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EDITORIAL

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The essentials of effective scientific writing – A revised alternative guide for authors

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1 | FOREWORD

Effective science communication is an essential skill for researchers. The ability to engage different audiences with research ideas is crucial for acquiring funding, securing a job, attracting media coverage and (of course) publishing great papers. At *Functional Ecology*, we aim to help authors make the most of their work by providing useful resources for communicating research to varied audiences via different media: we encourage authors to produce plain language summaries of their papers, we provide opportunities to create podcasts, and we launched a blog where researchers can share the background stories and inspiration behind their work.

Clearly, these journal resources are useful once a paper has been accepted, but the biggest hurdle authors face is getting published in the first place. As an editor or reviewer, it is disheartening to reject a manuscript because a good idea has been poorly communicated. Unfortunately, the effort required to fix a badly written article usually goes far beyond what is normally required of a handling editor or reviewer. I have tried to address this, at least in part, by creating writing guides that describe the key traits of a well-written manuscript. In particular, authors have told me that my *Short Guide to Scientific Writing*, first introduced as an author resource two years ago, has proven immensely useful. In this editorial, I update the *Short Guide*, taking into account recent scientific evidence for the impact of better writing (Freeling, Doubleday, & Connell 2019).

2 | AN ALTERNATIVE GUIDE FOR AUTHORS

Getting research funded and published depends to a very large extent on our ability to *get the point across*. Although scientific texts differ substantially from other forms of writing, a good research paper follows the same basic principles of effective communication as a newspaper article or advertising text.

The tremendous growth in the number of people doing science globally has dramatically increased the number of manuscripts submitted to international journals like *Functional Ecology*. As a result, the rejection rates at highly selective journals have also increased substantially. For your paper to be successful in this competitive publishing environment, you need to know how to present and structure written information to get the point across and highlight key messages.

2.1 | Know your audience

The central principle for any type of communication is '*know your audience*'. A research paper is not just about presenting information – it is about communicating that research to others (Gopen and Swan 1990). When you start preparing a manuscript, you need to think about who will read it. In the first instance, this is probably a busy editor or reviewer, so you should make sure that you get your key messages across without making your readers work too hard. Good science writing is about getting the point across in such a way that readers can understand the research and reach the right conclusion (i.e. the one you want them to reach).

Years of research in education and marketing have revealed some general principles of how to get a message across and to make it stick in people's minds (Heath & Heath, 2007); these can be adapted to science writing (Schimel, 2011) and remembered with the acronym SUCCES:

- Simple – keep it simple by finding the main message and sticking to it
- Unexpected – use the unexpected to grab the reader's attention (e.g. a knowledge gap, unforeseen consequences, an unusual feedback)
- Concrete – make the central concept easily grasped and remembered

- Credible – support your interpretation and discussion with evidence
- Emotional – stimulate interest and highlight the relevance of the study to make people *care* about the research
- Story – people enjoy and remember stories, so a good manuscript is a narrative about your research, with a logical train of thought

Although you are constrained by scientific convention and the fixed format of most journals, you can still tell a simple, concrete and credible 'story' about your research (Schimel, 2011). You can use elements of the unexpected to show the novelty of the research and help the reader remember your paper by tapping into emotion (e.g. curiosity, amazement and surprise).

2.2 | A different take on manuscript structure

The title gets people reading the paper, so it should be brief and clear, summarizing the main finding of the paper (think of a headline). The title should not assume expertise in the subject or study organism, and it is wise to avoid questions, convoluted sentences and too much detail. The title should be simple and concrete, and it can also incorporate something unexpected. The most important part of the title should come first because the second half may not appear in a list of search results. (See Fox & Burns, 2015).

The abstract determines whether they read on, and many people will only ever read the abstract, so it should get the main messages across without drowning the reader in detail. It can be the hardest section to write because it needs to contain key information in an easily digestible form within a strict word limit. *Functional Ecology's* convention of numbered paragraphs is useful to ensure that your abstract includes all the essential elements: a brief justification, a broad description of the approach, key findings and a final statement about the relevance of the study.

The introduction sets the scene by presenting the context of your research. A logical train of thought should lead the reader to the conclusion that the study is novel, exciting and worth doing. It should be simple and concrete, including only the information relevant to the immediate study subject and the reasons you are doing the research. It is useful to follow the "inverted pyramid" of information in the introduction, which starts with broad general statements to provide context and successively introduces more specific information to conclude with clear research aims or the hypotheses you will test in the paper (Cargill & O'Connor, 2013). By the end of the introduction, the reader should *want* to know more about your study.

Methods: it is all about the detail and it can be hard to get the level of detail right. You should provide enough information for the reader to understand how the study was designed to address the research aims and judge whether the methodology and data analyses are appropriate. Details such as the number of plots, experimental treatments, or frequency of data collection are crucial, but you can usually omit details that have no influence on the measurements, results or the way the data are collected.

Results: logical versus *interesting***.** You should describe your results in a way that demonstrates their biological relevance, using statistics to support your statements rather than making the reader work out what your statistics mean. Reporting the magnitude and direction of effects is an important part of telling the biological story behind your work, but determining the order in which to report findings is tricky: the 'logical order' gives basic results first, whereas the 'interesting order' highlights the novelty of the study by reporting the most exciting results first. The solution usually lies somewhere between the two. You need to show how the results address the aims or hypotheses, so a good way of thinking about this section is to decide which results are the 'key results' you want to discuss, and which ones are 'supporting results' that are less interesting but useful for interpreting the main findings. Remember that many people skip the methods section, so clear statements about the biological meaning of experimental treatments, patterns and effects will help the reader interpret your results.

The discussion is your playground because you are less constrained by convention, and there is room for interpretation. There are four common types of discussion that really let a paper down:

> *The Saga*, in which each result (no matter how trivial) is discussed separately in turn. This can produce a very long and unexciting discussion that buries your most interesting findings.
>
> *The Whodunnit*, in which the reader is presented with various lines of evidence and the conclusion is drawn at the end. This leaves the reader guessing about the important facts while they wade through details.
>
> *The Report*, in which the results are presented only in comparison to other studies, with little or no interpretation. This not only distracts from your study by highlighting other people's work but also misses the opportunity to show your unique contribution to the research field.
>
> *The Fairy Tale*, in which the discussion is side-tracked into lengthy sections about things that could have been important but were not actually measured, or where much of the interpretation is not supported by evidence and crosses the line into speculation.

A really interesting discussion brings together different lines of evidence (the results of your study and other published work) to make sound conclusions and/or propose new ideas and hypotheses to be tested in future.

The conclusions section really is about conclusions, and it should not just summarize the results. What do you want the reader to remember? Why should anyone care about your study? Are there any unanswered or new questions? *The worst way to end a paper is to leave the reader thinking: "So what?"*

2.3 | Structure within structure

You can use the way readers naturally process information to your advantage by placing different types of information in strategic locations to emphasize key messages. Sentences, paragraphs and sections can all be structured in three parts: the beginning provides vital information to understand the context, the middle contains relevant supporting material and the end emphasizes key messages.

Topical sentences guide the reader. The first sentence of each paragraph should make it instantly clear what the paragraph is about and stops the paragraph from becoming a 'whodunnit'. You can check for topical sentences by copying the first sentence of each paragraph into a separate document and seeing whether it gives a rough outline of the content. A good topical sentence also creates a logical link between paragraphs by creating a bridge between "old" and "new" information. Topical sentences are particularly important in the discussion because they highlight the key results before discussing them in context.

The middle of a paragraph or section is the best place for information you need to report but that is not particularly exciting; this supporting information can also help plug logic gaps (see below).

Use the stress position to emphasize information. Readers naturally emphasize the material at the end of a sentence; this is referred to as a 'stress position' (Gopen & Swan, 1990). By placing information at the end of a sentence, it appears at the moment when the reader will naturally give it the greatest emphasis, so you should place your most important point at the end of a sentence. You can also highlight key point(s) by summing them up in the last sentence of the paragraph.

2.4 | Improving the flow of information

Mind the logic gap! You can become so familiar with your research that you omit information that seems unnecessary to you but is important for your readers. Following a line of reasoning through to a conclusion is like climbing a ladder: each piece of information is a rung required to reach the next one. If there is a rung missing, the line of reasoning is broken and the reader could miss the point entirely. Avoiding logic gaps is a balancing act: you need to provide enough information for a non-specialist to understand the paper without burdening the reader with detail or simplistic statements. It is good to get feedback from someone who works outside your immediate research area, because they are more likely to spot logic gaps.

Get straight to the point! You are often constrained by word limits, so it is important to omit unnecessary detail or jargon. You should drop anything that is not relevant to the study and the interpretation of the results – no matter how tangentially interesting or how much hard work it was. It is better to keep the story simple, and there is certainly no need to flesh out a manuscript that is otherwise short and to the point. If there is a lot of repetition, then the text probably needs restructuring to improve the flow of information.

Use figures and tables to your advantage. Many readers will only skim the text in the results section, so the best figures show your important results at a glance. Figures and legends should be understandable without reference to the text and without lengthy explanation. Tables are useful for summary and auxiliary data: as a general rule, if a text section reads like a list with lots of numbers, the information would probably be better off in a table. Unless your paper is actually about statistical methods, tables of statistics are best placed in an appendix.

Use terms consistently and avoid too many abbreviations. It is tempting to use different terms to reduce repetition, but this can confuse readers who are less familiar with the study subject. Non-standard abbreviations should be logical or intuitive (e.g. N+ for nitrogen addition treatments) and you should only use abbreviations or acronyms when absolutely necessary.

2.5 | Using passive and active voice

Scientific writing is often associated with passive voice, but many journals now prefer active voice. Passive sentences emphasize the person or object receiving the action, whereas active sentences emphasize the person or object performing the action. Using the active voice creates a connection between writer and reader, and it can make your text clearer, livelier and more concise (Gopen and Swan 1990). However, there are at least three situations in which using passive voice can be the better choice:

- *The actor is unknown, irrelevant or obvious* – we often use passive for very general statements. For example, in the sentence "The effect of nitrogen deposition on grassland biodiversity has been extensively studied", it is clear that we are referring to other researchers but it is both unnecessary and impractical to name everyone who has performed the work.
- *The actor is less important than the action* – we can use passive voice to describe methods and procedures in a clear and concise manner. For example, in the sentence 'The samples were oven-dried at 60°C for 48 hr', the procedure is more important than emphasizing who carried out the task.
- *The recipient is the main topic* – for example, the active sentence "Bees collect pollen" is the better choice when the text is about bees, but the passive "Pollen is collected by bees" is better when the subsequent text focusses on pollen (Gopen & Swan 1990).

Passive voice is also used for hedging, when the writer wants to express caution, uncertainty or possibility (Hyland, 1996). Hedging is important for distinguishing speculation from fact in scientific writing, but the passive voice can also appear evasive because it diminishes personal responsibility for a statement (Hyland, 1996) and should therefore be used with caution.

2.6 | Learn from the best

We all read a lot of papers – some are a pleasure to read and others are confusing. It is worth trying to work out why one paper is so much easier to follow or so much more memorable than others. Why does a

particular phrase or sentence catch your attention and make the subject sound important? If you really like a paper, chances are that the authors have done a great job at structuring the content to tell a clear story about their research.

Last but not least, one of the best ways to improve your writing is by commenting on your peers' written work. It is easier to spot issues in someone else's text, and providing constructive feedback can help you avoid similar problems with your own manuscripts. So the next time we send you an invitation to review for *Functional Ecology*, remember that contributing to the peer-review process not only represents a vital service to the research community, but can also increase your own chances of getting your paper published.

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