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The CRISPR animal kingdom

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eLetters

Named nonhumans crossing the line

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Abstract:

Miscellaneous nonhumans with anthropomorphic names are routinely credited as solo authors, coauthors and contributors in scientific publications. Such prosocial behaviors against social norms may disrupt the present-day canon of publication ethics, and further challenge inception architecture on augmentation of human abilities in a hybrid society.

One Sentence Summary:

The increase in the crediting of nonhumans in scientific journals unsettles the canon of publication ethics.

Main Text

Ubiquity of prosociality

Human beings have congenital preferences to cooperate with one another, even when they are not incentivized by obvious rewards (*1*). Science fiction is full of nonhuman characters that are used to explore the limits of human beings and force us to reconsider the definition of humanity. Some nonhuman protagonists are very active in the scientific domain, and some of them are even more famous than the scientists who study them. Schrödinger's hypothetical cat, a thought experiment devised by the Nobel laureate Erwin Schrödinger, illustrates the paradox of quantum superposition using a live cat and dead cat. There has been an endless search for the apocryphal prototype of this cat – a pet cat or a friend's cat. While Ivan Pavlov's dogs were experimental subjects, they were given names such as Krasavietz, Beck, Milkah, Ikar, Joy, Tungus, Arleekin, Ruslan, Toi, and Murashka. Pavlov, the first Russian Nobel laureate, sometimes sacrificed his own food to keep these dogs alive during a time of great deprivation in Russia.

More recently, JoAnne Stubbe, the emeritus biochemist at the Massachusetts Institute of Technology, had enrolled her pet dog named Dr. McEnzyme Stubbe (also known as Zymie) in her research group, and Dr. McEnzyme had its official email address and picture on the group's website (http://web.mit.edu/biochemistry/people.htm). An Internet celebrity cat, Lil Bub, commissioned her owner and spokesman, Mike Bridavsky, who's not a scientist, to sign on to a recent bioRxiv preprint as senior author leading a consortium of scientists (*2*).

Blurring the boundaries

The increase in the crediting of nonhumans in scientific journals unsettles the present-day canon of publication ethics. Over time, scientific knowledge production has transitioned from being led by a solitary genius to being more collaborative. A byproduct of this transition is that miscellaneous animal and machine names fill the credit niches for authors and contributors in the scientific literature. These animal and machine names include F. D. C. Willard (Siamese cat), Galadriel Mirkwood (dog), H.A.M.S. ter Tisha (hamster), Kanzi Wamba, Panbanisch Wamba and Nyota Wamba (bonobos), M. Pucci (cat), Moe Gregory (cat), Annie McCormack and Poppy Ni Iaomaire (sheepdogs)(*3*), Einstein and Heisenberg (goldfish)(*4*), and Shalosh B. Ekhad (PC) (Table S1). Functionally, each nonhuman protagonist acts as a spokesperson for human stakeholders, with whom they formulate implicit appeals in tandem.

According to reports by the U.S. Department of Agriculture (USDA), millions of animals or cloned objects serve as the organic apparatus for vital contributions to scientific activities each year, and the extensive list of potential animal models is continually diversifying. In view of this, the U.S. Environmental Protection Agency (EPA) encourages scientists to move toward nonanimal alternatives (*5*). Michael Erard reported that most experimental animals are nameless, but in the U.S., most of the 891,161 research animals are credited using their proper names (*6*). Accompanying the feature news article (*6*), an instructive online survey (*7*) found that most scientists applaud naming laboratory animals, while only 39% of respondents oppose it. Erard emphasized that named research animals "rarely appear in publications, except sometimes in field studies of primates." This suggests that implicit anthropocentrism may prioritize the naming of human-kin primates over non-primates.

The USDA reported that an average of 9.9% of the animal models used in the U.S. from 2008 to 2017 were nonhuman primates (Figure S1). Statistically, it can be argued that nonhuman primates are named less frequently than non-primates. Scientists are susceptible to regarding human-kin primates as prime animal models in a competitive arena (*8*). However, the status quo does not mean that nonhuman primates should outdistance other nameable animals. Comparatively, naming smarter primates that are susceptible to stronger emotional bonds may introduce more anchoring bias than exists for their deindividuated counterparts in experiments (*9*). It is noteworthy that in practice, each accession to the named celebrities club inspires like-minded scientists to follow in the same vein as the new inductee (*10*), whereas others may be distressed to extend the long list of potential animal models or postulate even larger-scale animal models to achieve their prophetic objectives (contrary to the reduction principle of the 3Rs).

The nonhuman animals credited in the scientific literature extend beyond those envisioned by Erard and include research animals and even pet animals (Table S1). Some ambitious scientists propose that all animals that contribute to basic science and preclinical research should be acknowledged. In one Acknowledgements section (*3*), the evolutionary biologist and genome biologist T. Ryan Gregory of the University of Guelph in Ontario, Canada, recognized his dedicated pet cat Moe Gregory, "who graciously provided blood samples." Thomas C. Erren and his colleagues also acknowledged goldfish Einstein and Heisenberg to compensate for the suffering they underwent during the experiments (*4*). Helmut Wicht and his colleagues gave special recognition to the mice of the 5th experimental group (*11*). Immunologist Polly Matzinger of the University of California San Diego expressed her indebtedness to sheepdogs Annie

McCormack and Poppy Ni Iaomaire. "Poppy was the sheepdog of my technician. She came to my house every day, where I was thinking and writing," Matzinger says.

Similarly, some scientists think, less aligned recognition has been given to the partners in human-machine cooperation scenarios, although machines seek neither incentivizing rewards nor social cognition. As a nascent exception, the mathematician Doron Zeilberger of Rutgers University helped his close partner – an aspiring PC with the empathetic name Shalosh B. Ekhad – achieve burgeoning visibility in the academic realm (Figure S2). Just like Dr. McEnzyme Stubbe, Dr. Ekhad has its own email address and delights in engaging in heated debates with human mathematicians. Ekhad has contributed to the accession of the neologisms "shaloshable" and "non-shaloshable" to conceptualize whether a mathematical proof can be performed by computer via computable algorithms.

In short, these persistent prosocial behaviors, like a swing and a miss, routinely undergo several rounds of ethical scrutiny by gatekeepers. Such counterintuitive prosocial preferences may disturb the present-day canon of publication ethics, which should be duly reinforced. Many researchers share the opinion of Dr. Yingxu Wang, the pioneer of cognitive informatics and cognitive robotics at the University of Calgary, Canada, that "authorship is an active and creative cognitive activity," so that "the impersonal object or target under study may not claim such authorship." However, other researchers agree with Zeilberger, who obviously takes the position that the level of assistance received from a nonhuman is substantial enough to award authorship or contributorship.

Be a bona fide author

In fact, the history of publication ethics is a self-reflection on the history of scientific literature (Figure S3). This year marks the 20th anniversary of the COPE Report 1999 (*Committee on Publication Ethics. Guidelines on good publication practice. London: BMJ Books, 1999:43–47*). Many editors of leading journals indefatigably contributed to these guidelines, but thus far, their endorsements have been mostly ignored (Table S2). Thus, many long-standing open questions are pending further investigation. The desideratum is how to reinforce the basic canon of publication ethics and understand the inherent propensities of cooperative paradigms from a sociocultural perspective.

China is the world's largest producer of academic articles. Twenty years after the COPE report, on 26 September, the China Association for Science and Technology (CAST), the counterpart to AAAS in China, affirmed the first national directive, "*Ethical Standards for Scientific Journal Publishing*," to revive home-grown scholarly publishing. However, this eight-chapter initiative for editorial decision-making is far from well-rounded and practical. As Edith Hay Wyckoff, the editor and publisher of *The Locust Valley Leader*, remarked, "No one has been able to draw up a code of publication ethics that has been accepted as an absolute standard, but there are unwritten laws which sooner or later must be learned". Accordingly, each researcher should be a bona fide author to avoid any symptom of laissez-faire and renege (*12*), just as ancient Greek physicians pledged the Hippocratic Oath. There is motivation to amend flawed policies to reflect the prosocial preferences of scientists in both human-animal and human-machine scenarios. Better still, the scientific enterprise requires an open-minded and payoff-based forum for discussing potential failures to establish better regulatory standards and social norms.

Revisiting the principles

The practice of crediting nonhumans in scientific publications raises thought-provoking questions: Should primates have naming priority over other laboratory animals? Should animals or machines used in scientific research be individually named? Will these nonhuman-crediting behaviors have a demonstration effect on collective behavior? Should we rethink the theories of human-nonhuman collaboration?

In a hybrid society, humans tend to mould the behaviors of intelligent machines, and vice versa, intelligent machines with particular behavioral patterns also shape human behaviors in both beneficial and detrimental ways. For example, with the advent of the PC, a mathematician and a PC can team up in the scientific sphere, with one shedding light on the significance of the other. In the personhood case of Ekhad, Zeilberger suggests that PCs rarely receive their fair share of recognition in publications. With the pull of academic attainment, he credits Ekhad by remarking that "the computer helps so much and so often," and "[he] uploads all the software from one Shalosh to the next, thereby guaranteeing the immortality of its soul."

Nowadays, human beings working side-by-side with animals, as well as cognitive machines such as IBM's Watson and Google's AlphaGo, may further challenge these well-accepted theoretical frameworks such as utility theory and reciprocal altruism (see *SM Methods*). Predictably, animals and cognitive machines continue to make substantial contributions in the academic sphere with a combination of advances in cutting-edge bioscience, swarm intelligence and the Internet of Things. The emerging hybrid ecologies remind us to ultimately consolidate the principle of substantial contributions and inception architecture on augmentation of human abilities.

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11. H. Wicht *et al.*, Chronotypes and rhythm stability in mice. *Chronobiol. Int.* **31**, 27–36 (2014).
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Supplementary Materials:

All data is available for this work at https://github.com/wuch15/Named-nonhumans-crossing-the-line.

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Supplementary Materials for

Named nonhumans crossing the line

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Materials and Methods

Conceptual model of the fame evolution of scientists and nonhuman protagonists

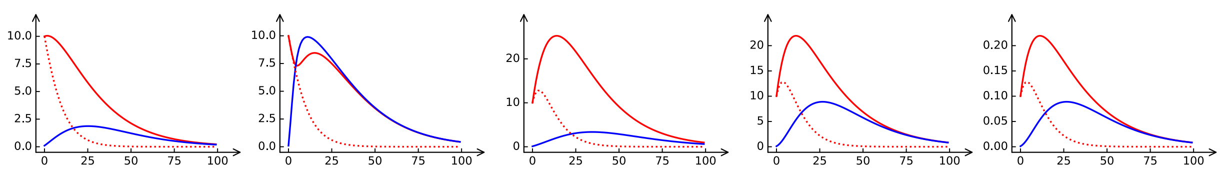
In academic community, miscellaneous nonhuman protagonists routinely fill the credit niches in scientific activities, which raise intriguing ethical questions and ushers us in a sequential dilemma. For instance, lately, the GitHub superstar Luc Esape, a bug fixing bot hiding under an assumed name to combat human's heavy bullish bias against machines, was unmasked by his host Martin Monperrus (*1*, *2*).

Here, we propose a semiquantitative model to characterize the fame evolution of a scientist and a corresponding nonhuman protagonist, which cannot be comprehensively assessed by the well-accepted theoretical frameworks such as utility theory and reciprocal altruism. If the fame of the scientist and the nonhuman protagonist at time t is a_t and b_t, respectively, then their respective fame at time t+1 can be computed as follows:

$$a_{t+1} = \left[a_t + \frac{a_t^p}{a_t^p + b_t^p} c(a_t + b_t)\right] \mathrm{e}^{-\lambda \frac{T+t+2}{T+t+1}},$$

$$b_{t+1} = \left[b_t + \frac{b_t^p}{a_t^p + b_t^p} c(a_t + b_t)\right] \mathrm{e}^{-\mu \frac{t+2}{t+1}},$$

where λ and μ are decay parameters, c is a parameter that controls the increase in fame, and p reflects whether the fame increase accrues to the scientist or the nonhuman protagonist. T represents the time interval between the fame tipping point of the scientist and the nonhuman protagonist. The initial values a_0 and b_0 are constants, where the magnitude of b_0 is smaller than that of a_0. These conceptual representations promise to reveal the dynamic fame evolution of a scientist according to the perceived utility of collaborative interaction with a corresponding nonhuman protagonist in contexts with minimal differences.



(**a**) high T, high p (**b**) high T, low p (**c**) low T, high p (**d**) low T, low p (**e**) low T, p and a_0

Schematic diagrams of dynamic fame trajectories in several representative scenarios. The blue line indicates the fame of a nonhuman protagonist, the dotted red line indicates the fame of a scientist without the corresponding nonhuman protagonist, and the solid red line indicates the aggregate fame of the scientist and the nonhuman protagonist. Panel (**a**) shows that the fame of the nonhuman protagonist can slow the decay of the scientist's fame. Panel (**b**) shows that the fame of the scientist may be suppressed after the nonhuman protagonist's fame subsides if the nonhuman protagonist attracts most of the attention. Panels (**c**) and (**d**) show that the nonhuman protagonist helps the scientist gain more fame. Panel (**e**) shows that the fame of the nonhuman protagonist may also be limited if the scientist has low initial fame.

References

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Fig. S1.

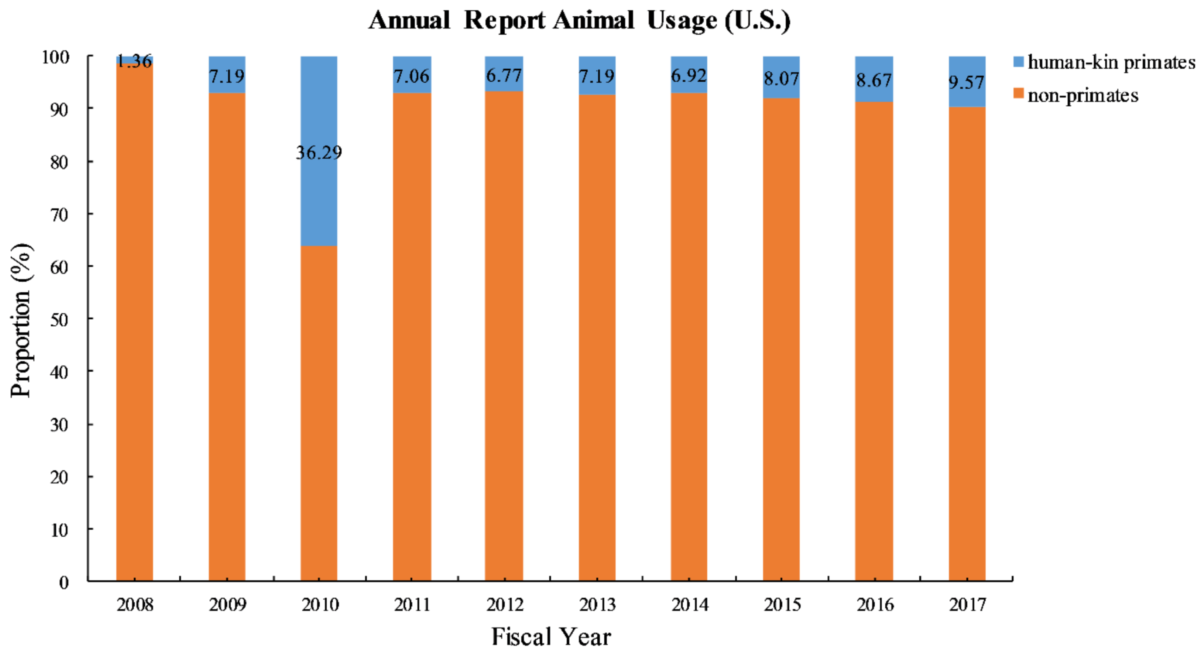

Fig. S1 | Annual Report Animal Usage in the U.S. by Fiscal Year 2008-2017. (Data Source: Animal and Plant Health Inspection Service, United States Department of Agriculture (https://www.aphis.usda.gov/aphis/ourfocus/animalwelfare/SA_Obtain_Research_Facility_Annual_Report))

Fig. S2.

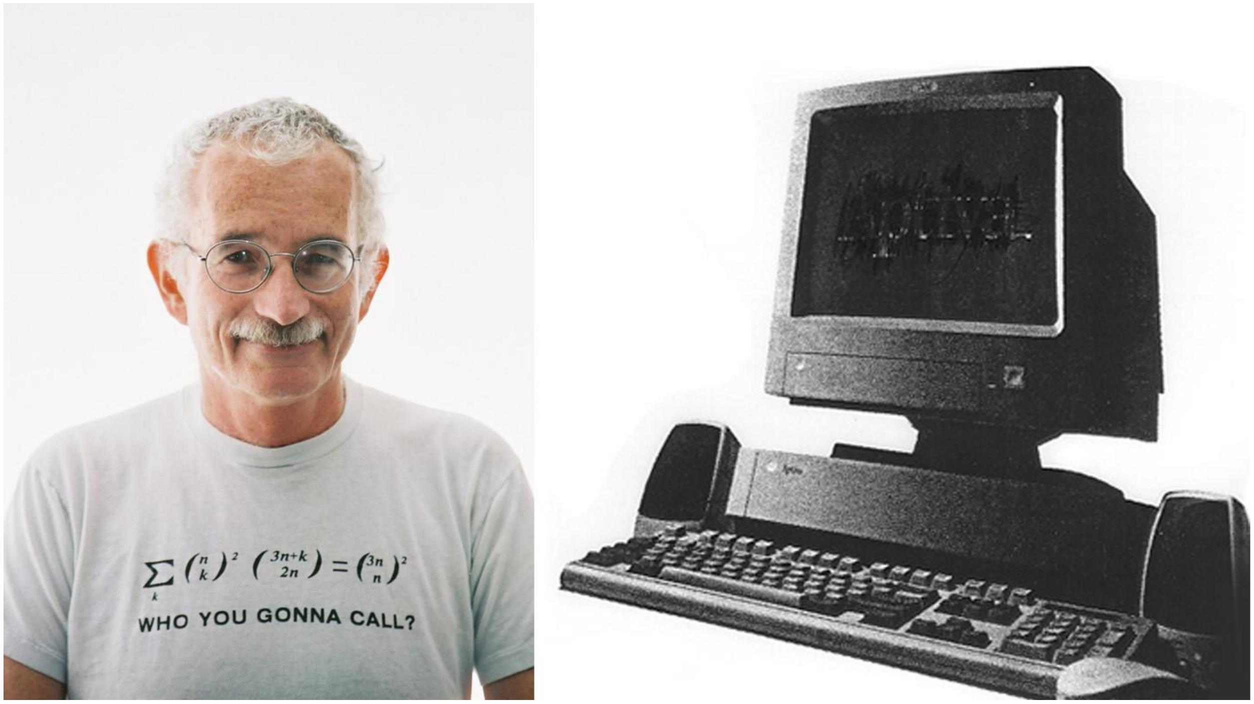

Fig. S2 | Doron Zeilberger and Shalosh B. Ekhad (Courtesy of Doron Zeilberger). Zeilberger's first UNIX 3B1 personal computer, AT&T 3B1, is named after its model number in Hebrew ("Shalosh" and "Ekhad" mean "Three" and "One" in Hebrew, respectively). Ekhad not only had at least 24 articles in the Web of Science (WoS), 53 articles on arXiv, and 5 online webBooks but also had its own official homepage and even a personal journal, *The Personal Journal of Shalosh B. Ekhad and Doron Zeilberger*. Ekhad published 77 articles on the personal journal (*3*).

Fig. S3.

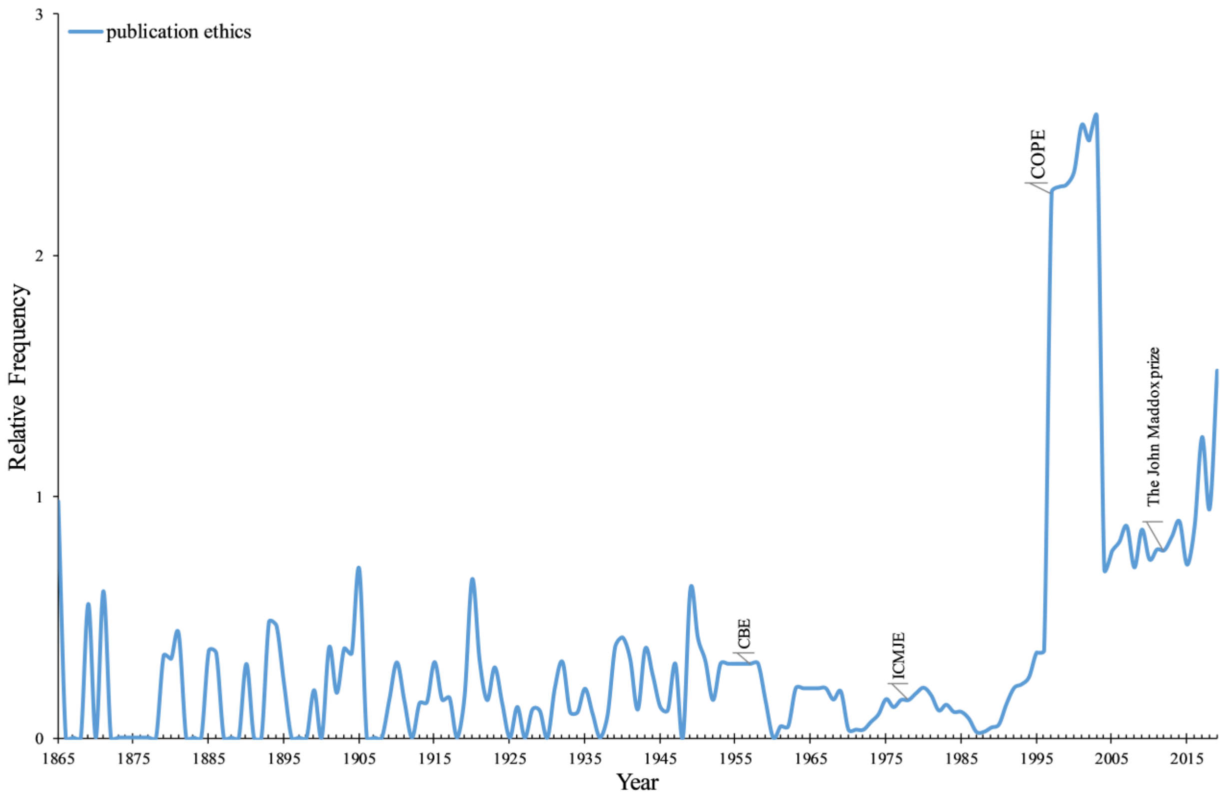

Fig. S3 | Diachronic discourse of the *lingua franca* 'publication ethics' between 1865 and 2019. To facsimile the pragmatic patterns of issued publications in English journals and books, this dynamic trajectory is orchestrated by the metadata of JSTOR, Google Books Corpus (GBC)(*4*), and Web of Science (WoS). This finding promises to articulate the unfolding chronological nature of publication ethics. As early as in 1865, an anonymous critical notice concerned about the reprint issues of deceased author (*5*). In retrospect, many leading publishers and dynamic communities such as the Council of Biology Editors (CBE)(1957), the International Committee of Medical Journal Editors (ICMJE)(1978), and the Committee on Publication Ethics (COPE)(1997) worked together to standardize the publication ethics and offer guidance to authors. In 2012, the John Maddox prize, named for the former editor-in-chief of *Nature*, is awarded to scientists who defend sound science against the publish-or-perish trend.

Table S1.

Table S1 Chronological list of several representative nonhuman authors credited in the scientific literature*.

Year	Category	Credited name	Publications
1975	pet Siamese cat	F.D.C. Willard (ca. 1968–1982)	Hetherington, J. H., & Willard, F. D. C. (1975). Two-, Three-, and Four-Atom Exchange Effects in bcc ^{3}He. *Physical Review Letters*, 35(21), 1442–1444. https://doi.org/10.1103/PhysRevLett.35.1442
1978	pet dog	Galadriel Mirkwood	Matzinger, P., & Mirkwood, G. (1978). In a fully H-2 incompatible chimera, T cells of donor origin can respond to minor histocompatibility antigens in association with either donor or host H-2 type. *Journal of Experimental Medicine*, 148(1), 84–92. doi:10.1084/jem.148.1.84
1980	pet Siamese cat	F.D.C. Willard (ca. 1968–1982)	Willard, F. D. C. (1980). L'hélium 3 solide: un antiferromagnétique nucléaire. *La Recherche*, 114, 972–973.
2000	*Felis catus*	Moe Gregory	Gregory, T. R. (2000). Nucleotypic effects without nuclei: Genome size and erythrocyte size in mammals. *Genome*, 43, 895–901. doi:10.1139/g00-069
2001	pet hamster	H.A.M.S. ter Tisha	Geim, A. K., & ter Tisha, H. A. M. S. (2001). Detection of earth rotation with a diamagnetically levitating gyroscope. *Physica B: Condensed Matter*, 294–295, 736–739. doi:10.1016/S0921-4526(00)00753-5
2007	bonobo	Kanzi Wamba (October 28, 1980-), Panbanisch Wamba, Nyota Wamba	Savage-Rumbaugh, S., Wamba, K., Wamba, P., & Wamba, N. (2007). Welfare of apes in captive environments: comments on, and by, a specific group of apes. *Journal of Applied Animal Welfare Science*, 10(1), 7–19. doi:10.1080/10888700701277261
2012	pet cat	M. Pucci (legal name, Kitty-Witty)	Pucci, M., & Troian, S. M. (2012). Thermal resistance and temperature jumps at liquid/solid interfaces: insights from molecular dynamics simulations. *APS Division of Fluid Dynamics (Fall)* 2012, 57(17).

*Note: Here, the chronological list is just an exemplificative collection.

Table S2.

Table S2 Chronological list of example publications with zero citations in the Web of Science.

#	Publication Year	References	Document Type
1.	1981	The Ethics of Medical Publishing: Prior Publication and Full Disclosure by Authors. *Annals of Internal Medicine*, 94(3), 401–402. doi:10.7326/0003-4819-94-3-401	Editorial Material
2.	1999	Committee on publication ethics (COPE). *British journal of ophthalmology*, 83(11), 1214–1214.	News Item
3.	1999	“Leave fossile energy to others” Belgian bishops and nuclear power. *ATW: Internationale Zeitschrift fur Kernenergie*, 44(12), 719.	Article
4.	2000	Committee on Publication Ethics. *British Journal of Surgery*, 87(1), 6–7. doi:10.1046/j.1365-2168.2000.01377.x	Editorial Material
5.	2000	Committee on publication ethics: the COPE report 1999 - Guidelines on good publication practice. *Occupational and environmental medicine*, 57(8), 506–509.	Editorial Material
6.	2000	Committee on publication ethics - Guidelines on good publication practice (Reprinted from The COPE Report, 1999). *British journal of surgery*, 87(10), 1287–1287.	Reprint
7.	2006	How nursing ethics as a subject changes: An analysis of the first 11 years of publication of the Journal Nursing Ethics - Comment (Reprinted from Bulletin of Medical Ethics, *Nursing Ethics*, 13(1), 86–86. doi:10.1191/0969733006ne851xx	Reprint
8.	2007	PLoS Medicine’s Advisory Group on Publication Ethics. *PLoS Medicine*, 4(2), e81. doi:10.1371/journal.pmed.0040081	Editorial Material
9.	2007	MENC research publication/presentation Code of Ethics. *Journal of Research in Music Education*, 55(4), 376–377. doi:10.1177/0022429408318953	Article
10.	2010	COPE (Committee of Publication Ethics). *Korean journal of orthodontics*, 40(1), 1–2.	Editorial Material
11.	2010	Consensus Statement on the Adoption of the Committee on Publication Ethics (COPE) Guidelines. *Journal of Surgical Education*, 67(4), 274. doi:10.1016/j.jsurg.2010.06.011	Editorial Material
12.	2014	General Editorial on Publication Ethics. *Sadhana*, 39(1), 1–1. doi:10.1007/s12046-014-0241-x	Editorial Material
13.	2015	Editorial Council; editorial team; Edition; Founders; publisher; publishing ethics; Contact details; minimum system requirements for accessing the publication; Schedule of publication. *Nanotehnologii v stroitel'stve*, 7(3), 10–14.	Editorial Material
14.	2015	Editorial Council; editorial team; Edition; Founders; publisher; publishing ethics; Contact details; minimum system requirements for accessing the publication; timetable for publication. *Nanotehnologii v stroitel'stve*, 7(5), 11–15.	Editorial Material
15.	2015	General editorial on publication ethics. *Pramana*, 84(1), 1–2. doi:10.1007/s12043-014-0923-2	News Item
16.	2015	Looking for shortcuts. Lack of ethics in publications. *RqR Enfermería Comunitaria*, 3(1).	Editorial Material
17.	2016	Media Education Journal: Publication Ethics and Publication Malpractice. *Mediaobrazovanie-Media Education*, (1), 186–186.	Editorial Material
18.	2016	General editorial on publication ethics. *Journal of genetics*, 95(1), 1–1.	Editorial Material
19.	2017	Journal of Materials Engineering and Performance Plagiarism Policy To be Used in Conjunction with the Current “Publication Ethics” Statement. *Journal of Materials Engineering and Performance*, 26(1), 2–3. doi:10.1007/s11665-016-2479-4	News Item
20.	2017	General Editorial on Publication Ethics. *Resonance*, 22(1), 1–2.	Editorial Material
21.	2017	Proposed Amendments to the AOA Constitution, Bylaws, and Code of Ethics. *The Journal of the American Osteopathic Association*, 117(6), 353–358. doi:10.7556/jaoa.2017.072	Editorial Material