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Into the Animal Mind: Perceptions of Emotive and Cognitive Traits in Animals

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ABSTRACT

As incidences of human–wildlife interaction escalate, it is useful to increase understanding of the perceptions that might underpin these interactions or explain human behavior so associated. This study sought to identify public perceptions of the animal mind across wildlife species and to examine how states or qualities such as conscious thinking and feeling are perceived. We also aimed to evaluate whether people anthropomorphize species as readily as is often postulated. Using an online survey of 2,342 participants from the United States, we characterized perceptions of 36 wildlife species. In doing so, we also sought to stabilize inconsistent terminology in previous animal mind studies, by characterizing and measuring attributions of two specific traits, which we categorized as "cognitive" and "emotive." We found that people differentiate between cognitive traits (intellectual traits) and emotive traits (experiential, emotional states). Contrary to some past studies as well as popular assumptions, cognitive traits were ascribed more frequently than emotive traits for all animals. In addition, different animal classes were perceived as having varying levels of capacity of both traits. Mammals were ranked highest on qualities that defined both traits, followed by birds, reptiles, amphibians, and fish. The ranges within class also varied. Our findings provide new insights on how the public view the mental capabilities of wildlife species. The study further suggests that perceptions regarding the cognitive ability of animals may be higher than previously believed and that emotive traits may not be as notable as traditionally assumed. Elucidating these points may contribute to further progress in wildlife discussions and conservation strategies.

KEYWORDS

Animal cognition; anthropomorphism; conservation; human–animal interaction; perception; wildlife

An unprecedented number of species are facing extinction (Díaz et al., 2019), and the conservation of non-human animals in the wild has necessarily assumed new urgency. Habitat that used to be utilized primarily by wild species has been increasingly usurped by human needs and incursion. This has pushed animals and humans into smaller and more confined spaces, forcing increased interactions between them

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(Soulsbury & White, 2015). Additionally, interactions between humans and non-human animals that do exist are often driven by understandings and perceptions of animals that are based on popular assumptions. Yet our empirical knowledge of how wild animals behave, and in particular think, remains nascent at best. Such knowledge is generally referred to as studies of animal mind. Animal mind is the idea that animals have mental states, that they are capable of consciousness, and can think and feel (Knight et al., 2004).

Elucidating public perceptions regarding animal mind may also inform our understanding of human–wildlife interactions (Mascia et al., 2003) and even contribute to knowledge regarding novel conservation interventions. Conservation campaigns, for example, are often supported and funded by members of the public and are aided by the fact that people favor some species over others, seeing them as more charismatic and sympathetic than others (Martín-López et al., 2007). Thus, understanding public perceptions of species in detail might better explain why giraffes are less popular than elephants, or why we care about some species and ignore others (Lindsey et al., 2009).

The idea of animals having minds and being more than Descartes' "mindless machines" is not new. Indeed scientists from Darwin on continue to increase their understanding of multiple levels of mental abilities (e.g., problem-solving, emotions, self-awareness) within a variety of species (de Waal, 2016). However, studies of public perception have not kept pace; instead the extent to which people ascribe mental capabilities to animals is varied and poorly understood (Sarter, 2004). Moreover, some studies of these perceptions focus only on examining the idea that animals might have capable minds in broad terms (e.g., questions such as "do you believe animals have minds?") as opposed to more specific questions that evaluate animal capabilities (e.g., "are animals capable of problem-solving, emotions, etc.") (Maust-Mohl et al., 2012; Waytz et al., 2010). While there are studies that focus on specific questions such as perceiving emotions in animals (Morris et al., 2007), there is a lack of studies focusing on a multitude of different animal capabilities across a wide range of species.

Furthermore, it is unclear as to whether or not the results of the emerging sciences that explore the animal mind have reached a wide public audience, despite the growth of research in this field. For example, a recent study found that the degree of self-recognition in animals was not well understood by the lay public (Maust-Mohl et al., 2012). However, there have been multiple studies on the subject regarding species as diverse as chimpanzees (Gallup, 1970) and magpies (Prior et al., 2008). This finding may be explained in part by the fact that people often cite personal experiences and media reporting instead of scientific studies to legitimize their belief, or lack of belief, in animal minds (Knight & Barnett, 2015; Maust-Mohl et al., 2012).

In order to examine the extent of emerging understandings of animal cognition and consciousness as well as broader comprehension regarding animal capabilities, more robust and detailed understandings of public perceptions are needed, including those that reference animal mental traits. It is also useful to understand how those are bundled or classified as categories of perception and to which species they are thought to apply. To the extent that research has emerged along those lines in the form of a limited number of studies, they are difficult to analyze as a body of work as there is little consistency in the terminology used across studies. For example, one focus is on what is termed "intelligence," and asks whether people see animals as having such capacity or not (Nakajima et al., 2002). Other studies focus on whether people have "belief in animal mind" (BAM) (Knight et al., 2004), and still others on whether animals can be said to have general cognitive abilities (Eddy et al., 1993). Studies determining if the public perceives animals as having separate and different mental abilities are sparser and the descriptive terminology varies here as well, depending on the investigation. One study found three categories of capacity and referred to them as: cognition, affect, and sentience (Herzog & Galvin, 1997). Others, however, have defined capacities in reference to two categories: experience (emotional states such as pleasure and embarrassment) and agency (cognitive states such as memory and planning) (Gray et al., 2007), or sensation (such as pleasure and pain) and intellect (such as thinking and imagining) (Bastian et al., 2011), or sense and feeling contrasted with planning and action (Waytz et al., 2010b). Despite this lack of consensus in terminology, these pairings do suggest dichotomous constructs, which fit under or could be regrouped as *emotive traits* and *cognitive traits*.

This terminology touches on the concept of anthropomorphism, but is also distinct from it. The very nature of describing animal traits necessarily involves ascribing human characteristics to animals, which is how anthropomorphism is generally defined (Guthrie, 1997). Anthropomorphism is extensively discussed and sometimes narrowly defined (Servais, 2018). Researchers have attempted definitions of subsets of anthropomorphism (Arbilly & Lotem, 2017; Burghardt, 1985; Kennedy, 1992). Additionally, the application of human traits to animals brings into focus the question of what traits are ascribed uniquely to humans and the knowledge that in many cases the animal mind can only be approximated, not definitively determined (Bavidge & Ground, 1994). The terminology of emotive traits, for the purpose of this study, will only approach anthropomorphism in the most general sense and will include characteristics such as emotions, thoughts, and motivations (Davis, 1997). This includes but is not limited to subjective attributions and perceptions (Waytz et al., 2010a). Cognition has also emerged as a relatively more popular topic among studies of the animal mind and is described in most studies as a mental state involving information-processing in the brain. Some cognitive processes are said to be conscious and are expressed as intentional behavior that can be modeled and can be replicated in animal-behavioral studies (Shettleworth, 2001; Urquiza-Haas & Kotrschal, 2015). Studies examining cognition in animals include those focusing on planned behavior such as tool use (Bentley-Condit & Smith, 2010), memory recognition (Lind et al., 2015), and skill learning (Brown & Laland, 2003). Across many studies it has been shown that animals that are more similar to humans (i.e., phylogenetically closer) are seen as having higher levels of cognitive abilities (Eddy et al., 1993; Howell et al., 2013), intelligence (Nakajima et al., 2002), mental states (Herzog & Galvin, 1997; Urquiza-Haas & Kotrschal, 2015), and tend to elicit more emotive attributions (Harrison & Hall, 2010).

While emotive and cognitive traits may be perceived in animals, the general use of anthropomorphism in scientific studies has been a point of contention. By and large, pejorative connotations are associated with anthropomorphism on the assumption that assigning human characteristics to animals will lead to incorrect behavioral motivations or attributions (Wynne, 2004). Postures toward the study of any trait that might be deemed anthropomorphic have thus been discouraged, especially those such as emotions and motivations. This is signaled by a heightened focus on studies featuring only objective and observable behavior (Dawkins, 2012; Gallant, 1981; McFarland, 1982; Shettleworth, 2009; Wynne, 2004). Conversely, the general public does not reflect these proscriptions and often anthropomorphizes animals, especially by applying emotions and motivations, or more emotive traits, onto animals (Bruni et al., 2018). Indeed it is reported to be the most common way in which people describe animals and the basis people most often use to inform their understandings of and interactions with animals (Horowitz & Bekoff, 2015).

Given this tendency, it is often assumed that the general public too readily ascribes emotive traits to animals or misunderstands cognitive traits. For example, in one study, "simple thinking" (which included subjective measures such as emotion, play, and imagination) was more likely to be ascribed to animals than "complex thinking" (which included a variety of objective capabilities such as enumeration, sorting, memory, and foresight) (Rasmussen et al., 1993). A further study found that people were more likely to attribute emotions and thoughts to animals as compared with more complex processes (Gallup et al., 1997). Lastly, the capability to "experience" such things as pleasure, joy, or embarrassment was ranked higher than were intentional actions associated with "agency," that is, a capacity for memory, planning, or recognition (Gray et al., 2007). More recent work found that perceiving an animal as relatively similar to humans led to attributions of "sensation" (e.g., pain, pleasure, happiness) as opposed to "intellect" (e.g., thinking, imagining, planning) (Bastian et al., 2011). One study did, however, find that traits more conventionally associated with intelligence (e.g., belief in the presence of learning and communication in animals) were seen as more likely than those associated with conscious emotive qualities (e.g., behavior motivated by deception, empathy, or awareness of their environment or themselves) (Maust-Mohl et al., 2012).

While public perceptions of animals may impact human–animal interactions (Servais, 2018), the limited data and nonstandard nomenclature make it difficult to utilize the results in future work. Efforts to reclassify traits covering what we here refer to as animal cognition and emotive traits is warranted, particularly as some version of the perceived animal abilities that comprise these traits is evident in work thus far. This necessary work on perceptions enables three researchable questions: (i) Do people distinguish between these two trait classes in animals and if so, based on what ascribed criteria? That is, which animal capabilities define these traits? (ii) Does the perceived capability relate to the overall animal class or is there variation within and between classes (e.g., mammals as opposed to amphibians)? And (iii) Do people over-ascribe one trait relative to the other(s) to some animals and not others? We predicted that people would distinguish between cognitive and emotive traits and a wide range of abilities would be present in each trait. We also predicted that individual species and classes of species "closer" to humans (i.e., mammals) would be perceived as having higher trait capability. Based on the aforementioned studies we also anticipated that people would over-ascribe emotive traits relative to cognitive ones.

Methods

Participants

We conducted online surveys using Qualtrics (Qualtrics, LLC, 2005) to examine the public perceptions of wildlife species. Participants were recruited from Amazon Mechanical Turk (Mturk), a crowdsourcing platform that allows researchers to access a large population of participants. Participants gave informed consent before participating and were compensated US$0.25 each for their participation. In total, 2,342 eligible participants from the United States took part in the survey (1,481 female, 847 male, 6 other, and 8 preferred not to answer; mean age of 37.0 ($SD = 12.3$)). To ensure data quality, ineligible participants were removed if they selected the same numerical response for all questions, or took less than two minutes to complete the survey, or responded to the qualitative questions with copied, robotic, or unintelligible responses. This work was given ethical approval by the University of British Columbia (UBC) Behavioral Research Ethics Board (ethics certificate number H16-01907).

Survey Design and Procedure

The survey included 36 different wildlife species with varying sizes, diets, and colors (see Table 1). We tried to ensure that the animals selected represented a range of different geographic locations due to the wide-ranging geographic potential of Mturk. Additionally, we included species with both positive and negative associations. For example, in general people have been shown to have negative preferences for snakes (Özel et al., 2009), but have higher positive attitudes towards turtles or even lizards (Batt, 2009; Hartel et al., 2015). Overall, six different classes were included: amphibians, birds, fish, invertebrates, mammals, and reptiles (Table 1). The species were chosen because each had been featured in past studies and had demonstrated a capability for at least one of the items included in the survey. For example, Nile crocodiles have a "cognitive map" of valued nest areas from years past, indicating long-term memory (Combrink et al., 2017); the giant moray eel cooperates with the grouper to hunt (Bshary et al., 2006); and the New Caledonian crow can use tools and solve problems that include multiple steps (Taylor et al., 2007).

The survey started with the presentation of a picture of a randomly selected species on a white background along with its common name (e.g., Gray Wolf). Species included involved those found on all continents except Antarctica. Participants were asked to rate the capability of the animal on 40 different traits on an 11-point Likert scale ranging from not at all capable (0) to extremely capable (10). The 40 questions were presented in a random order for each participant. The survey closed with a set of demographic questions. The questions were designed to encompass a large range of potential cognitive and emotive abilities.[1] To standardize the terminology, we defined emotive traits as subjective experiential states that an animal may be perceived as having. Such traits tend to be emotion based at their core and replication may be more difficult because different human individuals may ascribe different descriptions based on variations in culture, language, and background. For example, while one observer may ascribe the emotion of jealousy to an animal, other observers may see it as

Table 1. Focal species with their scientific name and class.

Common name	Scientific name	Class
African Elephant	*Loxodonta africana*	Mammal
African Gray Parrot	*Psittacus erithacus*	Bird
Alpine Newt	*Ichthyosaura alpestris*	Amphibian
Amur Tiger	*Panthera tigris altaica*	Mammal
Australian Green Tree Frog	*Litoria caerulea*	Amphibian
Banded Archerfish	*Toxotes jaculatrix*	Fish
Blue Poison Dart Frog	*Dendrobates tinctorius "azureus"*	Amphibian
Bottlenose Dolphin	*Tursiops truncatus*	Mammal
Burrowing Owl	*Athene cunicularia*	Bird
Coho Salmon	*Oncorhynchus kisutch*	Fish
Common Octopus	*Octopus vulgaris*	Invertebrate
Coral Grouper	*Epinephelus corallicola*	Fish
Earthworm	*Lumbricus terrestris*	Invertebrate
Eastern Fence Lizard	*Sceloporus undulatus*	Reptile
Egyptian Vulture	*Neophron percnopterus*	Bird
Fiddler Crab	*Uca pugilator*	Invertebrate
Fire Salamander	*Salamandra salamandra*	Amphibian
Fire-bellied Toad	*Bombina bombina*	Amphibian
Fruit Bat	*Pteropus rodricensis*	Mammal
Giant Manta Ray	*Manta birostris*	Fish
Giant Moray Eel	*Gymnothorax javanicus*	Fish
Gray Wolf	*Canis lupus*	Mammal
Great White Shark	*Carcharodon carcharias*	Fish
Green Iguana	*Iguana iguana*	Reptile
Green Sea Turtle	*Chelonia mydas*	Reptile
Komodo Dragon	*Varanus komodoensis*	Reptile
Leaf-cutter Ant	*Atta cephalotes*	Invertebrate
Meerkat	*Suricata suricatta*	Mammal
Mute Swan	*Cygnus olor*	Bird
New Caledonian Crow	*Corvus moneduloides*	Bird
Nile Crocodile	*Crocodylus niloticus*	Reptile
Paperwasp	*Polistes humilis*	Invertebrate
Plains Garter Snake	*Thamnophis radix*	Reptile
Ruby Throated Hummingbird	*Archilochus colubris*	Bird
Tungara Frog	*Engystomops pustulosus*	Amphibian
Western Honey Bee	*Apis mellifera*	Invertebrate

aggression, sadness, or anger. Examples of emotive traits would include grief, guilt, and imagination among others. We defined cognitive traits as intellectual and problem-solving behaviors (e.g., opening a jar to retrieve food), especially that which is inherent in strict scientific protocols. They are less dependent on human interpretations and are designed to probe depths of such characteristics as memory, problem-solving, and learning.

The 40 traits were selected based on a literature review on animal behavior. Different indicators of mental states in animals were identified as capabilities that had been evaluated in regards to animals and that could fit under the broadest definitions of emotive or cognitive traits. We found some general themes such as emotions, problem-solving/decision-making, reflection, perceptions of other, communication, and altruism, and created questions that focused on specific aspects of each theme in order to get more nuanced distinctions between potential traits. For example, for problem-solving/decision-making, we included questions regarding tool use, imparting and receiving knowledge, and problem-solving through trial and error and through learning, among others. Similarly, for questions regarding emotion, we included secondary emotions (e.g., guilt, remorse), and generally avoided primary emotions (e.g., fear, anger) (Panksepp, 2005) as primary emotions are believed to exist in all vertebrates (Panksepp & Biven, 2012). Furthermore primary emotions are often linked to instinctual behaviors and are ascribed more often than secondary emotions (Wilkins et al., 2015). Examples of questions included: Do you see these animals as capable of experiencing jealousy? Capable of helping other members of their own species? Capable of solving problems through trial and error? (see Note 1) Overall, we wanted to ensure we covered as many capabilities as possible in order to identify distinctions that were perceived among traits, and thus included capabilities that were not as commonly found in other perception studies such as play, communication, and perception of others, among others.

Data Analysis

Data analysis began with an exploratory factor analysis, using data pooled per question from all of the different species. This included 40 capability items, measuring degrees of perceived capability based on the aforementioned 11-point Likert scale. This analysis included an examination of the variance of the factors as well as a principal components factor analysis to determine the number of factors. Based on the results we conducted a maximum likelihood factor analysis with orthogonal rotation (varimax) retaining two factors. We used a factor loading threshold of 0.6 when assigning the survey items to the two factors, excluding those items which did not load at or above 0.6 on either factor. We calculated Cronbach's alpha for each factor as a test for internal consistency. All statistical analyses were conducted using the statistical software R, version 3.4.1.

To examine whether there were significant differences among the animal classes in perceived capability for emotive and cognitive traits we ran one-way ANOVAs. We then conducted Tukey HSD post-hoc tests for pairwise comparisons of the classes.

Finally, to examine our demographic data, we used a multiple regression predicting emotive traits and cognitive traits from participant age (centered), knowledge (centered), gender (reference group = female), conservation membership (whether participants were members of a conservation organization) (reference group = no), and zoo/aquarium visits (whether or not they had visited a zoo or aquarium in the last year) (reference group = no).

Results

To examine our first question about whether people distinguish between two trait classes and on what ascribed criteria, we first ran a parallel analysis (Zwick & Velicer, 1986) where the scree plot suggested either two or three factors. To determine the number of factors, we then ran a maximum likelihood factor analysis with varimax rotation (Costello & Osborne, 2005). The two-factor model explained 53% of the variance, while the three-factor model explained 55% of the variance. However, in the three-factor model the Eigen values leveled off after two factors (the third factor was just over 1). Moreover, there were not enough item loadings on the third factor, leading to difficulty with interpretations. For this reason, we decided to use a two-factor model. The results are depicted in Table 2. We labeled the two factors "Cognitive traits" (eigenvalue = 2.49) and "Emotive traits" (eigenvalue = 19.44). Cognitive traits, as a class of individual

Table 2. Factor loadings of perceived capabilities of animals.

	Factor	
Capability	Emotive traits	Cognitive traits
Guilt	**0.85**	0.20
Shame	**0.84**	0.20
Embarrassment	**0.84**	0.17
Remorse	**0.81**	0.26
Imagination	**0.72**	0.35
Appreciating Art	**0.70**	0.15
Understanding how other members of a different species feel	**0.69**	0.36
Pride	**0.68**	0.36
Jealousy	**0.66**	0.38
Concern for the wellbeing of members of a different species	**0.64**	0.43
Grief	**0.62**	0.49
Helping members of their own species	0.27	**0.71**
Intelligence	0.38	**0.70**
Problem-solving through trial and error	0.27	**0.70**
Solving a problem with multiple stems	0.37	**0.68**
Solving problems through imitating the same species	0.23	**0.68**
Cooperating with other individuals	0.28	**0.66**
Concern for wellbeing of members of their own species	0.44	**0.64**
Remembering information in the long term	0.35	**0.63**
Demonstrating problem-solving techniques	0.45	**0.61**
Proportion variance	0.27	0.25
Cumulative variance	0.27	0.53
Cronbach's alpha	0.94	0.91

Note: Factor loadings greater than 0.60 are indicated in bold.

capabilities, were characterized by 12 items. These illustrate cognitive capabilities which include such things as problem-solving in general and problem-solving involving multiple steps, general intelligence (e.g., perceived as intelligent), and social intelligence (e.g., learning by imitating other members of their own species, helping members of their own species, demonstrating problem-solving techniques). The factor labeled emotive traits included eight capabilities, each of which referenced relatively more subjective qualities about that species or ways in which that species is said to conceive of other species. These included ascribed capabilities such as complex emotions (e.g., shame, remorse), creative or imaginative processes (e.g., appreciating art), and understanding the emotions of other species (e.g., understanding how members of another species feel). Cronbach's alpha was high for both cognitive and emotive traits (0.91 and 0.94 respectively), which indicates high internal consistency (see again Table 2). Overall, items which referred to interactions with and perceptions of other species (separate from the animal's own species) loaded only onto the emotive traits, whereas items referring to interactions with and perceptions of the same species loaded only onto the cognitive traits. Of the 40 items, half (20 items) did not load onto either factor or provide a basis for any new factor. This was expected given the broad nature of the selections for the potential animal capabilities and the relatively more limited awareness of the general public about many of those capabilities.

To answer our second question regarding whether perceived capability relates to the overall animal class, we plotted the species on a graph comparing the perceived capability of the emotive traits by the perceived capability of the cognitive traits (Figure 1). One-way ANOVAs for cognitive traits showed significant differences by class ($F_{(5,\ 2336)}$ =

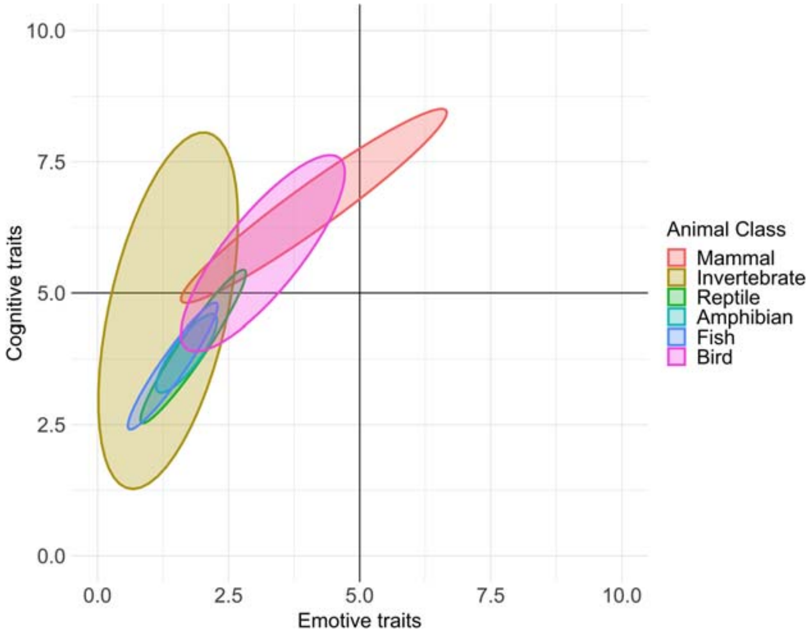

Figure 1. Ellipses demonstrating 90% confidence intervals of the species in each animal class, where the x-axis values are perceived capability of emotive traits and y-axis values are perceived capability of cognitive traits.

125.2, $p < 0.001$, $\eta_p^2 = 0.21$). Tukey HSD tests revealed that mammals ($M = 6.83$, $SD = 2.07$) were higher than birds ($M = 5.81$, $SD = 2.27$; $p < 0.001$), amphibians ($M = 3.87$, $SD = 2.35$; $p < 0.001$), fish ($M = 3.60$, $SD = 2.31$; $p < 0.001$), reptiles ($M = 3.93$, $SD = 2.28$; $p < 0.001$), and invertebrates ($M = 4.75$, $SD = 2.53$; $p < 0.001$). Birds were higher than amphibians ($p < 0.001$), fish ($p < 0.001$), reptiles ($p < 0.001$), and invertebrates ($p < 0.001$). Invertebrates were higher than amphibians ($p < 0.001$), fish ($p < 0.001$), and reptiles ($p < 0.001$). Amphibians had the same effect on perceived cognitive capability as fish ($p = 0.55$) and reptiles ($p = 0.99$). Fish had the same effect as reptiles ($p = 0.33$). Table 3 indicates these differences.

One-way ANOVAs for emotive traits showed significant differences by class ($F_{(5,\ 2336)} =$ 138, $p < 0.001$, $\eta_p^2 = 0.23$). Tukey HSD tests revealed that mammals ($M = 4.29$, $SD = 2.36$) were higher than birds ($M = 3.20$, $SD = 2.24$; $p < 0.001$), amphibians ($M = 1.70$, $SD = 1.92$;

Table 3. Tukey HSD pairwise comparisons of animal classes for cognitive traits. *P*-values are indicated for each comparison of class, with bolded text denoting significance. Mean values and standard deviations of each class are included.

	Mean (*SD*)	Mammals	Birds	Invertebrates	Reptiles	Amphibians	Fish
Mammals	6.83 (2.07)	—	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**
Birds	5.81 (2.27)	**0.001**	—	**0.001**	**0.001**	**0.001**	**0.001**
Invertebrates	4.75 (2.53)	**0.001**	**0.001**	—	**0.001**	**0.001**	**0.001**
Reptiles	3.93 (2.28)	**0.001**	**0.001**	**0.001**	—	0.99	0.33
Amphibians	3.87 (2.35)	**0.001**	**0.001**	**0.001**	0.99	—	0.55
Fish	3.60 (2.31)	**0.001**	**0.001**	**0.001**	0.33	0.55	—

Table 4. Tukey HSD pairwise comparisons of animal classes for emotive traits. *P*-values are indicated for each comparison of class, with bolded text denoting significance. Mean values and standard deviations of each class are included.

	Mean (*SD*)	Mammals	Birds	Invertebrates	Reptiles	Amphibians	Fish
Mammals	4.29 (2.36)	—	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**
Birds	3.20 (2.24)	**0.001**	—	**0.001**	**0.001**	**0.001**	**0.001**
Invertebrates	1.41 (1.65)	**0.001**	**0.001**	—	0.11	0.33	0.99
Reptiles	1.79 (1.90)	**0.001**	**0.001**	0.11	—	0.99	0.12
Amphibians	1.70 (1.92)	**0.001**	**0.001**	0.33	0.99	—	0.37
Fish	1.43 (1.79)	**0.001**	**0.001**	0.99	0.12	0.37	—

$p < 0.001$), fish ($M = 1.43$, $SD = 1.79$; $p < 0.001$), reptiles ($M = 1.79$, $SD = 1.90$; $p < 0.001$), and invertebrates ($M = 1.41$, $SD = 1.65$; $p < 0.001$). Birds were higher than amphibians ($p <$ 0.001), fish ($p < 0.001$), reptiles ($p < 0.001$), and invertebrates ($p < 0.001$). Amphibians had the same effect on perceived emotive capability as fish ($p = 0.37$), reptiles ($p =$ 0.99), and invertebrates ($p = 0.33$). Fish had the same effect as reptiles ($p = 0.12$) and invertebrates ($p = 0.99$). Reptiles had the same effect as invertebrates ($p = 0.11$). Table 4 indicates these differences.

To answer our third question as to whether or not one trait is over-ascribed in comparison to the others, we grouped the factor scores for each species and ran a paired *t*-test to determine significant differences between the two factors. We found that counter to our prediction, people perceive that animals have significantly higher levels of cognitive capabilities compared with emotive traits in all species ($t_{(35)} = 22.46$, $p < 0.0001$, $d = 1.86$) (Figure 2). Tests of individual species also verified that people perceived significantly higher levels of cognitive traits compared with emotive traits in all species ($p < 0.05$).

We also examined how demographic variables of our participants predicted these traits, including gender, age, self-reported knowledge (measured by a 7-point Likert scale from not at all knowledgeable about wildlife (0) to very knowledgeable (7)), conservation organization membership, and zoo and aquarium visits within the last year (Table 5). Variables that negatively predicted cognitive traits were age ($p = 0.003$) and male gender ($p < 0.001$). Surprisingly zoo and aquarium visits also negatively predicted cognitive traits ($p = 0.02$). Variables that positively predicted cognitive traits were knowledge ($p < 0.001$) and conservation organization membership ($p = 0.001$).

The variables that negatively predicted emotive traits were age ($p < 0.001$) and male gender ($p = 0.03$). Variables that positively predicted emotive traits were knowledge (p < 0.001) and conservation organization membership ($p = 0.006$). Zoo and aquarium visits ($p = 0.43$) were not a significant predictor (see Table 5, also online supplemental Figure S1).

Discussion

While studies of people's perceptions of animals often focus on understanding perceptions of animal mind as a whole (Maust-Mohl et al., 2012; Waytz et al., 2010b), we found that people do distinguish between general emotive and cognitive traits, and that such distinctions are multi-faceted and internally consistent. One explanation for this distinction may relate to the fact that many humans have long believed there

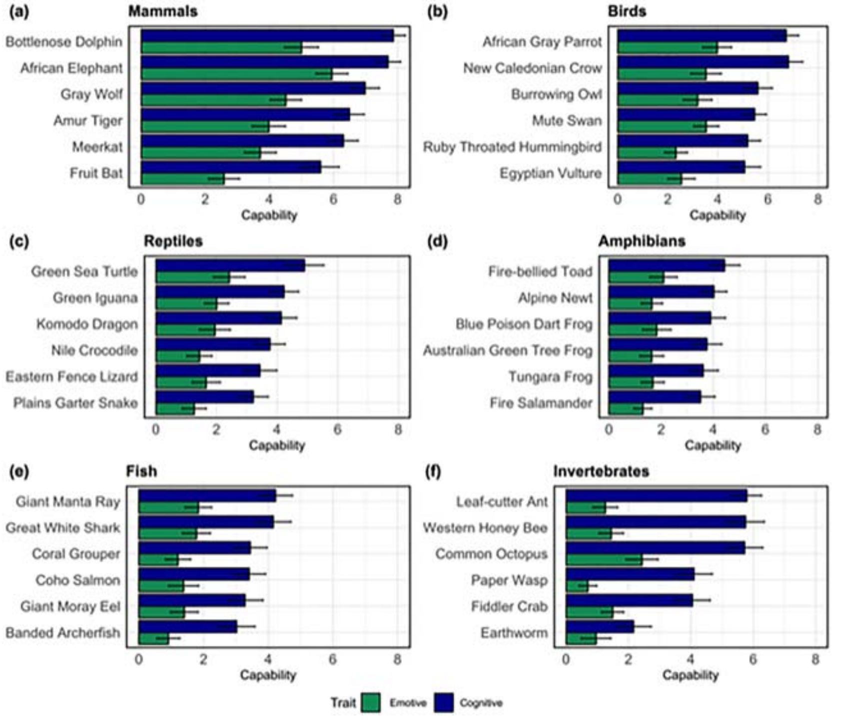

Figure 2. Bar graphs of the mean perceived capability ($n = 2{,}342$) for each species in (a) mammals, (b) birds, (c) reptiles, (d) amphibians, (e) fish, and (f) invertebrates. Emotive traits are in green and cognitive traits are in blue, with 95% confidence intervals shown.

exists separate dimensions within their own brains that, given their distinct natures, are often in opposition to one another. These are loosely referred to as cognition and emotion (Dolan, 2002). Despite this perception, psychological science is increasingly demonstrating the interrelatedness of these two seemingly disparate processes and how they are much more closely linked than previously thought (Dolcos et al., 2011; Schwarz, 2000).

The classification was also consistent with the re-categorization we predicted into emotive traits and cognitive traits. Interestingly, however, cognitive traits tended to be

Table 5. Multilevel regression models of demographic data using cognitive traits and emotive traits as the dependent variables.

	Cognitive traits				Emotive traits			
	b	*SE*	*t*	*p*	*b*	*SE*	*t*	*p*
Gender	−0.57	0.11	−5.12	< 0.001	−0.2	0.1	−2.09	0.04
Age	−0.01	0.004	−2.93	0.003	−0.02	0.004	−5.9	< 0.001
Knowledge	0.25	0.04	5.86	< 0.001	0.18	0.04	4.78	< 0.001
Zoo/Aquarium	−0.26	0.11	−2.39	0.017	−0.06	0.1	−0.71	0.48
Membership	0.43	0.13	3.36	< 0.001	0.32	0.11	2.85	< 0.001
Multiple R^2	0.039				0.034			
Adjusted R^2	0.036				0.032			

Note: Zoo/Aquarium = Zoo/Aquarium visits in the last year. Membership = Conservation organization membership.

ascribed only to same species interactions and relationships, whereas emotive traits included those ascribed to inter-species relations as well. This may be due to the fact that people are more likely to witness interactions between two members of the same species as compared with different species, especially in wild animals. Thus, participants may have felt it possible to more conclusively identify communication and care between two members of the same species as opposed to members of a different species. Additional study into this finding would be beneficial.

Our evaluation as to which specific animal capabilities were ascribed to each of the two traits revealed active use of 20 of our 40 capabilities loaded onto the two constructs. This may be explained by the fact that we included a broad range of capabilities that various scientific studies have attributed to animals such as object permanence, self-awareness, and communication. However, the public may not as readily see such entities as part of animal capabilities. Previously, many of these capabilities had been included under cognition, as studies have been able to demonstrate and replicate facets of them, such as with the mirror-test indicating self-awareness (Gallup, 1970; Prior et al., 2008) and search tests indicating awareness of object permanence, an understanding that objects remain in place even when they cannot be seen (Mendes & Huber, 2004). However, the public may not be as aware that these capabilities have been seen in animals. Indeed one study showed people did not believe self-awareness had been tested in animals (Maust-Mohl et al., 2012).

We did find a general relationship between the "closeness" of species to humans and the perceived capability. Mammals ranked the highest in both emotive and cognitive capabilities, followed by birds. Then reptiles, amphibians, and fish followed, though with little difference between them. This order generally echoes findings from previous studies regarding preferences of species (Batt, 2009; Driscoll, 1995; Moss & Esson, 2010; Tisdell et al., 2006). Thus, there does appear to be a link between preference and perception of traits. People generally prefer and view as more capable those animals which have a phylogenetic similarity to humans (Eddy et al., 1993; Nakajima et al., 2002), and this was echoed in our results.

It is important to note that this particular public perception does not always correlate with actual findings of capabilities of animals. Indeed, studies of parrots and corvids have found that they have the same cognitive skills as primates across a variety of different tests (Güntürkün & Bugnyar, 2016). While not as much work has been done with reptiles and amphibians, there are calls for increased study of those classes as they have been shown to engage in behaviors and mental processes previously thought to be found only in humans and later only in mammals (Burghardt, 2013).

While we did find differences between classes with a large effect size, it should also be noted that there was a high error variance. Animal class alone was thus not the only driver of people's perceptions about the animal, but instead many factors influence perception. For example, it is also useful to note that the "proximity to humans" effect is less predictable in other ways. Notably, mammals, birds, reptiles, amphibians, and fish followed a more predictable pattern, yet a wide range of perceived capabilities was visible in the class invertebrates. In general, cognitive traits were ranked higher in relation to emotive traits than in other classes, indeed invertebrates ranked higher in cognitive capability than all but mammals and birds. This could be due in part to the diversity within our group of tested "invertebrates." While we sought diversity in every class, invertebrates encompass significantly more species than any of the other classes. There are an estimated 1.2 million species worldwide that have been identified, and likely many more that have not been and the vast majority (around 98%) of these are invertebrates (Mora et al., 2011). For comparison, there are thought to be less than 6,500 extant mammal species (Burgin et al., 2018) and only around 18,000 bird species (Barrowclough et al., 2016).

Additionally, it is likely that increased awareness may have played a role in the higher ascription of the capability of traits to some invertebrates. In the case of the common octopus (*Octopus vulgaris*) for example, octopus intelligence and affect are increasingly being explored and disseminated in forms more accessible to a general public audience, such as newspaper articles and popular non-fiction books (e.g., Godfrey-Smith, 2016; Montgomery, 2015).

Our finding that women ascribe higher cognitive and emotive capability to animals was also found in previous studies which have shown women generally are more empathetic towards animals and more willing to ascribe traits to animals overall (Herzog & Galvin, 1997; Hills, 2015). Our finding that conservation organization membership positively predicted cognitive and emotive capability was echoed in prior studies as people who are members of conservation organizations generally have more positive attitudes and concern towards animals than those who are not members (Falk & Adelman, 2003; Williams et al., 2002). Similarly, it has been shown that young age influences higher belief in animal mind (Kupsala et al., 2016) and our findings echoed this with age negatively predicting cognitive and emotive capabilities. Lastly, higher education levels are correlated with higher beliefs in animal mind (Maust-Mohl et al., 2012); somewhat consistently we found that self-reported knowledge positively predicted cognitive and emotive capabilities. Interestingly, zoo and aquarium visits did not predict emotive capability, and such visitors also expressed a comparatively negative or lesser ascription of cognitive capability. One study did find that zoo visitors perceived zoo animals as "passive" or "tame" while wild animals were seen as "free" and "active" (Finlay et al., 1988). If participants perceived the animals in a zoo environment as passive and tame, then they might subsequently perceive these animals as less cognitively capable. Additionally, other studies have noted that the zoo exhibits can alter visitors' perceptions of zoo animals (Godinez & Fernandez, 2019). This may also impact people's perceptions of the cognitive abilities of these animals. For example, if animals are routinely seen in cages, that image may elicit the perception that they are dominated by or less than their human counterparts.

A particularly surprising finding and counter to our hypothesis was that across all species surveyed, people were significantly more likely to ascribe cognitive traits to animals than emotive traits. Previous studies indicated that people tended to more readily ascribe emotions to animals (Gallup et al., 1997; Rasmussen et al., 1993) and this had led to claims that anthropomorphism especially as it pertained to assigning animals feelings and emotions, should not be used in scientific study in part because it is over-applied (Wynne, 2004). This study shows that traits such as feelings and emotions are indeed not being over ascribed by the general public compared with cognitive traits. As such, the current findings are important as they give us a more complete understanding of the perceptions of the animal mind. While anthropomorphism may remain a pejorative attribution in the sciences, such positions have been found to positively impact people's relationships with animals. Specifically, increasing anthropomorphism increases the recognition of animal mind (Bastian et al., 2011). As such, anthropomorphism can also be used effectively in conservation campaigns (Chan, 2012; Root-Bernstein et al., 2013).

In addition, this finding that people are more willing to ascribe cognitive traits than emotive may counter justifications offered for a focus on evidence for cognition in animals, specifically that there is a lack of public belief in animal cognition. Rather, the assumption that people over-ascribe emotive traits to animals as compared with cognitive traits appears over-stated. This may relate to a desire for people to believe those traits are instead "reserved" or "restricted" to humans. Indeed, most people still maintain a belief that there is a difference between human and animal minds (Penn et al., 2008). Throughout history, humans have considered themselves to be apart from animals and they consciously or unconsciously sought ways to remain differentiated from animals. Many of these distinctions have since been refuted to the extent that the scientific community recognizes that humans are not the only species to be able to use tools (Bentley-Condit & Smith, 2010), possess language (Kako, 1999), or display emotions such as grief (King, 2013).

Given our strong finding regarding the willingness to ascribe cognitive traits to animals, it may be useful to further explore the effectiveness of utilizing cognitive traits in conservation campaigns. Instead of focusing on promoting "cute and cuddly" animals (Small, 2012), or attempting to create an emotional response with the animal (Kollmuss & Agyeman, 2010) as is often done, it might be equally or more effective to focus on ways in which the animals exhibit cognitive abilities. Our finding of people's affinity for and willingness to ascribe cognitive capabilities may open new avenues of understanding between humans and non-human animals.

Inexorable pressure placed on wildlife habitat by increasing human populations and activity has vastly changed the need to understand interactions between humans and wildlife in general and as such might aid conservation. We found that people not only perceive mental states in animals, but also perceive differences between those states. Specifically, we found that the public recognizes the cognitive capabilities of wildlife more strongly than the emotive capabilities. This was contrary to our initial prediction and in part refutes the presumption that the ascription of emotive traits such as feelings and emotions is widespread and problematic. This new finding suggests that much can still be learned about public perception and that there is room for fresh and imaginative approaches to conservation-based pursuits. As humans and wildlife increasingly share space and resources, conservation-based research must have a clear idea of perceptual factors that may inform conservation donations, policy decisions and perhaps ultimately, and longer term, lay the groundwork for new schools of thought on human–animal interaction and offer commensurate guidance for the benefit of both groups.

Note

1. The survey can be found at the following, open-access link: https://osf.io/dkuc5/?view_only=dca2a1d26390437c9d84060625cd3a16

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