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 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 inspected whether the relative frequency of the use of novelty (e.g. 'groundbreaking', 'new') and confirmatory (e.g. 'replicated', 'reproducibility') terms has increased over time. Further, we tested whether relationships exist between the use of these terms and either Impact Factor of the journal a paper had been published in or number of citations a paper had received. The frequency of novelty terms almost doubled between 1997 and 2017, and was positively related to the journal Impact Factor and the number of citations. Conversely, no such patterns were found for confirmatory terms. We argue that, while increasing research opportunities are possibly triggering advances in ecology, the writing style and publishing habits should better reflect the inherent confirmatory nature of ecological research. The possible causes and consequences that such language-use matter may have for the scientific and broader community remain unknown, and we call for opening a discussion among researchers.

The recent rise of scientific production

"*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), as science is indeed 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 et al. 2004).

In the digital era, scientific results are published at a vertiginous rate (Landhuis 2016). In 2022 alone, >6.7 million new scientific papers entered the Dimension repository of scientific literature (www.dimensions.ai; accessed on 10 February 2023). No surprise that there is not enough time to remain updated with all this literature production, even within a single discipline, such as ecology (Courchamp and Bradshaw 2018). Consequently, readers are forced to be more selective in what they read (Mabe and Amin 2002), while writers may be adjusting their language to attract more attention (França and Monserrat 2019, Mammola 2020), possibly also in response to journals requiring authors to stress the novel nature of each and every publication. As avid

readers, 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 tackle the question: is this a real or perceived trend?

The growing use of novelty terms in ecology

We analyzed the 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 (Figure 1). If ecological research is indeed mostly confirmatory, we would expect to see a constantly higher relative use of confirmatory terms than novelty terms over time (H1; Figure 1A,C). Conversely, if the pressure to emerge from the “research crowd” prevails in authors’ and journals’ habits, we should observe the opposite trend, that is, a significant increase in the relative use of novelty terms over time (H2; Figure 1B,C). We also checked whether relationships exist between the use of novelty or confirmatory terms and the Impact Factor of the journal a paper had been published in or the number of citations a paper had received. Any relationship with Impact Factor would provide insights into the willingness of journals to accept papers that use either novelty or confirmatory terms. Any relationship with number of citations would instead reflect the reader’s preference to cite papers that foster the usage of either type of terms.

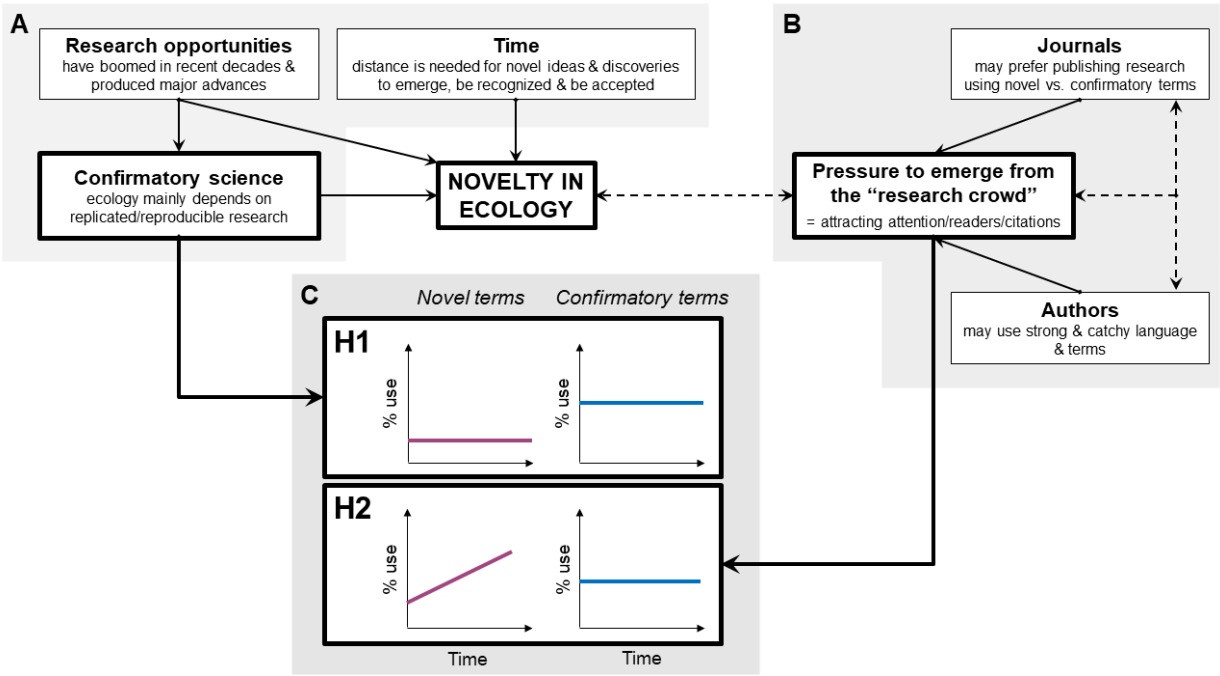

Figure 1. The hypothesis framework adopted in this study. The confirmatory nature of ecological research (A) contrasts with the necessity of authors and journals to emerge (B), ultimately giving rise to two (opposing) scenarios (C). We also acknowledge that research opportunities have boosted in recent decades, which most probably had a positive impact in the likelihood of making discoveries or producing novel ideas, which however may require some time before being recognized and accepted (A). Solid arrows identify putatively direct relationships between components. Dashed arrows illustrate plausible relationships or synergies between two or more components, which in turn form the basis for the predicted temporal patterns of novelty and confirmatory terms.

Using a dataset of 52,236 papers published between 1997 and 2017 in 17 ecological journals (Mammola et al. 2021), we examined the frequency of appearance (presence/absence) of 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. 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 and Mammola 2021). We used linear models to assess temporal trends in the frequency use of terms. We used linear mixed-effects models to test whether there is a relationship between the frequency use of terms and the journal Impact Factor and the number of citations. We normalized the number of citations by the year of publication following the approach proposed by Mammola et al. (2021). 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. R code and data to reproduce the analyses are available in GitHub (https://github.com/StefanoMammola/Ottaviani_et_al).

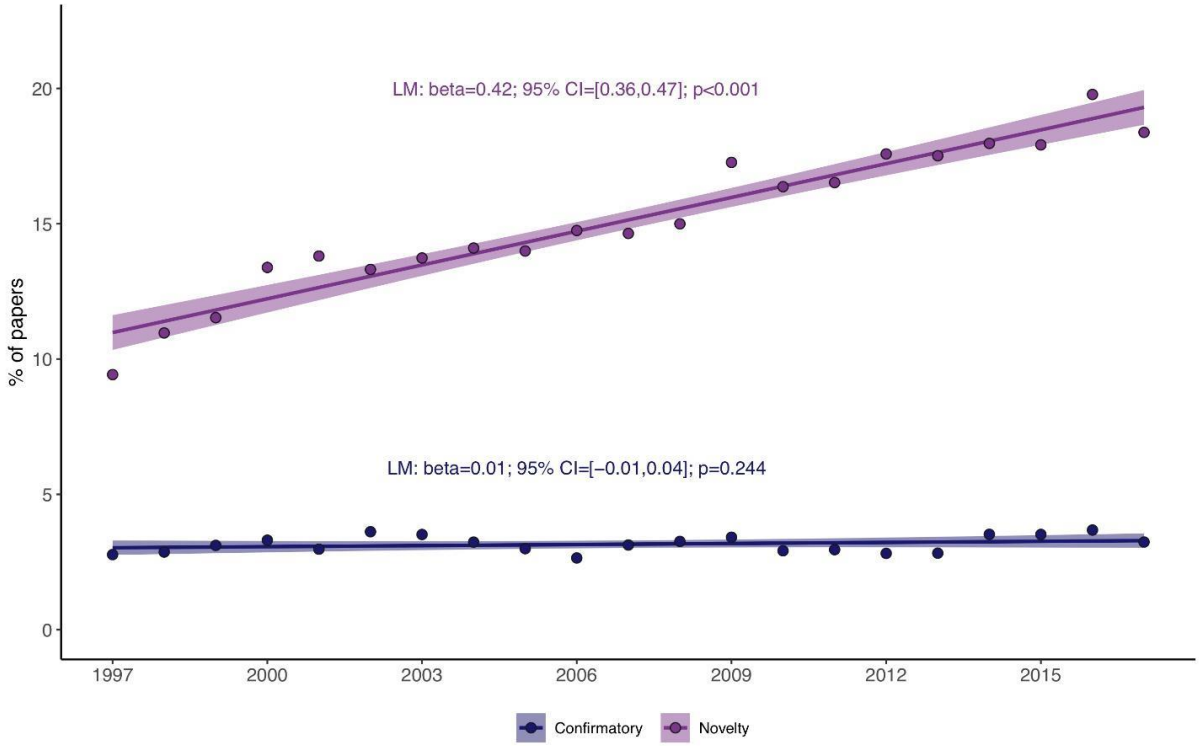

Figure 2. Temporal trends in the relative use (i.e. frequency [%]) of novelty and confirmatory terms across the 17 ecological journals considered in this study.

The frequency of use of novelty terms in paper abstracts doubled over the studied period (i.e. from ~10% in 1997 to ~20% in 2017; Figure 2). Conversely, we did not find any pattern for confirmatory terms, with their frequency of use steadily hovering around 3–3.5% (Figure 2). The use of novelty terms was also positively associated with both journal Impact Factor (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), whereas no relationships were found for confirmatory terms (journal Impact Factor: 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).

What could be behind the rising trend of novelty terms?

Our perception that more and more papers are using novelty terms was confirmed. Here, we can only speculate about possible causes behind this pattern, as we did not perform an in-depth analysis of what motivated authors to choose novelty over confirmatory terms. Perhaps, thanks to recent methodological developments and the increasing availability of data (e.g. McCallen et al. 2019, Cardoso et al. 2020, Tosa et al. 2021, Besson et al. 2022), ecologists are truly able to make breakthroughs and thus write novel stories at such an accelerating speed. However, as the history of science shows that game-changing discoveries emerge quite rarely and require some time to be recognized (Van Raan et al. 2004, Morris 2009), we find this hard to believe. Even if the

pace of new discoveries has accelerated, science still relies primarily on the systematization of knowledge built via a lengthy and steady accumulation of confirmatory work (Hoyningen-Huene 2013). We must then face an alternative, possibly uncomfortable, explanation: are we, researchers, using a more sensationalized and novelty-driven language (either consciously or not) to increase our chances to catch the reader's attention amidst the incessant production of scientific literature (Figure 1B, C; Doubleday and Connell 2017, Mammola 2020)? The interpretation of the observed patterns is certainly tangled, and the increasing use of novelty terms possibly involves a combination of different causes. Nevertheless, we are leaning towards a cautious interpretation, assuming that science is most likely not advancing as quickly as the language we use may suggest.

The importance of language use in ecology

Words are used not only 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 and Mammola 2021). We wonder whether using an increasingly sensationalized language (Mammola 2020), in which novelty may be exaggerated, could hinder our thinking process at many 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 (Wheatley 2018). To this end, we emphasize the importance of opening a conversation around possible causes and implications this linguistic issue may have in ecology, and likely for the scientific community and communication at large.

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Declaration of interests

The authors declare no competing interests.

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