12-2023

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Citation
CHEN, Nicole Ruiying, MAJEED, Nadyanna M., LAI, Gloria J., KOH, Paye Shin, MANMEET KAUR, , KASTURIRATNA, K. T. A Sandeeshwara, HO, Zhi Yan Alycia, YONG, Jose C., & Andree HARTANTO, .(2023). Human-animal interaction and human prosociality: A meta-analytic review of experimental and correlational studies. *Anthrozoös,* , 1-20.
Available at: https://ink.library.smu.edu.sg/soss_research/3891

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Human-Animal Interaction and Human Prosociality: A Three-Level Meta-Analytic Review of Experimental and Correlational Studies

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This research was supported by grants awarded to Andree Hartanto by Singapore Management University through research grants from the Ministry of Education Academy Research Fund Tier 1 (21-SOSS-SMU-023) and Lee Kong Chian Fund for Research Excellence. On behalf of all authors, the corresponding author reports no financial or non-financial conflict of interest.

Abstract

Pet ownership and interactions with animals have been shown to confer various physiological and psychological benefits to humans. Although interactions with animals are commonplace, there is no consensus in the literature on the actual impact of animal exposure on prosociality. Hence, this meta-analysis investigated 20 eligible studies (N = 4,116, k = 48) and provided an extensive examination into the different potential moderators of the relationship between human-animal interaction (HAI) and prosociality, such as the distinction between empathy and prosocial behaviour, HAI characteristics, and sample characteristics. Overall, a small positive effect size was found (d = 0.22), suggesting that human exposure to animals is associated with an increase in empathy and prosocial behaviours. Additionally, the type of prosociality measure, nature of human-animal interaction, animal species and animal class significantly moderated the relationship between human-animal interaction and prosociality. We discuss the theoretical, methodological, and practical implications of these findings and highlight areas for further research.

Keywords: human-animal interaction, pet ownership, animal-assisted therapy, prosocial, empathy

Human-Animal Interaction and Human Prosociality

The ownership of pets (e.g., dogs, cats, birds, fish) is ubiquitous in human life. With approximately 57% of the global population keeping a pet (GfK, 2016), the effects engendered by various forms of interaction or contact between human and animal—that is, human-animal interaction or HAI (Fournier et al., 2016)—warrant closer examination. HAIs occur in various forms such as pet ownership and animal-assisted therapy, wherein animals form a key part of a remedial journey (Nimer & Lundahl, 2007), or even fleeting encounters such as when one goes on a walk and interacts with someone else's pet dog. In countries like Singapore and Istanbul, it is also common to interact with stray cats, specifically those that are not feral and are comfortable with humans (Chan, 2016; Mattson et al., 2015). Numerous studies on the benefits of HAI have primarily focused on physiological and psychological outcomes, with payoffs such as lowered blood pressure and reduced incidence of cardiovascular disease (Anderson et al., 1992), aided recovery from depression (Le Roux & Kemp, 2009; Souter & Miller, 2007), reduced loneliness (Wood et al., 2005), and higher levels of positive affect (Goh et al., 2023). These findings reveal HAI to be a significant component of individual wellbeing with potentially important implications for improved social functioning.

One promising area of HAI research that may help to shed light on positive human relations is the association between HAI and prosociality. Prosociality refers to the collection of positive emotions, attitudes, and behaviours directed toward others (Knafo-Noam et al., 2015) and serves as a key factor underlying social harmony, cooperation, and altruism (Batson & Powell, 2003). Furthermore, far from being a stagnant trait, prosociality can be developed over one's life course through various social interactions (Roberts & Mroczek, 2008; Wrzus & Roberts, 2017), and it can also change with age (Foulkes et al., 2018; Mayr & Freund, 2020). Research has uncovered a link between HAI and prosociality (Komorosky & O'Neal, 2015) as well as several explanations for this link that reflect the dynamic and malleable nature of human prosociality, and the potentially different degrees of contributions toward prosociality that distinct types of HAI afford. According to the *oxytocin hypothesis* (Beetz et al., 2012), interacting with a friendly animal promotes the release of oxytocin, which is an important hormone that facilitates empathy (Bartz et al., 2010) and which mediates the positive psychological and physiological effects of social interactions (Domes et al., 2014). The *experiential learning hypothesis* (Kolb, 1984) emphasises that owning pets teaches us how to understand other social individuals—both animal and human—as well as how to interact with and care for them (Grandgeorge et al., 2012; Vizek-Vidović et al., 1999). Indeed, research has revealed that animals can elicit prosociality in humans because they can be perceived as social beings like humans are (Serpell et al., 2017). Finally, the *social catalyst hypothesis* (Wijker et al., 2020; Wood et al., 2005) posits that pets can promote social contact between humans, which in turn enhances socioemotional development and social competencies (Melson, 2001). Accordingly, studies have shown that being accompanied by a dog incites more frequent positive social interactions with others (Guéguen & Ciccotti, 2008; Mader et al., 1989), and the ability to function and regulate oneself in different social scenarios leads to more prosocial behaviour (Eisenberg & Fabes, 1992).

These various lines of research present both insights and gaps. Importantly, they dovetail in suggesting that prosociality across attitudinal and behavioural contexts is catalysed by increased empathy (Decety et al., 2016; Eisenberg et al., 2006), which is the ability to appreciate and share in the feelings of other individuals (Hodges & Myers, 2007). Empathy may be enhanced by HAI through the practice of caring for an animal or forming a relationship with it, which promotes the development of sensitivity toward others (Levinson, 1978). However, some shortcomings also exist in the research. First, much of the literature pertaining to the oxytocin hypothesis has thus far centred on human interactions with dogs rather than animals in general (Beetz et al., 2012). Second, tests of the experiential learning hypothesis are limited to specific participant groups (e.g., children, individuals with autism) in the context of pet ownership (Grandgeorge et al., 2012; Vizek-Vidović et al., 1999), which hinders the generalisation of these findings to other populations and interaction scenarios. Lastly, the literature on the relationship between HAI and human prosociality is mixed, with some research having demonstrated a positive relationship (Hergovich et al., 2002; Paul, 2000; Rothgerber & Mican, 2014; Schuck et al., 2015) while others have not found any increase in empathy or prosociality from HAI (Daly & Morton, 2003; Donaldson, 2016; Ewing et al., 2007; Poresky & Hendrix, 1990).

Given these research gaps alongside the potential insights for improved human relations from a better understanding of HAI and prosociality, a meta-analysis was conducted to determine the overall impact of HAI on empathy and prosociality as well as to explore additional nuances, including whether the type or setting of HAI or the type of animal would affect prosociality-related outcomes, given the heterogeneity of results in the field. To this end, the current meta-analysis systematically accumulated relevant existing research to glean a bird's-eye view of the current state of the literature and determine more nuanced ways by which researchers can pursue further analyses. Findings from the present investigation may also help to inform many practices or interventions, such as whether animals should be used in schools that cater to children with developmental disorders, whether parents should get a pet for their child to cultivate prosociality, and whether animals should be utilised more in therapeutic settings.

Method

Transparency and Openness

No ethical approval was required as no primary data was generated in the current work. The current meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). The work was not pre-registered. Relevant records detailing the screening process, along with the processed data extracted from the included records, have been made publicly available on Researchbox (#156; https://researchbox.org/156). All analyses were conducted in R version 4.3.0 (R Core Team, 2023), with the aid of *metafor* version 4.2-0 (Viechtbauer, 2010). All analyses were conducted using random- and mixed-effects with restricted maximum likelihood estimation.

Search Strategy

A literature search was conducted using the keywords (dog OR canine OR cat OR feline OR pet OR animal) AND (human) AND (empathy OR pro-social* OR prosocial* OR cooperat* OR altruis*) in the electronic databases *ERIC*, *PsycINFO*, *PubMed*, *Scopus*, and *Web of Science* for all reports available by January 2020. Manual searches were conducted in *Google Scholar* and were supplemented by examining previous reviews related to HAI, including pet ownership (Gilbey & Tani, 2015; Purewal et al., 2017) and animal-assisted therapy (Hoagwood et al., 2017; O'Haire, 2013). To capture unpublished literature such as dissertations, a manual search was conducted in *ProQuest Dissertations & Theses*.

Inclusion Criteria

The PRISMA diagram (Moher et al., 2009) showing the process for including studies in the present meta-analysis as well as the number of records at each stage is displayed in Figure 1. A total of 4,827 unique records were split into two sets and were first screened for inclusion by the first and third authors separately (i.e., each author screened approximately 2,400 records) based on their titles and abstracts; records which were clearly irrelevant (e.g., studies on animal subjects) or were clearly ineligible for quantitative synthesis (e.g., qualitative studies) were removed at this stage. A total of 302 and records were retained after screening based on titles and abstracts for further screening. Of these 302 records, 8 could not be accessed in full and were excluded from further screening. The remaining 294 records were read in full by the third author and were screened for inclusion based on the following criteria:

1. Studies were included if they reported current pet ownership status or if participants were exposed to a live animal during the course of the study. Studies were excluded if they operationalised exposure to animals as reading about an animal, viewing a picture of an animal, or interacting with a soft toy or robot that resembled an animal.

2. Studies were included if they measured current human-oriented or animal-oriented prosociality in humans. Acceptable operationalisations of prosociality included prosocial attitudes, prosocial behaviours (e.g., altruism, cooperation), and empathy.

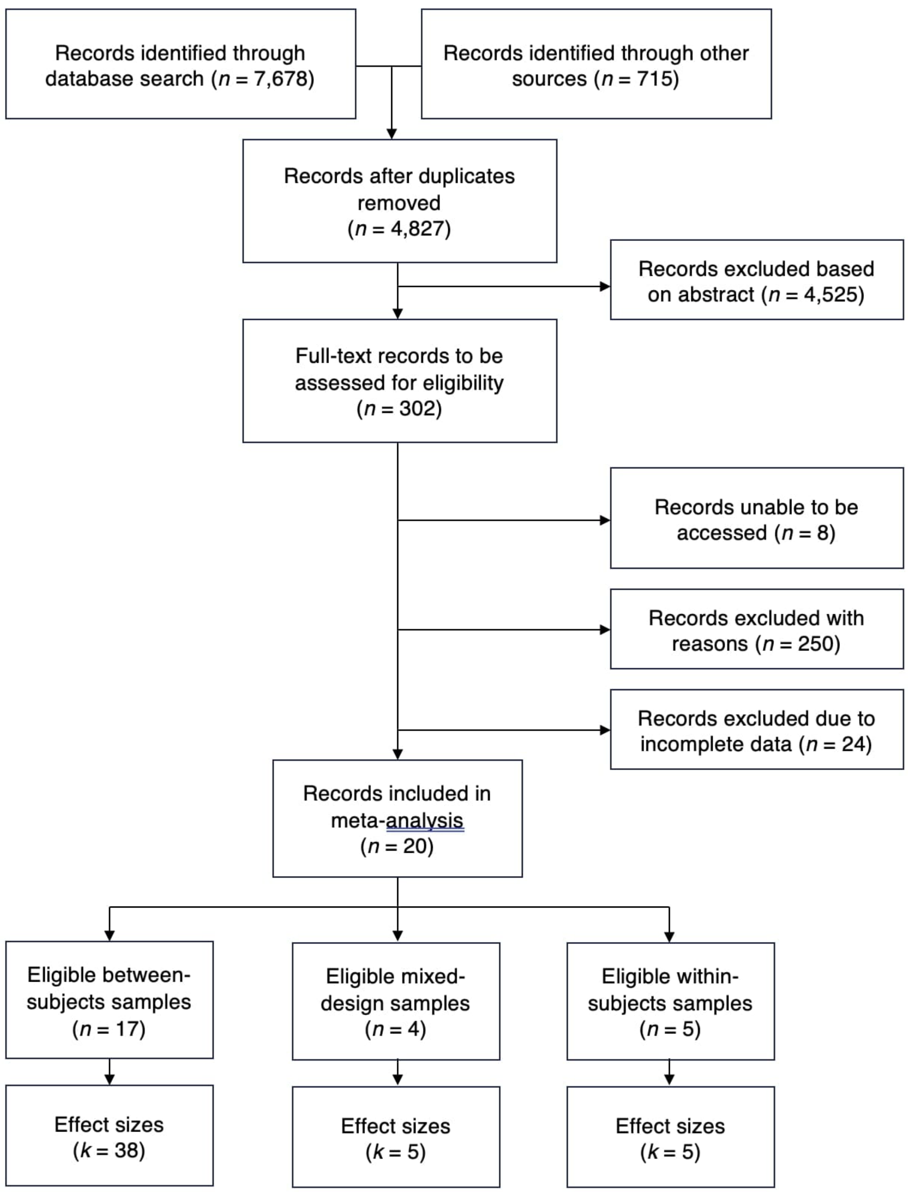
3. Studies were included if they involved the use of a control group who were not pet owners or who were free from exposure to animals during the course of the study. Alternatively, studies were included if they used a within-subjects design wherein subjects served as their own controls.

4. Studies were included if information necessary to compute effect sizes were reported (see Coding of Variables below). If a study was eligible but did not report the appropriate statistics, the original authors of the study were contacted to obtain usable data. Out of 22 authors contacted, nine responded and indicated that they could not provide the requested data. The remaining 13 did not respond to repeated requests.

Based on the criteria and process outlined, 250 records were excluded due to various reasons, of which 29 were due to the lack of a control group. Some examples of other reasons include: the absence of a measure of prosociality, lack of quantitative data (e.g., qualitative studies), no exposure to live animals (e.g., usage of robots resembling animals), and no empirical data reported (e.g., purely theoretical papers). 44 records met inclusion criteria 1 to 3. Of these records, 24 were excluded due to incomplete data (criterion 4) while 20 (50% unpublished) met the criterion of having sufficient data to compute effect sizes (see Coding of Variables below). These 20 records accounted for a total of 26 samples which contributed a total of 48 effect sizes. All records were published (journal articles) or submitted (final versions of dissertations) between 1999 and 2020 inclusive, with most studies being conducted in North America. Experimental approaches were employed in only four records (Carlisle et al., 2021; Guéguen & Ciccotti, 2008; Lahav et al., 2019; Schuck et al., 2015) while the remainder used non-experimental approaches. Based on available data, all studies involved the use of either mammals only (e.g., dogs, cats, rats) or a mix of mammals and non-mammals (e.g., snakes, fish).

Figure 1

PRISMA Diagram Outlining the Systematic Search Process



Coding of Variables

Information about study and sample characteristics was obtained directly from the Method and/or Results sections of the respective studies. If information was not available, the original author of the study was contacted with a request for information. One record was written in Mandarin and was translated into English by a native Mandarin speaker who was fluent in English and was unaware of the research question or hypothesis. Two blind coders (the third and fifth authors) independently extracted available information from all records; the inter-rater agreement was almost perfect for all variables (range = 77%–100%). Discrepancies were discussed and resolved after the initial coding process.

Most critically, we recorded the measure of prosociality used as well as the relevant statistics required to compute effect sizes (i.e., means and standard deviations of prosociality scores for the group exposed to animals and for the control group). If the measure also assessed non-prosociality constructs—such as the Interpersonal Reactivity Index (Davis, 1983) which measures four dimensions of empathetic concern, perspective-taking, fantasy, and personal distress, of which the validity of the latter two in assessing empathy have been disputed (Alterman et al., 2003; Beven et al., 2004; Jolliffe & Farrington, 2004; Remigio, 2014)—only subscales directly assessing prosociality were recorded. After the blinded coding process, the recorded measures were categorised according to the construct assessed (e.g., empathy) through discussion and mutual agreement.

In addition, the following study characteristics were coded: (1) the year in which the record was published (journal articles) or submitted (dissertations), (2) whether the record was peer-reviewed, (3) the nature of the study (longitudinal vs. cross-sectional), (4) the study design (between-subjects vs. mixed vs. within-subjects), (5) whether the study was experimental or non-experimental, and (6) the country in which the study was conducted. Additionally, the following demographic characteristics were coded: (1) the proportion of females in the sample and (2) the age range and mean age of the sample. In terms of HAI-related characteristics, the following were coded: (1) the type of interaction (e.g., pet ownership, short-term animal exposure), (2) the setting of the interaction (e.g., home, school), (3) the species of the animal (e.g., cat, dog), and (4) the classification of the animal (e.g., mammal).

Meta-Analytic Approach

Effect Size Index

Two possible calculations of the effect size were used depending on whether the study employed a between-subjects (independent-groups posttest) design, or within-subjects (single-group pretest-posttest) design. Studies which involved mixed designs (i.e., animal condition × time) were treated as between-subjects, that is, only post-test scores (i.e., animal condition: animal vs. control) were considered. In all cases, the effect size d was calculated such that positive values indicated a positive association between HAI and prosociality (that is, groups exposed to animals displayed higher levels of prosociality than did control groups), while conversely, negative values indicated a negative association between HAI and prosociality. This calculation is in line with the mechanisms proposed in previous studies, which posited that individuals exposed to animals will display higher levels of prosociality.

For between-subject designs and mixed designs, Cohen's standardised *d* was used as the effect size index and was calculated as follows respectively (Cohen, 1988):

$$d = \frac{M_{animal} - M_{control}}{SD_{pooled}}$$

$$d = \frac{M_{post\ animal} - M_{post\ control}}{SD_{post\ pooled}}$$

In both cases, the respective pooled standard deviations were calculated as follows (J. Cohen, 1988):

$$SD_{pooled} = \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}$$

Finally, for studies with within-subject designs, the effect size index used was Becker's standardised *d*, an estimate of the population effect size that is comparable to the two previously described effect sizes (Becker, 1988). Becker's *d* was calculated as follows:

$$d = \frac{M_{animal} - M_{control}}{SD_{control}}$$

Sampling variances for the three types of study design were calculated using formulae from Morris and DeShon (2002). For between-subjects and mixed designs, sampling variances were calculated as per the formula:

$$v = \frac{1 + \tilde{n}d^2}{\tilde{n}}\left(\frac{N-2}{N-4}\right) - \frac{d^2}{\left(c(N-2)\right)^2}$$

Where:

N = Combined number of observations in both groups

$$\tilde{n} = \frac{n_{animal} \times n_{control}}{n_{animal} + n_{control}}$$

$$c = 1 - \frac{3}{4\,(n_{animal} + n_{control} - 2) - 1}$$

Lastly, sampling variances for within-subject designs were calculated using the following formula:

$$v = \frac{1 + nd^2}{n}\left(\frac{n-1}{n-3}\right) - \frac{d^2}{(c\,(n-1))^2}$$

Where:

$$n = \text{Number of paired observations}$$

$$c = 1 - \frac{3}{4\,(n-1) - 1}$$

Study Design

To address concerns previously highlighted in the meta-analytic literature on combining effect sizes from studies using different designs—that is, between-subjects versus mixed versus within-subjects (Morris & DeShon, 2002)—we conducted sensitivity analyses prior to all other analyses to determine if the design of the study significantly influenced the overall meta-analytic effect size. If study design was a significant predictor of the overall meta-analytic effect size, analyses would then be conducted separately for each study design. Nevertheless, even if study design was not a significant predictor of the overall meta-analytic effect size, we additionally reported the results of all analyses using only studies with between-subjects designs and have made them publicly available in the associated Researchbox.

Non-Independence of Effect Sizes

As some samples completed more than one measure of prosociality, it was possible for samples to contribute more than one effect size, thereby violating the assumption of independent effect sizes in a meta-analysis. As such, a multilevel meta-analytic approach (Pastor & Lazowski, 2018) was taken when computing the overall meta-analytic effect size, with each individual effect size (i.e., measure-specific effect size) nested within the sample it was extracted from.

Data Analysis

Overall, we examined the hypothesis that HAI is associated with higher levels of prosociality by computing the overall meta-analytic effect size. To ascertain the validity of the present meta-analysis, we tested for bias which may arise for various reasons such as selective reporting and small-study effects (van Enst et al., 2014). Thus, we conducted Egger's regression test (Sterne & Egger, 2001) where sampling variances of the effect sizes were included as a moderator of the effect size. A significant slope estimate would imply that bias was present, while a significant intercept estimate would imply that despite correcting for such bias, the HAI-prosociality relationship was still statistically present. In addition, to ascertain if publication status was a significant factor predicting the effect size of the HAI-prosociality relationship, dummy-coded publication status was entered as a predictor of the magnitude of the effect size.

Following that, we examined whether various moderators would impact the magnitude of group differences by conducting meta-regressions, with the respective factor dummy-coded if necessary. Specifically, we examined the following moderators: (1) the type of prosocial outcome (empathy vs. prosocial behaviour), (2) the nature of human-animal interaction (pet ownership vs. short-term animal exposure), (3) the setting of human-animal interaction (home vs. school), (4a) animal species (dog vs. cat), (4b) animal class (only mammals vs. mix of mammals and other classes), and (5) sample-related factors namely (5a) female proportion of the sample and (5b) mean age of the sample.

Results

Assessing the Acceptability of Combining Across Methodological Characteristics

We assessed the impact of collapsing our analyses across study designs and across experimentality on the overall meta-analytic effect size to ensure that all further results would not be confounded by these characteristics. First, study design (between vs. mixed vs. within) was dummy coded with *between* as the reference category, and each of the two dummy variables was entered as a predictor of the overall meta-analytic effect size. The test for moderators was not significant, $Q(2) = 0.33$, $p = 0.849$, with both predictors being individually non-significant (mixed: $p = .719$; within: $p = 0.677$).

Second, to further examine if the heterogeneity of methodological characteristics would prevent us from combining the studies, we tested whether experimental and non-experimental studies provided significantly different effect sizes. The test for the moderator was significant, $Q(1) = 33.80$, $p < 0.001$, suggesting that effect sizes differed according to whether studies were experimental or non-experimental. Subgroup analyses revealed that experimental studies were associated with significantly larger effect sizes, $d = 0.56$, $SE = 0.07$, 95% CI = [0.43, 0.70], $p < 0.001$, whereas non-experimental studies were associated with smaller albeit still positive and statistically significant effect sizes, $d = 0.09$, $SE = 0.04$, 95% CI = [0.01, 0.17], $p = 0.024$.

As study design did not have a significant impact on effect size, and both experimental and non-experimental studies were consistently associated with significant and positive associations, we combined all studies into a single dataset. Hence, all further analyses were conducted with the combined dataset comprising all records eligible for inclusion in the meta-analysis. Results of the sensitivity analyses where we narrowed our dataset to only between-subjects studies or only experimental studies have been made publicly available on the associated Researchbox.

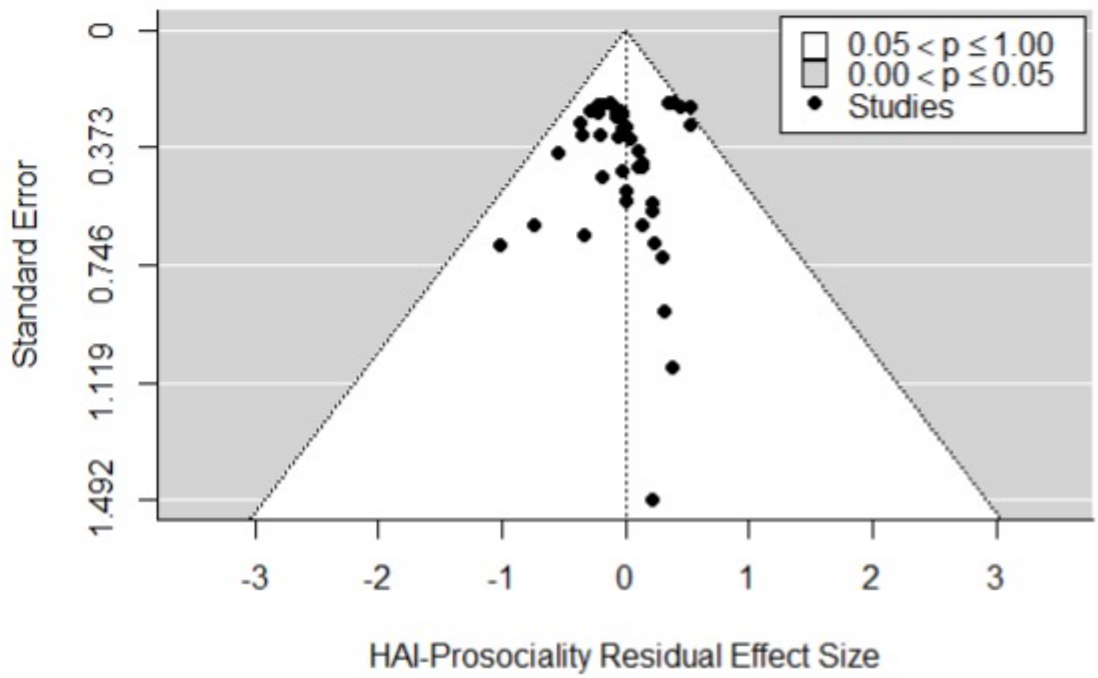
Tests of Bias

Egger's Regression Test

A funnel plot (Figure 2) displayed a visual asymmetry of effect sizes, suggesting some evidence of publication bias. However, Egger's regression test returned a non-significant slope estimate, $b = 0.39$, $SE = 0.34$, 95% CI = [-0.29, 1.07], $z = 1.13$, $p = 0.257$, with a significant intercept estimate, $b = 0.18$, $SE = 0.07$, 95% CI = [0.05, 0.32], $z = 2.66$, $p = 0.008$, suggesting that there was no significant threat of bias in the current meta-analysis and that the overall HAI-prosociality effect size remained statistically significant even after correcting for potential bias. Breakdowns by design revealed consistent results (for detailed breakdown, see Researchbox).

Figure 2

Funnel Plot Assessing Evidence of Publication Bias



Publication Status as a Moderator

We found no evidence that publication status was significantly related to the magnitude of the effect size, $Q(1) = 1.20$, $p = 0.274$, suggesting that the magnitude of the HAI-prosociality relationship was not affected by whether a work was published or not.

Overall Meta-Analytic Effect Size

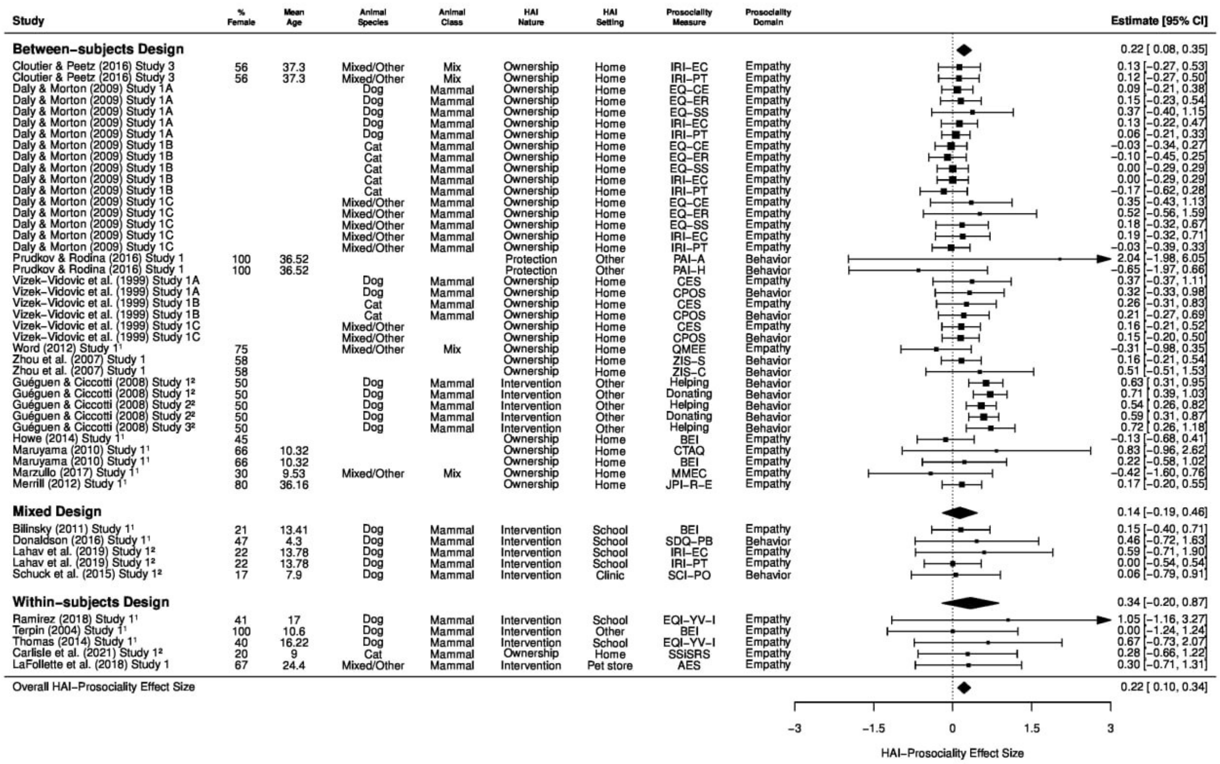
We examined the overall meta-analytic effect size of the relationship between HAI and prosociality in humans. Based on 48 effect sizes across 26 samples, HAI was significantly associated with prosociality ($d = 0.22$, $SE = 0.06$, 95% CI = [0.10, 0.34], $p < .001$).[1] The positive, albeit small, association between HAI and prosociality suggests that individuals exposed to

[1] In an additional analysis, LaFollette et al. (2018) study was removed as the human-animal interaction involved rat tickling, which is too fleeting to achieve any material change in prosociality. When this study was excluded, the association remained statistically significant, positive, and small in magnitude ($d = 0.22$, $SE = 0.06$, 95% CI = [0.10, 0.34], $p < 0.001$) with the forest plot displaying the effect sizes in the Researchbox. We conducted a similar analysis where we removed the studies by Guéguen and Ciccotti (2008) due to participants being merely exposed to the confederate's dog for only a short moment. When this study was excluded, the association also remained statistically significance and positive, albeit trivial in magnitude ($d = 0.09$, $SE = 0.04$, 95% CI = [0.01, 0.17], $p = 0.020$). The relevant forest plot can also be found in the Researchbox.

animals were more prosocial than controls. The forest plot depicting these patterns is displayed in Figure 3.

Figure 3

Forest Plot of All Effect Sizes



Note. Diamonds represent overall effect sizes while squares represent effect sizes extracted from each study. Larger squares represent larger sample sizes. Whiskers represent 95% confidence intervals. AES = Animal Empathy Survey (Paul, 2000), BEI = Bryant Empathy Index (Bryant, 1982), CES = Child Empathy Scale (Vizek-Vidović et al., 1999), CPOS = Child Prosocial Orientation Scale (Vizek-Vidović et al., 1999), CTAQ = Children's Treatment of Animals Questionnaire (Thompson & Gullone, 2003), EQ = Empathy Quotient (Baron-Cohen et al., 2001), EQI-YV = Emotional Quotient Inventory–Youth Version (Bar-On & Parker, 2000), IRI = Interpersonal Reactivity Index (Davis, 1983), JPI-R = Jackson Personality Inventory (Jackson, 1976), MMEC = Marzullo Measure of Empathy in Children (Marzullo, 2017), PAI = Prudkov Altruism Inventory (Prudkov & Rodina, 2016), QMEE = Questionnaire for the Measurement of Emotional Empathy (Mehrabian & Epstein, 1972), SCI = Social Competence Inventory (Rydell et al., 1997), SDQ = Strengths and Difficulties Questionnaire (Goodman, 1997), SSiSRS = Social Skills Improvement System Rating Scale (Gresham & Elliott, 2008), ZIS = Zhou Inclination Scale (Zhou et al., 2010). [1]Articles were unpublished dissertations. [2]Studies were experimental.

Comparison of Prosociality Domains

We examined whether the magnitude of the HAI-prosociality relationship varied across different domains of prosociality. From the included studies, two main categories of prosociality measures were identified and tested: empathy (self-reported and observer-reported; 71% of effect sizes) and prosocial behaviour (self-reported, observer-reported, and directly observed behaviour; 29% of effect sizes). A moderation analysis was conducted with the prosociality domain dummy-coded based on *empathy* as the reference category. The test for moderators was significant, $Q(1) = 21.37$, $p < .001$, suggesting that the HAI-prosociality association was significantly influenced by the type of prosociality measure used. Follow-up subgroup analyses revealed that the HAI-prosociality association was statistically significant and positive to a small extent when the measure of interest was prosocial behaviour ($d = 0.41$, $SE = 0.09$, 95% CI = [0.23, 0.59], $p < 0.001$), but there was no evidence for an effect when the measure was empathy ($d = 0.07$, $SE = 0.04$, 95% CI = [-0.01, 0.15], $p = 0.075$). Full details are available in Table 1.

Table 1

Effects of Moderators on the Magnitude of the HAI-Prosociality Relationship

Moderator	n	k	$Q(1)$	z	d	SE_d	95% CI
Study type	**26**	**48**	**33.80*****				
Experimental	6	9		8.19***	0.56	0.07	[0.43, 0.70]
Non-experimental	20	39		2.25*	0.09	0.04	[0.01, 0.17]
Prosociality domain[a,b]	**26**	**48**	**21.37*****				
Empathy[a]	19	34		1.78**	0.07	0.04	[-0.01, 0.15]
Prosocial behaviour	10	14		4.44**	0.41	0.09	[0.23, 0.59]
Nature	**25**	**46**	**30.93.*****				
Ownership	14	32		2.12	0.09	0.04	[0.01, 0.17]
Short-term intervention	11	14		5.69***	0.50	0.09	[0.33, 0.69]
Setting	**19**	**38**	**0.42**				
Home	14	32		2.12*	0.09	0.04	[0.01, 0.17]
School	5	6		1.15	0.20	0.17	[-0.14, 0.54]
Species	**15**	**28**	**2.68**				
Dog	12	20		3.91***	0.39	0.10	[0.20, 0.58]
Cat	3	8		0.43	0.05	0.12	[-0.18, 0.28]
Class	**20**	**38**	**2.29**				
Mammals only	17	34		3.53***	0.29	0.08	[0.13, 0.45]
Mix	3	4		-0.13	-0.02	0.18	[-0.38, 0.33]

Note. n = number of samples, k = number of effect sizes, $Q(1)$ = test statistic for the moderator with 1 degree of freedom, d = effect size, SE_d = standard error of the effect size. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. [a]It should be noted that results for the prosociality domain of empathy became non-significant when looking at only experimental studies. Readers can refer to the Researchbox for further details. [b]Three samples contributed data on both the empathy and prosocial behaviour measures, hence the total unique sample size in this analysis was 26.

Investigation of Human-Animal Interaction Characteristics

We conducted various moderation analyses to investigate the impact of specific characteristics of HAI on prosociality. Detailed results for all analyses in this section are provided in Table 1.

Nature of human-animal interaction

We conducted moderation analyses to examine whether the nature of HAI (i.e., pet ownership vs. short-term animal exposure) affected the magnitude of differences in prosociality between animal-exposed groups and control groups. One study that contributed two effect sizes and operationalised HAI as *animal protection* was excluded from this analysis due to the low number of cases available. The test of moderation using data from the remaining 46 effect sizes (25 samples) was statistically significant, $Q(1) = 30.93$, $p < 0.001$. Follow-up subgroup analyses revealed that short-term animal exposure was associated with significantly larger group differences in prosociality ($d = 0.50$, $SE = 0.09$, 95% CI = [0.33, 0.67], $p < 0.001$) compared with pet ownership ($d = 0.09$, $SE = 0.04$, 95% CI = [0.01, 0.17], $p = 0.034$). These findings suggest that while short-term exposures and ownership are both significantly associated with increased prosociality, short-term exposure-type studies yield significantly larger associations with prosociality than do ownership studies.

Setting of human-animal interaction

We further examined if the setting of HAI would affect the magnitude of the association between interaction and prosociality. Data from included studies allowed us to examine whether the influence of HAI on prosociality differed between home (67%) versus school (13%) settings. Studies that reported other locations such as clinics ($k = 1$), pet stores ($k = 1$), and other miscellaneous settings ($k = 8$) were excluded due to the low number of cases available. Based on data from the remaining 19 samples ($k = 38$), the moderation test was not significant, $Q(1) = .0.42$, $p = 0.518$, thus indicating that the relationship between HAI and prosociality was consistent across settings.

Type of animal

We investigated if the species and class of the animal(s) involved in the interaction would have an impact on the HAI-prosociality relationship. In terms of species, the majority ($k = 20$) of the effect sizes involved dogs while a smaller proportion ($k = 8$) involved cats. A sizable proportion ($k = 12$) of the effect sizes involved multiple species of animals or were simply reported as involving ‘other’ species of animals, and one effect size involved rats. The remaining 8 effect sizes did not report the exact species involved in the HAI. As the two most common species were dogs and cats, we looked at whether human-dog interactions and human-cat interactions differed in their associations with prosociality. There was a non-significant difference, $Q(1) = 2.68$, $p = 0.101$, indicating that the species of animal did not significantly affect the HAI-prosociality association, at least when comparing between dogs and cats. However, it should be noted that human-cat interaction was represented by only three samples contributing eight effect sizes, thereby limiting the conclusiveness of these species-specific findings.

In terms of the animal classes involved, the vast majority (71%) of effect sizes involved only mammals while a minority (8%) involved a mix (i.e., mammals and other classes). The remaining 21% of effect sizes did not provide accompanying data about the type of animal(s) involved and were hence removed from the current analysis. The test of moderation for 38 effect sizes across the remaining 20 samples was not significant, $Q(1) = 2.29$, $p = 0.130$, indicating that probing the effect of animal class was unwarranted.

Investigation of Sample Characteristics

To test the robustness and generalisability of the current findings, we examined if demographic characteristics moderated the HAI-prosociality relationship. For demographics, the proportion of females across samples ranged from 17% to 100% and the age range across samples varied from children ($M_{age} = 4.30$ years) to adults ($M_{age} = 37.30$ years). We found no evidence that the HAI-prosociality effect size varied as a function of these factors (female proportion: $Q(1) = 0.21$, $b = -0.203$, $SE = 0.44$, 95% CI = [-1.07, 0.66]; age: $Q(1) = 0.06$, $b = -0.002$, $SE = 0.01$, 95% CI = [-0.02, 0.01]; all *p*s > 0.062), suggesting that the results hold across sex and age at the sample level. The results of these analyses are presented in Table 2.

Table 2

Sample Characteristics as Moderators of the HAI-Prosociality Effect Size

Moderator	*n*	*k*	*Q*(1)	*b*	SE_b	95% CI
Demographics						
Gender proportion	20	27	0.21	-0.203	0.442	[-1.07, 0.66]
Mean age	14	18	0.06	-0.002	0.007	[-0.02, 0.01]

Note. *n* = number of samples, *k* = number of effect sizes, *Q*(1) = test statistic for the moderator with 1 degree of freedom, *b* = slope coefficient.

Discussion

The current meta-analysis found a small, positive association between HAI and prosociality, suggesting that exposure (vs. non-exposure) to animals, whether through pet ownership or short-term animal exposure, is correlated with an increase in human prosociality. Additionally, our examination of several potential methodological moderators of the relationship between HAI and prosociality, such as various prosociality domains and various HAI characteristics, returned significant results that held true across sample factors such as sex and age group.

Several other insights on HAIs were also gleaned from our analysis. In particular, the HAI-prosociality association was notably stronger in experimental studies than in non-experimental studies. This difference might be attributed to the fundamental design of experimental studies whereby random assignment is employed to increase control and rule out confounding factors. Moreover, although the higher likelihood of prosocial individuals interacting with animals contributes to the positive relationship between HAI and prosociality, experimental studies help address this potential alternative explanation by manipulating the independent variable of animal interaction and exposure. Hence, more weight should be given to experimental studies, and we recommend that future studies adopt an experimental approach with random assignment for all types of animal interventions to further establish the causal relationship between HAI and prosociality. Additionally, future studies can also investigate if the length of exposure to the animal may influence levels of prosociality. Furthermore, while there is the possibility of reverse causality whereby more prosocial individuals already have higher levels of HAI, our experimental results posit otherwise which states that the HAI to prosociality direction is valid and observable.

Regarding the class of animal that participants were exposed to, the HAI-prosociality relationship was observed only in samples that were exposed to mammals but not to a mix of mammals and non-mammals. This finding is consistent with the Perception-Action Empathy Model (de Waal & Preston, 2017), which posits that as similarity between subjects increases, so do empathic responses between them. In this case, the greater phylogenetic similarity between humans and mammals compared with humans and non-mammals would translate to more empathic responses toward mammals (Preston & de Waal, 2002). Hence, the effect of HAI on prosociality may be suppressed in samples where mammals were mixed with non-mammals, resulting in the pattern seen in our findings. This has important implications as the effect of HAI on empathy toward non-mammals could have a larger effect.

Analyses of the nature of HAI that participants were exposed to revealed significant positive associations between HAI and prosociality for both ownership and short-term exposure conditions, but this association was stronger for individuals exposed to animals through a short-term exposure. This finding went against the expectations of the experiential learning hypothesis, which posits that pet ownership may be able to teach owners how to better interact with and care for other social beings (Grandgeorge et al., 2012; Kolb, 1984; Vizek-Vidović et al., 1999). However, it could also be that simply owning a pet does not immediately translate to actively caring for it, which may be a necessary step for the benefits put forth by the experiential learning hypothesis to be reaped. Indeed, pet ownership is a spectrum, ranging from passive sharing of residence to active engagement with the pet (Goh et al., 2020). Therefore, future research on pet ownership should consider factors such as who the main caretaker is or the amount of time an individual spends with their pet. On the other hand, those who experienced HAI in short-term exposure settings may have been in a position where they were tasked to actively care for the animals (Lahav et al., 2019; Schuck et al., 2015; Thomas, 2014) which, in accordance with the experiential learning hypothesis, may have been the key ingredient necessary for the development of prosociality. Nevertheless, as the association between HAI and prosociality was positive for both ownership and short-term exposure conditions, it does suggest that the presence of an animal comes with benefits.

Our results did not find any moderating effect of setting (e.g., home, school) on the HAI-prosociality relationship. This suggests that the benefits of HAI on prosociality may be relatively consistent across different settings. One possible reason could be that pet in homes offer consistent companionship, and animals in schools might be part of a routine. Both settings provide regularity and stability, which might facilitate the same degree of prosocial learning over time. Additionally, interactions with animals often involve caretaking tasks like feeding, grooming and playing, regardless of the setting. Similar caretaking responsibilities could foster the same level of prosocial outcomes. However, as most studies in our analysis examined HAI at home, further research is needed to ascertain the impact of HAI more confidently in school and other settings.

Our meta-analysis failed to find any moderating effect of sex on the HAI-prosociality relationship. While this result may be somewhat puzzling due to the large number of studies that have shown sex differences in prosociality (e.g., Daly & Morton, 2003; Vizek-Vidović et al., 1999), the lack of sex differences has also been suggested in other studies (e.g., Daly & Morton, 2003). A possible explanation for such an occurrence could be how prosociality was operationalised and measured—it may be possible that some measurement tools are less sensitive to sex differences compared with other forms of measurement. A preliminary support for this view can be found in Cohen and Strayer (1996)—of the three empathy measures they utilised, the Bryant Empathy Index showed no evidence of sex differences in empathy. Moreover, when empathy is measured using experimental tasks, no sex differences emerge as well (e.g., Batson et al., 1997; Derntl et al., 2010).

Limitations

Perhaps of particular interest to individuals mired in the dog-versus-cat battle (Gosling et al., 2010) is our finding that human-dog interaction, but not human-cat interaction, was significantly associated with increased prosociality, indicating that the relationship between HAI and prosociality varies as a function of species. This provides preliminary support for the social catalyst hypothesis—whereby animals facilitate human-human social contact (Wijker et al., 2020; Wood et al., 2005) which, in turn, fosters prosociality—in that dogs instigate and attract more human attention than cats do and hence function better as social catalysts (Serpell, 1996). Indeed, the idea that human-dog interaction can serve as practice for social skills was explored by Mueller (2014), who posited that social skills that are imperative to positive human-human interactions (e.g., reciprocal eye contact, the regulation of facial expressions; Buck, 1994; Kleinke, 1986) can be learnt and practised through interacting with dogs. Furthermore, dog people have been shown to display higher levels of rule consciousness compared with cat people (Guastello et al., 2017), which might have led them to social conform and display high levels of social desirability when completing self-report measures. However, it should be noted that only three samples measured human-cat interaction, which limits our findings on the dog-cat distinction as well as on human-cat interaction itself. Likewise, other variables of the studies, such as research design and pet ownership, had insufficient data. This highlights the need for more research investigating potential interaction to gain further clarity.

In addition, although our screening yielded a substantial number of papers that were eligible for this meta-analysis, we were unable to include the majority of them due to the lack of statistical information required to compute effect sizes. As such, this field of research would benefit from being more transparent with regards to the reporting of data.

Lastly, the domain of prosociality measured also affected the strength of the HAI-prosociality association. Although significant positive associations were found for both empathy and prosocial behaviour, HAI appears to be more strongly associated with prosocial behaviour. This finding may reflect the dynamics proposed by the experiential learning hypothesis, whereby the act of caring for an animal contributes most to behavioural outcomes over attitudinal or cognitive ones (Kolb, 1984).

Conclusion

In sum, the current meta-analysis found that exposure to animals is positively associated with human prosociality and provides a reference point for future research where empirical studies on the HAI-prosociality link are currently lacking, namely HAI in school settings, the effects of non-mammals in HAI, and human-cat interactions in comparison with human-dog interactions. Importantly, the findings call for more experiments to be conducted in order for causal effects to be established as the current meta-analysis can only suggest associations between the two variables. Once causal effects have been established, it will provide a much clearer picture to therapists who wish to devise the most appropriate intervention strategies and duration to help their clients reap the most benefits.

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*Asterisks indicate records that were included in the meta-analytic review.

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