However, these same studies reveal consistency in attitudes toward reptiles over recent decades and between children and adults, at least in western societies.

Attitudes toward nonhuman animals have been frequently described under two major motivational categories: one related to affection and another related to utility (Serpell, 2004). These are influenced by modifiers such as the characteristics of the human or the characteristics of the animal (Serpell, 2004). Because animals' physical and behavioral characteristics influence attitudes toward them (Driscoll, 1992, 1995; Powell & Ardaiolo, 2016), they are expected to influence the likelihood of their selection for companionship. Species that display "human-like" behaviors, such as parrots or primates, might be more frequently kept for companionship (Reuter & Schaefer, 2017; Rodríguez et al., 2020). Reptiles lack these behavioral traits and many of the characteristics that elicit positive attitudes from humans, such as neotenic features or large size. Human preference for different species can be influenced by minor features that do not follow these general trends, such as warm colors or contrast (Stokes, 2007). In addition to color, other traits such as shape or type of locomotion might underlie different motivations to keep reptiles as pets (Landová et al., 2012; Ptáčková et al., 2017).

Exotic pets are usually considered non-native and non-domesticated animals that are kept in captivity, but defining what exactly is an exotic pet is challenging. However, Mitchell and Tully (2008) acknowledge that some exotic pets are native or domestic; they prefer to use the term to designate those animals that are "strikingly, excitingly, or mysteriously different or unusual" (p. 1). Research on the motivations for owning exotic pets is scarce and the results are inconsistent (Kampfer & Love, 1998; Kieswetter, 2017; Shukhova & MacMillan, 2020; Vonk et al., 2016). While exotic-pet ownership has been associated with narcissistic and "borderline personality disorders" and linked to the social projection of status (Vonk et al., 2016), some authors argue it is driven by the same affect-related motivations as with domestic species (Kieswetter, 2017). Based on survey data, Kampfer and Love (1998) suggest that although motivations for desert tortoise (*Gopherus agassizii*) ownership differ from "general pet ownership," tortoise owners appear to feel similar concern and affection for their pets. Shukhova and MacMillan (2020) used open-ended interviews in an attempt to capture the motivations for exotic-pet ownership in Russia and classified them into four categories: "life-savers," "accidental owners," "new experience seekers," and "collectors." Although generalizations are limited by the qualitative nature of the study, results suggest that motivations are likely to differ between the exotic species' taxonomic groups. The diversity of exotic-pet species and the variety of human–animal relations, coupled with the limited knowledge about innate fears resulting from co-evolutionary "arms-races" with species that predated on or threatened human ancestors, make open-ended approaches a useful tool for prospective studies of motivations for exotic-pet ownership.

The diversity of attitudes and motivations toward animals according to culture and evolutionary history is illustrated by the example of snakes. Humans have a unique relationship with snakes that differs from other animals and might even pre-date the relationship with dogs (Isbell, 2006). In many primates including humans, snakes capture attention more rapidly than other animals and elicit fear reactions, even in individuals who have never seen a snake before; this has led to the suggestion that primates possess an innate fear of snakes owing to the risk they posed over the course of their common evolutionary history

(Weiss et al., 2015). In light of this "hard-wired" aversion, the popularity of snakes as pets does not seem to align with the "cross-species adoption" paradigm, based on the expression of human nurturing behavior. Studies of children's attitudes toward animals have found snakes to be the object of two distinct and non-mutually exclusive perceptions of danger and beauty (Almeida et al., 2014; Landová et al., 2012) that are present in different cultures (Marešová et al., 2009).

Janovcová et al. (2019) assessed attitudes toward photos of reptiles and found that people discriminate snakes and legless lizards from all other reptiles. Overall, legless reptiles scored higher in fearfulness, and the most feared species were also perceived as the most beautiful. Conversely, in the legged reptiles, the most disgusting and feared species were considered less beautiful. Contrary to the consistent tendency to perceive snakes as dangerous, lizards evoke ambiguous attitudes in humans, ranging from harmless food sources (e.g., *Iguana iguana, Tupinambis* sp.) to deadly threats (Alves et al., 2012). Notable examples of fears of lizards specific to certain cultures are the fear of harmless geckos (Ceriaco et al., 2011) or of monitor lizards (Rahman et al., 2017). Additionally, large species like some crocodilians and Komodo dragons induce fear, probably owing to their recognition as potential predators (Janovcová et al., 2019). In the same study, chelonians were grouped with, and followed the same trends as, other legged reptiles.

Reptiles pose challenges in terms of their welfare and care, as well as conservation and environmental concerns, and little is known about the reasons for acquiring and keeping them. As part of a wider survey on the welfare issues of captive reptiles in Portugal, the aim of this study was to characterize the human–reptile bond and the diversity of arguments that may contribute to the decision of acquiring and keeping them. The results of this study will contribute to the knowledge base required to promote responsible reptile keeping and trade.

Methods

Ethics Statement

The study conformed to standard procedures for ethical approval at Escola Universitária Vasco da Gama (EUVG), Coimbra, Portugal that were in place at the time. It was part of a *MSc* dissertation in Veterinary Medicine that had received approval from the EUVG Scientific Council before data collection. Participation was voluntary and anonymous and no identifiable information was stored. Participants were informed about the aims of the study and that the information gathered would be used solely for the purpose of this research and not shared with third parties. The contact details of the researcher responsible for the study, LG, were provided for further inquiries.

Survey Design

An online survey was developed to gather the views and opinions of reptile owners[1] in Portugal. It followed procedures used in previous studies (d'Ovidio et al., 2016; Pirrone et al., 2015; Warwick et al., 2013), and questions were based on a literature review. Both multiple-choice and short-answer questions were used. A draft of the survey was independently piloted by a group of exotic-animal veterinary practitioners ($n = 5$) and was revised accordingly.

The survey was divided into five sections (see online supplemental materials: S1). The first section aimed to describe the animals (scientific or common name, age, sex, and source). The second section dealt with husbandry and care, the results of which have been described elsewhere (Azevedo et al., 2021). The third section dealt with the human–animal relationship, including satisfaction, social interactions, and bond type (family member, friend, pet, burden, no opinion, and other). In the fourth section, participants were asked what they thought were the causes of 10 characteristic reptile behaviors, adapted from Warwick et al. (2013) (questions and possible answers listed in Table 1). Some of the answers were related to emotions and

feelings. Among those, “pain or discomfort,” “stress or fear,” and “attempt to communicate” were selected for analysis in this study as they are unambiguously associated with the perception of reptiles as sentient beings. The remaining questions, and the assessment of the competence of participants to interpret reptile behavior, are discussed in a separate publication. The last section included owners’ demographic information (age, gender, housing, location, education) and an open-ended question to explore the reasons why they had decided to acquire and keep a reptile. Closed-ended research questions were mandatory, although a “Other/Don't Know” option was available, whereas open-ended questions were voluntary. All demographic questions (Section five) were voluntary. The full questionnaire is provided in S1 of the online supplemental material.

Table 1. Reptile behaviors that survey participants were asked to assess, followed by the list of possible answers. (Table view)

List of behaviors	Possible answers
• The animal investigates its environment, approaching and smelling people and/or objects. • The animal exposes itself to light (solar/lamp) or moves near to the heat source. • The animal frequently hits its head or tries to climb the enclosure glass or wall. • A reduction in physical activity or appetite. • Aggression toward humans (for example trying to bite). • Fast open-mouth breathing accompanied by neck extension. • The animal defecates/urinates or regurgitates when in contact with, or in the presence of, a person. • The animal moves to a darker area or hiding place in the enclosure. • The animal has difficulty coiling (snakes only). • The animal spends long periods in water (snakes only). • Retraction into the carapace in the presence of humans (chelonians only). • The animal repeatedly retracts and protrudes its head into the carapace (chelonians only). • The animal inflates its body and appears larger (lizards only). • Changes in skin color (lizards only).	• Attempt to communicate • Stress/fear • Attempt to escape • Pain • Discomfort or illness • Search for food • Breeding season • Beginning of hibernation • Hot • Cold • “Other” followed by an open field

Using the Google Forms platform, the survey was submitted via e-mail by the second author (L.G.) to clients attending an exotic-animal veterinary practice (Centro Veterinário de Exóticos do Porto) between November and December 2017. It was also promoted via seven veterinary practices with high exotic-animal caseloads, three pet shop franchises, and 11 private groups on social media that focused on pet reptile ownership and care (from which L.G. is a member). In case they had more than one reptile, participants were instructed to consider only one animal when answering the questions. Repeated submissions ($n = 3$) were identified and discarded.

Data Handling and Analysis

Quantitative data were handled using Microsoft Excel 2010 and analyzed using statistical software R (R Core Team, 2020). For questions where answers were not mutually exclusive, dummy-coding of variables was performed to calculate descriptive statistics. Pearson's chi-square test with Yates’ continuity correction was used to test the association between the taxonomic group and bond type. We considered $p < 0.05$ statistically significant.

Qualitative answers on why participants decided to acquire and keep a reptile were imported into NVIVO (QSR International) and analyzed through sequential rounds of coding, following the preparation, organizing, and reporting phases described by Elo and Kyngäs (2008). Inductive coding of these answers (without *a priori* categorization) was used in a three-round process. In the first round, the content was coded into generic themes that emerged from data immersion by MMS, who is a veterinarian experienced in qualitative content analysis. Five generic themes were initially identified (Affective states, Convenience, Entertainment, Negative Aspects, and Origin). Themes were iteratively revised as the analysis progressed. In the second round, sub-categories were generated and items were iteratively relocated (e.g., Companionship moved from "Affective states" to "Reasons for acquiring a reptile").

At this stage, both positivistic and constructivist reliability measures were applied. Data were independently coded by another researcher (AA) following a brief description of the themes that were generated at the end of Round 2. A 97.43% average agreement and a Cohen's coefficient of $k = 0.62$ were obtained, which indicates substantial intercoder agreement (McHugh, 2012). In the third round, differences in coding were identified, discussed between the authors, and a consensus was reached. Incorporating the coding consensus process into the thematic analysis allowed for a constructivist revision of the themes. The themes that emerged from the thematic analysis will be described in the results section. Quantitative content analysis was also performed to identify the frequency of key terms. The Oxford English Dictionary was used to ensure that the English translation encapsulated the original meaning.

Results

Quantitative Data

In total, 220 reptile owners answered the questionnaire, 123 (56%) of which were women, and 95 (43%) were men (1% did not answer). The median age of the respondents was 27 years (ranging from 16 to 65). The majority (83%) came from an urban environment, and 33 (15%) came from a rural environment (2% did not answer). Most participants lived in an apartment (128; 58%), and 89 (40.6%) lived in a family house (1.4% did not answer). In terms of education, 127 participants (58%) had a university education and only three (1.4%), aged 25, 31, and 39 had less than the minimum mandatory education (currently the 9th grade, with expected completion at 17–18 years of age).

In terms of the pet reptile, 144 participants (65%) had chelonians, 41 (19%) had lizards, and 35 (16%) had snakes. Almost two-thirds of respondents acquired their reptile from a pet shop (65%), 23% said it was gifted, and 10% obtained them directly from a breeder. A list of all reptile species reported in the survey is provided in the online supplemental materials (S2).

All 220 respondents answered the question on how they defined their reptiles. The options were not mutually exclusive. Reptiles were most frequently defined as "family member" (64%), followed by "pets" (43%) and "friends" (21%). A 32-year-old male respondent owning a red-eared slider (*Trachemys scripta*) that had been given to him by his mother when he was nine defined it as a "burden" (< 1%). When only the closest bond type in each answer was taken into account (considering family member > friend > pet > burden) the results were qualitatively similar, with "family member" as the most frequently reported bond type (64%), followed by "pet" (28%), "friend" (8%), and finally "burden" (<1%). Different trends were observed in the distribution of answers between taxonomic groups (Figure 1). A significant association was present between taxonomic group and reporting the reptile as "family member" ($\chi^2_{(2)} = 7.14$, $p = 0.03$); lizards were reported as "family member" most frequently, followed by chelonians and finally snakes.

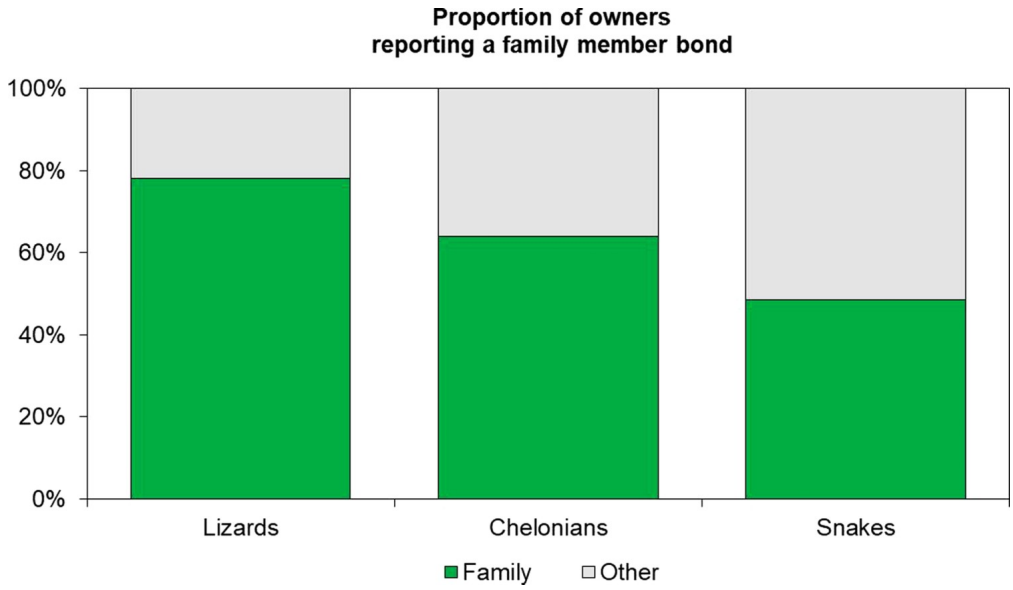

Figure 1. Frequencies of owners reporting a family member bond with their reptile pet, across taxonomic groups.

Regarding the interpretation of characteristic reptile behaviors, "stress or fear" was mentioned at least once by 92% of chelonian owners, 90% of lizard owners, and 80% of snake owners. "Pain or discomfort" was mentioned at least once by 77% of snake owners, 76% of lizard owners, and 74% of people keeping chelonians. "Attempt to communicate" showed the greatest variation between groups, and was mentioned at least once by 54% of lizard owners and 49% of chelonian owners, but only 20% of snake owners (Figure 2). The frequency of sentience-related mentions varied between the taxonomic group for "attempt to communicate" ($\chi^2_{(2)} = 9.91$, $p < 0.01$), but not for "pain or discomfort" ($\chi^2_{(2)} = 0.60$, $p = 0.74$) or "stress or fear" ($\chi^2_{(2)} = 2.69$, $p = 0.26$).

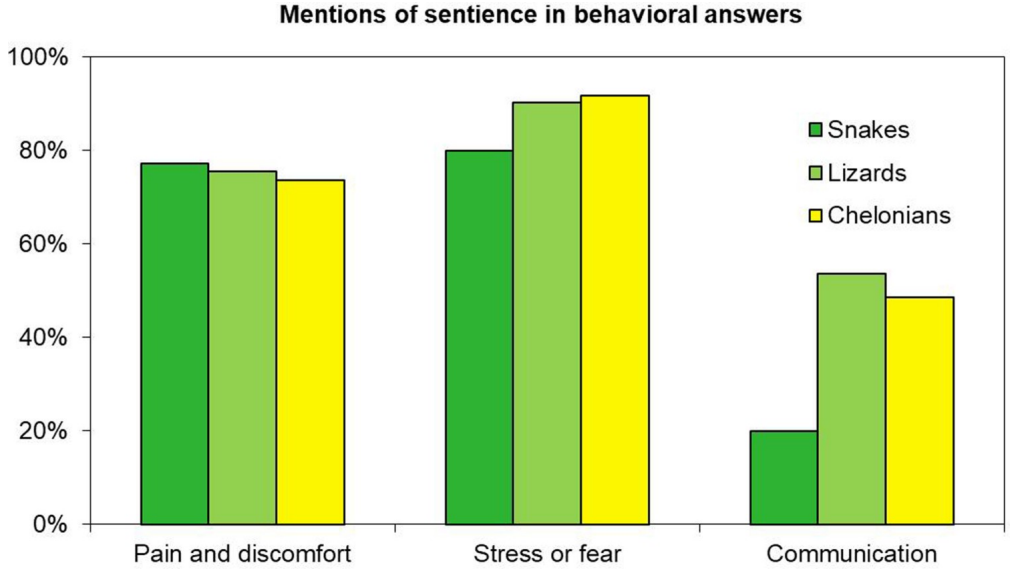

Figure 2. Frequencies of participants justifying at least one behavior of their pet reptile with feelings of pain and/or discomfort, stress or fear, and attempts to communicate.

Qualitative Data

Eighty-two percent of participants ($n = 180$) answered the open-ended question on why they decided to acquire and keep a reptile, and four main themes emerged from the analysis: affective states, motivations for acquiring reptiles, reasons for keeping reptiles, and negative aspects of reptile ownership. Themes and sub-

themes will be described in further detail. A word count was conducted (Table 2) and related to the number of respondents who used each particular expression or theme.

Table 2. Terms used by owners of reptiles in Portugal to designate affective states toward their animals. (Table view)

Affective state (in English)	Original Portuguese term	*n*	Percentage of total (180) respondents
Fondness (to like)	Gostar	40	22.2
Love	Amar, adorar	20	11.1
Fascination	Fascínio	19	10.5
Passion	Paixão, apaixonado,	20	11.1
Other: obsession, desire, dream	Obsessão, desejo, sonho	6	3.3

Note: A few owners used two or more terms.

Affective States

Ninety-seven respondents (54%) reported to at least one affective state in order to explain why they decided to acquire and keep a reptile. Respondents described their affection toward reptiles using terms that convey emotions and affective states of increasing intensity: “to like” (fondness), “to love,” “fascination,” and “passion” (Table 2, Figure 3).

Figure 3. Word Cloud of 100 most frequent words using NVIVO Software (in Portuguese). Search specifications: minimum length of four characters; with synonyms; default stop words excluded. Most used terms (in the center) include: *always, like, very, animals, reptiles, turtles*; followed by (in bold): *conditions, knowledge, past, better, species, years, have/had, little, my, child, passion, love, care, home, and offered*.

For example, the theme “love” was used to denote the use of the terms love and adoration toward the animal itself, the species, or even nature. In Portuguese (Portugal) “to adore” [adorar] is more frequently used than “to love” [amar] to designate a feeling of great affection (Table 2). Although most respondents only briefly explained what they meant by their affection, two described how having a reptile transcends the caring of one animal and symbolizes their passion for all of nature. The response of a student from the area of life sciences owning a leopard tortoise (*Stygmochelys pardalis*) was particularly revealing of the transcendent experience of keeping a reptile:

> As passionate about the History of Life, having a reptile, in particular a land turtle (…), brings me closer to the past, something that I find extraordinary. Due to the characteristic longevity of turtles, I always liked to imagine them (…) as holders of great wisdom due to the knowledge accumulated over a long life. And knowledge is the only wealth that cannot be stolen from us.

Reasons for Acquiring a Pet Reptile

Participants alluded to different reasons for having acquired a reptile. The animals were either purchased, gifted, inherited, adopted, or rescued from the street or from someone close. Several owners ($n = 3$) claimed to have rescued their reptile from the pet shop instead of saying that they had bought it. Participants explained how they were so unhappy with the housing conditions at the pet shop – or lack thereof – that they felt compelled to buy the animal in order to provide it with better care. A musician from an urban area owning a ball python (*Python regius*) described how he walked into a pet store "by chance" and felt sorry for the animal. After acquiring knowledge about the species, he came back a few days later to "rescue" it. Another urban reptile owner with a university education, who kept several semi-aquatic turtles, among which she chose the river cooter (*Pseudemys concinna*) for the survey, elaborated:

> I like to take care of my turtles, and provide them with a better life than the ones they had in the store where they were sold. I like to think that I saved them from that life, or from another possibly less happy life, considering any other owner who might have bought it instead of me.

Past experiences with reptiles, particularly childhood experiences, were a theme that emerged frequently ($n = 36$). For some, having a reptile was a childhood dream that they were only able to fulfill in adulthood (e.g., "I wanted to have a reptile [since I was a child] but my parents never liked [the idea]"). Others mentioned that they have had reptiles since they were children (often a gift) and that they were fond of these animals ever since. Finally, some participants mentioned that the reptile was gifted to one of their children, at their request or because they thought it would be amusing.

Motivations for the Long-Term Keeping of a Pet Reptile

Participants described reptile keeping in terms of entertainment, convenience, companionship, and duty of care. Twenty-six (12%) participants highlighted how keeping reptiles was a source of *entertainment*. For some, what moved them were the exceptional characteristics of reptiles, which made them very interesting to watch. For a 22-year-old reptile breeder who owned a ball python, reptiles "are completely different from mammals and birds and have very interesting behaviors." Owners mentioned enjoying their beauty, intelligence, mysterious nature, and unusual behaviors. Keeping reptiles was also regarded as a stimulating challenge, an entertaining hobby that requires continuous study of their biological needs.

Keeping reptiles was also seen as a matter of *convenience* ($n = 28$). Reptiles were described as manageable, independent, low-maintenance, high longevity pets. Some of the advantages over other pets identified by participants included the absence of irritating noises, shedded hair, or allergies. It was also mentioned that turtles are well adapted to the local climate which enables them to live outdoors all year round. Finally, one turtle owner reported the benefit and utility of the pet in controlling pest snail populations.

Some of the answers conveyed the idea of *companionship* ($n = 22$). Participants referred to their reptile as "interactive creatures" that are even capable of acquiring habits similar to their owners'. One respondent described her bearded dragon (*Pogona vitticeps*) as a sociable animal and another said that his red-footed tortoise (*Chelonoidis carbonaria*) conveyed calmness and affection. The need for physical contact and interaction with their reptiles was also mentioned.

The status of *family member* emerged as a sub-category of companionship, and was mentioned by seven reptile owners, such as a 24-year-old university student owning a map turtle (*Graptemys sp.*) that was given to her when she was seven:

> It was offered to me when I was younger. I think that people should make a commitment to take care of animals and not abandon or give them away when they have them. A turtle is a member of the family like any other animal.

The previous quote also provides an example of those who framed reptile keeping in terms of *duty of care* ($n = 15$). The arguments put forth to justify the duty of care were related to the challenges of keeping a reptile, challenges that participants seemed to be well aware of. Some respondents claimed that, although having a reptile was not a choice of their own, they had no alternative but to take care of the animal because they were afraid that it would fare worse if readopted. Others mentioned that they keep their reptile because they were yet to find someone else who could provide the same level of care as they did. One example was provided by a 31-year-old female medical doctor who reported rescuing an abandoned false map turtle (*Graptemys pseudogeographica*):

> When he came to me, abandoned and malnourished, I decided that I would take the responsibility of taking care of him, not least because I didn't know anyone who wanted to do it.

Negative Aspects of Reptile Ownership

Negative aspects of reptile ownership were also mentioned, although less frequently ($n = 11$). These included the grief after the death of animals that had been companions for decades or the lack of access to reliable information on behavior, husbandry, and care. Others admitted that, despite their best efforts, they were unable to provide their animals adequate standards of care, or that it was irresponsible for them to acquire a reptile without having an idea of its basic needs. One participant (female, urban, 38) regretted having turtles because she now acknowledged that these animals belong in the wild. Another owner, a 27-year-old female respondent with a university education who owned a false map turtle, said that she would never buy another reptile because "I consider that I am interfering with the freedom of the animal and promoting the, often violent and illegal, trade of animal species."

Discussion

Using a mixed-methods approach, this research provides the first empirical investigation on the reasons and motivations for owning reptiles as pets in Portugal, as well as on the nature of the human–reptile bond. Our results unveiled several reasons for acquiring pet reptiles. While most reptiles in the study sample were purchased, many were received as gifts, and some were inherited, adopted, or rescued. Similarly, four main motivations were identified for their long-term keeping: entertainment, convenience, companionship, and duty of care. Despite this diversity of experiences, most survey respondents described their pet as a "family member." Overall, our results suggest that pet reptile ownership is driven by the same underlying feelings of empathy, duty of care, attachment, and companionship that drive traditional pet ownership.

Reasons for Acquiring and Motivations for Keeping Pet Reptiles

Based on our results, motivations for keeping reptiles seem to be more nuanced than those involving dogs and cats, which are mostly based on companionship (Animal Medicines Australia, 2016, 2019) and where affection seems to play a bigger role than utility (Johnson et al., 1992; Lago et al., 1988; Zasloff, 1996). Utilitarian motivations such as *entertainment*, including hobby, *companionship*, including relaxation, and *convenience*, including low maintenance, are all important drivers to acquire and keep reptiles as pets.

However, the belief from some respondents that reptiles require little attention and are low-maintenance pets is at odds with the currently accepted view that providing these creatures with the best possible care is challenging (Azevedo et al., 2021).

In the 2019 report on pet ownership in Australia (Animal Medicines Australia, 2019), low maintenance was considered the main reason for acquiring a reptile (21%), closely followed by rescuing (18%), relaxation (17%), and companionship (16%). The 2016 Australian report, on the other hand, had identified companionship as the main reason (34%), followed by relaxation (17%), hobby (14%), and low maintenance (10%) (Animal Medicines Australia, 2016). This trend of increasing demand for low-maintenance pets may lead to reptiles being preferred over cats or dogs based on the idea that they are easy to care for. Others have addressed this misconception, often perpetuated by folklore knowledge and misleading information from the exotic-pet industry, which portrays some species like terrapins as "easy to keep" (Arbuckle, 2013; Warwick et al., 2018, 2019). The view that reptile species are quite difficult to care for was only expressed by a minority of survey participants; this reinforces the need for intervention through educational campaigns and mandatory information or labeling that has been advocated for by several authors (Warwick et al., 2018; Warwick & Steedman, 2021).

A significant proportion of respondents relied upon affective states to explain why they decided to acquire and keep a reptile (Table 2, Figure 3). In one of the few studies on motivations for keeping pet reptiles, Kampfer and Love (1998) reported that American desert tortoise owners spontaneously expressed affection toward their animals. The expression of the affection of Portuguese owners toward their reptiles (love, fascination, and passion), together with the duty to care for these animals, reinforce the perception that nurturing is also a relevant motivator for owning a pet reptile (Kieswetter, 2017; Serpell, 2004). However, these feelings could be driven by the esthetic value of reptiles and not an indication of genuine affection, a distinction that is beyond the reach of this study. Moreover, affection alone is insufficient to ensure that owners are aware of their animals' welfare requirements. We have shown elsewhere that 85% of these owners fail to provide pet reptiles with at least some essential husbandry needs, despite reporting their welfare as good or very good (Azevedo et al., 2021). These findings should be considered when developing effective campaigns aimed at promoting welfare-friendly husbandry practices.

Kampfer and Love (1998) also found that duty and esthetics were the main motives for owning a desert turtle. Entertainment and relaxation were also strong motives for tortoise ownership, but companionship, interaction, and social support ("feel needed") assumed a lower rank. In the present study, the importance of entertainment and duty of care are consistent with Kampfer and Love's results, but convenience and companionship are at least as important. Both methodological and cultural differences, in addition to the 20-year gap between both studies, could explain these differences. Alternatively, this difference could reflect a change in preferred pet characteristics (low-maintenance pets might be more suitable for people with busy urban lifestyles) or on the type of benefits people derive from their ownership, such as companionship and social support (Antonacopoulos & Pychyl, 2010).

The importance of social support as a key benefit derived from reptile ownership is supported by our results: reptile keeping was frequently framed in terms of companionship, with answers that included physical and affective interactions. A mixed-methods study from the Netherlands (Endenburg et al., 1994) identified companionship as the main motive for keeping companion animals, although participants struggled to explain why. According to these authors, "Companionship is a reason for taking an animal but people do not use reason to reach this conclusion" (Endenburg et al., 1994, p. 201). The diversity of answers gathered in our study seems to corroborate this perception. Comparisons have been made between relations of humans with cats or dogs while developing human–pet attachment scales (Johnson et al., 1992; Lago et al., 1988; Zasloff, 1996). When items describing species-specific behaviors and characteristics were eliminated from the scales measuring attachment, the importance of pets (cats and dogs) in providing social

support and companionship was consistent, irrespective of the species (Johnson et al., 1992; Zasloff, 1996). Our results suggest these findings are likely to extend to pet reptiles, albeit with different expressions of how entertainment is derived from pet ownership and new dimensions driven by convenience or ease of maintenance and by a duty of care.

Our results also suggest a connection between childhood experiences with reptiles and their ownership in adulthood. This finding is in line with previous research on other pets such as cats and dogs (Johnson et al., 1992; Paul & Serpell, 1992; Serpell, 1981). Portuguese children have been shown to feel a duty to care for animals and to protect even species that they fear or dislike (Almeida et al., 2014). In the same study, lizards were described by children as funny and cute, and snakes were considered beautiful and gracious. In another study, younger respondents were also found to be more likely to rank desert tortoises higher than other pets (Kampfer & Love, 1998). These positive childhood attitudes toward reptiles need to be framed against their welfare needs and wider environmental concerns. Altogether, findings from the present and previous studies suggest that combining early education about wildlife conservation with responsible pet keeping is warranted.

Similar opportunities to build on positive attitudes are present in adulthood. This is evident in the way survey participants describe their reptile ownership experience. The four categories of exotic-pet owners identified by Shukhova and MacMillan (2020) can also be found in our sample, although the reliability of categories and the overlap between them warrants further investigation. Respondents who rescued their reptiles – directly from the street or even from the pet shop – can be grouped into “life-savers,” perhaps motivated by pity or concern for the animal's welfare. Those who adopted, who were offered a reptile as a gift or who inherited their animals are “accidental owners.” In these cases, the acquisition is mostly driven by chance, assisted by a duty to care for the animal, even in the rare cases where it represents a burden. Most of the participants who bought their reptiles can probably be seen as “new experience seekers” or “collectors,” looking for something different and potentially motivated by their childhood experiences with reptiles. In all of these cases, the reptile seems to be awarded a high value in different ways, suggesting that educational campaigns could empower these owners to take action to improve welfare and preserve that value.

Bond, Sentience, and Snakes

Almost two-thirds of survey participants defined their reptiles as a “family member,” followed by pet and friend. These findings are consistent with the results observed about cats and dogs (Cain, 1985; Lago et al., 1988; McConnell et al., 2016; Voith, 1985) and support the idea that reptile pets can also provide social support and improve wellbeing. However, there was an influence of the taxonomic group on the proportion of respondents that considered their reptile a family member ($\chi^2_{(2)} = 7.14$, $p = 0.03$), with snake owners doing so less frequently than lizard and chelonian owners (Figure 1). This difference could signal a less anthropomorphic perception of their animals between snake owners and other reptile owners.

Most respondents answered that at least one of the reptile behaviors was caused by “pain or discomfort” or “stress or fear” (Figure 2). These results were similar across taxonomic groups and are consistent with the observations of Gray et al. (2007), where animals (including non-primate, non-domestic animals such as frogs) were perceived as being able to experience emotions and feelings such as pleasure and pain. Our results demonstrate that reptile owners, like owners of cats and dogs, perceive their pets as capable of feelings and emotions, recognizing them as sentient beings.

Approximately half of the chelonian and lizard owners, but only 20% of snake owners, said that at least one of the behaviors was caused by “an attempt to communicate.” Although our survey did not elaborate on the precise meaning of these behaviors (and no attempt was made to differentiate, for example, between interaction with the owner and communicating pain or distress), communication is considered a higher-order

cognitive ability that is attributed to animals to different extents. Harrison and Hall (2010) observed an association between the perception of animals' ability to communicate and human empathy and phylogenetic relation to the animal species. In that study, snakes and turtles scored equally low on their perceived ability to communicate. Our results support these findings by showing that the perception of the ability of reptiles to communicate is not as widespread as the perception of their capacity to experience emotions and feelings. However, in our study, there is a difference in the proportion of respondents attributing the ability to communicate to snakes compared with other reptiles ($\chi^2_{(2)} = 9.91, p < 0.01$), which was not evident in other studies. While targeting only reptile owners, sampling bias toward people familiar with and living with reptiles and increased knowledge of the differences between snakes and other reptiles could help explain the difference between these results (Morris et al., 2012). Alternatively, the fact that our study focused only on reptiles while others included a wider range of species, including humans, could have influenced the results by providing different references for comparison.

The less frequent recognition of communication in snakes and the lower proportion of snake owners recognizing their pets as family members suggest differences in the attribution of, or perception of, mental states to snakes compared with chelonians and lizards. The attribution of mental states to animals is supported by mechanisms that are sensitive to biological motion and expressions, such as the activation of the brain's social network and the mirror neuron network (Urquiza-Haas & Kotrschal, 2015). The behavior of snakes in captive environments, coupled with the lack of limbs and apparent facial expressions, could lead to lower levels of activation of these systems. Another explanation could be related to evolved learning biases that may also influence the attribution of mental states to animals (Urquiza-Haas & Kotrschal, 2015). Innate responses of fear and alertness resulting from co-evolution between snakes and primates (Isbell, 2006) could represent one of these cases and explain the differences we observed between snakes and other reptiles.

This study relied upon non-probabilistic convenience sampling using self-reported data; we did not aim to be representative of the views of all reptile owners in Portugal. Instead, we aimed at gathering the breadth of views regarding the research topic and providing empirical evidence for further research. The possibility of a social-desirability *bias* needs to be considered, as pet attitude survey results have been shown to correlate with social-desirability scores (e.g., Templer et al., 1981), an effect which could be exacerbated by the now widespread recognition of animal sentience. The 2019 Australian pet survey found an average of 1.9 reptiles per household in the country (Animal Medicines Australia, 2019). Similarly, 39% of our respondents had additional reptile pets. By asking participants to have one specific animal in mind, we aimed for accuracy, but it is likely that their views may have changed respective of the animal or taxa being considered. Participants were not asked why they chose that individual (a question that could have yielded relevant information) but it is likely that they chose their preferred animal. Therefore, results may not be generalizable to other reptiles from the study population.

Relating these results to the cross-species adoption hypothesis of domestication, our results show that reptiles can induce levels of anthropomorphism and feelings of companionship and attachment in their owners that are comparable to mammalian pets, despite not being domesticated. These results show that this may be less common with snakes than with chelonians and lizards. The human–reptile relation seems to be further nuanced by feelings of admiration and fascination for reptile beauty, mysterious nature, and unusual behaviors, and by the challenge of keeping them.

Conclusion

To the authors' knowledge, this is the first study to gather the views of reptile owners in Portugal, and one of the few in Europe. Overall, respondents in this exploratory study perceived their reptile pets as sentient beings and family members, and they had a strong companion bond with them. Up to half of the participants

attributed them with the cognitive ability of communication. Snakes differed from lizards and chelonians in the sense that they were less frequently considered a family member and were perceived as less able to communicate. The most common motivations for owning pet reptiles were convenience, entertainment, companionship, and a duty of care, suggesting relations driven by the same feelings as those previously reported for mammalian pets, although more diverse and nuanced by a sense of admiration and fascination for their mysterious nature and unusual behaviors. The results of this study show that despite idiosyncratic co-evolutionary relations, reptiles induce the feeling of a duty of care as is found for mammalian pets, which may also extend to all of nature. This bond is shaped from a young age, providing opportunities to improve captive welfare and promote responsible pet-keeping through education.

Notes

Although some authors reject the term "owners" and suggest "carers" instead (e.g., Linzey & Cohn, 2011), we decided to adopt the terms owner and ownership because they are more commonly used in the existing literature.

Acknowledgements

The authors thank all survey respondents and the following exotic veterinary practitioners who contributed to piloting the survey: Joana Mendes (*VetExóticos*), Marta Castelejo (*Exóticos em Braga*), Filipe Martinho (*University of Liverpool*), Hélder Craveiro (*Hospital Veterinário do Baixo Vouga*). We also extend our gratitude to two anonymous referees for their constructive criticism.

Disclosure Statement

AA, LG and MW declare no potential conflict of interest. JF is Clinical Director of Centro Veterinário de Exóticos do Porto, Porto, Portugal, and was not directly involved in recruiting survey participants. MMS is supported by the research project *VETHICS 2022: A structured approach to describing and addressing the ethical challenges of the veterinary profession in Portugal* (SFRH/BPD/117693/2016), funded by FCT - Fundação para a Ciência e a Tecnologia, I.P., Portugal.

Funding

This research was funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., Portugal under the grant SFRH/BPD/117693/2016 and the European Social Fund. APC were covered by Project UIDB/00276/2020 (funded by FCT). This work was also supported by project LA/P/0059/2020 - AL4AnimalS (funded by FCT).

References

Almeida, A., Vasconcelos, C., & Strecht-Ribeiro, O. (2014). Attitudes toward animals: A study of Portuguese children. *Anthrozoös*, *27*(2), 173–190.

Alves, R. R. N., Vieira, K. S., Santana, G. G., Vieira, W. L. S., Almeida, W. O., Souto, W. M. S., Montenegro, P. F. G. P., & Pezzuti, J. C. B. (2012). A review on human attitudes towards reptiles in Brazil. *Environmental Monitoring and Assessment*, *184*(11), 6877–6901.

Animal Medicines Australia. (2016). *Pet ownership in Australia 2016*. Animal Medicines Australia Pty Ltd, Newgate Research. https://animalmedicinesaustralia.org.au/wp-content/uploads/2016/12/AMA_Pet-Ownership-in-Australia-2016-Report_sml.pdf

Animal Medicines Australia. (2019). *Pets in Australia: A national survey of pets and people*. Animal Medicines Australia Pty Ltd, Newgate Research. https://animalmedicinesaustralia.org.au/wp-content/uploads/2019/10/ANIM001-Pet-Survey-Report19_v1.7_WEB_low-res.pdf

Antonacopoulos, N. M. D., & Pychyl, T. A. (2010). An examination of the potential role of pet ownership, human social support and pet attachment in the psychological health of individuals living alone. *Anthrozoös*, *23*(1), 37–54.

Arbuckle, K. (2013). Folklore husbandry and a philosophical model for the design of captive management regimes. *Herpetological Review*, *44*, 448–452.

Azevedo, A., Guimarães, L., Ferraz, J., Whiting, M., & Magalhães-Sant'Ana, M. (2021). Pet reptiles – are we meeting their needs? *Animals*, *11*(10), 2964.

Bradshaw, J. W. S. (2016). Sociality in cats: A comparative review. *Journal of Veterinary Behavior*, *11*(Supplement C), 113–124.

Cain, A. O. (1985). Pets as family members. *Marriage & Family Review*, *8*(3–4), 5–10.

Ceriaco, L. M. P., Marques, M. P., Madeira, N. C., Vila-Vicosa, C. M., & Mendes, P. (2011). Folklore and traditional ecological knowledge of geckos in southern Portugal: Implications for conservation and science. *Journal of Ethnobiology and Ethnomedicine*, *7*(1), 26.

Driscoll, J. W. (1992). Attitudes toward animal use. *Anthrozoös*, *5*(1), 32–39.

Driscoll, J. W. (1995). Attitudes toward animals: Species ratings. *Society & Animals*, *3*(2), 139–150.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115.

Endenburg, N., Hart, H., & Bouw, J. (1994). Motives for acquiring companion animals. *Journal of Economic Psychology*, *15*(1), 191–206.

Galton, F. (1865). The first steps towards the domestication of animals. *Transactions of the Ethnological Society of London*, *3*, 122–138.

George, K. A., Slagle, K. M., Wilson, R. S., Moeller, S. J., & Bruskotter, J. T. (2016). Changes in attitudes toward animals in the United States from 1978 to 2014. *Biological Conservation*, *201*, 237–242.

Gray, H. M., Gray, K., & Wegner, D. M. (2007). Dimensions of mind perception. *Science*, *315*(5812), 619–619.

Hare, B., Brown, M., Williamson, C., & Tomasello, M. (2002). The domestication of social cognition in dogs. *Science*, *298*(5598), 1634–1636.

Harrison, M. A., & Hall, A. E. (2010). Anthropomorphism, empathy, and perceived communicative ability vary with phylogenetic relatedness to humans. *Journal of Social, Evolutionary, and Cultural Psychology*, *4*(1), 34–48.

Isbell, L. A. (2006). Snakes as agents of evolutionary change in primate brains. *Journal of Human Evolution*, *51*(1), 1–35.

Janovcová, M., Rádlová, S., Polák, J., Sedláčková, K., Peléšková, Š, Žampachová, B., Frynta, D., & Landová, E. (2019). Human attitude toward reptiles: A relationship between fear, disgust, and aesthetic preferences. *Animals*, *9*(5), 238.

Johnson, T. P., Garrity, T. F., & Stallones, L. (1992). Psychometric evaluation of the Lexington Attachment to Pets Scale (Laps). *Anthrozoös*, *5*(3), 160–175.

Kampfer, K., & Love, J. (1998). Motivational aspects of desert tortoise caretaking. *Anthrozoös*, *11*(2), 87–94.

Kieswetter, S. (2017). *The motivations behind obtaining exotic pets: A discussion paper*. Zoocheck inc. https://www.zoocheck.com/wp-content/uploads/2017/10/The-Motivations-Behind-Obtaining-Exotic-Pets_September-2017.pdf.

Lago, D., Kafer, R., Delaney, M., & Connell, C. (1988). Assessment of favorable attitudes toward pets: Development and preliminary validation of self-report pet relationship scales. *Anthrozoös*, *1*(4), 240–254.

Landová, E., Marešová, J., Šimková, O., Cikánová, V., & Frynta, D. (2012). Human responses to live snakes and their photographs: Evaluation of beauty and fear of the king snakes. *Journal of Environmental Psychology*, *32*(1), 69–77.

Linzey, A., & Cohn, P. N. (2011). Terms of discourse welcome. *Journal of Animal Ethics*, *1*(1), vii-ix.

Marešová, J., Antonín, K., & Frynta, D. (2009). We all appreciate the same animals: Cross-cultural comparison of human aesthetic preferences for snake species in Papua New Guinea and Europe. *Ethology*, *115*(4), 297–300.

McConnell, A. R., Lloyd, E. P., & Buchanan, T. M. (2016). Animals as friends. In M. Hojjat & A. Moyer (Eds.), *The psychology of friendship* (pp. 157–174). .

McHugh, M. L. (2012). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276–282.

Mitchell, M., & Tully, T. N. (2008). *Manual of exotic pet practice*. Elsevier Health Sciences.

Morris, P., Knight, S., & Lesley, S. (2012). Belief in animal mind: Does familiarity with animals influence beliefs about animal emotions? *Society & Animals*, *20*(3), 211–224.

d'Ovidio, D., Pierantoni, L., Noviello, E., & Pirrone, F. (2016). Sex differences in human-directed social behavior in pet rabbits. *Journal of Veterinary Behavior*, *15*, 37–42.

Paul, E. S., & Serpell, J. (1992). Why children keep pets: The influence of child and family characteristics. *Anthrozoös*, *5*(4), 231–244.

Pirrone, F., Pierantoni, L., Mazzola, S. M., Vigo, D., & Albertini, M. (2015). Owner and animal factors predict the incidence of, and owner reaction toward, problematic behaviors in companion dogs. *Journal of Veterinary Behavior*, *10*(4), 295–301.

Powell, D. M., & Ardaiolo, M. (2016). Survey of U.S. zoo and aquarium animal care staff attitudes regarding humane euthanasia for population management: Attitudes on management euthanasia. *Zoo Biology*, *35*(3), 187–200.

Ptáčková, J., Landová, E., Lišková, S., Kuběna, A., & Frynta, D. (2017). Are the aesthetic preferences towards snake species already formed in pre-school aged children? *European Journal of Developmental Psychology*, *14*(1), 16–31.

R Core Team. (2020). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/.

Rahman, K., Rakhimov, I., & Khan, M. (2017). Public attitudes toward monitor lizards (reptilia: Varanidae): A conservation challenge in the human-dominated ecosystems of Bangladesh. *Annual Research & Review in Biology*, *13*(6), 1–10.

Reuter, K. E., & Schaefer, M. S. (2017). Motivations for the ownership of captive lemurs in Madagascar. *Anthrozoös*, *30*(1), 33–46.

Riedel, J., Schumann, K., Kaminski, J., Call, J., & Tomasello, M. (2008). The early ontogeny of human–dog communication. *Animal Behaviour*, *75*(3), 1003–1014.

Rodríguez, L., Reuter, K. E., & Seabocy, M. S. (2020). Motivations of pet parrot ownership and captive conditions of the pets in Madagascar. *Madagascar Conservation & Development*, *15*(1), 13–18.

Serpell, J. A. (1981). Childhood pets and their influence on adults' attitudes. *Psychological Reports*, *49*(2), 651–654.

Serpell, J. A. (2004). Factors influencing human attitudes to animals and their welfare. *Animal Welfare*, *13*(1), 145–151.

Serpell, J. A. (2021). Commensalism or cross-species adoption? A critical review of theories of wolf domestication. *Frontiers in Veterinary Science*, *8*.

Shukhova, S., & MacMillan, D. C. (2020). From tigers to axolotls: Why people keep exotic pets in Russia. *People and Nature*, *2*(4), 940–949.

Stokes, D. L. (2007). Things we like: Human preferences among similar organisms and implications for conservation. *Human Ecology*, *35*(3), 361–369.

Templer, D. I., Salter, C. A., Dickey, S., Baldwin, R., & Veleber, D. M. (1981). The construction of a Pet Attitude Scale. *The Psychological Record*, *31*(3), 343–348.

Toland, E., Bando, M., Hamers, M., Cadenas, V., Laidlaw, R., Martínez-Silvestre, A., & van der Wielen, P. (2020). Turning negatives into positives for pet trading and keeping: A review of positive lists. *Animals*, *10*(12), 2371.

Urquiza-Haas, E. G., & Kotrschal, K. (2015). The mind behind anthropomorphic thinking: Attribution of mental states to other species. *Animal Behaviour*, *109*, 167–176.

Voith, V. L. (1985). Attachment of people to companion animals. *Veterinary Clinics of North America: Small Animal Practice*, *15*(2), 289–295.

Vonk, J., Patton, C., & Galvan, M. (2016). Not so cold-blooded: Narcissistic and borderline personality traits predict attachment to traditional and non-traditional pets. *Anthrozoös*, *29*(4), 627–637.

Warwick, C., Arena, P., Lindley, S., Jessop, M., & Steedman, C. (2013). Assessing reptile welfare using behavioural criteria. *In Practice*, *35*(3), 123–131.

Warwick, C., Arena, P., & Steedman, C. (2019). Spatial considerations for captive snakes. *Journal of Veterinary Behavior*, *30*, 37–48.

Warwick, C., & Steedman, C. (2021). Exotic pet trading and keeping: Proposing a model government consultation and advisory protocol. *Journal of Veterinary Behavior*.

Warwick, C., Steedman, C., Jessop, M., Arena, P., Pilny, A., & Nicholas, E. (2018). Exotic pet suitability: Understanding some problems and using a labeling system to aid animal welfare, environment, and consumer protection. *Journal of Veterinary Behavior*, *26*, 17–26.

Weiss, L., Brandl, P., & Frynta, D. (2015). Fear reactions to snakes in naïve mouse lemurs and pig-tailed macaques. *Primates*, *56*(3), 279–284.

Zasloff, R. L. (1996). Measuring attachment to companion animals: A dog is not a cat is not a bird. *Applied Animal Behaviour Science*, *47*(1–2), 43–48.