

Is it time to put a humidifier in the dry domain of writing scientific papers?

Given the inaccessibility of many research papers, young scientists should receive more formal training to write clear, understandable, and even enjoyable papers

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The first formal lessons I had in writing scientific papers occurred midway through my undergraduate degree. The class was called *Writing for the Life Sciences* and was taught by an old, grizzled biologist who appeared to have spent one too many seasons in the field and who had very strict views on how to write a research article. The course material contained all the standard fixings. For example, we learnt how to write a clear and succinct abstract, what to include in an introduction, the difference between results and discussion, and when to use the past or present tense.

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What I remember most from these lessons is the three-page handout we were given on the first day, containing bullet-pointed rules—commandments—on proper scientific writing. Avoid first-person pronouns at all costs. Use the passive voice to stress what was done. Save flare and flourishes for your creative writing class. Never use abbreviations for *That is*, *It is*, *Is not*, etc. When possible, always use acronyms for scientific words. Do not, under any circumstances, be imaginative or have any fun was not one of the bullet points, but it was certainly implied.

That handout would haunt me in the years to come. It followed me to graduate school in a beat-up binder labeled *useful resources* and eventually made its way onto the corkboard above my office desk. And there it sat, like Poe’s raven, scrutinizing and disrupting my every scientific sentence. Those bullet points became a firing squad directed at my productivity. Are there too many adverbs in my abstract? Is the opening paragraph of the introduction too colorful? How can I rephrase that section of the methods without using a personal pronoun? My goodness, did I just use the present tense in the results section?

In the second year of my PhD, when I was drafting my first peer-reviewed article, the handout finally got the better of me. It was a blizzard night in February, and I had spent twelve hours at my desk and made no progress on the manuscript. Exhausted and downcast, I got up, tore the handout off the wall, and tossed its crumpled pages out the laboratory window to find their fate among the wind, sleet, and snow plow. Ever since, I have vowed to be more relaxed, unconstrained, and creative in my approach to academic writing, a path, which has brought its own set of rewards and troubles.

Break the rules

I credit the shift in my approach to science writing to my mentor at the time who encouraged me to be a more thoughtful and inventive writer. I still recall his words of advice as we sat together and worked through drafts of my manuscripts: “Smitty, a research paper isn’t a dumping ground for

data; it’s more than just figures and tables linked together by text; it’s not just an afterthought to the experiments. You should want people to actually enjoy reading your work, to take pleasure in the sentences, to savour the flow of ideas—to keep reading past the abstract, for Pete’s sake”. Upon hearing this, I thought to myself, this surely was not one of the bullet points on the handout. What I ultimately gleaned from these one-on-one instructions was that the writing of a research paper can involve as much time, effort, and innovation as the research itself and that science can be as much an artistic endeavor as one of scholarship and precision.

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Much has been made about the inaccessibility of academic writing, or as Steven Pinker [1] put it in his essay *Why Academics Stink at Writing*: “Why should a profession that trades in words and dedicates itself to the transmission of knowledge so often turn out prose that is turgid, soggy, wooden, bloated, clumsy, obscure, unpleasant to read, and impossible to understand?” But if you dig deep enough in any academic discipline, you will find those gifted writers,

who, like Pinker, can write for the masses, eloquently and effectively communicating complex ideas without diluting the content or simplifying the message.

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As a young scientist struggling with writing [2], I studied and derived inspiration from these excellent communicators, trying to emulate and employ their techniques. What I discovered is that they, too, have thrown the rule book out the window and in turn cultivated their unique styles and distinct voices. And although their styles can differ greatly from one another, their writing is united by a strong, coherent narrative from beginning to end, the presence of humor, irony, and satire, especially as tools for rhetoric, and the use of clear, direct language. More than anything, the works of these academics taught me that scientific writing, despite what I was originally led to believe, can be fun, provocative, and nuanced.

Unfortunately, I also discovered that it is easier to break from the entrenched writing styles and norms of your discipline when you are a famous scientist than when you are a little-known graduate student. As I worked to make my research papers on genome evolution and mutation rates more accessible and palatable to a broad audience, I came up against a lot of resistance and criticism. “This research reads more like investigative journalism than genomics”, said an editor who rejected one of my manuscripts without sending it out for review. When another paper did get reviewed the feedback included “Great writing for a blog post, but much too unprofessional for this journal”. Once, after waiting over a month to learn the fate of a manuscript, I received a four-word reply: “Language overly conversational. Reject”. Other comments were even more cutting: “Apart from the disputable general style, the wording throughout the manuscript is inappropriate on several occasions, reminding me of a sensation-seeking article rather than a scientific contribution”.

It was not just editors and reviewers who were critical of my “conversational” tone. One close colleague suggested that “I stop trivializing my message and start writing for more erudite readers”.

There was truth in some of these reproaches. And I likely would have given up my crusade to be the Hemingway of genomics had it not been for the encouragement from my supervisor (“keep fighting the good fight, Smitty”), certain editors, and fellow students. Particularly encouraging was the feedback I received from international graduate students who had come across some of my review articles and emailed me to say that the writing had helped them understand a topic or idea that they had been having trouble with. For instance, a student from Iran wrote to me saying: “David, really enjoyed your article on mutation rates and genome size in mitochondria ... it was a great help for digesting this complicated subject”. My attempts to write in a more easy-going manner bore real fruit when an editor who handled one of the manuscripts (and enjoyed the style of it) invited me to write a front-page commentary for the journal. This led to other writing opportunities, including commissioned articles for popular science magazines.

I am not suggesting that scientists write research papers in the form of popular science articles. The purpose of the latter is to inform the public on the overarching findings of a scientific study and its relevance to society, whereas the former, by definition, must contain intricate details about the results, methods, and materials, which are meant to be read by experts in the field. Nevertheless, I believe that many researchers could improve their writing by modeling successful journalists, who put a premium on accessibility, style, and succinctness. Moreover, certain parts of research articles lend themselves more easily to a relaxed style than others. For example, the introduction and discussion sections leave a lot of room for imagination and originality, unlike the methods and results, which are best written in the most straightforward manner possible. In addition to research papers, many academic journals publish journalistic types of papers, such as viewpoints, perspectives, and opinion pieces. These kinds of articles typically have a laid-back, pop-sci feel, and, in my opinion, favor authors with strong creative writing skills.

Loosen up a little

In the decade since completing my PhD, I have noticed that more and more journals and editors are receptive to, and even encourage, untraditional styles in scientific writing. Skim through a recent issue of *Current Biology* and you will easily find conversational sentences like “Our planet is teeming with photosynthetic life”, which not that long ago would have seemed inappropriate and out of place in a science journal. Certainly, the popularity of social media, blogging, and other forms of online publishing has helped usher in a new age of freedom, openness, and flexibility in academic prose. Today, it is not hard to find scientists who blog and tweet about their research [3]. And many mainstream science journals maintain blogs—written by editors, scientists, science journalists, and other volunteers—to highlight major discoveries and discuss current events. *PLoS*, *BMC*, and the *Royal Society of Biology* all have popular blogs or entire networks of blogs in the case of the former two publishers. It is not surprising that their casual tone has spilled over into the actual pages of the journals themselves. Arguably, the rise of preprint servers [4], such as *PeerJ*, *PrePrints*, and *bioRxiv*, which, with little editorial oversight and no peer review, allow authors to upload freely available research papers, has also contributed to the loosening up of scientific writing.

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All this lack of rule and rigor would have the nitpicky instructor from my undergraduate science writing class reaching for the grave for a red pen and eraser. And in some respects, he would be right to do so. Alongside the increased freedom and flexibility in how and where we can publish our research has come a barrage of abysmally bad writing, writing that even experts can have a hard time deciphering. Bad writing can express itself in many ways but almost always emanates from a lack of care and concern on the part of the author for the reader—or as Samuel Johnson put it: “What

is written without effort is read without pleasure". Early in my career, I believed that big words, long sentences, and bloated ideas made my writing more profound. I learnt my lesson when a reviewer wrote: "This author has a wonderful ability to take something intuitively interesting and make it incredibly boring". Understanding a challenging topic or the results of a research experiment is not easy, nor should it be, but it should not be made inadvertently hard by an impenetrable style. Acronyms, equations, and complicated concepts have their place in scientific papers, but so too does everyday language and a little levity. If you can say it in three words, do not use five. If you can say it simply, say it simply. And if does not need to be said, do not say it.

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The huge increase in online-only, open-access predatory journals, which will publish almost anything for a fee, is also likely contributing to a rise in atrocious writing. But more reputable publishers have also jumped on the "online, open-access bandwagon", starting journals with suspiciously high acceptance rates and troublingly fast peer review turnaround times. These kinds of journals regularly publish great research, but their high acceptance rates and large throughput mean that papers receive little to no editing for grammar, spelling, or syntax (let alone coherent English) and consequently bad writing abounds. Perhaps, this is why some journals are reluctant to shift toward online-open models, still enforce strict limits on the rate of publication, and remain stringent about the style, tone, and format of writing they deem acceptable. However, I would argue that journals can be more tolerant of diverse prose styles while still publishing papers that are written to a very high standard. You could follow the bullet points of that old handout of mine to a T and write poorly and ungrammatically, or you could use seemingly simple words and an amenable style and write as clearly and effectively as Pinker.

Teach it well

Whatever your views on this topic, many will agree that we need to update and change how we teach science students to write. In the biology department at the University of Western Ontario, where I work as an associate professor, students are only required to take seven lectures on scientific writing (or any other kind of writing, for that matter), which are part of a module within a one-semester, second-year course on the scientific method. In other words, in the 4 years of their undergraduate studies, many biology students will receive fewer than ten hours of formal instruction on writing. The same is true for other departments within the faculty of science at Western and, sadly, for other universities across Canada and beyond. This lack of writing training seems ridiculous when considering that writing is one of the *most* important skills for professional scientists, most of who live and die by their grantsmanship and paper-publishing prowess. It is not a coincidence that the most successful scientists I know are all great writers.

University science departments and instructors could learn a lot about effective writing education from their counterparts in the humanities and faculty of communications, who typically put a premium on writing ability, train their students in the art of the essay, and emphasize the importance of editing. There is also something to be said for budding scientists to read widely, including works of fiction and nonfiction. I have learnt more about writing scientific papers from reading classical literature and the essays of Christopher Hitchens than from the thousands of academic articles I have consumed over the past two decades. If I had to go back and do my undergraduate science training all over again, I would do it differently. Instead of rearing myself on an early diet of biology, chemistry, physics, and math, I would enroll in something like the Foundation Year Program (FYP) at King's College, Halifax, where students spend their entire first-year studying fundamental texts from the ancient to the contemporary—from *The Holy Bible* to Dante's *Divine Comedy* to Darwin's *On the Origin of Species*, from titles like *Biology as Ideology: The Doctrine of DNA* (R. C. Lewontin) to *The Second Sex* (Simone de Beauvoir). Through immersive learning, involving lectures, tutorials, and regular essay assignments, FYP students become

equipped with the crucial abilities of analysis, argumentation, and expression—what better skills for an aspiring scientist? Other universities also offer comprehensive, holistic, and integrated science programs for first-year students. For instance, in 2014, Stanford University began an integrated humanities and computer science program for undergraduates, and students at Harvard can enroll in a mind, brain, and behavior focus in history and science with thoughtful attention to sociocultural, philosophical, and historical questions raised by those disciplines.

But, alas, I will have to wait until retirement to get my shot at FYP. In the meantime, I will keep trying to hone my writing chops, to make my science as coherent, accessible, and engaging as possible, and to instill in my students a passion for reading and writing. It is noteworthy that shortly before writing these words, I received a rejection letter for one of my papers. One of the reviewer's comments read: "Your writing is certainly engaging, and your message is worthy of discussion, but the style and content are not really appropriate, even if there is some fit with the journal. Perhaps this should appear on a blog, which would reach a wider audience and the style would be welcomed". Plus ça change ...

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Conflict of interest

The author declares that he has no conflict of interest.

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