

Writing Global Science

Life isn't fair.

Science is increasingly dominated by scholars for whom English is a second language and by nations with developing scientific cultures. These don't necessarily overlap: Germany was a founder of the modern scientific tradition, whereas India, where English is well established, has a developing science program. Language and scientific culture, however, can each pose challenges to publishing in the international marketplace of high-impact journals.

Many people understandably feel language is *the* struggle. Writing a scientific paper seems daunting when even ordering dinner at a restaurant can be a trial. If English is your second language, you may feel that writing science must be easy for native speakers. If that were true, I wouldn't have written this book. Writing is hard for all of us.

The hardest part of writing science, though, is developing the story and laying it out cleanly. The essence of getting the story across is structure: knowing what to put where. Structure comes before language in the SCFL formula I discussed in chapter 17, and most of this book is about structure. Story structure transcends language; OCAR isn't about English.

Ultimately, the greater challenge is learning to do the kind of science that leading journals are looking for. That was a challenge for me, and I had teachers who were the academic offspring of generations of leaders. Figuring out how to be competitive in a sophisticated game without world-class mentorship is tough. Look at how long it has taken the United States to learn to play soccer.

19.1. DOING GLOBAL SCIENCE

To get papers published in an international English-language journal, you must structure an effective story and write it in correct English. But the first and most important step, of course, is to do good science. Learning to do good science is hard—you have to stretch your intellect and creativity to push the boundaries of knowledge. To develop those skills, most of us need training and mentorship, yet many places are still in the process of developing a culture of inquiry that supports and trains researchers to take risks, challenge established ideas, and question authority.

Doing science is inherently an act of both confidence and humility. Confidence in developing your own ideas and data, doing the work knowing it may fail, and then putting it out in public where people can criticize it (and you). Humility in that you know that those data and ideas are imperfect and incomplete, and you have to admit openly to the limitations. Too much confidence can blind you to the limitations; too much humility can blind you to the accomplishments.

Getting the balance between confidence and humility right is one of the greatest challenges all developing scientists face, in both doing and writing science. Most of us struggle with confidence—I went through the phase I call “academic adolescence” halfway through my doctoral program, asking, “can I do this?” My advisors were scientists at a level of accomplishment I never imagined I could reach, yet they challenged me to develop and present my own ideas. They pushed me to recognize that I had to do more than just present my results; I had to reach for new knowledge and understanding (remember figure 2.2). They taught me that to do good science, you have to develop intellectual courage and embrace living outside of your comfort zone.

Many, however, are learning not directly from a world-leading scientist but from reading the work of world-leading scientists. That distinction has led to too many papers that basically say “Well-known Professor Genelle found X, and I want to see whether X occurs in my system.” I suspect this grows from a sense that “if Prof. Genelle did it, it must be good science, so if I repeat it in a new system, I’ll be doing good science, too.” When Prof. Genelle did it, it was good science because it was novel. But because she did it, it isn’t novel anymore—now it’s an old story.

If Prof. Genelle’s paper were, for example, “Fungi are more drought tolerant than bacteria in a French grassland,” what made it novel was showing that fungi were more drought tolerant than bacteria, not that it was in a French grassland—that’s just incidental qualifying information. Showing the same pattern in another

system only reinforces her conclusions. For a paper to be publishable in a high-profile journal, it would need a new story. That might be that Prof. Genelle's pattern does not hold in another system, which would pose the question of why they differed. It might analyze the mechanism of enhanced drought tolerance in fungi or evaluate how drought tolerance interacts with other stresses. There would be many ways to take what Prof. Genelle did, figure out what questions her work left on the table or opened up, and ask those. Those would be new questions.

Answering an old question in a new system won't make the science novel. Answering an old question using new technology also won't make the science novel. Even answering an old question in a new system with new technology won't make the science novel. Such work merely fills in the information base. Leading journals look for more than that; they look for papers that provide new knowledge and understanding.

When you develop the courage and ability to ask new questions and take the risks inherent in trying to answer them, you will be prepared to do cutting-edge science. When you push beyond producing information to producing understanding, you will be doing cutting-edge science. Then you will be ready to write the papers major journals are searching for.

19.2. WRITING FOR INTERNATIONAL JOURNALS: TARGET THE RIGHT AUDIENCE

Science isn't complete until it has been published, and the first step in that process is identifying your audience and choosing a journal to submit the paper to. For many scientists (not just those in developing nations), there are competing pressures that can make sorting out story, audience, and outlet difficult. The first pressure is to do research that is practical, solving immediate social problems. The second is to publish in prestigious journals.

The pressure to be relevant can lead to studies that provide information useful to local managers or industries but that may not offer knowledge that would be relevant to a global audience. The pressure to succeed, however, can lead researchers to submit those papers to high-profile journals even when they may not be a good fit. I have seen many of them, and I've rejected the majority, many without even sending them out for review.

Being rejected is painful; no one likes to be told that their work isn't good enough. I've seen authors claim instead that a paper was rejected because the editor discriminated against them or their region. We don't. Rather, the opposite is true—we want to broaden the international base of the research (and reviewing) community. Our problem is that we see many papers that were rigorously done but only offer *information*. In these papers, authors often highlight that what is novel is that it presents the first data on a process in a new region—trace gas emissions, nitrification, and so on. They are usually right, but that very argument is why the paper was rejected.

Any leading journal is likely to reject a paper if all it does is flesh out the information base: it's the first data set on a new region, it demonstrates that a reaction works similarly with a slightly different substitution pattern on a molecule, or that the gene sequence from a new bacterium is only modestly different from that in known bacteria.

This isn't about basic versus applied research. It's about information versus knowledge. First-rate applied research goes beyond presenting a data set—it provides broader insights into the nature of the problem, insights that are useful to people working on related problems and in different areas. For example, a paper on how plowing a soil alters nitrate leaching and nitrous oxide emissions might be valuable for local managers who are trying to maximize crop yield while minimizing groundwater pollution and greenhouse gas emissions. They need the information, and it should be published in an appropriate venue. But unless the paper also offers new insights into the fundamentals of N-cycling or develops a new, transferable management regime, that venue is not likely to be a high-impact basic-science journal—and that will be true regardless of whether the work was done in India or Indiana.

So before you submit, make sure you know a journal's focus and intended audience. Do you want to offer local farmers improved tillage techniques or soil biologists new insights into how bacteria process N? Read a journal's description carefully and analyze the papers it publishes. If you are still unsure, email the editor and ask for advice. Then pick a journal appropriate for your story and intended audience. Don't focus on the journal's status, but on its scope. There will always be a draw toward the journals with the highest impact, but submitting a paper that doesn't fit is a waste of everyone's time and energy. Ultimately, journal prestige means little—the top journals publish some mediocre papers and lower impact journals publish some extraordinary ones. In the modern world of search engines and open-access journals, good papers will be found and cited whereas bad ones will be ignored, regardless of where they are published.

19.3. WRITING THE PAPER

Wrapped up with targeting your audience is figuring out the story. The best general insight I can offer on this appears in the first sections of the book. Be thoughtful, analytical, and critical about your data and ideas. Figure out what is novel in what you did. Remember that there are few data sets so imbued with novelty that they can't be made dull, and few that are so dull that there aren't novel insights that can be drawn from them. It is your job to find the novelty and highlight it. If you've found the novelty, you've done the hard part—nature gives up her secrets grudgingly. We all wrestle with our data sets, trying to figure out their meaning and their story.

It's only after this that specific language skills matter. You must produce a document in which, at an absolute minimum, the right words are used, they are spelled correctly, and the rules of grammar and usage are followed. It is your

responsibility as the author to ensure this. Do not submit a manuscript thinking that the reviewers, the editors, or the publisher will fix imperfect English. We won't.¹ It isn't our job, none of us have the time, and the journals don't have the money. Most journals screen papers for language and bounce back those that are not up to an acceptable standard; they won't send them out for review. We have a responsibility not to overwork reviewers by sending them papers that are not ready. The author's job is to make the reader's job easy.

The tool most authors rely on to fix writing problems is their word processor. The spell checker is essential, but it will miss errors like "their" versus "there" and typos that create a real but wrong word, like "from" versus "form." Then there is the grammar checker; this can be useful in catching some errors and it's better than nothing (but not much). As I write, I periodically check on the things it underlines—it catches some real errors, but it makes a lot of mistakes.

Better information is available in any of a number of excellent books and websites. I may be a native English speaker and an experienced writer, but I still have a shelf full of books on grammar and language (see appendix B for a list of my favorites) and I keep a bookmark in my Web browser to the *Oxford English Dictionary*. It is essential to have good references. Countless books have been written for people who are insecure in their knowledge of English. For guides to grammar and usage, shorter is better. You don't need to understand the deepest arcana of English grammar—you need practical, everyday advice. It's no accident that the most battered and coffee-stained book on every writer's shelf is the shortest: Strunk and White, *The Elements of Style*.²

The advice most people will give you, however, is not a reference book, but to give your manuscript to an English-speaking colleague to go over before you submit. This can be useful, but I recommend against relying on a friend down the hall as your only language check—at least, not unless they are both a good friend and a good editor. I've sent back too many papers that were edited by friends who hadn't done an adequate job, and I've had some "polite disagreements" with authors who were sure that because their American friend looked over the paper it must be okay. Editing is difficult and time-consuming. Most friends don't have the time, and many don't have the skills, to do a complete and careful word-by-word edit. There are professional services that do this; some are excellent, and they aren't very expensive. Some publishers list editing services on their websites. After spending the equivalent of thousands of dollars to do the research, spending a few hundred more to ensure the final paper is of the highest possible caliber is a small and worthwhile investment. When you need the job done well, use a skilled professional.

1. Actually, many of us do help with language and writing. We know that beginning writers struggle, and most of us want to help. But we usually only do so when it means tidying up and fixing quirks of English, rather than doing a full copy edit. It is also an act of generosity you should not count on. Editors help those who help themselves.

2. If you don't have access to Strunk and White, the original 1918 version by Strunk is available online for free, <http://www.bartleby.com/141/>.

My suggestion to not rely on an English-speaking colleague changes completely, however, when that colleague is a coauthor. All authors are responsible for a paper's entire content, and that includes the language. Your English-speaking coauthor is responsible for ensuring the language is correct. When reviewers read poorly written papers with coauthors from the United States, Great Britain, or other English-speaking countries, they can be appropriately brutal. They may question whether those authors were actually involved in the paper or whether they merely failed in their responsibility to ensure it was ready to submit. Either way, your coauthor doesn't look good. Unfortunately, as fallout, you may not look good either. If you are collaborating with a native English speaker, make sure he or she will be willing to do the necessary language-editing, and make sure you allow appropriate time to do it.

As a closing story, a colleague of mine questioned whether this book would be useful for scholars for whom English is a second language. She worried that for people who struggle to write grammatical sentences, my focus on storytelling might be overkill. I pointed out that as an editor, when I get a paper where the story is strong but the language weak, I'll send it back to get the language fixed before sending it out for review. If I get a paper where the story is weak I'll just reject it.

So which is more important—getting the grammar or the story down? I'll vote for story every time. You can hire an editor to help with the language. But you can't hire a scientist to help with the science. It's your science and only you can develop the story. Remember, always, that science is not about information; it is about knowledge and understanding. If you can offer understanding, you are most of the way to writing a paper that will be publishable in the world's best journals.