

# Crediting animals in scientific literature

Recognition in addition to Replacement, Reduction, & Refinement [4R]

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Animals have made an immense contribution to science and medical practice as experimental models in basic research, to study human disease and for drug development. Over the last few decades, animal rights activism and concerns for animal welfare in general have led to an increasing emphasis on and adoption of the “3R” approach (Replace, Reduce and Refine) in biomedical research. This was originally proposed in 1959 by William Russell and Rex Burch with the overall aim of reducing animal suffering while improving the quality of experiments that rely on animal models (see Box 1). Nonetheless, in addition to having no choice in the matter, animals receive no credit for their sacrifice, with the exception of some “celebrities” such as Dolly the famous cloned sheep. In this article, we explore whether animals should also receive more recognition for their vital contribution to research via credit in publications.

“At least in theory, animals other than humans do not seem equipped to become formal authors.”

Authorship and contributorship are essential aspects of scientific publishing and widely discussed issues. While considerable attention is paid to whether bylines are too long [1] or too short and to ghost and guest authorship, the possibility of crediting animals as (co)authors has never been systematically explored. At least in theory, animals other than humans do not seem equipped to become formal authors.

## Animals as authors

In order to establish whether animals have been credited for their crucial role in research, we conducted a systematic literature search with the focus on (co)authorship using PubMed and ISI’s Web of Science databases. This was complemented by an unsystematic search using Google and by contacting authors with experience in the field (the search strategy and respective results are available from the authors). Our searches revealed five empirical examples where non-human animals were co-authors [2–5], or the sole author [6], of a scientific publication. Two of these instances [3,5] are included in PubMed, and all cases are listed in the ISI Web of Science [2–6].

The five instances of (co)authorship of non-human animals are as follows: F.D.C. Willard [2,6]—a Siamese house cat named Chester who was sired by a cat named Willard—was associated with the American physicist and mathematician Jack Hetherington. Galadriel Mirkwood [3] was a dog owned by the immunologist Polly Matzinger. Once the dog co-authorship was discovered in the latter instance, papers of which Matzinger was a major author were banned from the journal until the editor died and a new one was appointed; she also faced internal review by her university. H.A.M.S. ter Tisha [4] was—indeed—a hamster owned and valued by Andre Geim, the 2010 recipient of the Nobel Prize in Physics for his co-discovery of graphene ([http://www.nobelprize.org/nobel\\_prizes/physics/laureates/2010/geim-facts.html](http://www.nobelprize.org/nobel_prizes/physics/laureates/2010/geim-facts.html)). To date, he is the only Nobel laureate who also received the Ig-Nobel prize in 2000 for making frogs fly

(<http://www.improbable.com/ig/winners/>). Finally, three bonobos named Wamba K, Wamba P, and Wamba N [5] were credited as co-authors alongside the primatologist Sue Savage-Rumbaugh.

Careful examination of these papers revealed that they do not report who precisely did what in terms of the published work. Thus, the reader can only speculate how Hetherington, Matzinger, Geim, and Savage-Rumbaugh conducted parts or all of the work by interacting with or being inspired by their non-human co-authors, or why and how Willard [6] published as a sole author.

“... we should show gratitude to all animals who contribute to basic science and preclinical research”

With regard to the question “How often are members of the animal kingdom other than humans listed as (co)authors of scientific publications?”, our systematic literature search yielded not one instance beyond our unsystematic Google search, in which a non-human animal was listed as a (co)author. Why merely five publications out of millions between the 1950s and today within PubMed and Web of Science are (co)authored by non-human animals—a result which we dare say without formal statistics is significant—can only be speculated upon. All instances were (co)authored—in chronological order—by a cat, a dog, a hamster, three bonobos, or solely authored by the cat, which means that 100% of identified non-human animal (co)authors are mammals.

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## Defining authorship

The answer to “Can non-human animals qualify as (co)authors?” would appear to be a simple “yes” because there are documented instances when they are. These articles [2–6] were cited 61, 110, 12, 11, and 3 times, respectively, as of October 4, 2016. Moreover, we expect that non-human animals have substantially stimulated the formation of critical ideas, for instance through biomimicry—porcupine quills as a model of needle penetration and patch adhesion, or the Michael Phelps 2008 Olympic Games shark-skin emulating swimsuit. Beyond contributing to conceiving scientific work, Geim specified that “ter Tisha participated in the levitation experiments directly, which made his contribution much more valuable than that of some occasional co-authors” [personal communication].

However, the International Committee of Medical Journal Editors (ICMJE) recommends that four criteria [C1–C4] should be used when deciding who is an author and who is merely a contributor:

“C1: Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; C2: Drafting the work or revising it critically for important intellectual content; C3: Final approval of the version to be published; C4: Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Individuals who meet all four criteria should be identified as authors and those who do not meet all four criteria should be acknowledged as contributors”.

How non-human animals can have a role in regard to C1 is addressed above and also below. While C2 likely poses problems for most non-humans, C3 has already been tackled: In tentative agreement with C3, Hetherington sent the work in question to colleagues with Willard’s paw “signature” (Fig 1). In terms of C4, one can assume that humans are better placed than other animals to resolve most research questions.

## Some animals are more equal than others

When answering the question “Are some non-human animals better represented as (co)authors than others?”, we would like to

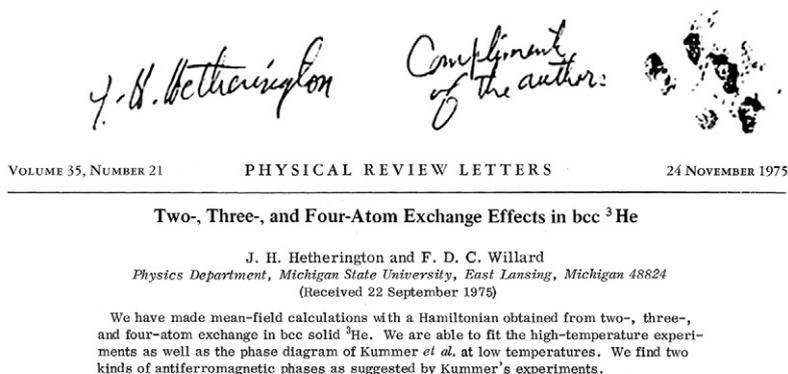
avoid the Orwellian maxim that “All animals are equal, but some animals are more equal than others”. Nevertheless, the empirical answer is “mammals” because the papers identified by us are confined to this class. Consequently, the additional question must arise “Why can and/or do mammals—as a class—make better (co)authors than, for instance, fish?” One possible answer may be that you can share a high-five with your dog after developing a good thought which you could not—and presumably would not—with your rattle-snake or your pelican, the former for anatomical reasons and the latter for reasons of stability. Furthermore, mammals such as dogs need walks, and the intellectually stimulating nature of walking has been scientifically observed [note personal communication with Dr. Matzinger below]. Again with regard to C1, it does not seem implausible that dogs should be credited with contributing to ideas that might not have arisen had they not needed to rise and stretch their legs. However, two famous animals are known beyond providing, or allowing, inspiration: Dolly the sheep as the result of cloning and Marjorie the dog as she was essential when Frederick Banting and Charles Best developed a treatment for diabetes.

Finally, here is our answer to “How should we treat non-human animals’ contributions to scientific papers?” Assuming that we wish to comply with the ICMJE’s standard, the appropriate way of considering non-human animals’ factual role in scientific publications should be the Acknowledgements section. This was actually the case

with regard to another publication by Matzinger. That seminal paper [7] was critically stimulated by observing her sheep dog Annie. However, the author “merely” acknowledged “Annie McCormack [...] for occasional diversions” due to the repercussions she experienced after coauthoring work with Galadriel Mirkwood [3] [personal communication]. Wicht *et al* [8] may have followed this commendable lead with their recent acknowledgement: “We thank especially animal #5”. Now, while the reader is grappling with the “what for?”, the authors will know and apparently appreciate the “why”. If that animal were to have a mutation, which instigates one or more papers with breakthroughs as was in the case of the tau-mutant hamster, sometimes called Ralph hamster [9,10], this could open the discussion around “substantial contributions” of #5 again—see requirements for C1 above. In any case, inclusion of non-human animals’ contributions in the Acknowledgements section may be difficult when increasing numbers of journals require that those who are acknowledged agree in writing to such acknowledgement—but then again, see the example of cat Willard in Fig 1 [6].

## Credit and recognition

Importantly, not only animals who have inspired human authors or who have yielded a novel mutation should be credited; we should also show gratitude to all animals who contribute to basic science and preclinical research. We would argue that any and all animals that are used in



**Figure 1.** A reprint of an article by J.H. Hetherington and F.D.C. Willard in *Physical Review Letters* signed by the authors.

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**Box 1: From 3R to 4R**

R1: Replace the use of animals with alternative techniques, or avoid the use of animals altogether.

R2: Reduce the number of animals used to a minimum, to obtain information from fewer animals or more information from the same number of animals.

R3: Refine the way experiments are carried out, to make sure animals suffer as little as possible. This includes better housing and improvements to procedures which minimize pain and suffering and/or improve animal welfare.

R4: Recognize contributions made to research by giving credit where credit is due, that is, the Acknowledgements section, unless authorship criteria (C1–4) are fulfilled.

research should be recognized on all publications arising from that research. This would go beyond simply mentioning the number and type of animal used, which must already be stated when such information can impact the interpretation of data and statistical methods.

Clearly, anyone named as an author has rights but, more importantly, responsibilities, and can be held accountable for the work as specified in contributorship statements. Recognizing non-human animals' input may be ethically required, even if they do not meet the normal standards for authorship. The appropriate way of considering non-human animals' factual role in scientific publications should generally be the Acknowledgements section. Human researchers should also diligently consider this option, for instance, to avoid authorship inflation. Overall, we suggest that Recognize

should be added to Refine, Reduce and Replace, making it 4R. Such animals usually have no names, but giving them this simple credit is the least we can do. In closing, we would like to encourage readers to complement our literature search by letting us know about their “pet authors” and their contributions, be they monitor lizards (*Varanus*) or, possibly likely candidates, parrots.

**Acknowledgements**

Assessing whether animals were appropriately treated in research is beyond the scope of this article. Clearly, no acknowledgement can compensate for animals' suffering in research. The authors thank Drs. Matzinger and Geim for personal communications. Two goldfish named “Einstein” and “Heisenberg” contributed to this work, which was conceived during TCE's 2015 sabbatical in Oxford. The search strategy and respective results are available from the authors.

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