On the quest for novelty in ecology

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Abstract

The volume of scientific publications is ever increasing, making it difficult for scholars to publish papers that can capture the attention of the readers. An obvious way to attract readership is by making a truly significant discovery; yet another way may involve tweaking the language to overemphasize the novelty of results. Using a dataset of 52,236 paper abstracts published between 1997 and 2017 in 17 ecological journals, we found that the relative frequency of the use of novelty terms (e.g. groundbreaking, new) almost doubled over time. Conversely, we found no such pattern with the use of confirmatory terms (e.g. replicated, reproducibility). While increasing research opportunities are triggering advances in ecology, the writing style of authors and publishing habits of journals may better reflect the inherent confirmatory nature of ecology. We call for an open discussion among researchers about potential reasons and implications associated with this language-use and scientometrics matter.

Keywords Journal Impact Factor, language use, number of citations, scientific discovery, scientific writing, scientometrics

Introduction

"*Eureka!*"– yelled Archimedes when he solved a scientific problem that, among other things, would have cost him his life. This is only one out of many tales of serendipitous discoveries that populate the history of science. An often-common element in all these narratives is the presence of a lonely genius who, perhaps in a stroke of luck or inspiration, succeeded in shedding light on the unknown. However, the reality behind these tales can be quite different (Foucault, 1969); modern science is a systematized body of positive knowledge (Hoyningen-Huene, 2013) mostly built through a lengthy and steady accumulation of confirmatory work, only seldom interrupted by game-changing discoveries typically arising from anomalous results or observations (Darwin, 1859; Kuhn, 1962). But even after a game-changing discovery, paradigms rarely shift abruptly, and many pioneering ideas remain dormant until subsequent researchers recognize their value (Van Raan, 2004).

In the digital era, scientific results are published at a vertiginous rate (Landhuis, 2016), with the number of scientific articles published yearly more than tripling over the last two decades (reaching >6 million papers in 2023; www.dimensions.ai). The field of ecology does not evade this trend (Pautasso, 2012), with researchers struggling to keep up with an ever-increasing production of new literature (Courchamp & Bradshaw, 2018). Consequently, readers are forced to be more selective in what they read (Mabe & Amin, 2002), while writers may adjust their language to attract more attention (França & Monserrat, 2019; Mammola, 2020). Moreover, journals may contribute to this trend by requiring authors to stress the novel nature of publications. As readers trying to remain

up to date with the incessant production of ecological literature, we got the hunch that more and more ecological papers are studded with terms that highlight, in one way or another, the novelty of the research presented therein. Here, we tackled the question: is this a real or perceived trend?

To address our question, we analyzed the relative use (i.e. frequency in the use) of novelty and confirmatory terms in ecological publications over a twenty-year time span. We built a dual-hypothesis testing framework (Fig. 1). If ecological research is indeed mostly confirmatory, we would expect to see a constantly higher relative use of confirmatory terms than novelty terms (H1; Fig. 1A,C). Conversely, if the pressure to emerge from the “research crowd” prevails in authors’ writing style and journals’ publishing habit, we should observe a significant increase in the relative use of novelty terms over time (H2; Fig. 1B,C). We also carried out a scientometrics analysis to inspect whether relationships exist between the use of novelty or confirmatory terms and the Journal Impact Factor (JIF) of the journal a paper had been published in or the number of citations a paper had received. Any relationship with JIF would be indicative of the tendency of journals to accept (positive relationship) or decline (negative relationship) papers that use either type of terms. Any relationship with number of citations would instead reflect the tendency of readers to cite (positive relationship) or not to cite (negative relationship) papers that use either type of terms.

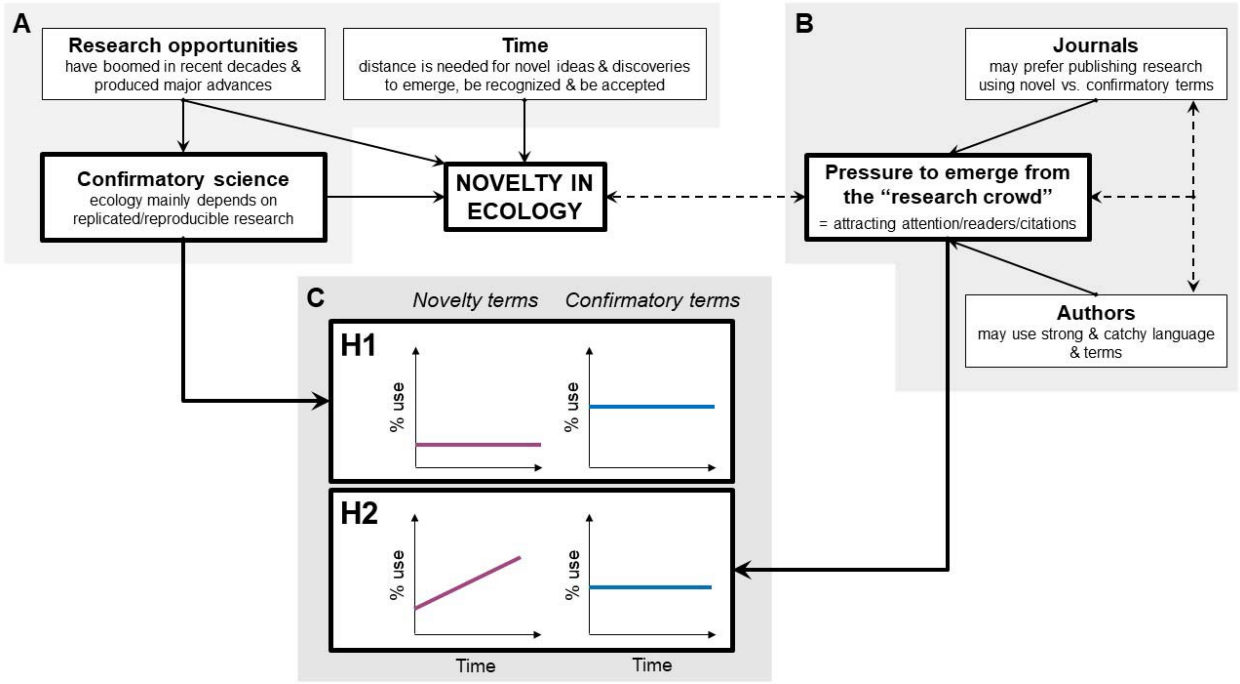

Fig. 1 Schematics of the dual-hypothesis framework. The confirmatory nature of ecological research (A) contrasts with the necessity of authors and journals to emerge and be distinguishable from the increasingly crowded research arena (B), giving rise to two different scenarios (C). Solid arrows identify putatively direct relationships between components. Dashed arrows illustrate plausible relationships or synergies between two or more components, which in turn lay the foundations for the hypothesized temporal patterns in the frequency use of novelty and confirmatory terms.

Methods

We assembled a dataset of 52,236 papers published between 1997 (year in which JIF was introduced) and 2017 in 17 representative ecological journals (Mammola et al., 2021) (Table S1) – these constituting ~20% of all ecological journals listed in the Web of Science in 1997, and ~11% of those listed in 2017, and covering most of the JIF range

in ecology. We examined the frequency of appearance (presence/absence) of a set of selected novelty terms (“breakthrough", "groundbreaking", "innovated", "innovation", "innovative", "new", "newly", "novel", "novelty") and confirmatory terms ("confirm", "confirmatory", "replicability", “replicate", "replicated", "replication", "reproducibility") over time in paper abstracts. The frequency in the use of terms was expressed as % of papers (using novel or confirmatory terms) per year, hence obtaining terms’ annual relative use. We focused on abstracts because they reflect the overall writing style of articles (Plavén-Sigray et al., 2017), while representing the lark mirror to capture the attention of readers (Martínez & Mammola, 2021). We used linear models to assess temporal trends in the relative use of these terms. We used linear mixed-effects models to test whether there was a relationship between the relative use of these terms and either JIF or number of citations. Here, we included ‘journal’ as a random factor, assuming that abstracts of papers published in the same journal share more similar writing features than those found in different journals. We normalized the number of citations by the year of publication following the approach proposed by (Mammola et al., 2021).

Results

The relative use of novelty terms in paper abstracts doubled over the studied period (i.e. from ~10% in 1997 to ~20% in 2017; Fig. 2). Conversely, we did not find any pattern for confirmatory terms, with their relative use steadily hovering around 3% (Fig. 2). The use of novelty terms was also positively associated with both journal JIF (beta = 0.17 [95% CI = 0.14, 0.21], p-value < 0.001) and number of citations (beta = 0.53 [95% CI = 0.29,

0.76], p < 0.001). Conversely, no relationships were found for confirmatory terms (JIF: beta = 0.04 [95% CI = –0.03, 0.11], p-value = 0.26; number of citations: beta = –0.03 [95% CI = –0.51, 0.45], p-value = 0.90).

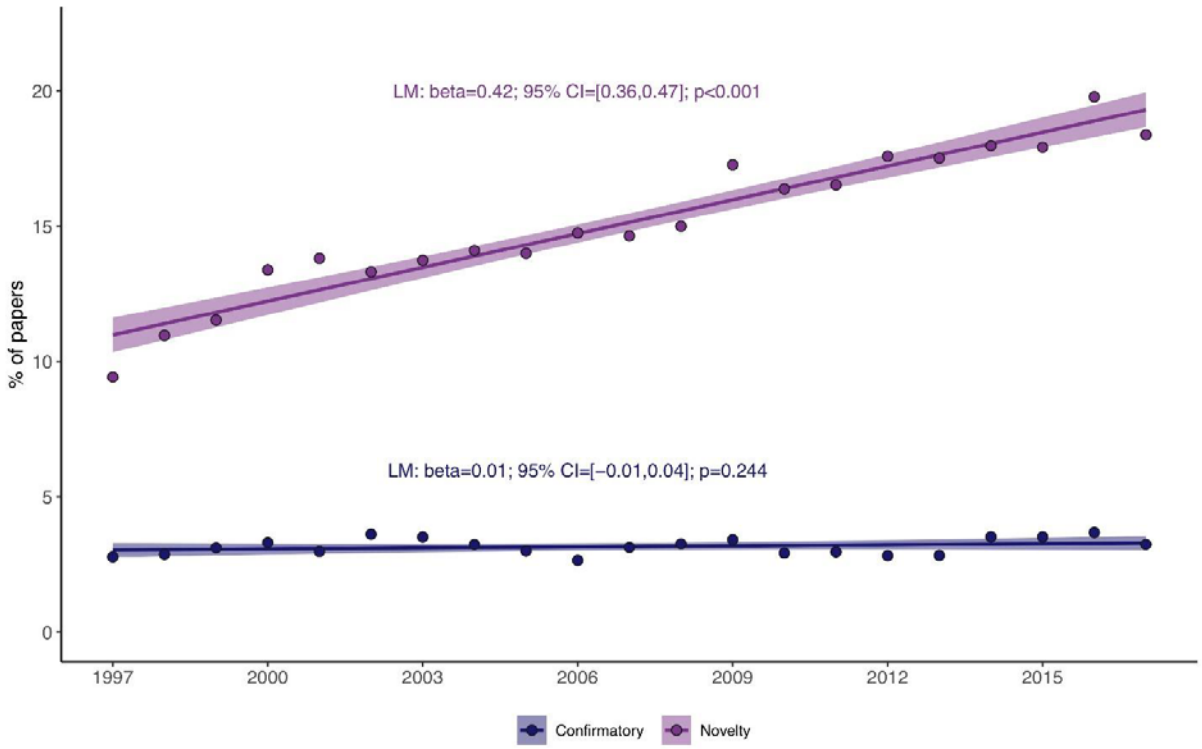

Fig. 2 Temporal trends in the relative use (i.e. frequency [% per year]) of novelty and confirmatory terms across the 17 selected ecological journals.

Discussion

We found evidence supporting our perception that more and more papers are using novelty terms. We can only speculate about possible causes behind this rising trend since correlation does not necessarily imply causation. Perhaps, thanks to recent conceptual developments (Dubois & Peres-Neto, 2022) and the increasing availability of data and analytical tools (e.g. Besson et al., 2022; Cardoso et al., 2020; McCallen et al.,

2019; Tosa et al., 2021), ecologists are truly able to make groundbreaking discoveries and thus write novel stories at such an accelerating speed. However, science still relies primarily on the systematization of knowledge built via a lengthy and steady accumulation of confirmatory work (Hoyningen-Huene, 2013), and the history of science shows that game-changing findings emerge quite rarely and require some time to be recognized (Morris, 2009; Van Raan, 2004). This scenario seems to find further corroboration in a recent overview illustrating how papers are increasingly less likely to make scientific breakthroughs (Park et al., 2023).

We must then face an alternative, possibly uncomfortable, explanation: are we, ecologists, using a more sensationalized and novelty-driven language (either consciously or not) to increase our chances of catching readers' attention amidst the incessant production of scientific literature (scenario reported in Fig. 1B, C) (Doubleday & Connell, 2017; Mammola, 2020)? This speculation seems to be supported by the modeled positive relationship between the use of novelty terms and both journal JIF and number of citations. These positive relationships may also imply that JIF can in turn benefit from publishing papers using novelty terms capable of better attracting citations. Concurrently, journals may also be contributing to this trend. Among the 17 ecological journals included in our analysis, ~65% explicitly mentioned the criterion of novelty in their current author guidelines (Table S1). Likewise, novelty is a core requisite in pre-peer review editorial decisions of some journals (Arnqvist, 2013). Hence, this "quest for novelty" may partly find its roots in the challenges faced by journals to attract readers and citations, making them more visible and distinguishable in a crowded publishing

arena. At the same time, “more novel” papers may tend to end up in journals with higher JIF than “less novel” papers may tend to, so contributing to shape the observed patterns.

We acknowledge that a deeper mechanistic understanding of what drives these scientometrics patterns related to writing and publishing behaviors would require a closer examination of each manuscript included in this study. This step would imply reading each of the >50k papers as well as contacting corresponding authors asking for their feedback and reasons behind the choice of using or not novelty terms. We are also aware that the selection of terms and searched journals can affect the revealed patterns. However, thanks to the representativeness of the chosen ecological journals (11–20%), JIF range, and set of selected terms, we are confident that what we have found offers a reliable picture of what has happened in the studied 20-yr timespan. To sum up, the interpretation of the observed patterns is certainly tangled; the increasing use of novelty terms involves a combination of different causes, wherein the pressure to emerge from the research crowd (Fig. 1) felt by both authors and journals is likely to play a key role.

Conclusions

Words are not only tools to communicate our key findings to other scientists or to the broader public (Feynman, 1969), but also serve as the building blocks in the process of knowledge construction (Martínez & Mammola, 2021). We wonder whether using an increasingly sensationalized language (Mammola, 2020), in which novelty may be

exaggerated, could hinder our thinking process at various levels. After all, knowing what is truly new is crucial not only when writing and disseminating results but also when designing future projects and experiments; otherwise, we risk reinventing the wheel over again. We join the call for evaluating the relevance of each and every publication based on its quality, soundness, clarity, and replicability, giving less emphasis to its confirmatory or novelty (true or claimed) nature (Pautasso, 2013; Romero, 2017). Encouragingly, this approach appears to be increasingly implemented in ecological (mostly, but not exclusively, open access) journals. As such, we stress the importance of opening a conversation around possible causes and implications this linguistic and scientometrics issue may have for the scientific community and science communication at large.

Author contributions

GO conceived the research idea, with significant inputs to further develop it provided by SM, AM, MPB. SM gathered the data and conducted the statistical analysis. GO and SM led the writing, and all coauthors contributed to revisions.

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Data accessibility statement

The dataset used in this research is associated with Mammola et al., (2021) and is publicly available at: https://doi.org/10.6084/m9.figshare.12941639.v1

The R code to reproduce the analyses of this study is publicly available at: https://github.com/StefanoMammola/Ottaviani_et_al

Artificial Intelligence (AI) declaration

No AI technologies have been used.

Conflicts of interests/Competing interests declaration

Nothing to declare.

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Table S1. The 17 journals selected for the analysis and sample size (readapted from Mammola et al., 2021).

Journal name	Initial year	Timespan selected	N of primary research articles used	Use and requirement of novelty terms in journal description*
Acta Oecologica	1983	1997–2017	1,408	No
American Naturalist	1867	1997–2017	2,852	Yes
Austral Ecology	2000	2000–2017	1,434	Yes
Ecography	1978	1997–2017	1,743	Yes
Ecological Applications	1991	1997–2017	3,051	Yes
Ecology	1920	1997–2017	5,505	Yes
Ecology Letters	1998	1998–2017	2,098	Yes
Functional Ecology	1987	1997–2017	2,326	No
Global Change Biology	1995	1997–2017	3,937	No
Global Ecology and Biogeography	1993	1997–2017	1,377	No
Journal of Animal Ecology	1932	1997–2017	2,250	Yes
Journal of Applied Ecology	1964	1997–2017	2,407	Yes
Journal of Biogeography	1974	1997–2017	2,852	No
Journal of Ecology	1913	1997–2017	2,170	Yes
Molecular Ecology	1992	1997–2017	6,209	No
Oecologia	1968	1997–2017	5,446	Yes
Oikos	1949	1997–2017	3,812	Yes

* Novelty terms considered in the journal description (i.e. scope and authors' guidelines; search conducted in 2021) are the same as of the paper abstract search.