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EDITORIAL

Biased Citation Practice and Taxonomic Parochialism

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Abstract

Citation bias in scientific literature is as widespread as unwelcome. Among other drawbacks, it has a detrimental influence by the wide use of citation statistics for political decisions on resource distribution. Here I ask whether a taxonomic citation bias exists in behavioural studies. The analysis revealed that (1) the taxonomic citation bias is on average large, with nearly a quarter of articles in a haphazardly chosen sample referring to the studied taxon alone, and (2) behavioural studies on mammals and birds show a significantly larger bias than work on other taxa. In contrast, research themes and questions studied do not seem to influence the taxonomic citation bias. Authors of different regions of the world do not differ in their taxonomic citation bias, and the number of papers cited in an article does not relate to the degree of bias. I discuss potential reasons for the substantial citation bias revealed by this analysis and conclude that taxonomic parochialism is a likely cause.

Scientific endeavour has one goal: to unravel mechanisms underlying the real world with utmost objectivity. Rigorous logic and experimentation are as essential for this purpose as is the consideration of extant knowledge. Bias is the demon of science at any level, and our incessant effort is to escape its temptation. It is always worth to scrutinize our success (Gluud 2006; Lortie et al. 2007). The publication process involving peer review and editorial advice and decision is one way to keep biases down. The adoption of published evidence as basis to build on future research is another mechanism towards this end. The use of previous results as research basis depends on its relevance for a study, which is a function of its specific importance and general quality. Previous research that we use as a basis is referred to in our papers and hence included in their reference lists. A glance at the reference list of a paper hence allows to appraise its context. Any form of bias in the selection of articles to which a study refers, intended or accidental, will hamper this judgement.

Nevertheless, there is ample evidence that such unwanted bias exists (Nicolaisen 2007; Bornmann & Daniel 2008). The probability of a paper to be considered and hence cited in subsequent articles is influenced, among others, by social networks (Case & Higgins 2000), the number of authors (Leimu & Koricheva 2005), the authors' institutional affiliation (Crane 1965; Podsakoff et al. 2008), the author's and the journal's reputation (Merton 1968; Callaham et al. 2002; Judge et al. 2007), whether results are 'positive' or 'negative' (i.e., supportive of the hypotheses tested or not; Kjaergard & Gluud 2002; Leimu & Koricheva 2005; Nieminen et al. 2007), regional affiliations (Wardle 1995; Paris et al. 1998; Grange 1999; Wong & Kokko 2005), whether the authors are from native English speaking countries (Tregenza 2002; Leimu & Koricheva 2005), the alphabetical position of authors' surnames (Tregenza 1997), and the citing authors' motivation to persuade the reader (Merton 1968; Gilbert 1977; MacRoberts & MacRoberts 1996); although there are opinions and studies qualifying these observations (Garfield & Welljamsdorof 1992; White 2004; Radicchi et al. 2008). An important reason for bias is the limitation of journal space, which is why often not all sources on which a study is based can be cited (MacRoberts & MacRoberts 1989).

Provided this extensive evidence of biased citation practice, any use of bibliometric data for the evaluation of research seems highly problematic (Paris et al. 1998; Seglen 1998; Kotiaho 1999; Moed 2002; cf. Gauffriau et al. 2008; Larsen 2008). Nevertheless, citation rates and journal impact factors are increasingly used for decisions to employ scientists, allocate research funds and develop science policies. The introduction of the science citation databank and Science Citation Index (SCI) by Eugene Garfield in 1963, and the ongoing activities of the Institute of Scientific Information in Philadelphia (ISI, now part of Thomson Reuters) have not only opened 'a new dimension in indexing' (Garfield 1964) but revolutionized the handling of scientific literature for everyone interested – scientists, librarians, administrators and policy makers. 'Scientometry' and 'Informetrics' are the prospering offspring of this development. On the upside, we now dispose of tools regarding the access and analysis of scientific references that no scientist would like to miss. However, these tools are used also for citation counts serving a plethora of other purposes – including quality estimation of scientists, journals, projects, programs, disciplines, universities, even the academic performance of nations (Taubes 1993; May 1997; Seglen 1998; Adam 2002; King 2004; Bar-Ilan 2008; Bornmann & Daniel 2008; Lehmann et al. 2008; cf. Taborsky 2007). These new utilities are an additional reason for a responsible handling of references in scientific publications.

Are there any citation biases specific to biology or behavioural research? Like in other fields, discipline affects citation habits (Lange 1985; Merchant et al. 2003), which is neither surprising nor *a priori* inadequate. If we extrapolate from recent studies of citation biases in ecology, we might assume that the citation of a paper depends on the direction of the study outcome, the number of authors, their country and affiliation, and on the journal's impact factor (Leimu & Koricheva 2005; Wong & Kokko 2005). One potential source of citation bias in biological literature hardly has been scrutinized, though, despite its potential importance for scientific progress: taxonomic parochialism, which is the bias to refer to only a narrow range of taxonomic groups when discussing the context of a study. The 'Aims and Scope' of ETHOLOGY, for example, state that this journal 'contains scientific articles of general interest in English that are based on a theoretical framework'. Recently we have scrutinized the theoretical basis of articles in this journal (Taborsky 2008), but what's about their generality? Other than with journals that are devoted to particular taxa, such as the 'Journal of Fish Biology', 'Primates' or 'Insectes Sociaux', a reader of a journal of behavioural biology might want to conceive an article in perspective beyond a close taxonomic group. Hence, when setting up a study on the functions and mechanisms of cooperative breeding in birds, for example, one might be expected to consider and refer to published research on similar phenomena also in mammals, fish and insects. Is this the practice? In other words, how much is the scope of ethologists confined to the taxonomic group they study?

To check for a potential bias in the reference to taxonomic groups I analysed the reference sections of all papers of four haphazardly selected issues of Volume 114 of ETHOLOGY (Table 1). 1603 citations of empirical work on certain taxa were contained in this sample of 42 articles, i.e., 38.2 citations per article. The overall citation bias was 80.6%, meaning that on average the authors referred to the class to which their own study organism belonged in four out of five cases. Only the vertebrate classes, insects and spiders were analysed separately (note that for convenience all fish classes were lumped), in addition to crustaceans (5) and 'other invertebrates' (4), plus 'other taxa', which comprised plants (1) and robots (1) [1]. In the table these latter three categories are combined in the column 'others'.

The range of taxonomic citation biases is remarkable (32.7–100%). Nearly a quarter of articles contained in the sample only referred to studies dealing with the taxon on which the study had been performed (i.e., 10 of 42 papers with 100% bias). Interestingly, the taxonomic citation bias does not relate to the number of citations contained in an article, which ranged between 16 and 64 ($R^2 = 0.014$, $n = 42$, Pearson correlation analysis; Fig 1a). This reveals that this bias is not a result of 'space limitations' of the journal. The taxonomic citation bias is not distributed equally among researchers working with different animals. Studies on birds and mammals showed a greater citation bias than those on 'other vertebrates' ($p = 0.029$, $n = 21 + 10$, $U = 53.5$, Mann–Whitney U-test) or those on 'other vertebrates' and 'invertebrates' combined ($p = 0.047$, $n = 21 + 21$, $U = 142$, Mann–Whitney U-test; Fig. 1b). In contrast, the taxonomic citation bias does

[1]Other, coarser or finer-grained taxonomic categories could be used for such analysis. However, 'class' seemed to be the optimal compromise, both with regard to potential conclusions and for practical reasons, e.g. due to the distribution of taxa in our sample. It can be assumed that any bias found at this level is indicative of taxonomic biases in general.

Table 1: Taxon-specific citations of all articles contained in four evenly spaced issues of volume 114 of ETHOLOGY

Authors	Theme	Taxon	Bird	Mam	Fish	Rep	Amph	Ins	Spi	Oth	n	% Bias	Region
February													
Fernandez-Juricic & Beauchamp 2008	Foraging, vigilance	Cowbird	**33**	10	2			1	1		47	70.21	US
Polo-Cavia et al. 2008	Response to predators	Turtle	1		1	**24**	3	5		6	40	60	EU
Cassinello & Calabuig 2008	Kin recognition	Ungulate	2	**51**							53	96.23	EU
Mehta & Burghardt 2008	Predator behaviour	Snake			4	**44**	1	3	1		53	83.02	US
Viera et al. 2008	Territoriality, ornaments	Penguin	**39**		1	3		1			44	88.64	CAN
Ellis 2008	Mobbing calls	Magpie-jay	**14**	8							22	63.64	US
Newman et al. 2008	Song variation	Junco	**45**								45	100	US
Muller & Manser 2008	Scent marking	Mongoose	2	**45**							47	95.74	EU
Moskat et al. 2008	Egg discrimination	Warbler	**57**								57	100	EU
Kemp & Alcock 2008	Territorial displays	Wasp						**27**			27	100	AUS
Kelly 2008	Post-copula behaviour	Weta						**19**			19	100	CAN
May													
Lehongre et al. 2008	Song variation	Canary	**30**								30	100	EU
Sloan & Hare 2008	Alarm call response	Ground squirrel	1	**35**							36	97.22	CAN
Dunbar & Shi 2008	Sex-specific feeding	Feral goat	**16**								16	100	EU
Raihani et al. 2008	Juvenile aggression	Babbler	**14**	12	2					1	29	48.28	EU
Schwagmeyer et al. 2008	Parental care	Sparrow	**21**								21	100	US
Kazial et al. 2008	Individual recognition	Bat	1	**60**	1		1				63	95.24	US
Agrillo et al. 2008	Male mate choice	Mosquitofish	3	5	**38**		1	3		1	51	74.51	EU
Briggs 2008	Mating pattern	Treefrog	1	1		2	**60**				64	93.75	US
Almeida et al. 2008	Calling behaviour	Moth						**23**			23	100	BRAZ
Perry & Rowe 2008	Mating effects longevity	Ladybird beetle						**47**	2		49	95.92	CAN
LaDage et al. 2008	Female multiple mating	Gecko	8	6	2	**16**	3	14			49	32.65	US
August													
Blanckenhorn et al. 2008	Mating success	Fly	2	1		1		**24**			28	85.71	EU
Uhl & Maelfait 2008	Secretion, copulation	Spider						15	**16**		31	51.61	EU
Gregory 2008	Death-feigning	Snake	4	2		**11**	1	3	1		22	50	CAN
Andersen et al. 2008	Nuptial gifts	Spider						6	**10**		16	62.5	EU
Ortolani et al. 2008	Parasite seasonality	Wasp	14	1				**11**			26	42.31	EU
Smiseth & Moore 2008	Parental care	Burying beetle	8					**10**	1	1	20	50	EU
Hale et al. 2008	Sperm, fertilization	Hide beetle	6	7	1			**28**	3	1	46	60.87	AUS
Diego-Rasilla et al. 2008	Homing orientation	Newt	3			1	**36**				40	90	EU
November													
Jones & Whittingham 2008	Predator response	Chaffinch	**39**	6	6	2	1			1	54	72.22	EU
Ledesma & McRobert 2008	Shoaling behaviour	Molly			**18**			1			19	94.74	US
Manno & Dobson 2008	Territoriality	Ground squirrel	6	**36**	1	2	1	1			47	76.6	US
Hopewell & Leaver 2008	Caching	Grey squirrel	17	**18**							35	51.43	EU
Peixoto & Benson 2008	Territoriality	Butterfly	1					**33**	1		35	94.29	BRAZ
Moreno et al. 2008	Parental care	Flycatcher	**18**					1			19	94.74	EU
Cardoso et al. 2008	Song and body size	Junco & serin	**52**	5	3	1	2	1			64	81.25	AUS
Hoi & Griggio 2008	Sexual ornament	Bearded tit	**35**								35	100	EU
Colmenares & Silveira 2008	Conflict management	Baboon		**53**							53	100	EU
Stahlschmidt et al. 2008	Egg care	Python	10	1		**25**		6			42	59.52	US
Baube 2008	Reproductive isolation	Stickleback	2		**45**		2	1			50	90	US
Blumstein et al. 2008	Predator discrimination	Marmot	1	**30**	4	1					36	83.33	US

Classes cited in these articles include birds, mammals (mam), fish (all fish classes combined), reptiles (rep), amphibians (amph), insects (ins), spiders (spi), and all other taxa (oth). The number of taxon-specific citations per article is given (n) and the bias (%), i.e. the percentage of citations referring to the taxon that was subject of the respective article, as well as the authors' region (based on address of first author; US = USA, EU = Europe, AUS = Australia, BRAZ = Brazil, CAN = Canada). Numbers of cited studies of the taxon that was subject of the citing article are printed in bold. If a cited study contained work on two taxonomic categories (e.g. on reptiles and amphibians), both were counted.

not differ between the authors' regions of origin (USA, Europe and 'others'; $p = 0.54$, $n = 13 + 19 + 10$, $\chi^2 = 1.21$, Kruskal–Wallis ANOVA). There was no difference in taxonomic citation bias between studies of different themes (categories considered: communication, mating, brood care, aggres-

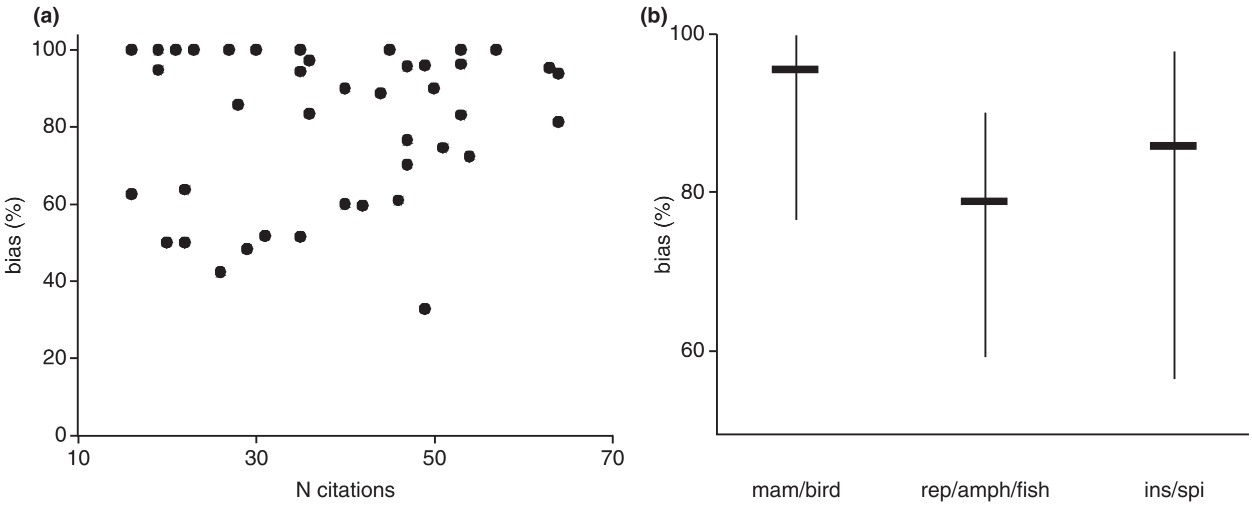

Fig. 1: (a) The taxonomic citation bias in relation to the number of references included in an article (n = 42). (b) The taxonomic citation bias for articles reporting studies on mammals and birds (n = 21), other vertebrates (n = 10), or insects and spiders (n = 11). Medians and quartile ranges are given. Abbreviations as in Table 1. See text for analytical statistics.

sion/territoriality, foraging, recognition, predator/prey relations, and 'others'; data not shown).

The pattern shown by these data suggests that (1) a large proportion of studies is not placed in a wider taxonomic context (61.9% of the articles had a taxonomic citation bias exceeding 80%); (2) This tendency is particularly strong in research on mammals and birds (7 of 10 articles with 100% bias). This might be due to the phenomena or questions studied: if certain traits are specific for a particular taxon, it may not be obvious to relate one's study to different taxa. If this was the case, we would expect that the studies' themes relate to the taxonomic citation bias, which was not the case. Notably, studies of behaviours that are confined to certain taxa, like death feigning, caching of food or presenting nuptial gifts, for example, showed low biases, whereas some studies of widespread traits, such as sexual ornaments or parental care, showed a heavy bias. This leaves taxonomic parochialism as an alternative explanation for the citation bias that has emerged here.

We might ask if this is of concern. Does it hamper scientific progress in any significant way? To answer this question, we should go back to the start. Authors are expected to select references based on their relevance and contribution to their own work (Leimu & Koricheva 2005). If an article refers only to studies of closely related taxa, readers might suspect that the scope of the study is so narrow that it has little general relevance. If not for other reasons, authors should consider this when discussing the framework of their study. Are there other concerns of a taxonomic citation bias in biological papers? For example, could it affect any relevant political decisions? Given the wide and increasing use of citation analyses for decisions on resource distribution, one might suspect that funding schemes can be affected by taxonomic citation statistics. If research on particular taxa is hardly cited, it might appear to be redundant.

The most important cause against taxonomic parochialism, in my view, is the wealth of knowledge, ideas and insight we can gain when considering how different organisms solve similar problems. So often in biology comparison affords amazing surprises, which a blinkered view is going to miss. Therefore my plea to the biology lot at large: abstain from taxonomic parochialism!

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