**Moral Concern Toward Different Categories of Animal Species:
Using the Animal Moral Concern Scale to Examine Animal-Related Self-Perceptions and
Behaviors**

Keywords: human-animal relations, moral circle, animal welfare, speciesism, bifactor structure

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Abstract

Scholars have called for increasing theoretical and empirical attention to the diversity of human-animal relations, aiming to better understand the psychological mechanisms that underlie humans' varied perceptions of and interactions with different types of animal species. Employing data from 1650 adults demographically representative of the United States population, we explored the factorial structure of individuals' level of moral concern towards different categories of animals; developed a 15-item multidimensional Animal Moral Concern Scale (AMCS), and investigated the relations of AMCS scores with external variables. We found that moral concern towards animals can be represented by a bifactor structure where a general factor captures "level of concern towards animals in general," and four specific factors capture the residualized concern towards "Wild," "Farm/Food," "Pest", and "Companion" animals. Factor scores of the AMCS showed differential relationship with participants' perceived level of being an animal lover, diet choices, and engagement with animal welfare support activities.

Keywords: human-animal relations, moral circle, animal welfare, speciesism, bifactor structure

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Moral Concern Toward Different Categories of Animal Species:

Using the Animal Moral Concern Scale to Examine Animal-Related Self-Perceptions and Behaviors

According to the Catalogue of Life, a global collaborative scientific database of the world's species, there are approximately 1.9 million known species of animals who currently live on planet Earth (Roskov et al., 2020). Given that many animals on land and in sea have not yet been cataloged, this figure is generally regarded as a vast underestimation. Projections from one well-regarded model suggest that a total of approximately 7.77 million animal species currently inhabit the planet (Mora et al., 2011). Elsewhere, a model that takes into account additional groups of micro-animals estimates that total animal richness could actually be as high as 163 million species (Larsen et al., 2017).

Despite this vast landscape, humans interact directly with only a small proportion of living nonhuman animals (hereafter referred to simply as animals). Human-animal interaction occurs across varied contexts – including in close quarters with animals who are treated as pets, at a begrudging distance from those animals who are considered pests, and from afar or through purely mediated depictions with those animals who live in the wild. For many people, of course, much of their interaction with animals comes with species who are no longer living at all, as they appear on peoples' plates as food.

In recent years, scholars of social psychology and intergroup relations have called for increasing theoretical and empirical attention to the diversity of human-animal relations, aiming to better understand the psychological mechanisms that underlie humans' varied perceptions of and interactions with different types of animal species (Amiot & Bastian, 2015; Dhont et al., 2019). A persistent insight throughout this body of research has highlighted how people tend to

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place animals into culturally and historically contextual categories, a psychological sorting process that has significant implications for how those animals are treated in a society (Caviola et al., 2019; Herzog, 2011; Serpell, 2004; Sevillano & Fiske, 2016). As a result, human-animal relationships are characterized by ongoing discomfort and cognitive dissonance, as individuals and societies attempt to reconcile their purported affection and moral concern toward animals with their participation in activities – such as meat eating – that cause harm to animals (Bastian & Loughnan, 2017). With this in mind, previous research has aimed to understand where different animals fit within the “moral circle” of respondents, a concept borrowed from moral philosophy that refers to the boundary drawn around those entities a person deems worthy of moral consideration (Crimston et al., 2016; Laham, 2009; Singer, 1981). However, reliable measures that capture the multidimensional and categorically contingent nature of humans’ level of moral concern for different types of animals are few and far between (Amiot & Bastian, 2015).

This current study builds upon this research through the development of a psychometrically sound brief scale that assesses respondents’ level of moral concern towards animals, in general, and toward different categories of animal species, specifically. From there, this Animal Moral Concern Scale (AMCS) is used to predict respondents’ level of self-identification as an animal lover, as well as to explore relationships with behaviors such as diet choices and engagement in animal welfare support activities. The findings shed light on ongoing conceptual discussions about the psychology of human-animal relations, while the AMCS is presented as a useful tool to explore the place of animals in individual moral circles and examine how these moral determinations relate to other aspects of individual psychology and identity.

Measuring Moral Concern for Animals

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Numerous measurement instruments have been developed to assess human-animal interactions. Despite the variety of animal species with which humans engage, however, the majority of existing scales have focused on human relationships with pets and other companion animals (Wilson & Netting, 2012). The work of Herzog et al. (1991) represents a notable and influential exception, as they developed a 29-item “Animal Attitude Scale” (AAS) that assessed attitudes toward the treatment and use of animals, as well as the degree to which people would engage in specific animal welfare-oriented behavior. The ethics subscale of the AAS was later refined by Herzog et al. (2015) into a 5- and 10-item version. These validated scales include a mix of questions about animal use, items that sometimes refer to expansive categories of animals (e.g. wild animals, or simply animals), and at other times make reference to specific animal species (e.g. cattle, whales, or hogs). Caviola et al.’s (2019) “Speciesism Scale,” which aims to capture the psychological constructs at the root of an individuals’ assignment of moral worth based on species membership, takes a somewhat similar tack. The majority of items on that 7-item scale make reference to animals in general but within specific contexts of use (such as medical experiments and circuses), while one item does include specific reference to chimpanzees.

Useful as these scales are, the consistent reference to undefined and expansive categories of animals does not fully engage with the complexity of human-animal relationships. Indeed, understanding how people perceive and think about animals as a multiple social outgroups has been posed as a central question for intergroup relations scholars interested in human-animal interaction (Dhont et al., 2019). Previous research has made it clear that, even if humans hold a general attitudinal disposition toward animals, they also cognitively situate animals into sets of culturally and historically contingent categories. With that said, there are varied

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conceptualizations of what, exactly, these categories are, as well as how, exactly, these categories are constructed (Amiot & Bastian, 2015). For instance, Serpell (2014) suggested that animals are placed within a psychological matrix that includes an axis of affect (ranging from love and sympathy to fear and loathing) and another axis of utility (ranging from detrimental to beneficial for human interests). Sevillano and Fiske (2016) adapted the Stereotype Content Model (SCM) – a framework traditionally used to assess stereotypes of human social groups on the basis of perceived warmth and competence – to a diverse set of animals. Their research identified four clusters – predators such as tigers and bears (low warmth, high competence), companions such as dogs and horses (high warmth, high competence), prey such as cows and ducks (high warmth, low competence), and pests such as lizards and rats (low warmth, low competence). Limitations of that study included the fact that half of the observed animals fell into mixed clusters, and that warmth and competence may not be equally easy to ascribe to all animals, with follow-up experimental research offering similarly mixed conclusions (Sevillano & Fiske, 2019). Elsewhere, Taylor and Signal (2009) proffered the categories of pet, pest, and profit animals. Author (2020) used focus groups to identify four emergent categories of animals among participants: food, pest, wild, and companion.

Regardless of these variations, there remains general agreement that, when prompted to think of animals, people do not think of a single, unified definition. Instead, our identification and categorization of animals is a multidimensional construct that varies not only across individuals, but also at an intraindividual level (Amiot, Lépine, & Zaky, 2019). Only by attending to this multidimensional context can the vagaries, contradictions, and cognitive dissonance that characterize human perceptions toward and use of animals be fully understood. Indeed, with greater attention to categories of animal species, complex psychological phenomena

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such as the so-called “meat paradox” – wherein people love certain animals but love to eat others, irrespective of the animals’ cognitive or emotional capacities – can be systematically explored and interpreted (Bastian & Loughnan, 2017; Bratanova et al., 2011; Loughnan et al., 2010).

Efforts to measure where animals fit within the moral circle of a respondent move closer to this goal of multidimensionality. Crimston et al. (2016) developed the “Moral Expansiveness Scale” (MES) to capture variations in the breadth of entities deemed worthy of moral concern and treatment. Using a list of different types of people, animals, plants, and aspects of the environment, respondents were asked to place each entity within an inner circle, outer circle, on the fringes, or outside the boundary of their moral concern. Laham’s (2009) moral circle task focused exclusively on animals, as participants were given a list of 26 common animals and asked to indicate for which animals they felt morally obligated to show concern. From there, the number of animals selected was summed to create an overall measure of moral concern. This approach has been adopted and slightly adapted by several researchers in the psychology of human-animal relations. The moral circle task has been used as part of an experiment to test whether eating meat reduced moral concern for animals (Loughnan et al., 2010), to explore whether moral concern was affected by framing humans as either similar or dissimilar to animals (Bastian et al., 2012), and in the development of a scale related to rationalizing meat consumption (Piazza et al., 2015), among other applications.

Despite its utility, the moral circle task as currently constructed has several limitations. First, the full scale has not been validated nor has the full list of animals been published in existing literature. Second, the development of a moral concern measure based on summing affirmative answers to a dichotomous question provides suboptimal statistical texture. Third, the

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scale is quite long, and there are likely opportunities to eliminate some of the listed animals without losing statistical power. Fourth, the scale has not explicitly ensured that theoretically relevant categories of different species of animals are all represented, constraining its ability to provide insight on the multidimensional nature of human-animal relations. Meanwhile, as noted previously, measures used to examine animal categorization processes have often stopped short of including specific species (Amiot, Lépine, & Zaky, 2019). Other research has led to the construction of categories that do not necessarily match lay understandings, with the creation of clusters, for instance, that include monkeys and elephants alongside dogs and cats on account of their perceived warmth and competence (Sevillano & Fiske, 2016).

Fundamentally, researchers have a demonstrated interest in understanding the relationships between the moral consideration of animals and a host of demographic, attitudinal, and behavioral dynamics, including gender (Herzog, 2007), dietary behavior and vegetarianism (Loughnan et al., 2010; Piazza et al., 2015), and participation in various forms of animal advocacy. (Herzog & Golden, 2009). Through the development of an improved measure, the Animal Moral Concern Scale (AMCS), this current study aims to expand upon this literature, with an aim to better predict animal-related perceptions and behaviors while remaining cognizant of intraindividual animal categorization processes.

Method

Participants

We collected data (available upon request) from 1650 participants representative of the United States population. Among the participants, 742 (45.0%) were females, 902 (54.7%) were males, and 6 (0.4%) were identified as “Other”. The average age was 43.9 ($SD = 17.1$). The sample included 803 Caucasian (48.7%), 384 African/American (23.3%), 185 Hispanic (11.2%),

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136 Asian (8.2%), 37 American Indian or Alaska native (2.2%), 9 Middle Eastern or North African (0.5%), 11 Native Hawaiian or other Pacific Islander (0.7%) while 69 (4.2%) of the participants were identified as mixed race, and 16 (1.0%) were identified as “Other” race.

Among all participants, 596 (36.1%) reported to live in urban areas, 397 (24.1%) in rural areas, and 657 (39.8 %) in suburban areas.

We randomly divided the sample into exploratory factor analysis (EFA) group ($n = 990$, 60%), and confirmatory factor analysis (CFA) group ($n = 660$, 40%), and carried out a series of exploratory and confirmatory factor analyses using the respective subsamples. Sample size requirements in factor analysis depend on multiple aspects of the study including number of observed variables, number of factors, magnitude of factor loadings and level of communalities of the variables (MacCallum et al., 1999; Wolf et al., 2013). Our sample sizes for both the exploratory and confirmatory analyses were found to be appropriate in simulation studies that investigated the effects of such study aspects on minimum required sample sizes for factor analysis (MacCallum et al., 1999; Wolf et al., 2013). We used a larger sample for the exploratory analysis due to larger initial item pool.

Procedures

All study procedures were approved by the university’s Institutional Review Board (Protocol #828). Participants were recruited by a private online survey firm and responded to a variety of survey questions related to demographics, perceptions of animals, and political perceptions and behaviors. This current article reports on measures related to perceptions of concern for animals, using outcome variables related to demographics, animal-related self-perceptions, and animal welfare-related activism.

Measures

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Item Pool for the Development of the Animal Moral Concern Scale

Participants were presented with the following prompt, which was adapted from Laham (2009) and refined for clarity using pre-survey cognitive interviewing: “When we think about different types of animals in the world, we might have different levels of concern for their well-being. Below is a list of animals. Please indicate how much concern you have for the well-being of each.” Participants were given a list of 43 animals (see Table 1) and responded on a 4-point Likert scale (*No concern* [1], *A little bit of concern* [2], *Moderate concern* [3], *High concern* [4]). The list of animals was adapted from Piazza et al. (2015), with further animals added in order to ensure variation across potential categories of animal species, a process that was again informed by pre-survey cognitive interviewing.

Perceived Level of Being an Animal Lover

Participants reported on a single item with a 5-point Likert scale [*Strongly disagree* [1] to *Strongly agree* [5)] the degree to which they consider themselves as an animal lover.

Diet

Participants reported the particular type of diet they followed among the following options: Atkins, Paleo, Keto, Pescetarian, Vegetarian, Vegan, Meat reduction/flexitarian, or no specific diet. Clear definitions were offered for each dietary option. Participants were allowed to select only one option. This measure was adapted from an existing bank of animal-related survey questions (Faunalytics, n.d.) and refined via pre-survey cognitive interviewing.

Animal Welfare Activism

Participants reported on a binary (i.e., Yes/No) scale whether they have ever participated in the following activities: “Worked or volunteered at an animal shelter or animal welfare

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organization”, “Participated in a protest in support of animals”, “Donated money to an animal-related charity”.

Study 1: Exploratory Factor Analysis

Initial EFA and Item Selection

The goal of the exploratory factor analyses was two-fold: First, we explored the factor structure of level of moral concern towards different animals. Second we selected the best items among 43 to form a brief multidimensional Animal Moral Concern Scale (AMCS) that has (a) a balanced number of items in each identified dimension, and (b) a simple structure in which each item shows a salient factor loading to one and only one latent dimension and no salient cross-loadings.

Analytical Procedure

For all the following analyses, we used the R software (version 3.6.2, R Core Team, 2019). For the EFA models, we first evaluated the factorability of the EFA dataset ($n = 990$) by the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s (1951) test of sphericity using the *psych* package (version 1.9.12; Revelle, 2019). We determined the number of factors to be extracted by evaluating the Kaiser (1960) criterion (all factors with eigenvalues > 1), parallel analysis (Horn, 1965), and Velicer’s Minimum Average Partial (MAP; Velicer, 1976) criterion using the *nFactors* package (version = 2.4.1; Raiche & Magis, 2020). We estimated the EFA models using polychoric correlation matrix and used principal axis factors extraction and direct oblimin rotation. We evaluated magnitudes of primary factor loadings and cross-loadings. An item was considered desirable if it showed salient ($>|.5|$) primary loadings, and non-salient ($<|.30|$) cross-loading(s). We compared multiple EFA solutions to identify the items that consistently load on the same factors. We further selected among those that showed the highest

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loadings to a primary factor and minimal cross-loadings to form the final scale comprising clearly identifiable factors.

Results

Table 1 presents the mean, standard deviation, skewness and kurtoses of the initial 43 Animal Moral Concern scale items for the whole dataset ($N = 1650$). The highest mean moral concern level was observed for *Dogs* ($M = 2.21$, $SD = 1.01$), and the lowest mean moral concern level was towards *Cockroaches* ($M = 0.56$, $SD = 0.97$). Skewness and kurtosis values showed some degree of nonnormality.

The KMO measure of sampling adequacy was .98, which was well above the recommended value of .6, indicating the items share enough common variance for factor analysis. Bartlett's (1951) test of sphericity was significant, $X^2(903) = 35002.12$, $p < .001$, indicating the item correlation matrix is not an identity matrix; that the items are related, and factor analysis is suitable. The mean inter-item correlation was .50 ($sd = .14$, $max = .76$, $min = -.004$). Kaiser (1960) criterion and the scree plot suggested three factors to be extracted, while parallel analysis (Horn, 1965) and MAP criterion (Velicer, 1976) suggested five factors. Therefore, we examined the patterns of item factor loadings in five-, four-, and three-factor solutions.

The first factor of the five-factor model captured wild animals (22% variance accounted for [VAF]), second factor farm/food animals (18% VAF), and the third factor pests (16% VAF). The last two factors resulted in zero, and one (*Cats*) item, respectively, that satisfied our criteria for inclusion. Also, there were several items that showed no salient loadings on any factors and/or that showed salient cross-loadings.

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Similar to the five-factor model, the first factor of the four-factor model captured wild animals (25% VAF), second factor farm/food animals (23% VAF), and the third factor pests (17% VAF). The fourth factor contained a single indicator (*Cats*), and there were several items with no salient loadings and/or salient cross loadings.

The first factor of the three-factor solution consisted of farm/food and companion animals (31% VAF), and the second and third factors captured wild animals (23% VAF), and pests (16% VAF), respectively. Since the three-factor solution resulted in an uninterpretable first factor, we focused on four- and five-factor solutions and identified items that consistently reflected the same factors. For the “Wild animals” factor, these animals included *Lions, Bears, Elephants, Dolphins, Whales, Gorillas, Chimpanzees, Monkeys, Penguins, and Bees*; the “Farm/Food animals” factor included *Cows, Pigs, Chickens, Goats, Sheep, Turkeys, and Bass fish*; and the “Pests” factor included *Bearded-dragons, Snakes, Rats, Cockroaches, and Spiders*. For theoretical considerations, we excluded *Bees* from the “Wild animals” factor, and *Bearded-dragons* from the “Pests” factor. We also tentatively retained the items *Cats, Dogs, and Horses* as theoretically representative of a “Companion animals” factor. This decision was made to increase the content validity of the eventual scale. The three “Companion animals” items are selected based on their relatively more desirable factor loading patterns in the five- and four-factor EFA analyses although they did not always meet our criteria for item selection. At this stage, we retained a total of 23 items reflecting “Wild animals”, “Farm/Food animals”, “Pests”, and “Companion animals”.

KMO of the 23 items was 0.97, and Bartlett’s test was significant ($X^2(253) = 17220.44, p < .001$). Parallel analysis suggested four factors. Thus, we submitted this reduced set of items to another EFA that is specified to extract four factors. This model achieved a simple structure,

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excepting *Horses*, in which each item showed one and only one salient factor loading. *Horses* showed primary loadings to “Companion animals” and cross-loading to “Wild animals”. We tentatively retained *Horses* for further evaluation. Overall, the three extracted factors explained 76% of the variance (VAF = Wild: 30%; Food/Farm: 22%; Pests: 14%; Companion: 9%).

Finally, in order to have a balanced number of items per subscale, we further chose four items from the “Wild animals” and “Farm/Food animals” factors that consistently showed the highest simple loadings across the EFA solutions. Those items included: *Gorillas*, *Elephants*, *Whales*, and *Lions* for the “Wild animals” factor; *Chickens*, *Turkeys*, *Cows*, and *Sheep* for the “Farm/Food animals” factor. Therefore, the final item set for the AMCS included the following 15 items: *Gorillas*, *Elephants*, *Whales*, and *Lions* (“Wild animals”); *Chickens*, *Turkeys*, *Cows*, and *Sheep* (“Farm/Food animals”); *Snakes*, *Rats*, *Cockroaches*, and *Spiders* (“Pests”); *Cats*, *Dogs*, and *Horses* (“Companion animals”).

EFA with Reduced Item Set

The goal of the second round of exploratory factor analyses was to further investigate the factorial structure of the 15-item AMCS. We employed the EFA dataset ($n = 990$) in the following analyses.

Analytical Procedure

We examined the factor structure of the 15-item AMCS using two exploratory factor analytic models. First, we estimated an EFA model with four factors. We evaluated magnitudes of primary factor loadings and cross-loadings, the “structure matrix”, and the correlations among the factors. Second, we administered a Schmid-Leiman bifactor EFA procedure (Schmid & Leiman, 1957). Bifactor models posit a general factor that reflects the common variance across all items and multiple orthogonal “specific” factors which capture any remaining systematic

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variance after the general factor is accounted for. In AMCS, the general factor can be conceptualized as the “level of concern towards animals in general”, and the specific factors correspond to level of concern towards the four animal groups (i.e. “Wild animals”, “Farm/Food animals”, “Pests”, and “Companion animals”; see Reise, 2012 for a review of the bifactor models). Therefore, with the Schmid-Leiman procedure, we examined (a) whether there is a “concern towards animals in general” factor underlying all 15 items of the AMCS, and (b) whether the items will cluster under their hypothesized specific factors after the general factor is accounted for. We administered the Schmid-Leiman bifactor EFA procedure via the *psych* package in R (Revelle, 2019). We used oblique (promax) rotation, and the minimum residual solution estimation. We examined the patterns of factor loadings to determine the appropriateness of the bifactor solution.

Results

The 15-item AMCS was suitable for factor analysis ($KMO = 0.93$; Bartlett’s test = $X^2(105) = 9337.137, p < .001$). The four factors together accounted for 77% of the variance (VAF = Wild: 23%; Farm/Food: 21%; Pests: 20%; Companion: 13%) in the four correlated-factors EFA model. The model showed a simple structure in which all items loaded to their hypothesized factors with no salient cross-loadings. Only the *Horses* showed a factor loading of less than .50 (.41) to the hypothesized “Companion animals” factor. We decided to retain this item since it showed an expected pattern of loadings with no considerable cross-loadings (Table 2). The structure matrix (available upon request) showed that, overall, all items show nonnegligible correlations with all four factors. Correlations among the four factors ranged between .20 and .69 (Table 2).

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The factor loadings from the Schmid-Leiman exploratory bifactor model are presented in Table 2. As expected, all 15 items showed significant factor loadings to the general factor (range: .27 - .80), and positive factor loadings to their respective specific factors with no salient cross-loadings (including *Horses*). Therefore, a bifactor structure appeared to be a plausible representation of the AMCS.

Study 2: Confirmatory Factor Analysis

Exploratory factor analyses revealed that a four correlated-factor model and a bifactor model with one general factor and four orthogonal specific factors are two candidate models representing the factorial structure of level of moral concern towards different categories of animals. Therefore, using the hold-out CFA sample ($n = 660$), we subjected the AMCS items to (a) a four correlated-factors CFA, (b) a confirmatory bifactor model with one general factor and four first-order factors, via the *lavaan* package (version = 0.6.6.1513; Rosseel, 2012).

Analytical Procedure

The confirmatory models were estimated with weighted least square mean and variance adjusted (WLSMV) estimator in which diagonally weighted least squares (DWLS) were used for model parameter estimation, and the full weight matrix was used to compute robust standard errors, and a mean- and variance-adjusted test statistic (Flora & Curran, 2004). We standardized latent factors for identification.

We compared the fit of the correlated-factors model and the bifactor model based on goodness of fit indices, and patterns of item factor loadings. The factor correlations and scale score reliabilities of the correlated-factors model also informed model selection (explained below). Goodness of model fit was assessed with Comparative Fit Index (CFI; Bentler, 1990), Tucker-Lewis Fit Index (TLI; Tucker & Lewis, 1973), and standardized root mean square

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residual (SRMR; Jöreskog & Sörbom, 1986). CFI and TLI compare the specified model to the baseline model where all items are uncorrelated. SRMR is an index of standardized discrepancy between the observed and model-implied correlations. CFI values $\geq .93$ were considered to indicate acceptable fit (Byrne, 1994). Models that meet the CFI criterion were further evaluated with respect to TLI and SRMR indices. We considered TLI $>.90$, and ideally $>.95$ (Hu & Bentler, 1999; Marsh et al., 1988); and the SRMR $<.08$ (Hu & Bentler, 1999) as indicative of adequate fit. Due to the non-normal nature of the data, we reported robust versions of these indices except for the SRMR for which there is no scaling correction. However, it is of great importance to note that (a) traditional benchmarks for SEM fit indices do not necessarily apply to SEMs with polytomous data (Cook & Kallen, 2009), and (b) nor polytomous data in the context of particular (e.g. bifactor) models (West et al., 2012). Therefore, the interpretation of these traditional fit indices must be treated “with extreme caution” (Reise et al., 2010). We did not report the traditional chi-square test for CFA or the root mean square error of approximation (RMSEA; Steiger & Lind, 1980) since it is widely acknowledged that the chi-square test tends to have inflated Type I error rates with larger (>200) sample sizes (Steiger, 2007; Van de Schoot et al., 2012), and the performance of any benchmark criteria (i.e. $<.05$, $<.10$) for the RMSEA depends largely on model in question, degrees of freedom, and sample size (Chen et al., 2008).

After model comparison, we fitted the selected model to the full sample ($N = 1650$) to obtain the most stable parameter estimates for further evaluations (described below).

Results

Confirmatory Correlated-Factors Model

The CFI of the correlated-factors solution was .964, which indicated good fit. Thus, we evaluated TLI and SRMR. The TLI was .955 which also indicated good fit; and SRMR was .073

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which indicated acceptable fit. Items showed large ($>.77$) and significant factor loadings to their respective factors (Table 3). The correlations among the three factors were substantial (range: .44 - .83; Table 3). Cronbach's coefficient alpha (α , 1951) for the "Wild animals", "Farm/Food animals", "Pests", and "Companion animals" factors were calculated as .93, .92, .92, and .87 respectively. These values exceeded the recommended maximal value of .9 for Cronbach's alpha (Tavakol & Dennich, 2011). Furthermore, the modification indices suggested freeing cross-loadings of multiple items to other factors. Overall, these findings (i.e. high intercorrelations among factors, too high subscale reliabilities, cross-loadings) imply that a substantial portion of the overall variability is common to all scale items. Therefore, we investigated whether a bifactor structure can provide a better explanation to the factorial structure of moral concern towards different categories of animals.

Confirmatory Bifactor Model

The bifactor CFA model also showed adequate fit to the data (CFI = .970; TLI = .957; SRMR = .068). The examination of factor loadings (Table 3) showed that the general factor, in fact, accounted for a substantial amount of variability in the data. All items showed significant factor loadings to the general factor: Items of the "Wild", "Farm/Food", and "Companion animals" showed standardized factor loadings of $>.68$ while items of the "Pests" were relatively lower (range: .22 - .58). As expected, the factor loadings to the specific factors in the bifactor model were lower than those in the correlated-factors model because the general factor accounted for some portion of the shared variance among the subscale items. Nevertheless, all item loadings on the general and specific factors were positive and statistically significant at the alpha level of .01. All in all, both the fit indices and patterns of item factor loadings suggested that the bifactor model is a better account of the data compared to the correlated-factors model.

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The configuration of the confirmatory bifactor model and the standardized factor loadings of items on the general and the specific factors that are obtained from the full sample (CFI = .968; TLI = .955; SRMR = .068) are presented in Figure 1. Overall, items of the “Wild”, “Farm/Food”, and “Companion” animals showed larger loadings to the general factor than their respective specific factors (except for *Dogs* in “Companion animals” which showed slightly higher loading to the specific factor). This implies that the common variance among those items are accounted mostly for by the general factor than the specific factors. On the other hand, the items of the “Pests” had larger loadings in the specific factor than the general factor, implying that these items are relatively better measures of their specific factors than the general factor. Patterns of factor loading also inform how viable the subscales are. Based on the CFA factor loading patterns, only the “Pests” factor appears to be a viable subscale for reporting and interpretation.

Dimensionality and Scale Score Reliability. Even when a scale has an apparent multidimensional structure, the scale scores can be treated as unidimensional in applications like item response theory if the scale is deemed “unidimensional enough” (Reise, 2012; Reise et al., 2013). For scales with a bifactor structure, like the AMCS, “unidimensional enough” refers to presence of a strong general factor which accounts for majority of the variance of the scale responses. Another practical consideration with multidimensional scales is whether the use of subscale scores is appropriate. Therefore, we investigated if (a) AMCS is “unidimensional enough” to apply unidimensional methods, (b) whether subscale scores of AMCS can reliably be interpreted, and/or be used to predict external variables. We used the full sample ($N = 1650$) for the following analyses.

Explained Common Variance (ECV) is the ratio of variance explained by the general factor divided by the variance explained by the general and specific factors (Reise, 2012;

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Rodriguez et al., 2016). Higher ECV indicates stronger general factor relative to the specific factors (Reise, 2012; Rodriguez et al., 2016). The ECV of the bifactor model of AMCS was estimated as .61, indicating that 61% of the common variance extracted can be explained by the general factor while the 39% is explained by the specific factors (Rodriguez et al., 2016).

We estimated the reliability of AMCS using McDonald's omega and omega subscale (McDonald, 1999; Revelle & Zinbarg, 2009; Zinbarg et al., 2005), and omega-hierarchical and omega-hierarchical subscale (McDonald, 1999; Reise et al., 2013; Zinbarg et al., 1997; Zinbarg et al., 2005; Zinbarg et al., 2006). McDonald's omega (ω) estimates the proportion of variance in scale scores that is explained by all sources of common variance among the scale items. Omega-subscale (ω_S) estimates the proportion of variance in the subscale scores that are explained by all sources of common variance among the subscale items. ω for the composite AMCS scores was estimated as .97. ω_S for the "Wild animals", "Farm/Food animals", "Pests", and "Companion animals" were estimated as .93, .92, .93, and .93, respectively. These values indicate high reliability of all five factors; however, since they do not take into account the bifactor structure of the scale, they can be severely misleading. Therefore, we computed omega-hierarchical (ω_H) and omega-hierarchical subscale (ω_{HS}) indices to separate the systematic variances in the total and subscale scores that are due to the general factor and the specific factor in question.

Within bifactor modeling, ω_H estimates the reliable variance in the unit-weighted total scale scores due to the general factor (i.e. treats common variance of the specific factors as error variance). ω_H determines the degree to which unit-weighted composite scale scores are interpretable as a measure of a single common factor (i.e. "general Animal Moral Concern level"). Higher values imply that even when item response data is multidimensional, the

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composite scores predominantly reflect the general factor (Zinbarg et al., 2006). ω_H for AMCS was estimated as .84.

ω_{HS} is an index of the extent to which subscale scores reliably represent the construct they are supposed to represent (above and beyond the general factor). In other words, ω_{HS} represents the reliability of the subscales after the effect of the general factor is removed. ω_{HS} estimates for the “Wild animals”, “Farm/Food animals”, “Pests”, and “Companion animals” were .26, .18, .70, .20, respectively.

These findings imply that the total scale score of AMCS would reflect an individual’s level of moral concern towards animals in general *plus* any additional (or lack of) concern towards wild animals, farm/food animals, pests, and companions. Observed subscale scores of these four specific factors would reflect their level of concern towards the given animal group, but these scores would be confounded by their level of concern towards animals in general. Therefore, despite the apparent multidimensionality of the AMCS, the manifest composite AMCS scores predominantly represent the general factor; and that the use of the manifest subscale scores except for the “Pests” subscale should be avoided. Researchers interested in unique relations of the specific factors of the AMCS with external criteria should utilize the bifactor model of the AMCS within latent variable modeling context (illustrated below) in order to control for the effect of the general factor.

Study 3: Relations of the Factors of the AMCS with Demographic variables, Self-Perception, and Observable Behaviors

Using the full sample ($N = 1650$) we utilized structural equation modelling to investigate the relations of the factors in the bifactor model of the AMCS with the demographic variables of gender and age; the respondents’ level of identification as an animal lover; self-reported diet

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choices; and engagement in animal welfare activities such as participating in a protest in support of animals, working on animal shelters, and donating money to animal-related charities.

Analytical Procedure

We estimated all SEMs with the *lavaan* package (Rosseel, 2012) in R. Demographic variables gender and age were treated as exogenous predictor variables in the respective models. Level of identification as an animal lover, diet choices, and engagement in animal welfare activities were treated as endogenous outcome variables. We treated ordinal variables as categorical and used the WLSMV estimation. We standardized the latent factors in all models. For all models, we reported the overall fit as well as the relevant path coefficients.

Results

Demographics

Gender. We tested gender differences on moral concern towards animals by estimating an SEM model in which the factor scores in the bifactor representation of the AMCS were predicted by gender. We coded males as “0” and females as “1” in the gender variable; therefore, the path coefficients represented level of concern of females towards animal categories in comparison to males. The SEM solution (CFI = .966, TLI = .958, SRMR = .068) showed that the only significant difference between males and females was on the general factor ($\beta = 0.183$, 95% CI = [0.065, 0.301], $p < .01$, $SE = .060$) such that females had higher concern towards animals in general. Controlling for the general factor, there were no significant gender differences in the specific factors (p -values $> .05$).

Age. To examine the effect of age on animal moral concern, we estimated an SEM model in which the factor scores in the bifactor representation of the AMCS were predicted by observed variable age. The SEM solution (CFI = .967, TLI = .959, SRMR = 0.067) showed that

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there was no significant effect of age on level of moral concern towards animals in general ($\beta = 0.000$, 95% CI = [-0.003, 0.004], $p = .80$, $SE = .002$). Controlling for the general factor, age showed significant effect on only moral concern towards Pests ($\beta = -0.014$, 95% CI = [-0.018, -0.011], $p < .001$, $SE = .002$), and marginal effect on moral concern towards Farm/Food animals ($\beta = -0.005$, 95% CI = [-0.010, 0.000], $p = .050$, $SE = .003$), such that increased age was related to a decrease in moral concern towards Pests and Farm/Food animals, controlling for the moral concern towards animals in general.

Predicting Perceived Degree of Identification as an Animal Lover

We investigated the relations between the bifactor model of the AMCS and one's self-perception as an animal lover using structural equation modeling (SEM). Out of 1650 participants, 725 (43.9%) responded "Strongly agree" and 446 (27.0%) responded "Somewhat agree" to the statement "I consider myself an animal lover," while 47 (2.8%) responded "Strongly disagree." In the SEM model, (CFI = .967; TLI = .954; SRMR = .064), the strongest relationship between perceiving oneself as animal lover and the factors of AMCS was observed between the general factor ($\beta = 0.433$, 95% CI = [0.376, 0.490], $p < .001$, $SE = .029$) followed by the specific factors "Companion Animals" ($\beta = 0.265$, 95% CI = [0.182, 0.349], $p < .001$, $SE = 0.043$) and "Wild animals" ($\beta = 0.210$, 95% CI = [0.137, 0.282], $p < .001$, $SE = 0.037$). The standardized regression coefficient of the specific factor "Farm/Food animals" was negative ($\beta = -.100$, 95% CI = [-0.188, -0.011], $p = .027$, $SE = 0.045$), and the coefficient of the "Pest" factor was negative but nonsignificant ($\beta = -.045$, 95% CI = [-0.109, 0.019], $p = .165$, $SE = 0.33$). In other words, the higher the level of moral concern towards "animals in general," "Companion animals," and "Wild animals," the higher the self-reported perceived level of being an animal lover; the higher the level of concern towards the "Food/Farm animals" (that is above and

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beyond general factor), the lower the self-reported perceived level of being an animal lover.

There was no significant association between concern towards “Pests” (above and beyond the general factor) and the self-reported perceived level of being an animal lover.

Predicting Behavior

Diet. Out of 1650 participants, 121 (7.34%) indicated that they follow a vegetarian (3.6%) or a vegan (3.7%) diet, values that align with previous research on the topic. Using the bifactor model of AMCS, we examined whether the general and the specific factors of the AMCS can predict following a vegan or vegetarian diet, CFI = .968; TLI = .955; SRMR = .065. There was no significant relationship between following a vegan or vegetarian diet with level of moral concern towards animals in general ($\beta = -0.014$, 95% CI = [-0.116, 0.089], $p = .797$, $SE = .052$), or level of moral concern towards wild animals ($\beta = -0.114$, 95% CI = [-0.239, 0.011], $p = .074$, $SE = .064$), or companion animals ($\beta = -0.084$, 95% CI = [-0.196, 0.028], $p = .143$, $SE = .057$) controlling for the general factor. On the other hand, controlling for the general factor, higher level of concern towards farm/food animals ($\beta = 0.303$, 95% CI = [0.160, 0.446], $p < .001$, $SE = .073$), and pests ($\beta = 0.422$, 95% CI = [0.326, 0.519], $p < .001$, $SE = .049$) was associated with higher probability of having a vegan or vegetarian diet.

Animal welfare activism. A total of 343 participants (20.8%) indicated that they worked or volunteered at an animal shelter or animal welfare organization; 151 (9.2%) indicated that they participated in a protest in support of animals; and 584 (35.4%) indicated that they donated money to an animal-related charity. We represented individuals' engagement with animal welfare activism as a latent factor measured by these three behavioral indicators and predicted engagement with animal welfare activism using the bifactor structure of AMCS (CFI = .969; TLI = .958; SRMR = .072). Higher levels of moral concern towards animals in general predicted

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engagement in animal welfare activities ($\beta = 0.262$, 95% CI = [0.160, 0.365], $p < .001$, $SE = .052$). Controlling for the general factor, moral concern towards wild animals ($\beta = 0.191$, 95% CI = [0.059, 0.323], $p < .01$, $SE = .067$), companion animals ($\beta = 0.205$, 95% CI = [0.073, 0.337], $p < .01$, $SE = .067$), and pests ($\beta = 0.249$, 95% CI = [0.146, 0.352], $p < .001$, $SE = .053$) also predicted participation in animal welfare activities. However, there was no relationship between moral concern towards farm/food animals and participation in animal welfare activities ($\beta = 0.003$, 95% CI = [-0.152, 0.159], $p = .965$, $SE = .079$).

Discussion

The goal of the present study was to investigate the factorial structure of moral concern towards different categories of animal species; to develop a psychometrically sound multidimensional scale to assess individuals' level of moral concern for the well-being of different types of animals; and from there to test the applicability of that scale for the prediction of other human-animal intergroup attitudes and behaviors. We collected data from 1650 adults on an initial set of 43 items. In Study 1, with a series of exploratory factor analyses we identified 15 items that reflect four factors: level of concern towards “Wild animals”, “Farm/Food animals”, “Pests”, and “Companion animals”. Confirmatory factor analyses in Study 2 revealed that a bifactor structure better accounts for the data. Specifically, we found that, a general factor – concern toward animals in general– underlies all of the scale items. Once this factor was accounted for, there was still systematic variance among the items of the four identified specific factors. This finding implies that individuals' responses to AMCS items are determined by (a) their concern towards animals in general; (b) any adjustments to this general concern level considering the particular animal “type” in question (e.g. wild animals vs. farm/food animals).

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The four categories of animals that emerged in the factor analyses overlapped with Author's (2020) focus group findings, and Sevillano and Fiske's (2016) four categories (i.e., predators, companions, prey, and pests), and partially with Taylor and Signal's (2009) three categories (i.e., pet, pest, and profit), indicating that different groups of researchers are converging on consistent categories using different methods. A unique finding of the current study is that, even as individuals' concern toward different animal species allows for the emergence of animal categories, individuals appear to "adjust" their level of concern toward these different categories of animals only to a limited extent, especially for the "Wild", "Farm/Food", and "Companion" animals. In other words, the main individual difference appears to be the individuals' concern towards animals *in general*, and intraindividual variation in concern towards different categories of animals appears to be relatively low. Concern towards "Pests" can also be predicted by individuals' concern towards animals in general, but there appears to be a higher level of differentiation of "Pests" from other animals, likely due to individuals' tendency to dislike "Pests" since they associate them with disease (e.g., Bjerke, Østdahl, & Kleiven, 2003; Prokop & Tunnicliffe, 2010), or to perceive them to have low sentience (e.g., Possidónio et al., 2019; Sevillano & Fiske, 2016), and to be harmful (e.g., Piazza et al., 2014; Sevillano & Fiske, 2016).

In Study 3, we investigated the relationship between the general and specific factors of the AMCS with external variables. Our finding that females have higher moral concern for animals in general than males is consistent with previous research (e.g., Caviola et al., 2019; Herzog, 2007; Possidónio et al., 2019), but the fact that there were no gender differences across the specific animal category factors deserves attention, especially in light of research that has found women to be more prosocially motivated to be vegetarian as compared to men (Rosenfeld,

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2020). Similarly, while we found no correlation between age and moral concern for animals in general, older respondents showed lower concern toward farm/food animals and pests.

Subsequent scholarship could examine the psychological and sociological reasons for these generational divides.

There was a significant positive relationship with one's self-identification as an animal lover and the general factor, as well as the "Wild animals" and "Companion animals" factors of the AMCS, while level of concern towards "Farm/Food animals" showed a weaker but significant negative relationship. Level of concern towards "Pests" did not have any significant relationship with considering oneself as an animal lover. We also examined whether AMCS factors can predict behavioral choices of individuals with respect to the type of diet they follow and level of engagement with animal welfare support activities. Results showed that following a vegan or vegetarian diet is predicted by level of moral concern towards "Farm/Food animals" and "Pests," controlling for level of moral concern towards animals in general. Engagement with animal welfare support activities was predicted by all factors except for level of moral concern towards Farm/Food animals.

The positive correlations between the general factor and the individuals' self-identification as an animal lover and level of engagement with animal welfare activism provide evidence for the convergent validity of the AMCS scores. The findings with respect to the specific factors provide statistical support for several key observations that have been offered by other scholars who have investigated the complexity of human-animal relations and the nature of speciesism (Caviola et al., 2019; Herzog, 2011). Notably, the research demonstrates the "meat paradox" (Bastian & Loughnan, 2017) in action by showing that moral concern toward food/farm animals, specifically, is not a prerequisite for one's self-identification as an animal

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lover, or even engagement in animal welfare-related activism (Herzog & Golden, 2009; Thomas et al., 2019). With this in mind, it is not a surprise that, even as large proportions of society insist that they care about the well-being of animals, a relatively small proportion of society follows a vegetarian or vegan diet. The cognitive dissonance of individuals who both love and love to eat animals is resolved through the exclusion of animals consumed as food from their conceptualization of animals who require moral consideration, a finding that has also been demonstrated through experimental means (Loughnan et al., 2010). Conversely, the fact that those who do follow a vegetarian or vegan diet express greater moral concern toward both “Farm/Food animals” and “Pests” suggests that they resolve their own potential cognitive dissonance through the extension of moral concern to all categories of animal species.

Taken together, this work has responded to the call that scholars of social psychology and intergroup relations should grant increased attention to the psychological components of humans’ perceptions of varied types of animal species (Amiot & Bastian, 2015; Dhont et al., 2019). It also builds upon the growing literature that has explored the nature of an individual’s “moral circle,” and in particular the place of different categories of animals within that moral circle. As the results above demonstrate, the AMCS represents a theoretically-grounded and empirically sound scale that can be used to assess the general level of moral concern that individuals grant to animals, as well as to more closely examine the level of concern they grant to varied categories of animals. From there, the AMCS can also be used to explore relationships with other demographic, psychological, and behavioral characteristics. It can therefore serve as a complement to other scales that investigate attitudes toward animals (Herzog et al., 2015) and speciesism (Caviola et al., 2019), as well as help to examine concepts such as the “meat paradox” (Bastian & Loughnan, 2017), offering a statistical tool that takes into account humans’

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tendency to place animals into conceptually relevant categories. The AMCS is also conducive for studies that move beyond moral judgements to investigate different appraisals about different categories of animals (e.g., Possidónio et al., 2019), which can help illuminate the gender and age comparisons in the general and the specific factors of the AMCS.

With that said, this work also comes with several limitations. The most significant emerges from the fact that the classification of animals into categories is culturally and historically contingent (Herzog, 2011), but this contingency is not reflected in the AMCS, which reflects respondents in the United States only. This means that animals categorized in the AMCS as food/farm, for instance, may reasonably be considered wild, pest, or companion in another culture or time period, and vice versa. Even as we argue for the value of the AMCS, we encourage other scholars to adapt the scale as necessary in order to better reflect the specific context of their respondents. The animal images database, developed by Possidónio et al. (2019), could offer additional animals for potential inclusion. Another limitation of the current study is that the behavioral choices of participants studied in Study 3 were all based on self-reports. Future work may investigate the predictive ability of the AMCS scores with observable behavior along with other psychological and behavioral constructs. The AMCS could also be used to look more closely at the complex perceptions and behaviors of interest groups with a more direct stake in human-animal relations. It would be worthwhile, for instance, to explore the animal-related moral perceptions of individuals who work in animal-oriented professions such as farming, as well as to examine the extent to which vegetarians' moral concern toward pests is reflected in observable interactions with those animals.

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Declaration of Conflicting Interests

The Authors declare that there is no conflict of interest.

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Table 1*Descriptive Statistics of the Level of Concern Towards the Initial Set of 43 Animals*

Item	Mean (SD)	Skew.	Kurt.	Item	Mean (SD)	Skew.	Kurt.
1.Cows	1.75 (1.04)	-0.31	-1.10	23.Whales	2.07 (1.02)	-0.74	-0.67
2.Pigs	1.57 (1.06)	-0.08	-1.21	24.Gorillas	1.89 (1.04)	-0.49	-0.98
3.Chickens	1.58 (1.06)	-0.09	-1.22	25.Chimpanzees	1.85 (1.04)	-0.41	-1.05
4.Goats	1.58 (1.02)	-0.07	-1.13	26.Monkeys	1.84 (1.03)	-0.38	-1.05
5.Sheep	1.64 (1.05)	-0.16	-1.18	27.Doves	1.60 (1.05)	-0.13	-1.19
6.Ducks	1.63 (1.03)	-0.10	-1.16	28.Penguins	1.92 (1.02)	-0.50	-0.94
7.Turkeys	1.51 (1.05)	0.00	-1.20	29.Alligators	1.27 (1.08)	0.29	-1.20
8.Bass fish	1.38 (1.08)	0.16	-1.25	30.Snakes	1.05 (1.10)	0.60	-1.02
9.Crabs	1.33 (1.07)	0.21	-1.20	31.Frogs	1.34 (1.06)	0.21	-1.19
10.Dogs	2.21 (1.01)	-0.99	-0.30	32.Butterflies	1.76 (1.07)	-0.31	-1.17
11.Cats	1.92 (1.08)	-0.53	-1.05	33. Sea stars	1.46 (1.07)	0.04	-1.25
12.Horses	2.01 (1.00)	-0.65	-0.72	34.Rats	0.79 (1.05)	1.04	-0.31
13.Turtles	1.77 (1.04)	-0.30	-1.12	35.Cockroaches	0.56 (0.97)	1.53	0.97
14.Parrots	1.67 (1.04)	-0.20	-1.14	36.Squirrels	1.45 (1.06)	0.10	-1.22
15.Goldfish	1.32 (1.08)	0.26	-1.20	37.Bats	1.19 (1.09)	0.38	-1.18
16.Rabbits	1.65 (1.04)	-0.16	-1.15	38.Spiders	0.87 (1.07)	0.88	-0.62
17.B.dragons	1.17 (1.12)	0.40	-1.26	39.Bees	1.73 (1.15)	-0.27	-1.38
18.Hamsters	1.40 (1.07)	0.15	-1.22	40.Pigeons	1.26 (1.07)	0.33	-1.16
19.Lions	1.95 (1.04)	-0.58	-0.90	41.Snails	1.02 (1.07)	0.64	-0.91
20.Bears	1.78 (1.04)	-0.33	-1.09	42.Beavers	1.56 (1.04)	-0.05	-1.16
21.Elephants	2.08 (1.02)	-0.76	-0.65	43.Octopuses	1.40 (1.07)	0.13	-1.23
22.Dolphins	2.11 (1.00)	-0.81	-0.53				

Note. B.dragons = bearded dragons, Skew. = skewness; Kurt. = kurtosis.

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Table 2*EFA Factor Loadings*

Animals	EFA				Schmid-Leiman				
	Wild	Farm	Pests	Comp.	General	Wild	Farm	Pests	Comp
Gorillas	.83				.72	.51			
Elephants	.84				.74	.52			
Whales	.84				.73	.52			
Lions	.80				.70	.49			
Chicken		.92			.77		.44		
Turkeys		.78			.74		.37		
Cows		.82			.80		.39		
Sheep		.57			.80		.27		
Snakes			.76		.47			.69	
Rats			.84		.41			.77	
Cockroaches			.90		.27			.83	
Spiders			.81		.48			.74	
Cats				.83	.70				.54
Dogs				.81	.67				.51
Horses				.41	.77				.26
<i>Correlations</i>									
Wild	1								
Farm	.65	1							
Pests	.26	.50	1						
Comp.	.69	.65	.20	1					

Note. Farm = Farm/Food animals, Comp. = Companion animals.

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Table 3*CFA Factor Loadings*

Animals	Correlated-factors				Bifactor				
	Wild	Farm	Pests	Comp.	General	Wild	Farm	Pests	Comp
Gorillas	.86				.73	.45			
Elephants	.91				.77	.48			
Whales	.88				.75	.46			
Lions	.86				.73	.47			
Chicken		.85			.75		.44		
Turkeys		.85			.75		.46		
Cows		.84			.78		.30		
Sheep		.92			.84		.34		
Snakes			.93		.58			.66	
Rats			.87		.47			.73	
Cockroaches			.77		.22			.90	
Spiders			.85		.45			.73	
Cats				.79	.74				.84
Dogs				.78	.69				.19*
Horses				.92	.86				.18*
<i>Correlations</i>									
Wild	1								
Farm	.74	1							
Pests	.44	.56	1						
Comp.	.81	.83	.56	1					

Note. Farm = Farm/Food animals, Comp. = Companion animals. All loadings except indicated

by * are significant at alpha level of .001.

* Significant at alpha level of .01

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Figure 1*Bifactor Model of the Animal Moral Concern Scale*

Note. All factor loadings are significant at alpha level of .001. For clarity, item error variances are not presented in the diagram.