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Anthropocentric bias may explain research disparities between animal tool use and nest building

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Scientists are not immune from bias. Studying nonhuman species objectively is inherently challenging, especially for 'charismatic' and ostensibly human-like behaviours. Animal tool use is a prime example: while often considered a hallmark of intelligence, the amount of research attention and public interest it generates seems disproportionate when compared with other behaviours involving similar manipulative skills, particularly nest building. Here, we reveal striking disparities in the treatment of tool use and nest building in the animal behaviour literature. We find that tool use publications are more highly cited, are more likely to be published in higher-impact journals and use more terminology suggestive of 'intelligence' and human-like cognition compared with nest building publications. Our findings are not confounded by taxonomic biases: these disparities persist even within studies of great apes and *Corvus* species. Further, we find that articles with more frequent use of 'intelligent' terminology are more highly cited, suggesting incentives for the use of anthropomorphic language in scientific articles. Finally, we find that tool use papers are more highly cited than nest building papers even when controlling for the use of 'intelligent' language, showing that both language use and behaviour have additive effects on research attention. We argue that these research disparities are partly driven by a widespread assumption that tool use requires more complex cognition than nest building. Since the cognitive mechanisms underpinning either behaviour are still not well understood, we suggest that the widespread appeal of animal tool use is partly due to anthropocentrism.

Human perceptions of other species' behaviour are influenced by implicit, often anthropocentric, biases. We have a widespread tendency to empathize with and ascribe human-like cognitive abilities preferentially to species most closely related to ourselves (e.g. Harrison & Hall, 2010; Miralles et al., 2019; Rae Westbury & Neumann, 2008), and perceptions of other species vary widely between people with different personal characteristics and experiences. Greater empathy for nonhuman animals (hereafter 'animals') has been reported in, for example, women, younger people, and people living with companion animals (e.g. Kupsala et al., 2014; Musto et al., 2014). Neurodivergent individuals, including autistic people, may also relate to nonhuman animals in distinctive ways, often experiencing intense, deeply emotional connections to nature (e.g. Atherton et al., 2023; Davidson & Smith, 2009). Perceptions of other species are, further, influenced by cultural variation in beliefs about the human place in nature. For example, a dualistic model in which human and other animal minds are fundamentally incomparable has been highly influential in the history of Western scientific thought, but not necessarily in other intellectual traditions (e.g. Root-Bernstein et al., 2013).

People who work professionally with animals are by no means immune to subjective perceptions of their behaviour. Those who spend long periods engaging closely with animals, such as field researchers, birdwatchers, farmers and vets, often develop complex, 'entangled' relationships with other species, whereby a strong sense of empathy interacts with one of 'professional' detachment (Candea, 2010; Root-Bernstein et al., 2013). Although animal behaviour researchers strive for objectivity, substantial taxonomic biases persist in our field, disproportionately favouring 'charismatic' vertebrate species in research effort, particularly mammals and birds (Rosenthal et al., 2017). Reports of 'clever' behaviours in animals are highly appealing to scientific and popular audiences

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alike, and there are long-standing academic controversies over the role of anthropomorphism in the interpretation of animal behaviour (Shettleworth, 2010). For example, debates continue over the extent to which sexual selection research is influenced by Western gender stereotypes (Ah-King, 2022, 2023; Dougherty et al., 2013; Karlsson Green & Madjidian, 2011; Pollo & Kasumovic, 2022). However, little research to date has directly investigated the implicit biases that may shape the study of animal cognition, a potentially important issue given that 'charismatic' species tend to be prioritized in conservation efforts (Brambilla et al., 2013; Clark & May, 2002; Root-Bernstein et al., 2013; Seddon et al., 2005).

In the present study, we investigated potential research disparities within the field of animal behaviour, focusing on tool use and nest building for two reasons. First, multiple authors have discussed the possibility that tool use attracts more research attention than other 'complex' behaviours, including nest building, due to its perceived intelligence and greater relevance to human evolution (Guillette & Healy, 2015; Hansell & Ruxton, 2008; Healy et al., 2008; Seed & Byrne, 2010). This suggestion, however, has not yet been confirmed by a systematic analysis of the animal behaviour literature. Second, while the cognitive mechanisms underlying both tool use and nest building remain debated, there is increasing evidence of overlap: experimental and observational work has challenged a long-held assumption that nest building is a largely instinctive behaviour (e.g. Bailey et al., 2014, 2015; Muth & Healy, 2011; Tello-Ramos et al., 2024; Walsh et al., 2013), and both tool use and nest building can involve the selection of material with appropriate physical properties, consistent with causal understanding and planning (e.g. Bailey et al., 2014; Visalberghi et al., 2009).

We therefore hypothesized that tool use receives more research attention than nest building due, in part, to an implicit assumption among researchers that tool use requires more 'complex', human-like cognitive abilities than nest building. To test this hypothesis, we conducted bibliometric and text-mining analyses of a large sample of published research articles. We predicted that compared with nest building articles, tool use articles would have higher citation rates, would be more likely to be published in higher-impact, general interest journals as well as those with a focus on cognition and human behaviour, and would make more frequent use of language suggestive of 'intelligent', human-like cognition in their abstracts. In contrast, we expected that nest building articles would be more likely to be published in ecology than cognition focused journals because nest building has been traditionally studied in the context of reproductive ecology rather than cognition. We also expected that nest building papers would be more likely than tool use papers to be published in specialist journals, including those with an applied or taxon specific focus rather than in general interest journals. We investigated whether results hold within great apes and *Corvus* species to check for taxonomic confounds and to test for further anthropocentric biases in terms of phylogenetic relatedness to humans. Finally, we used multiple regression models to disentangle the effects of behaviour (tool use versus nest building) and language use on citation rates.

METHODS

Data Collection

We searched the Clarivate Web of Science academic literature database (Clarivate, 2023a) to obtain samples of abstracts and meta-data (including citation counts) for published research articles concerning animal tool use and nest building. We limited our search to articles included in the Zoological Record collection (Clarivate, 2023b) to ensure that our queries identified articles from relevant academic fields. We ran separate queries for tool use and nest building, searching for articles that contained the relevant search terms in the 'topic' field, which includes article titles, abstracts and keywords. We included studies of all species in our main samples, and also investigated effects within two taxonomic subsets to ensure that any apparent disparities in the treatment of tool use and nest building were not simply a result of variation in the taxonomic groups represented in the tool use and nest building samples. We chose to obtain samples for great apes (*Hominidae*) and members of the *Corvus* genus in particular, for two reasons. First, these are both 'charismatic' taxa that contain tool using and nest building species, allowing for a fair comparison of the behaviours within two taxa that attract large amounts of research attention. Second, by comparing the same behaviours between the taxa, we can investigate potential anthropocentric biases in relation to phylogenetic distance - that is, we can test the prediction that both tool use and nest building attract more research attention and 'intelligent' language when performed by species closely related to humans.

Web of Science searches initially returned $N = 1702$ tool use articles, $N = 6132$ nest building articles, $N = 578$ articles on tool use in great apes, $N = 74$ articles on nest building in great apes, $N = 106$ articles on tool use in *Corvus* species and $N = 87$ articles on nest building in *Corvus* species. We excluded articles that exclusively concerned human behaviour (e.g. archaeological studies of hominin tools), although we included those that compared human and animal behaviour (e.g. comparisons of humans and nonhumans in a tool use experiment). We also removed duplicate entries and performed manual checks to remove irrelevant articles (e.g. articles discussing new methodological 'tools' or those describing nest predation rather than nest building by *Corvus* species). Full details of our search strategies, including search strings, query links and exclusion criteria, are reported in the Supplementary Material and summarized in Fig. S1. After data checking and cleaning, $N = 1542$ tool use articles, $N = 6108$ nest building articles, $N = 566$ great ape tool use articles, $N = 74$ great ape nest building articles, $N = 104$ *Corvus* tool use articles and $N = 75$ *Corvus* nest building articles remained.

The article meta-data obtained from the Web of Science searches did not contain information on journal impact factors (JIFs) or subject areas of focus. We therefore obtained this information separately from the Clarivate Journal Citation Reports (JCR) database (Clarivate, 2024a). JIFs are calculated as the number of citations accrued in a given year from articles published in a given journal over the previous two years, divided by the total number of citable outputs published in the same journal for the same time period (Clarivate, 2024b). We used JIFs for the year 2023, or the latest year provided if JIFs for 2023 were not available. To categorize journals into subject areas in a way relevant to our hypotheses and predictions, we used subject categories from the JCR database, together with contextual information from journal websites where necessary. Thus, we categorized journals into one of six main groups: 'general interest', 'cognition focused' and 'human focused', in which we expected tool use articles to be over-represented and 'ecology focused', 'taxon specific' and 'applied', in which we expected nest building articles to be over-represented. We included two further categories, 'other biology' and 'zoology', for which we make no predictions about the relative proportions of tool use and nest building articles, as these were catch-all terms for articles that did not fit into any of the aforementioned six categories. For a more detailed description of these categories, see Supplementary Material. JIFs and subject areas were available for $N = 1329$ tool use articles, $N = 2948$ nest building articles, $N = 475$ tool use articles for great apes, $N = 50$ nest building articles for great apes, $N = 97$ tool use articles for *Corvus* species and $N = 15$ nest building articles for *Corvus* species.

Text-mining

We used text-mining tools to identify words in article abstracts which are commonly used to describe animal behaviours assumed to require 'complex', human-like cognition, such as 'craft', 'intelligent' and 'technique'. English language abstracts were available for $N = 1196$ and $N = 2914$ tool use and nest building articles, respectively, for the full samples, while $N = 430$ abstracts were available for great ape tool use articles, $N = 48$ for great ape nest building articles, $N = 87$ for *Corvus* tool use articles and $N = 28$ for *Corvus* nest building articles. We compiled a dictionary of terms commonly used in scientific articles to describe 'intelligent' behaviours in nonhuman species based on our experience of the zoological literature. We then expanded this list by searching each of these terms in the Collins online thesaurus (Collins, 2023), adding any additional relevant synonyms to the list, resulting in a total of 61 terms (Table S1). We excluded purely descriptive terms, such as 'use', 'make', 'build' or 'cognition', as our focus here is on words suggestive of assumptions about the complexity of behaviours, not those simply used to describe the actions involved in behaviours. For brevity, we refer to the terms included in this list as 'intelligent' words, without committing ourselves to any particular definition of the term 'intelligent' or making any judgement as to its utility in the study of nonhuman species. We acknowledge that selecting terms in this way is potentially vulnerable to subjectivity and biases of our own. Therefore, we included additional analyses using an alternative list that comprises only the term 'intelligent' plus its 20 synonyms listed in the Collins online thesaurus (Table S2, Collins, 2023).

To process article abstracts for analysis, we tokenized (split) each abstract into individual words and converted words into stems (so that, for example, the words 'creative' and 'creativity' are both collapsed to the stem 'creativ') using functions from the 'tidytext' (Silge & Robinson, 2016) and 'SnowballC' (Bouchet-Valat, 2023) R packages. We then converted the words in the dictionary of 'intelligent' words into stems, searched for stems in the abstracts that matched those in the dictionary and calculated the percentage of 'intelligent' stems out of the total number of word stems in each article abstract. A key limitation of this approach is that matching at the level of individual word stems does not account for context. This issue creates noise in the data, but there is no reason to suspect that it affects tool use and nest building articles differently and therefore it should not bias the results in any particular direction.

Hypothesis Testing

To compare citation rates, impact factors and the percentage of 'intelligent' words between tool use and nest building articles, we used Wilcoxon two-sample tests because all variables had nonnormal (highly right-skewed) distributions. We used chi-square tests to compare the frequency of tool use and nest building publications in different journal subject categories, against a null hypothesis of equal proportions of tool use and nest building articles in each category. We repeated the citation rate, impact factor and language comparisons within the great ape and *Corvus* data subsets to ensure that our main results were not affected by taxonomic confounds. We also compared citation rates, impact factors and language for the same behaviour in great apes versus *Corvus* species to test for taxonomic biases. We did not repeat the chi-square tests for behaviour type against journal subject category within great ape and *Corvus* species, however, due to small sample sizes (Tables S3 and S4).

We also used multiple regression models to disentangle the effects of behaviour type (tool use versus nest building) and language use on citation rates by including both behaviour type and language use as predictors of citation rates in the same model. This model allows us to distinguish between three different scenarios: (1) higher citation rates are driven only by a greater interest in tool use versus nest building, in which case tool use but not 'intelligent' language should be associated with higher citation rates; (2) higher citation rates are driven by a greater interest in 'intelligent' behaviour rather than in tool use per se, in which case 'intelligent' language but not tool use should be associated with higher citation rates; and (3) higher citation rates are driven by both a greater interest in tool use and in 'intelligent' behaviour (that is, behaviour type and language have additive effects), in which case both should predict higher citation rates. Diagnostic plots suggested that linear models were unsuitable (even after log transformation of the variables), likely due to a large number of zero values in the outcome variable (citation count). Therefore, we used hurdle regression models instead, with the outcome variable (citation count) untransformed and the continuous predictor variable (% 'intelligent' words) log-10 transformed, adding 1 before log transformation to avoid infinite values. Hurdle regression models have two components: a count model for the nonzero observations and a binary model to predict the probability that observations are nonzero. We fitted hurdle models using maximum likelihood in the R package 'pscl' (Zeileis et al., 2008), with a truncated Poisson distribution and log link for the count variable and a binomial distribution and logit link for the binary component. As a measure of model fit, we calculate McFadden's pseudo R^2 as $R^2_{MF} = 1 - \ln(L_M)/\ln(L_N)$, where L_M is the likelihood of the focal model and L_N is the likelihood of a null (intercept-only) model (McFadden, 1972). All analyses were performed in R version 4.3.2 (R Core Team, 2023).

RESULTS

Compared with nest building articles, tool use articles attract more citations and are published in higher-impact journals (Table 1, Fig. 1a and b). Tool use articles are over-represented in general interest, cognition or human focused journals, while nest building articles are over-represented in journals with an ecology, taxon specific or applied focus (Table 1, Fig. 1d). Tool use articles make more frequent use of 'intelligent' terms in their abstracts compared with nest building articles (Table 1, Fig. 1c), such as 'learn', 'cultur', 'innov', 'complex' and 'skill' (Fig. 1e). We find similar results when using an alternative list of 'intelligent' terms identified using only synonyms listed in the Collins online thesaurus (Table S2; Fig. S2).

Our findings are not confounded by taxonomic effects, as we find the same patterns when limiting our analyses to great apes or *Corvus* species (Tables S5 and S6; Fig. S3), although some effects are weaker. Interestingly, differences between the treatment of tool use and nest building are generally less pronounced within studies of great apes but more pronounced within studies of *Corvus* species (Tables S5 and S6; Fig. S3). Comparing the same behaviour between the taxa, we found that, as predicted, nest building papers are more highly cited, more likely to be published in higher-impact journals and use more 'intelligent' terms in their abstracts when the focal species is a great ape rather than a *Corvus* species (Tables S7 and S8; Fig. S3). However, for tool use, we find a different pattern: citation rates are similar for tool use in both taxa, while impact factors and frequencies of 'intelligent' terminology are higher in *Corvus* compared with great ape articles, contrary to predictions (Tables S7 and S8; Fig. S3).

The literature disparities we identify between tool use and nest building have several potential explanations. One is that tool use papers attract more attention because researchers are more interested in tool use than nest building, while another is that tool use papers attract more attention as a byproduct of the context in which they are published. Tool use papers may be more highly cited

Table 1
Results for comparisons of citations, journal impact factors, journal subject categories and language use between tool use and nest building publications

Parameter	Tool use	Nest building	Test statistics
Citations	19 [6–46], $N = 1542$	2 [0–13], $N = 6108$	$W = 2\ 387\ 176$, $P < 0.001$
JIF	2 [1.3–2.9], $N = 1329$	1.4 [0.8–2.3], $N = 2948$	$W = 1\ 328\ 604$, $P < 0.001$
% general journals	24.1, $N = 320$	6.9, $N = 203$	$\chi^2{}_1 = 250.67$, $P < 0.001$
% cognition journals	19.0, $N = 253$	1.8, $N = 52$	$\chi^2{}_1 = 410.08$, $P < 0.001$
% human journals	10.0, $N = 133$	0.3, $N = 10$	$\chi^2{}_1 = 261.98$, $P < 0.001$
% ecology journals	3.8, $N = 50$	14.6, $N = 430$	$\chi^2{}_1 = 106.63$, $P < 0.001$
% taxon journals	27.0, $N = 359$	46.8, $N = 1381$	$\chi^2{}_1 = 148.49$, $P < 0.001$
% applied journals	2.9, $N = 39$	9.3, $N = 273$	$\chi^2{}_1 = 53.28$, $P < 0.001$
% 'intelligent'	1.5 [0.6–3.1], $N = 1196$	0 [0–0.6], $N = 2914$	$W = 619\ 472$, $P < 0.001$

Descriptive and inferential statistics for comparisons of citations, journal impact factors (JIF), journal subject categories and language use between tool use and nest building publications. In the 'Parameter' column, '% X journals' refers to the percentage of tool use and nest building papers that are published in journals of a particular subject category, out of the total number of tool use and nest building papers with journal subject data, respectively. The columns 'Tool use' and 'Nest building' report descriptive statistics (medians, IQR and sample sizes for citations, journal impact factors and % 'intelligent' terms; percentages and frequencies for % X journals) for each group, while the 'Test statistics' column reports the results of Wilcoxon two-sample or chi-square tests as appropriate for comparisons between the groups.

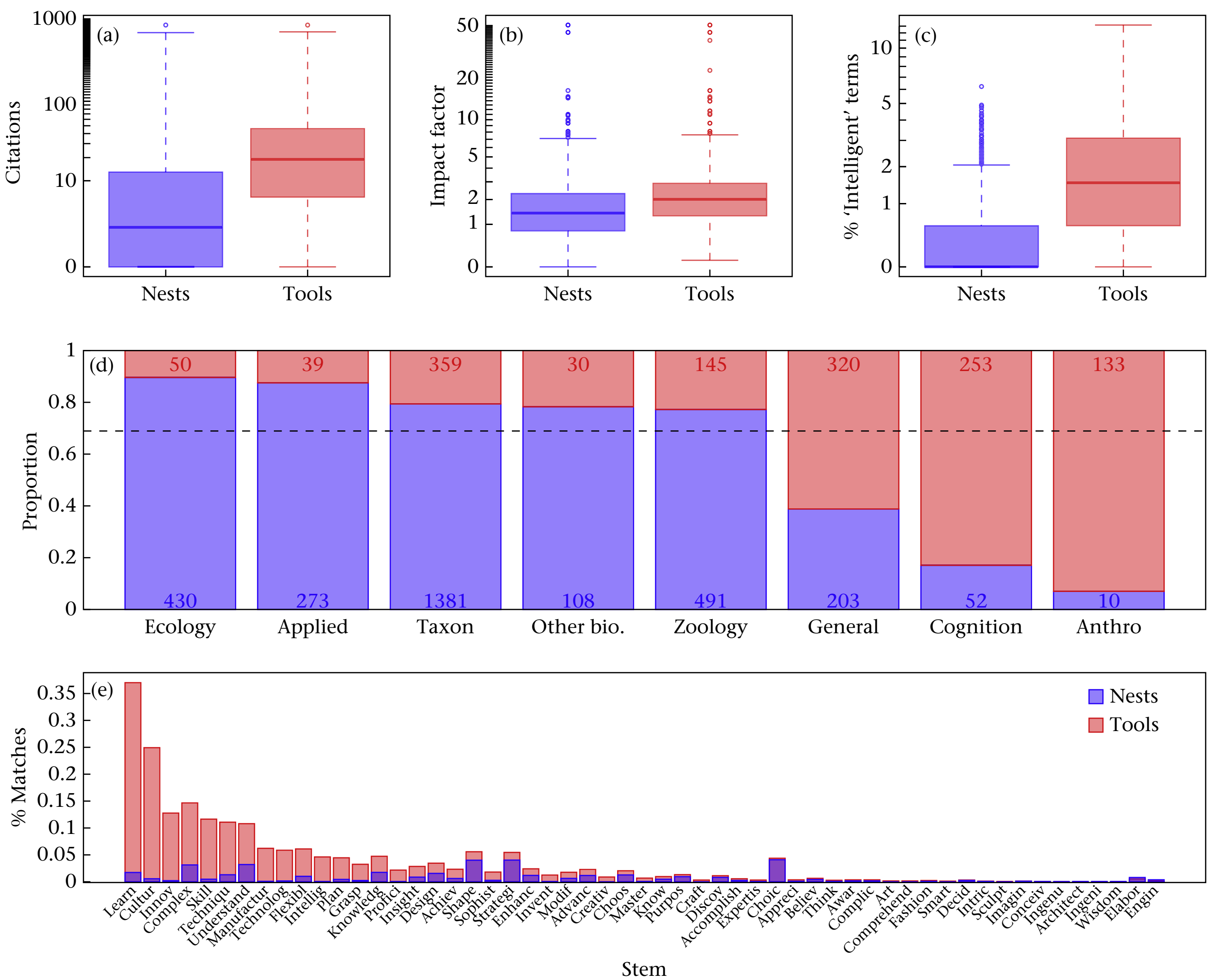

Figure 1. Box plots and bar plots illustrating contrasts in citations, journal impact factors, % 'intelligent' terms and journal areas of focus between nest building papers (blue) and tool use papers (red). In panels (a-c), medians and IQRs are indicated by the thick horizontal lines and shaded boxes, respectively, while whiskers encompass the range of data points that are no more than 1.5 × IQR from the edges of the shaded boxes. *Y* axes are presented on log-10 scales given the highly right-skewed distributions of the variables. Panel (d) shows the proportion (bars) and frequencies (overlaid numbers) of nest building and tool use articles published in journals of various areas of focus ('Ecology' = ecology focused, 'Applied' = applied, 'Taxon' = taxon specific, 'Other bio.' = other biology, 'Zoology' = zoology, 'General' = general interest, 'Cognition' = cognition focused, 'Anthro' = human focused) compared with the expected (i.e. overall) proportion of nest building articles in the dataset indicated by the dashed horizontal line. Panel (e) shows the percentage of terms matching those in our dictionary of 'intelligent' terms for each term separately for tool use and nest building articles, out of the total number of terms in the tool use and nest building samples. Bars are ordered by the absolute difference in percentage (so that terms used most often for tool use versus nest building appear further to the left of the plot). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

not because of a greater interest in tool use per se, but because they tend to be published in higher-profile journals and use more eye-catching language. A third explanation is a combination of these two effects; tool use papers may attract more attention partly because of an interest in tool use itself and partly because of the context in which they are published. Several follow-up analyses support the third of these explanations. Disparities in citation rate, impact factor and language largely persist even within articles published in general interest or cognition focused journals (Tables S9 and S10), showing that the effects of behaviour are not confounded by publication context. Further, in a multiple regression model predicting citation count from behaviour type (tool use or nest building), 'intelligent' language and an interaction term, we find positive main effects of both predictors and a positive interaction between them (Tables S11 and S12, Fig. 2). This means that tool use and 'intelligent' language have additive positive effects on citation counts, and that the positive effect of language on citations is stronger for tool use than nest building papers. Fitted lines from the regression models (Fig. 2) suggest that tool use papers are more highly cited than nest building papers even when they use no 'intelligent' terms at all in their abstracts.

Finally, out of curiosity, we conducted a post hoc analysis exploring how the language used to describe tool use and nest building in the zoological literature may have changed over time (Fig. 3). Linear regression models show that the frequency of 'intelligent' terminology in article abstracts has increased steadily over time, with a higher rate of increase for tool use ($\beta = 0.031$, $t = 5.182$, $P < 0.001$, $N = 44$, $R^2 = 0.390$) than for nest building articles ($\beta = 0.009$, $t = 10.490$, $P < 0.001$, $N = 44$, $R^2 = 0.724$).

DISCUSSION

Our findings reveal substantial disparities in the treatment of tool use and nest building in the animal behaviour literature. Tool use articles are more highly cited than nest building articles, and the two behaviours have very different publication profiles. Tool use articles are disproportionately likely to be published in higher-impact, general interest, cognition or human focused journals, while nest building articles are over-represented in lower-impact, ecology focused, applied or taxon specific journals. Further, tool use papers make much more frequent use of language suggestive of 'complex'

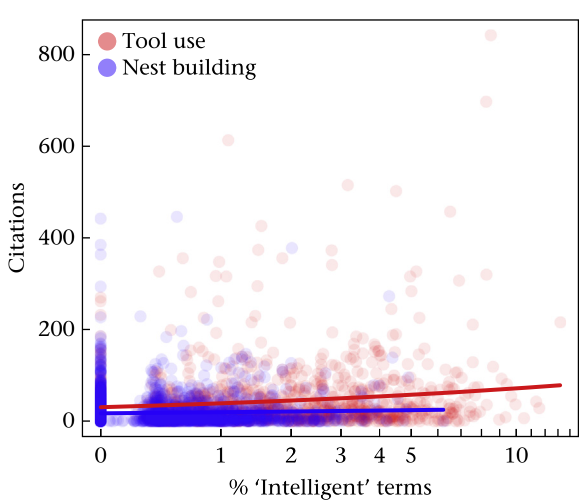

Figure 2. Scatterplot and fitted lines showing the relationship between citations, behaviour (tool use versus nest building) and % 'intelligent' words in article abstracts. Each data point represents a single article. Fitted lines are smoothed splines based on predicted values from the hurdle models ($N = 4110$, $R^2_{McF} = 0.10$).

cognition in their abstracts. Our results are not confounded by differences in the taxa represented in the tool use and nest building samples: we find the same pattern even within studies of great ape and *Corvus* species. Disparities also persist within cognition or general interest journals, showing that differences in the context of tool use versus nest building publications do not entirely explain the greater research attention paid to tool use compared with nest building papers. Tool use papers have higher citation rates even when controlling for language use, and there is a stronger positive effect of 'intelligent' language on citation counts for tool use than nest building articles. Therefore, 'intelligent' language and tool use appear to have additive positive effects on citation rates. We suggest that these findings, taken together, are consistent with anthropocentric bias in the animal behaviour literature, whereby tool use is considered a particularly special, 'intelligent' behaviour due to its central role in our own species' evolution.

As with any observational study, we must acknowledge multiple potential causal explanations for our findings. In our case, there are two main possibilities: the first is that tool use and nest building involve similar cognitive and manipulative abilities; hence, the literature disparities we identify are caused by researcher biases. The second, in contrast, is that the two behaviours require different cognitive and manipulative abilities; if tool use is genuinely a more flexible, innovative behaviour than nest building, then it would of course be justified to describe it as such. We argue that the second interpretation is less plausible than the first, based on several lines of evidence. Although nest building has been traditionally considered a largely instinctive behaviour, an increasing number of experimental studies have indicated that learning is involved (Breen et al., 2016; Guillette & Healy, 2015; Healy, 2022), particularly in nest material choice (e.g. Bailey et al., 2014, 2015; Muth & Healy, 2011). Although nest building is rarely described as 'flexible' or 'innovative', birds often adjust the location of their nests in response to fluctuating climatic conditions or predation risks (Mainwaring et al., 2014), and an increasing number of species incorporate novel anthropogenic materials into their nest structures (Jagiello et al., 2023; Sheard et al., 2024), sometimes with beneficial effects (e.g. cigarette butts may deter nest parasites; Suárez-Rodriguez et al., 2013). Further, aspects of nest design are likely culturally inherited in some cases (Tello-Ramos et al., 2024). The neural correlates of nest building are still poorly understood, but an experimental study of zebra finches suggests that it involves patterns of neural activation in the anterior motor pathway similar to those associated with tool use in macaques, suggesting that common motor learning and sequencing processes may be involved (Hall et al., 2014). Finally, phylogenetic comparative analyses suggest that evolutionary increases in cerebellar foliation are associated with both increased nest complexity (Hall et al., 2013) and tool use (Iwaniuk et al., 2009) in birds, providing further evidence of a shared neural basis. Nonetheless, we acknowledge that both behaviours can be underpinned by a variety of cognitive mechanisms, many of which remain poorly understood (Hansell & Ruxton, 2008; Seed & Byrne, 2010) and that they must be to some extent dissociable given the existence of species that are proficient tool users but not nest builders (e.g. Goffin's cockatoos: O'Hara et al., 2021) and vice versa (e.g. weaverbirds: Danel et al., 2021).

Given increasing evidence of an overlapping cognitive basis for tool use and nest building, we suggest that the research disparities between the behaviours are explained, to some extent, by researcher biases. We do not necessarily believe that these biases result from conscious decisions by researchers; rather, we suggest they largely arise from implicit assumptions about the complexity of cognitive processes underlying different behaviours in nonhuman species. Despite our best efforts, animal behaviour researchers are not entirely objective in our research practices, as demonstrated by

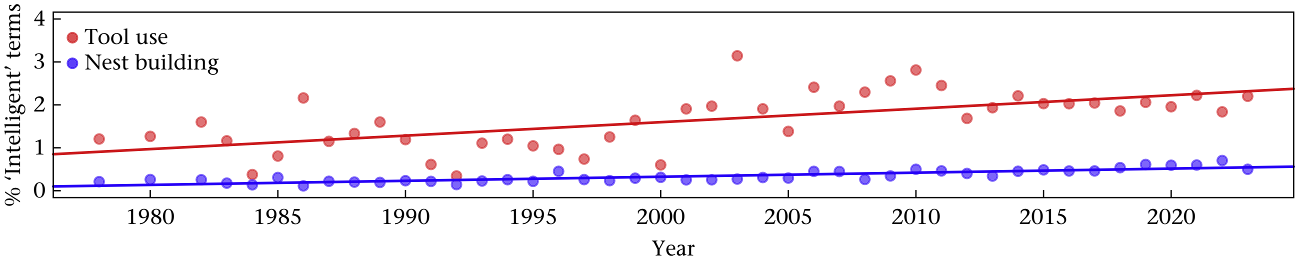

Figure 3. Scatterplots and fitted lines from linear regression models showing relationships between the percentage of 'intelligent' words in article abstracts and year of publication for tool use (red) and nest building articles (blue), for years in which abstracts were available for both tool use and nest building articles, up to the year 2023. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

substantial biases in research efforts towards 'charismatic' taxa that persist in our field (Rosenthal et al., 2017). In the case of tool use, there are plausible reasons to suspect that implicit anthropocentrism and anthropomorphism partly explain its widespread appeal. The importance of tool use in human evolution, coupled with its rarity in nature, may fuel the assumption that it requires unusually 'advanced' cognitive abilities similar to our own (Hansell & Ruxton, 2008). We speculate further that differing assumptions about tool use and nest building could also be unconsciously influenced by Western gender norms, whereby tool use is male-stereotyped and associated with technical skill, innovation and creativity, while nest building is female-stereotyped and associated with care, nurturing and maternal instinct. Scientific illustrations of extinct hominin communities traditionally depicted tool making as an almost exclusively male activity, with females usually portrayed in care-giving roles, if included at all (Wiber, 1997). Therefore, it is not so far-fetched to suggest that similar assumptions extend to nonhuman species, although we must acknowledge that further investigations into implicit biases among researchers are necessary to support this interpretation.

Our findings suggest that taxonomic biases interact with differing assumptions about the cognitive abilities underpinning tool use and nest building to produce both research disparities between different behaviours in the same taxa and between different taxa for the same behaviour. Consistent with anthropocentric biases, we found that nest building in great apes attracts more citations, higher-impact publications and more frequent use of 'intelligent' language than does the same behaviour in *Corvus* species. However, contrary to predictions, we found a different pattern for tool use: citation rates for tool use papers are similar between the taxa, while impact factors are higher and the use of 'intelligent' language is more frequent for *Corvus* than great ape tool use papers. These findings partly confirm an expected taxonomic bias (Rosenthal et al., 2017): nest building attracts more research attention and more evocative language when the nest builder is a primate than a bird, suggesting that some behaviours are more likely to be considered interesting and 'complex' when they are performed by species closely related to humans. However, our findings also suggest that taxonomic biases can be overshadowed in the case of particularly 'special' behaviours: tool use in *Corvus* is perhaps seen as sufficiently complex and human-like that the phylogenetic distance of birds to humans becomes irrelevant. The higher frequency of 'intelligent' terminology for *Corvus* than great ape tool use may even be driven by authors' pre-emptive concerns about taxonomic biases, whereby researchers feel the need to use eye-catching language to ensure that tool use in birds is taken as seriously as it is in great apes. The fact that we find positive (albeit noisy) relationships between citation rates and the use of such language in article abstracts, particularly for tool use, suggests that there is a subtle incentive for researchers to do so.

The social and cultural factors that underpin the language used by scientists to describe animal behaviour are complex and change over time. In the 19th and early 20th centuries, Western biologists were not shy of using colourful, emotive language to describe animal behaviour, which many contemporary researchers would consider inappropriately anthropomorphic. In '*The Descent of Man*' (1871) Charles Darwin referred to the songs and calls of many species, including insects, as 'music' (Darwin, 1871), while Elizabeth and George Peckham drew many explicit comparisons with human behaviour when writing about wasps in 1905, including using the term 'intelligence' to describe aspects of both wasp tool use and nest building (Peckham & Peckham, 1905). During the latter part of the 20th century, however, such language seems to have been largely sidelined in the zoological literature in favour of plainer, more 'objective' terminology, perhaps due to the influence of Lloyd Morgan's Canon, the rise of behaviourism and the recognition that complex behaviours can have simple explanations (Shettleworth, 2010). Our analysis, however, suggests that the use of 'intelligent' terminology to describe tool use and, to a lesser extent, nest building, has been increasing since the late 1970s. Here, we can only speculate on the causes of the apparent resurgence of this kind of language in the study of animal behaviour, but we suspect it is partly due to the eventual dominance of cognitivism over behaviourism in the latter half of the 20th century, together with increasing publishing pressures on animal behaviour researchers in recent decades that favour impactful studies of 'clever animals'.

We have shown that tool use attracts more research attention and is more often described using language suggestive of human-like cognition in animal behaviour publications compared to nest building, despite the arguable similarities between the behaviours. We suggest that this disparity arises in part due to unconscious, anthropocentric assumptions about the complexity of cognitive processes underlying the behaviours among researchers, as it persists despite a lack of strong evidence that tool use requires more 'complex' cognition than nest building. We acknowledge that not all readers will agree with our interpretation of the results, but we hope that our study stimulates further productive discussions about the role of societal biases in animal behaviour research. We urge researchers to consider more carefully the language we use to describe the behaviour of nonhuman species and its underlying assumptions, especially for behaviours such as tool use that have particular significance in our own species' evolution. While our results pertain to just two behaviours, we suspect that the effects we identify are indicative of anthropocentric and anthropomorphic assumptions at play in animal behaviour research more broadly. We do not, of course, suggest that animal behaviour research is hopelessly subjective; rather, that greater reflection and awareness of the potential effects of unconscious bias in our research may help us better understand the cognition and behaviour of other species. Donna Haraway's (Haraway, 1988) concept of 'situated knowledges', which Malin Ah-King (2023) has recently applied in the context of sexual selection research, is particularly useful here because it encourages self-reflection by researchers without completely dismissing the value of scientific research. Instead, Haraway's model (Haraway, 1988) allows for a more optimistic vision in which collective scientific knowledge is built by combining the 'partial perspectives' of researchers from diverse standpoints. It is exactly this collective enterprise of diverse researchers that we require for a fuller understanding of the diversity of cognition and behaviour of our nonhuman relatives.

Author Contributions

Sally E. Street: Writing – review & editing, Writing – original draft, Visualization, Investigation, Formal analysis, Data curation, Conceptualization. Inga Hamilton: Writing – review & editing, Investigation, Conceptualization. Susan D. Healy: Writing – review & editing, Investigation, Conceptualization.

Data Availability

Processed data and R code are available from the following Github repository: https://github.com/sally-e-street/tool-nest-language. The unprocessed data obtained from Clarivate databases cannot be shared for copyright reasons.

Declaration of Interest

None.

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Supplementary Material

Supplementary material associated with this article is available at https://doi.org/10.1016/j.anbehav.2025.123240.

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