Human attitudes towards animals in relation to species similarity to humans: A multivariate approach

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Research article

Human attitudes towards animals in relation to species similarity to humans: a multivariate approach

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Human attitudes towards animals are becoming of increasing importance in the areas of conservation and welfare. It has long been taken for granted that our attitudes are influenced by the degree of biological or behavioural similarity between a given species and ourselves. This research investigates whether there is a link between bio-behavioural similarity to humans and preferences for animal species that are obtained when subjects view a set of 40 pictures illustrating a wide diversity of animals. Extensive data regarding the natural history, behaviour and physiology of 40 species of animals from a wide range of taxonomic groups were collected. Bio-behavioural similarity between animal species and humans was formed on the basis of multidimensional analyses, including factors such as size, weight and lifespan among the physical attributes, and reproductive strategy, parental investment and social organization among the behavioural traits. It was found that a clear relationship between similarity and preference exists, suggesting that humans are predisposed to liking species on the basis of shared bio-behavioural traits. These results imply that efforts made in the conservation and welfare of species may be biased more by anthropocentric views than has been previously recognized. It may be important for a new approach to be taken when it comes to determining the targets of conservation.

Key words: human attitudes, animals, multivariate conservation.

Introduction

There is notable variation in human attitudes towards animals. Certain species and groups seem to be valued more highly in terms of conservation, research and public interest.[1, 2] To date, however, few studies have investigated the reasons for the occurrence of such variations. This is surprising when one considers the impact human preference may have on a species' future, perhaps determining how much time and money is spent on conservation[2] or affecting how far rights are granted in terms of experimentation and welfare.[3] Furthermore, determining which species inspire support and high regard may provide valuable insight into human reasoning and determination of attitudes. It may be thought self-evident that humans prefer some animal groups to others, but what determines which are favoured and which are disregarded?

Kellert[1] pioneered research into this area in a study conducted in 1978 that surveyed 3945 members of the American public on their attitudes to different species. The results of this investigation suggested that species preference is affected by a wide variety of influences that can be categorized into four major factors:

(i) An individual's prior attitude towards, and values of, wildlife and nature (e.g. humanistic, utilitarian).
(ii) An individual's previous experience and knowledge of a species or group.
(iii) The relationship between species and humans, for example cultural significance, utility value or conservation status.
(iv) Human *perceptions* of individual species (in terms of aesthetic value, assumed intelligence, threat, etc.)—the most important factor for the present study.

In a similar study, Czech *et al.*[2] found that certain groups of species are preferred to others, for instance, birds and mammals were favoured for conservation over reptiles and invertebrates and within the reptile group, conservational support is heavily biased towards the *Testudines*. Both studies propose a range of factors that may influence species or group perception. For example, domestic animals are frequently favoured, as are aesthetically pleasing species (further demonstrated in a study by Stokes[4] of human perception of penguin species). Within other groups (e.g. fish and invertebrates), those species with utility or monetary values are favoured, such as trout and honey bees.

Recently, Knight[5] highlighted the influence of perceived threat from a species, and also that of neoteny (sometimes referred to as the 'cute effect'). Other influential factors may be cultural significance and perceived sentience.[1]

Previous studies have often highlighted 'similarity to humans' as a factor influencing human attitude towards a species. Kellert[1, 6, 7] repeatedly notes the significance of this factor, yet does not discuss it in detail. Only one study to date has considered this factor in any depth. Plous[8] conducted four minor studies that found there were correlations between subjects' *perceptions* of a species similarity to humans and their proposed conservational importance, in which most people would prefer to 'save' species that they consider to be most similar to humans. However, these studies were on a small scale using a limited number of species. In some cases species were aggregated into uneven groups, such as the order 'frogs' and the genus 'dogs'.

It is generally presumed (and supported by Plous'[8] study) that humans will prefer species' that are perceived to be similar to their own. However, Beatson and Halloran[9] found a converse effect, in that after subjects watched a video of bonobos mating their subjects experienced negative feelings towards this species. It is suggested that recognition of similarities between humans and animals may make humans uncomfortable and consequently less disposed to positive feelings towards them.[9]

The current study attempts to approach this area in a different manner to previous studies by objectifying the meaning of 'human–species similarity'. A major issue with studies such as that by Plous[8] is that they have used human *perception* of species similarity to themselves as a measure. In terms of a species position in society, this may well be the most valuable gauge of similarity as it is this same human perception that will determine overall attitudes. However, human perception is subjective and so if participants *perceived* a species to be similar to humans then it would be recorded as similar, independently of any objective measure. Thus, if subjects were to perceive a dog to be more similar to humans than is a monkey, this would be held to be true, irrespective of the cladistical evidence. Secondly, human perception is affected by contextual cues, and may change over time. For instance, as an individual's knowledge and understanding of a species changes, then that species may appear to be more or less similar to humans. By way of contrast, any correlation between an objectively defined measure of species similarity and our preferences may imply that an adaptive function exists for such biases. Moreover, an objective study would be more widely applicable because it would be less dependent on the individual's knowledge or upon cultural variation.

Despite being a complex and intriguing area of research, particularly with regard to human decisions concerning species protection and conservation, our knowledge and understanding of factors affecting human preferences for different species has barely increased since Kellert's original work was published.[1] Furthermore, the measurement of species similarity has not advanced and studies employing this concept have generally used weak methodology. Although the potential influence of similarity as a factor has been acknowledged, the biological bases of species' similarity to humans have rarely been adequately defined. This is despite the fact that socio-psychological research on human–human similarities (e.g. in forming the basis of friend or mate choice) has had a relatively long history and suggests some plausible options for between-species measures.

This study takes a multivariate approach with the aim of providing an objective measure of species' biobehavioural similarity, and to test whether this measure of human–animal similarity influences our preferences for other species. Thus, the study questions if a species' biobehavioural similarity to humans affects human attitudes towards it. The term *biobehavioural* is used here to reflect that a wide range of biological, behavioural and social factors are involved in a multidimensional definition of similarity. Therefore, it does not relate simply to superficial appearance criteria such as body size or coloration, and unless otherwise stated, similarity will be used only with this strict multifactorial meaning for the remainder of this paper.

Materials and Methods

Species Catalogue

A catalogue of information on 40 animal species was created so as to represent as wide a range of species as feasible (Table 1). These were not chosen in proportion to the number of recorded species, simply because of the massive imbalance between vertebrates and invertebrates that would arise as the latter make up 97% of all animal species.[10] This study mainly used species that are easily recognizable to non-specialist participants. Most of the major invertebrate groups were represented, with an emphasis on the largest phyla, *Arthropoda*. The selection was intended to include a representative from each significant, recognizable grouping of species. For example, the mammals selected included a rodent, a bat, an ape, a monkey, an ungulate, a marine mammal and a marsupial. Another important factor determining the inclusion of species was the amount of information known about their

Table 1. Animals used in study (common names)

Mammals	Birds	Fish	Reptiles	Amphibians	Invertebrates
Badger	Eagle	Eel	Lizard	Frog	Bee
Bat	Emu	Sea Dragon	Python	Salamander	Beetle
Blue Whale	Goose	Shark			Centipede
Chimpanzee	Owl	Trout			Crab
Elephant	Sparrow				Earthworm
Elk					Housefly
Gemsbok					Jellyfish
Kangaroo					Millipede
Langur					Moth
Leopard					Prawn
Rat					Scallop
Shrew					Snail
Walrus					Spider
					Starfish

biology, ecology and behaviour. In order to control for any confounding effects of familiarity, domestic animals were excluded. Based on these prerequisites, the specific species were selected from a large collection of greyscale drawings, as each would require pictorial representation. In some cases, appropriate pictures were not available (e.g. of testudines), limiting the selection. Detailed species' information was acquired from authoritative books and articles, and where possible this was cross-referenced between a number of sources. It was occasionally necessary to collect data for a similar species. Collected data included life history details and physical and behavioural traits (Appendix A). Although the data set collected is by no means comprehensive, it may still be considered to be representative for the purposes of this study.

Materials

Greyscale line drawings of each species were prepared at the centre of a white card, all 40 cards having the same dimensions. Line drawings of each animal were taken from a single source.[11] Greyscale drawings were used so as to reduce the confounding effects of variations in image quality, lighting, colour or viewing angle that may differ widely between photographs. Naturally, greyscale drawings do not demonstrate the colour of natural pelage that often forms an important element in the impact and appearance of a species, but bright coloration may also act to divert the viewer's attention towards more aesthetic characteristics of species. The aim of the presentation was to prompt species recognition from participants without such distractions and so for this purpose, image degradation is a beneficial component of the presentation.

Participants

Seventy-one students from the University of Chester, predominantly females with a mean age of 23.7 years participated in this study. Although this sample size is very small for the multivariate analyses undertaken here, time restrictions during the final year of degree studies limited my intentioned target number. However, using small samples normally precludes finding significant main effects, which was not the case here. None of the participants were biology students, although most were taking science subjects. Each was given a questionnaire requesting gender, degree programme and date of birth, followed by 40 Thurstone scales ranging from 'Strongly Dislike' to 'Strongly Like' with a 'Neutral' centre-point.

Procedure

Participants were informed that they were taking part in a study investigating human perceptions of animals. They were read and shown instructions on a PowerPoint slide and it was stressed that it was their personal rating of the animal species (rather than the picture) that was required. The presentation automatically displayed the series of 40 animals in a random order. Prior to each slide, a number corresponding to that picture was displayed, with an alerting sound. After 3 s, this number was replaced by the species picture, displayed for 6 s. Within this time participants recorded their preference on the Thurstone scales described. Participants were fully debriefed regarding the study's purpose.

Results

Each participant rated each of the 40 species by placing a mark on a 10-cm wide scale (essentially, this is a blank line on which their responses are marked). The mean average liking ratings for each species are shown in Table 2. All analyses were carried out using SPSS (version 15) and MVSP (Kovach Computing). A number of multivariate statistics were used to explore similarities (measures of Euclidean distance) between species. First, an agglomerative, hierarchical cluster analysis identified three clusters (Figure 1). This partitioning was also found in a principal components analysis (PCA), created using varimax rotation and Kaiser normalization. The PCA extracted three principals (Table 3), two of which correspond to the two groupings from the cluster analysis, suggesting a robust set of similarities within these clusters. The third PCA component is made up of a small group of similar-sized insectivorous/omnivorous species, which is also evident in the hierarchical clustering shown in Figure 1. Finally, multidimensional scaling (MDS) was used to explore the cluster configurations in three dimensions. Again, the two major groupings were clearly identifiable, but rotation also demonstrated that species such as the elk, worm, millipede, bat and sparrow

Table 2. Mean average species ratings (to 1 decimal place), in ascending order

Species—negative ratings	Average rating	Species—positive ratings	Average rating
Jellyfish	1.9	Sea Dragon	5.2
Housefly	2.1	Shark	5.3
Bee	2.3	Trout	5.5
Centipede	2.3	Frog	5.7
Beetle	2.3	Badger	5.8
Millipede	2.4	Scallop	5.8
Spider	2.6	Walrus	5.9
Eel	2.7	Starfish	6.3
Earthworm	3.0	Goose	6.4
Python	3.2	Eagle	6.5
Elephant Shrew	3.6	Kangaroo	6.8
Rat	3.7	Whale	6.9
Prawn	3.7	Gemsbok	6.9
Snail	3.8	Elk	6.9
Crab	4.3	Moth	6.9
Bat	4.4	Sparrow	7.2
Salamander	4.4	Langur	7.3
Emu	4.8	Leopard	7.7
Lizard	5.0	Owl	7.7
		Elephant	7.8
		Chimpanzee	8.2

appear as more distant from the clusters, suggesting a looser affiliation within this group of species. MDS was also used to calculate (Euclidean) distance measures for each species in their proximity to humans (Figure 2). Two distinct groups were once again apparent from the MDS: those with closest proximity to humans (chimp through to gemsbok) and those furthest from humans (beetle to crab). The central group of species shown in Figure 2 are those not similar enough to form a single homogenous group, having correlations ranging from 0.177 (sea dragon) to 0.78 (barn owl). The Euclidean distance between humans and each of the 40 species and their liking ratings are shown in Figure 3. There are two anomalies to what would be expected from this association. Moth and starfish are rated more positively than expected and lie outside the 95% confidence interval, snake and worm had average ratings more negative than would be expected judging from their similarity to humans. A significant correlation ($r = 0.542$, $P < 0.01$) was found between similarity to humans and the average liking ratings of species.

Discussion

A significant association was found between the mean liking rating of a species and determined biobehavioural similarity to humans. This supports the hypothesis that, at some level, similarity to humans is an important factor influencing human attitudes towards animals. Why might this effect occur?

Research in social psychology suggests a potential explanation as to why humans may show preference for similar animals. It has been found that people are more empathetic, show greater helping behaviour and are more attracted to those other people whom they perceive to be similar to them.[12–14] Plous[8] suggests that humans may display a form of positive assortative mate choice in a more generalized sense that he terms 'positive assortative caring', which may encompass other animals. Although there are various theories as to why this form of preference may occur, Alvarez and Jaffe[14] note that that in humans this effect is most evident in non-biological traits, i.e. cultural or social similarities such as education or religion. This may support Plous' notion, in that we may be influenced just as much by a species resembling us in intelligence and behaviours as by physical similarities.[8] Many of these salient characteristics of animals (e.g. sociability) are evident in those species that humans commonly choose as pets, and have bred into domesticated stock animals.

In addition to a potential preference for similarity, there is evidence suggesting that humans also actively dislike dissimilar animals (e.g. invertebrates[7]). In the current study, 18 out of 40 species had average ratings below the neutral point of the scale, and participants frequently recorded a 'strongly dislike' rating (Table 2). There are a number of psychological theories that may provide some explanation for this.

First, all animals potentially remind humans of their own 'creatureliness', that is, a shared evolutionary history with many species and parallels in sexual behaviour and production of bodily products.[9] It is suggested that such reminders increase human 'mortality salience', i.e. awareness of the inevitability of one's own death,[15] as mortality is perhaps the predominant trait humans share with all animals. In turn, an increase in mortality salience may lead to a response known as 'terror management'.[15] This is described as a cognitive mechanism designed to control the panic created by knowledge of mortality by causing humans to cling to their 'cultural worldview' (*weltanshung*). An increase in identification with one's worldview (as a form of terror management) has the effect of derogating, directing and eliciting prejudice towards 'out-groups'; i.e. those with unfamiliar *weltanshung*.[9] In this case, a non-human species would be considered an extreme out-group, as their different natural histories and 'cultures' do not fit with the anthropocentric worldview.[7] Furthermore, out-group derogation is likely to increase with dissimilarity, as the increasingly alien morphologies and survival strategies of contrasting species become disassociated from the *weltanshung*. In addition, both the fecundity and caste-nature of many

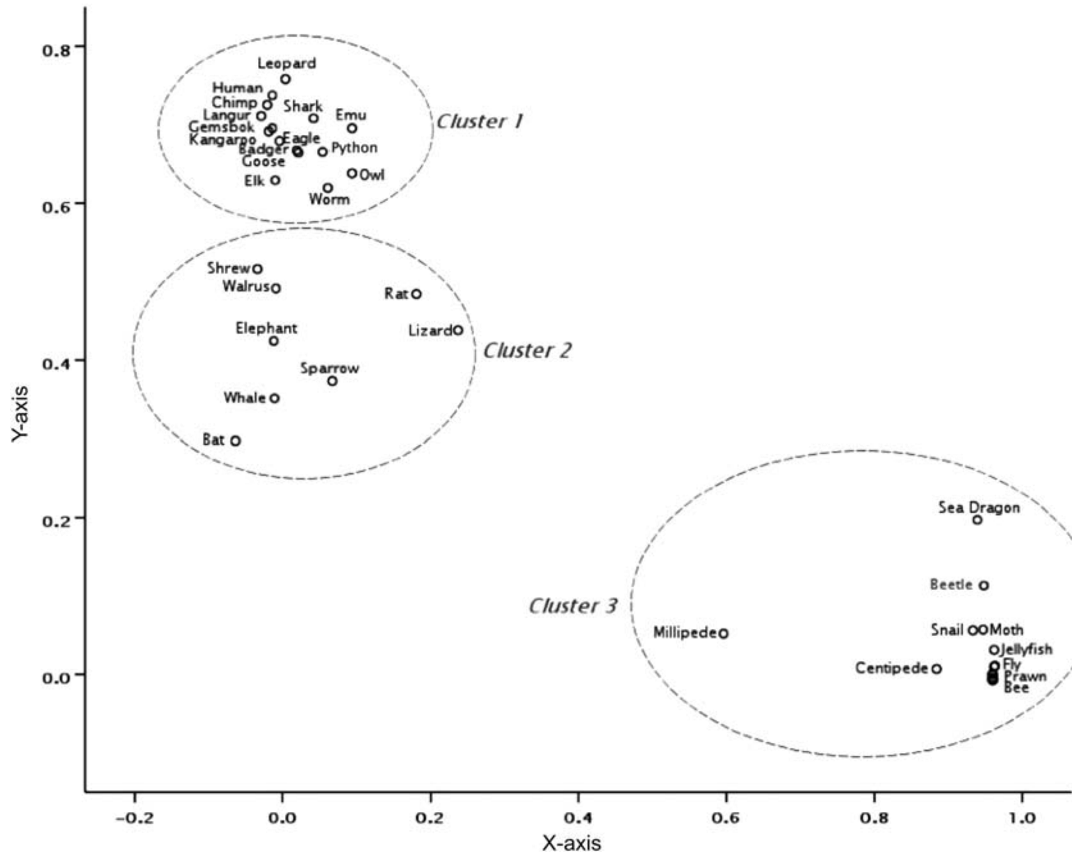

Figure 1. Clustering of species similarities based on two-means cluster analysis. The axes are similarity measures based on Euclidean distances.

species (such as eusocial insects) strongly conflicts with the human concepts of individuality and freedom, another potential incentive for in-group affiliation and intolerance of the out-group.[7]

However, any animal may remind us of our 'creatureliness', so should they not all be derogated as out-groups? Beatson and Halloran[9] investigated how reminders of similarity to bonobos (while watching a video of their mating behaviour) affected participants' attitudes towards them. The results implied that after reminders of bonobo–human similarity attitudes towards the bonobos became more negative, supporting the 'reminders of creatureliness' hypothesis. However, humans may only have this response to similar animals if they are forced to compare 'creaturely' acts to their own. In other words, had the participants watched bonobos displaying positive social behaviours such as altruism or cooperation, they may have identified with the bonobos in a more positive way.

As naturally social animals, humans may be adapted to empathize with others, and insofar as empathy improves social interaction it will consequently have fitness benefits.[12] Therefore, it may also be that humans are evolved to recognize and appreciate similarities between themselves and others and be suspicious of differences (which may signify conflict). Traits which humans recognize and understand in other species cause anthropomorphism, i.e. application of human mental states to non-human animals[16] and a form of identification with that species.[16] Though anthropomorphism has the potential to cause an overestimation of similarities, it also appears to increase interest, care and concern for a species.[3] Of course, any preference for similar animals created through anthropomorphic thinking may not be adaptive in itself, but simply a pleiotropic effect. However, anthropomorphism could be adaptive. Mithen[17] proposes that human ability to anthropomorphize may have evolved 40 000 years ago because of increased 'cognitive fluidity', that is, better connections between brain areas including increased ability to make inferences about the thoughts and feelings of others. Mithen[17] argues that anthropomorphism became a common human trait as a result of its adaptive value—modern humans in the Upper Paleolithic appear to have planned and executed hunts by predicting prey behaviour. Serpell[16] additionally suggests that anthropomorphism may have enabled domestication of companion and agricultural animals. This potentially evolved trait, combined with human identification with similar others, provides good reasoning as to why humans should recognize their similarities to other animals and prefer them.

Table 3. Results of principle component analysis

	Component		
	1	2	3
Shrew	−0.923		
Walrus	−0.881		
Elephant	−0.880		
Whale	−0.868		
Elk	−0.826		
Snail	0.824		
Salamander	0.817		
Beetle	0.811		
Moth	0.809		
Frog	0.809		
Spider	0.807		
Sea Dragon	0.806		
Prawn	0.804		
Fly	0.804		
Bee	0.804		
Scallop	0.804		
Trout	0.803		
Eel	0.803		
Jellyfish	0.802		
Crab	0.801		
Starfish	0.801		
Centipede	0.795		
Gemsbok	−0.749		
Millipede	0.732		
Python		0.912	
Badger		0.900	
Emu		0.898	
Goose		0.879	
Kangaroo		0.869	
Eagle		0.853	
Langur		0.800	
Human		0.787	
Leopard		0.780	
Shark		0.764	
Chimp		0.750	
Barn Owl		0.741	
Sparrow			−0.957
Lizard			−0.942
Bat			−0.915
Rat			−0.910
Worm			

In contrast, when humans encounter those animals with which they cannot identify (for example, many invertebrates), there is less care and concern. In this regard, Kellert's[7] survey found general dislike and aversion towards invertebrates to be irrespective of their potential risk to humans. Similarly, the current study found that the harmless beetle scored the same low mean average rating (2.3) as the more dangerous centipede. This suggests that within invertebrate groups, any similarity to humans may be virtually absent and the dissimilarity effect may become less influential, or even obsolete, compared with other factors affecting preference. Both Kellert[7] and the current study found invertebrates with aesthetic appeal (such as the moth and starfish) to be rated more positively than less-attractive species (e.g. the housefly). Although aesthetics are by no means the only deciding factor (especially considering subjectivity in aesthetic judgement), in this case attractiveness may outweigh other factors, including similarity to humans. However, it could be argued that for a preference based on similarity to exist, it must also coincide with some evolutionarily adaptive function.

Thus, there are many previous findings in the literature that support the proposal that human attitudes to animals are affected by species' similarity to humans. Theories suggesting contact between humans and other animals invokes mortality salience and terror management, affecting *weltanshung*, are rather abstract. However, these processes may act on the human preconscious when apprehending a species' behaviour. Therefore, despite their theoretical nature, these viewpoints are relevant to the current study because it is likely that even an instantaneous reaction to a species may derive from previous observation or consideration of its behaviour. However, the results of this study may have been more strongly affected by participant level of (or lack of) identification and empathy with each species, as this is likely to be more immediate than detailed consideration of a species' threat to one's worldview, individuality and so on.

It is evident from previous research[1, 2, 4, 8, 18] that a wide variety of factors affect human attitudes towards animals. To be realistic, the impact of multiple factors inducing human responses to other species must also be considered. The current study has attempted to control for some of the most influential confounding effects of other variables, for example by excluding domestic animals and, where possible, highly aesthetically attractive and neotenous animals. Unlike previous research using photographs,[5] line drawings of standardized sizes were used to prevent confounding effects of differing photograph colour, angle, quality and background. When species were placed in groups of variable, aposematic and cryptic colourings, there was only minor variation in mean average liking rating between these groups, suggesting that the use of greyscale pictures minimized the influence of colour on perception (as noted by Stokes[4]). There was also no significant correlation found between species' body length and mean average liking rating, suggesting that size effects (as investigated by Ward[18]) were also minimized in

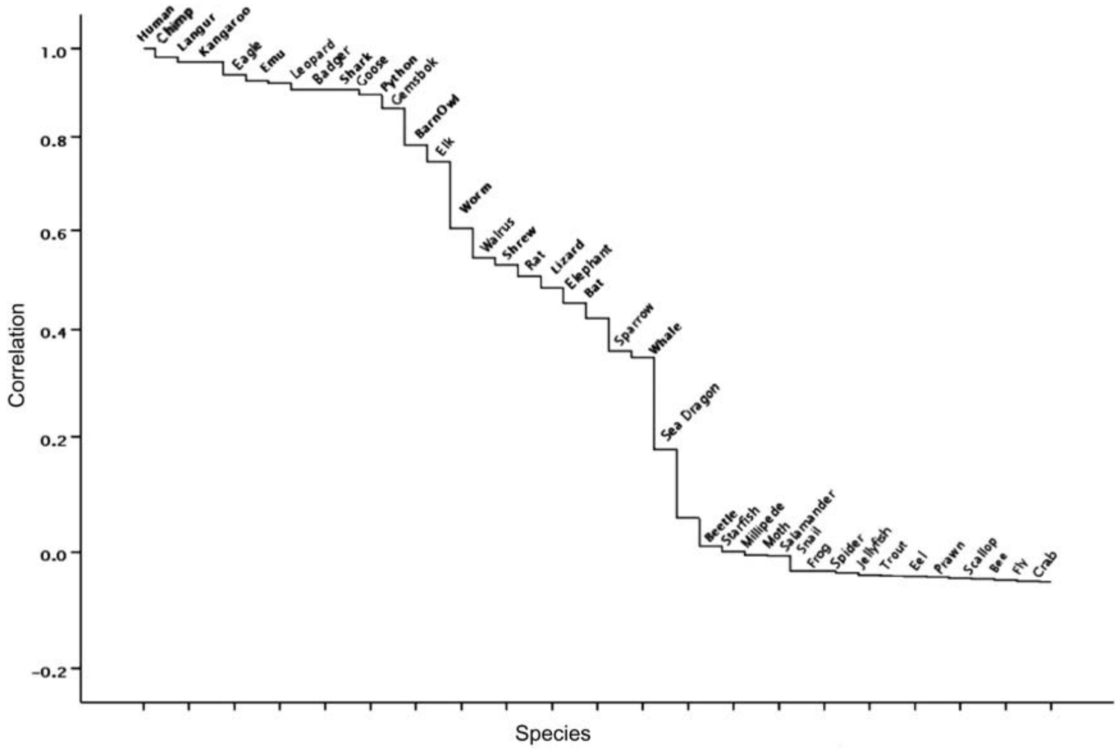

Figure 2. Euclidean distance measures between humans and the 40 species used in the study. The lower a species is on the scale, the more dissimilar it is calculated to be from humans. Groups of similar species can also be identified from this figure, as those with smaller vertical distances between them.

the current study. Humans may react more negatively to animals of which they are afraid. These reactions could have strong effects on this study's results, as fear-inducing animals are often the same invertebrates considered very dissimilar to humans. However, there was no obvious consistency—snakes and spiders, though commonly feared, were rated less negatively than more harmless species. Animals that are feared owing to their disgust-inducing nature (a response likely to have evolved because of close association with disease[19]) were negatively perceived (e.g. rat, fly), but the disease-association free desert rodent (elephant shrew) was perceived more negatively still. Although potential risk (whether real or perceived) clearly plays an important role in species preferences of invertebrates, humans frequently rate potentially dangerous vertebrates (such as the snow leopard and elephant) higher than their harmless fellow mammals. Czech *et al.*[2] found rarity to be an important influence on attitude and this finding is reflected in the current study, with preference for a species increasing alongside its IUCN status. However, conservation status *per se* may not influence attitude, as the most endangered species are often 'charismatic megafauna'[1] as opposed to the non-IUCN listed common invertebrates.

It is clear that many factors influence human attitudes toward species, but of those investigated none seem to completely explain the order in which these 40 species were rated by participants. This is not to suggest that similarity alone *does* fully explain the order, or human preferences, but that the strong connection between this composite measure of biobehavioural similarity to humans and the average rating given for a species is highly dependent upon this facet.

If the results of the current study can be said to demonstrate a real effect of biobehavioural similarity on the human attitude to species, this may partly explain why mammals, the smallest phyla, are so greatly over-represented by conservation efforts and human interest.[2] Interestingly, Kellert's[1] study found the American public's favourite wild animals to be birds. In this study, all birds but the Emu received a positive (i.e. above median) rating from participants. This has implications regarding potentially significant effects of behavioural similarities, as although birds are physiologically dissimilar to mammals, their frequently social nature, bipedalism and pair-bonding with high levels of biparental investment are all reminiscent of humans.

The strong bias towards our closest relatives the chimpanzees suggests that humans may recognize and identify with many of their own behaviours in this species. However, our affection for such species may diminish when we observe the more 'creaturely' of their behaviours.[9] This suggests that in promoting interest in a species, it may be more beneficial to use the anthropomorphizing nature of humans to highlight similarities between an animal's behaviour and our own.

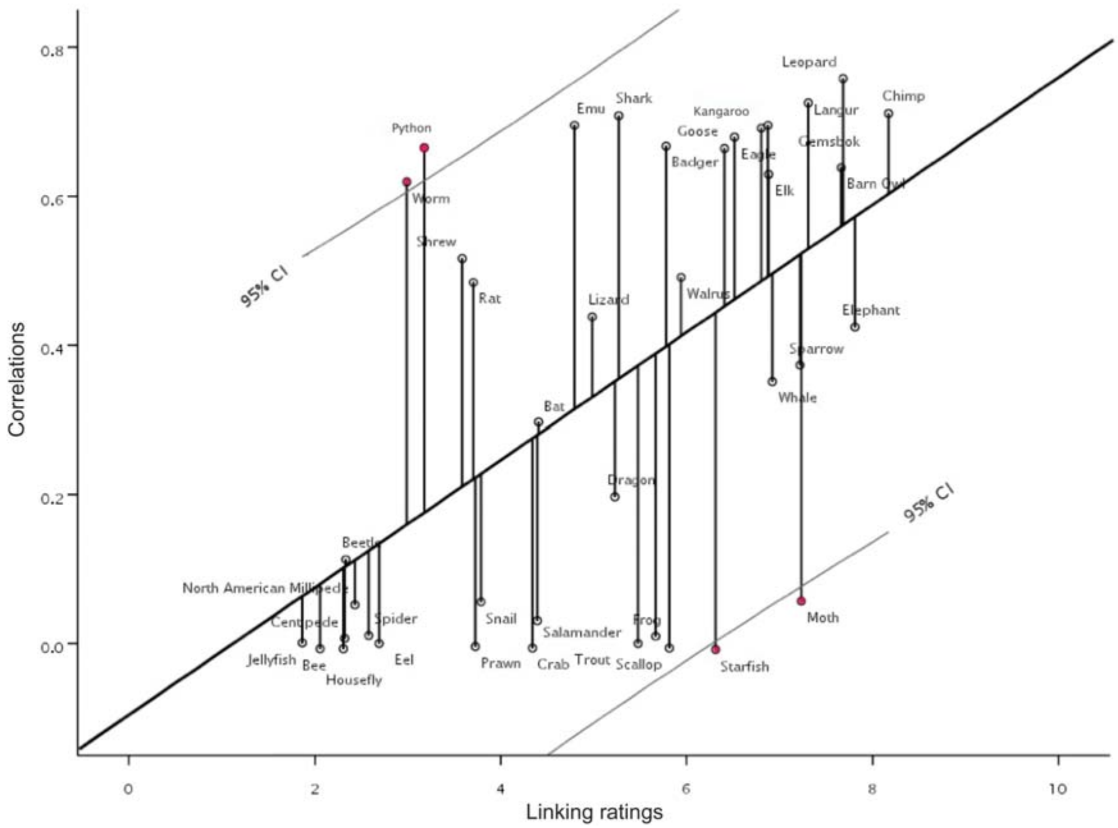

Figure 3. Scatter plot showing the correlation between mean average liking rating for each species with their similarity measures to humans. Discrepant instances are marked and positioned beyond the 95% confidence interval.

If many invertebrates are so dissimilar from humans that there is no real identification with them, they may remain generally disliked. However, recent evidence suggests that invertebrates may be more similar to humans than commonly thought, in that they may be capable of feeling pain.[20] Indeed many people believe that invertebrates feel pain,[7] suggesting that humans may be able to recognize even the most tenuous similarities between other species and ourselves, and education may play a crucial role in this regard. The results of the current study, however, imply that liking is strongly dependent upon similarity. If so, dissimilar animals may remain largely disliked. However, Czech *et al.*[2] found that despite fear and dislike, most participants still (reportedly) believe *all* species to be worth conserving.

It is clear that studies investigating factors that affect species preference should be carried out, as this area is vital to understanding how humans view the natural world and what impact these biases have on the direction conservation efforts take. Furthermore, though few studies have successfully investigated species preference in depth, those that have propose compelling evidence. It is important that the methodology of such studies be standardized as much as possible to enable direct comparisons. Ideally, a precise, accurate and comprehensive database could be created as a standard library of criteria that may be used to compare species, including their similarity to humans in terms of size, behaviour, physical features, etc. Increased application of cladistics may be influential in this approach, perhaps providing more precise measures of distances between species. Further studies in this area should also cover a much broader range of peoples, as all studies to date have focused on Western populations whose animal knowledge and attitudes may differ from those of other cultures. It is an obvious and intriguing observation that different cultures regard and treat animals very differently from one another. It is clear that this line of research may provide much information that will not only build our knowledge of human attitudes to animals, but also assist in our understanding and planning for conservation efforts worldwide.

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Appendix A

Data collected: biological and behavioural traits

Feature	Data Entered	Notes
Weight	number in KG/ < 0.005 kg	Mean averages. Male and female weight and length ranges from
Length	number in cm	cross-referenced resources (wherever possible)
Limb number	Number	
Limb type	Legs/Legs + Wings/Legs + Arms/Fins/Pereopods Feathers/Foot/Flippers/None	
Limb proportion to body	Short/Medium/Long 2-short-2-long/2-short-2-medium/None	Where: Short: 0–50% body length
Tail	Short/Medium/Long/None	Medium: 50–100% body length Long: >100% body length
Eye number	Number	
Eye position	None/Front/Sides/Snout/Eyestalks	
Colouring	Cryptic/Aposematic/Translucent/Variable	Where: Cryptic: inconspicuous Aposematic: highly conspicuous
Integumentary system	Skin/Skin covering/Scales/Exoskeleton	This further defined by following subcategories
Skin type	Thin stratum corneum + mucous/ciliated/thick stratum corneum/stratum corneum/squamous epithelium	
Skin covering	Fur/Feathers/Calcium Shell/None	
Scale type	Placoid/Coarse/Cycloid + Mucous/Organic Platelet/None	
Exoskeleton	Cephalothorax/Sclerite exoskeleton/Chitinous exoskeleton/None	
Perception	Single major/double major/triple major	These categories represent the species' most frequently utilised
Single major	Tactitiion / Vision / Electroception	senses. It is not suggested that a species lacks other senses
Double major	Chemoception + Vision/Vision + Audition/ Tactition + Chemoception/Audition + Taction	
Triple major	Vision + Tactition + Chemoception/ Vision + Audtion + Tactition	
Diet	Generalist/Specialist	These are further defined by following subcategories
Generalist Type	Omnivorous/Carnivorous/Herbivorous/Saprovorous/ Suspensivorous/Detritivorous	
Specialist Type	Nectarivorous/Insectivorous/Piscivorous/Planktonivorous/ Frugivorous	
Movement type	Multiple/Terrestrial/Aquatic/Airborne	Where: Multiple = frequently utilizes >1 movement type
Terrestrial movement type	Gait/Crawl/Slither/Saltation	Where: Gait = extended limbs, body lifted from ground. Crawl = bent limbs, body close to ground Slither = body in contact with ground Saltation = leaping upwards/forwards, all limbs leave ground
Gait type	Quadrupedal/Bipedal	(Primarily)
Crawl type	Quadrupedal/Hexapedal/Octopedal/Centipedal/Millipedal	
Slither type	Pedal wave/Water Vascular/Peristalsis	
Saltation type	Bipedal/Quadrupedal	

Continued

Continued

Feature	Data Entered	Notes
Aquatic movement type	Undulatory/Jet Propulsion/Swimming paired appendage	
Airborne movement type	Insect flight/Soaring flight/Manoeuvring flight	
Stance	Fully erect/Sprawling/Semi-erect/Suspended	Where: Fully Erect = legs placed beneath body Sprawling = legs spread to sides of body, body remains on ground Semi-erect = legs at sides of body, body held above ground Suspended = e.g. in water
Social Unit	Related group/Large group/Solitary/Paired/Variable	Where variable = changes social unit depending on time of year/life-cycle
Reproductive Behaviour	Monogamous/Polygynous/Polygynandrous/Hermaphrodite/Polyandrous/Variable	Where variable = able to reproduce in more than one way, or able to change sex.
Monogamous type	Successive/Obligate	Where: Successive = maintains monogamy with more than one mate in lifespan Obligate = maintains monogamy with only one partner in lifespan, inc semelparous species
Polygamous type	Unimale/Scramble competition	Where: Unimale = one male has mating control over a number of females Scramble Comp = where males mate with females where encountered, but no group formed
Selection strategy	*r*/*K*	Does not suggest that species chooses strategy, but nature of reproduction falls into: *r* = frequent reproduction, many offspring, short lifespan *K* = infrequent reproduction, high investment in less offspring, long lifespan
Offspring no. per brood	Number	Average, cross-referenced where possible, describing no. of offspring produced at one time – this may be per season, day, or once in lifespan
Offspring type	Altricial/Precocial	Where: Altricial = unable to care of self post-birth Precocial = born mature and independent
Reproduction type	Iteroparous/Polycyclic/Semelparous	Where: Iteroparous = 'reproduces more than once', and in this case, 'reproduces again after certain maturation of offspring', e.g. when female returns to oestrus Polycyclic = reproduces repeatedly at predictable times, e.g. each year Semelparous = reproduces once in lifetime
Post-birth Parental Investment	None/Uniparental female/Uniparental male/Biparental/Eusocial	
Dimorphism	None/Polymorphic/Males larger/Females larger/Morphology differences	Mainly considering sexual dimorphism, but including species with polymorphism depending on role, e.g. honey bees
Habitat	Terrestrial/Aquatic/Subterranean	Further defined by following subcategories

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Feature	Data Entered	Notes
Terrestrial habitat type	Variable/Temperate/Desert/Tropical/Tundra	Where variable = able to live in a variety of environs, OR lives in different environs depending on time of year/life-cycle
Aquatic habitat type	Oceanic/Coastal/Freshwater	
Temperature regulation	Hibernating Endothermic/Hibernating Ectothermic/ Endothermic/Ectothermic	
Lifespan	Number in years	Mean average, cross-referenced where possible, only data from wild animals

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Author Biography

Sarah Batt completed a first-class BSc with Honours in Animal Behaviour at the University of Chester in 2008. She is now planning to travel and conduct personal research on variation in human attitudes towards animals and human-animal relationships, with a view to write for publication. Sarah gained practical experience working with animals as a volunteer at rescue centres in the Andes and in the Amazon rainforest of Ecuador, and intends to take part in further volunteering projects whilst travelling. She is also considering post-graduate research in the above-mentioned area.

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