Writing and Publishing a Scientific Paper
An Overview

Opening Remarks

This book is designed to help you write, improve, submit, revise and publish high quality research publications or reports. Papers are the final products of your research, possibly relating to experiments or investigations that might have taken several years to complete. Published papers are crucial for helping you to become an expert in your chosen field, communicate to the world your important contributions to the advancement of knowledge, get the necessary feedback to improve your research plans and establish your career. Therefore we cannot emphasize enough the importance of learning to write your articles effectively. Remarkably few colleges, universities, companies and other organizations worldwide take the trouble to instruct their students, research staff and others in paper writing. They seem to expect people to assimilate the requisite skills from their mentors (who themselves often need training). This manual will instruct you how to go about writing a research paper. To keep it within reasonable bounds, it does not include much information on how to write in good idiomatic English (see A.10). There is a wealth of books on this matter, and a quick search online will lead you to many. This is true not only regarding non-native English speakers, as many native speakers often need help, particularly important in developing a personal style, so necessary if papers are to be less stereotyped in the presentation.

Part A of this Introduction is an overview or outline of what editors and publishers of learned journals will demand of you (yes, *demand*) if you wish to publish a significant article. The aim here is to provide enough guidance about paper writing to obviate the need for recurrent consultation of the chapters that follow. They will give the detailed advice for inexperienced writers, and are especially useful when the time comes to

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

revise and improve your draft manuscript before submitting a polished article; but the 'quick guide' presented here should help you to begin with the right mind-set.

(Note, however, that the sequence in which one should write a paper will be found to be different in Chapters 1–8 from the more familiar layout of a finished paper covered in this overview.)

Parts B and C of this Introduction will outline *Submission* and *Publishing* procedures, respectively. They present the most up-to-date details on how to take a draft paper through the complicated modern processes instituted by editors and publishers, which grow ever more sophisticated in terms of software as publications in nearly all major journals are now being posted on the Internet. Once again, few people have an intimate knowledge of what goes on after having just submitted a paper and the procedures that lead to a final decision on acceptance or rejection of a paper. This also goes for the publishing procedures; although similar in many journals, the exact requirements of publishers can vary considerably. A good knowledge of what is going on after acceptance of a paper is therefore as important as many of the previous stages. If you do not go deeper into this manual than this Introduction, you will nevertheless have recognized and to some extent assimilated the essence of what is required of you in preparing a paper and how it thereafter proceeds to publication.

Part A Major Issues in Drafting a Research Paper

A.1 Research: Having the Right Mind-Set

There are two challenges that anyone embarking on research will face. One is the daunting task of *writing up* a research project for submission to a learned journal. This manual will help to make it less daunting by guiding you through the process. While it might be especially aimed at the relative novice, many experienced researchers did not receive adequate training on this process. As emphasized in the early chapters, a primary research article is the final product of experimentation, possibly the outcome of months, often years, of diligent work. The main reason for having an explicit manual on scientific writing was summed up in an article (Wheatley, 2018) published after a conference in Philadelphia on the topic of preparing scientific papers for publication, which addresses the problem

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

of a declining standard in presentation.[1] The associated papers are very helpful.

The other challenge preceded the one above, which was taking on a research project in the first place. Some novices might have been fortunate enough to have had an induction on how to prepare mentally and practically in order to meet the challenge of carrying out experimental work. The less fortunate entered research and then found out how to go ahead by osmosis – picking up the necessary skills from others as you go along. It is important to know how best to approach research, and recognize the characteristics that should be developed in order to enter on a research project with confidence. Clearly every project will have its own requirements, but there are *basic skills* common to all projects.

What are some of these fundamental characteristics that can be developed? Key attributes include the following:

(1) Having an inquisitive mind that wants to know more about the universe and, in particular, our own world from both its physical and biological aspects.
(2) Seeing and seizing the opportunity of gaining greater insight into a phenomenon worth pursuing.
(3) Having a good memory and powers of observation.
(4) Having the ability to organize thoughts in a rational and logical manner.
(5) Remaining critical and sceptical of existing explanations of a phenomenon.
(6) Acquiring knowledge from what has been taught or published, along with discussions with your peers and mentors, remembering point (5).

Some people make 'natural' researchers, but everyone can acquire the necessary skills if properly motivated. The verb to *motivate* is one of the most important; many need help getting properly motivated, and this goes hand-in-hand with *inspiration* and *encouragement*. Thus for those wishing to progress, the correct mind-set is paramount – a good research project can be identified and approached with greater alacrity. A musician cannot give a good recital unless fully motivated to learn good technique, and then have the artistry to give exciting performances. When you finally succeed

[1] Wheatley D. (2018). Writing scientific and medical papers clearly. The Anatomical Record, **301**, 1493–1496.

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

in some research work, you get a similar buzz; writing about it then becomes an exciting challenge. The Nobel laureate Albert Szent-Györgyi once said of research that it is important 'to see what everyone sees, but think what nobody else thinks'; to have a mind of your own (see points (3) and (4) above). The starting point of a good paper lies in formulating a new hypothesis.

A.2 Getting the Right Framework

- Readers want to know, in the fewest possible words, what your research findings or studies are and why you wish to share them. You must have good and original information to communicate: a **message** to impart to – literally – the whole world.
- At the outset you must say what you hope to add to the sum total of human knowledge: a new method, a highly salient new finding or new data that call a hypothesis into question.
- Who are your intended readers? Make sure you have a clear answer to this. You can then write so that those readers will be interested in what you have to say and will understand it, regardless of whether they are few or many, specialists or laypersons. Think of a journal that would be appropriate for your message; this will help you write your paper. But leave the final decision about where to publish until later.

A.3 Introducing Your Topic

- The **Introduction** sets the scene for your paper, putting your work in the right context. Its aim is to explain why you did this piece of work. It must be relevant and focused, *not* a comprehensive review of knowledge to date.
- Imagine you are delivering a work report (seminar) to a group of people, for example in your own department, who have interests allied to yours and want to hear what you have to say. This will improve both your flow and your style. Start by setting out the background to the work very quickly, with no detail unless necessary (the Discussion is for details).
- The explanation for your choice of topic should lead you to formulate a hypothesis. State this briefly. Your readers may well know why you made this choice and are often experts in the same topic. But only put the essentials down, again without explanation unless absolutely necessary.

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

- At the end of the Introduction, some writers add a sentence about what they have discovered. This is usually unnecessary because your Abstract has done it already (see Section A.8).

A.4 Telling Others What You Did

- As succinctly as possible, describe the *experimental procedures* you used to find evidence for (or against) the hypothesis. This is the **Materials and Methods** part of the paper. (Some journals put this section after the Discussion, often in smaller font.) Most readers who are interested in your Methods section will want to know how your results were obtained and perhaps wish to repeat your experiments (for confirmation, and to see whether a consensus emerges: scientific and medical advances depend on consensus). Others may wish to check to see whether your experimental approach was a valid way of obtaining your findings.
- Usually, groups (experimental and controls) are compared. Seldom do biological findings reveal themselves in precise and unequivocal differences between such groups. You usually have to run many tests in duplicate or greater multiples. This means that statistics are required, so you need to tell your readers what statistical tests were applied and why.

A.5 Presenting the Results

- Give your **Results** in as orderly a fashion as possible. The aim is to marshal the evidence for your conclusions with maximum clarity. Do your data support or refute the hypothesis you are considering? The answer will enable you to display the information to best advantage.
- Collect all the relevant tables and figures (preferably as files of a PowerPoint presentation). This simplifies the task of finding the most suitable order in which to present them – as if you were giving that seminar.
- The logic of the presentation should be obvious to the reader. Keep the sequence in which you performed the experiments in mind as you write, but the logic might demand a quite different order – indeed, your final experiment may have been the most important and will be used as your leading point.

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

- Do not discuss points in the Results section unless absolutely necessary. The Discussion is where you will argue your case.
- If you have conflicting data – experimental results that are both for and against your hypothesis – you have to accept them at face value (nature does not lie). Present them as you found them, not as you wished or expected to find them. You can interpret them in the Discussion section.
- A suggestion based on experience: start with the Results section when you begin to draft your paper.

A.6 Discussing the Findings

- When you discuss your results along with other workers' findings, remember to maintain balance. It is best to select four or five major points for the **Discussion** rather than address every detail of the results. The lesser issues will fall into place if the main points are presented and argued logically and cogently.
- Some points you make will corroborate received wisdom, some will extend it with new knowledge and others will conflict with previous ideas, perhaps providing the next received wisdom. When conflict is found, or you have results that do not fit comfortably with a hypothesis, say so. At some later stage, you or another person might resolve the issue (and perhaps open up new ideas and avenues of research).
- Speculation should always be well-based and kept to the point. It should remain within the confines of how far your data, along with data from other people, allow you to go. Most editors delete wild speculation, so avoid it.
- There is an important reason for writing the draft of a paper, which is that you have had to put your work into a wider context throughout the discussion. This is the stage at which you sometimes, and quite suddenly, realize that your research missed something or some part of it was poorly designed. The exercise of writing up draws your attention to matters that could be improved and clarified, even if it means going back almost to square one (e.g. having to rephrase your hypothesis and/or perhaps do more experimental work before publishing)!

A.7 Coming to the End of the Writing of the Text

- **Conclusions** are generally the last one or two sentences of the Discussion – at most – telling what you have found. Some people prefer

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

to separate the Conclusions from the Discussion, but this is not usually necessary.

- The **Acknowledgements** section is to thank your funding agency (state the source and grant number) and all those who helped you in one way or another, including anyone who critically reviewed your draft manuscript.
- Cite the **References** you have used, keeping to the most appropriate – comprehensive lists are better kept for reviews. Reference managing software is now in common use; use it to your best advantage and to accord with the style of the journal to which you will send your paper.

A.8 Preparing an Abstract

- It might seem odd to leave the **Abstract** until after the Conclusions, but you will be clearer about to what to say when you have completed the rest of the draft. By then, your thoughts on the content of the paper will have been thoroughly rehearsed and refined.
- Certain things are required in the Abstract, but you need not add much background (many writers present too much – to readers who know as much as they do). The Abstract must be short and to the point. There often is a limit to the number of words permitted (typically 150–200), which forces you to be succinct.
- Some journals require a *structured* abstract, set out as Background, Methods, Results and Conclusions. In such cases, the word limit is usually higher.
- The first sentence can provide context, saying something about the area of research dealt with in your paper. Methods do not usually have to be described; there is little room for detail, so make only a short general statement unless some new technique or unusual application is involved. The sentence that assumes most importance is the main finding and it must have real impact. Shorter sentences should follow, indicating how the finding was corroborated by evidence. It is not a good plan to put data into the abstract unless they are needed to make the issue clear (e.g. a striking difference between certain measurements). Your Results section will give the full details, so do not give away your best evidence in the Abstract. Like a newspaper hoarding, the Abstract should draw in the potential reader.

- Do not include references (citations) in the Abstract unless absolutely necessary (many journals forbid them altogether).
- The last sentence needs to indicate what your research has shown, i.e. a brief conclusion, the main message to be imparted.
- Immediately below the Abstract is the place where *keywords* and *abbreviations* should be placed.

A.9 Giving the Paper a Title

- Deciding the **Title** is the last job in drafting an article. It must include keywords that will guide literature searches relating to your field of interest to your paper.
- The Title also has to interest and engage the reader, again like a newspaper headline. Therefore, do not make it too long, and ensure that it does not give the game away by stating the final result (known as a *declarative* or *pre-emptive title*, otherwise readers will see it, note its simple message and may not bother to read any further!).

Note: Although the order of preparation – Abstract and Title coming last – may seem odd, you will find in later chapters that some parts of a paper are better drafted in a different order from the way they finally appear in a publication, as has just been done here. The reasons will be explained more fully in the relevant chapters.

A.10 Writing in Good English

- Use the simplest form of sentence construction, but be mindful of sentence length, avoiding a 'staccato' delivery of successive very short sentences.
- Keep your subordinate clauses to a minimum and preferably after the main verb (this is preferred in English, though some other languages and cultures differ).
- Most reporting involves the past tense; if you switch to the present, do so only when essential. Results *were* found (past), but these *lead* to conclusions (now, the present).
- Vary the way in which sentences start; avoid repetition. The use of 'We' (We did this, and we found that. . .) is permissible nowadays, but it is

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

irritating if long successions of sentences begin with the same construction. (In past times, personal pronouns (I and We) were not permitted.) After a number of *active* sentences it is a relief to use the occasional *passive*. For example, 'We put five tubes in the incubator. . .' can be changed to the passive 'Five tubes were put into the incubator. . .'. However, this can be difficult for non-native English speakers and is another skill that must be learned

It is not easy to express yourself with style in English. This book does not intend to offer lessons in the art of English usage per se. However, suitable articles and books are given in the Further Reading section at the end of the manual from a vast array of books on the subject that are listed on the web in many search engines.

Part B Final Preparation of a Paper before Submission

B.1 Revising and Redrafting

- Read your draft paper again, and improve it by removing superfluous words and phrases.
- Make sure all your co-authors have read and helped you revise the new draft.
- If you have a chance to present your final draft in the form of a seminar, do so. Close colleagues who are not co-authors are often valuable critics. Revise your paper in the light of their comments. You may be surprised by how much they make you want to change what you have written.
- Go over the rewritten draft to see whether any words can be changed to make the meaning more precise. When you reread this draft, make sure the paper as a whole – not just each phrase or sentence – conveys the message(s) you want.
- Get an independent colleague (or two) who is/are quite expert in the same topic to read your penultimate draft. See whether the suggestions can improve the paper. If they do, make the appropriate alterations.

B.2 The Final Stages before Submission

- When you are satisfied you have your ultimate draft, reread the **Instructions to Authors** of the journal to which you have decided to

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

submit the article. Try to comply with every instruction. This will put you in favour with the referees and editors, and if the paper is deemed acceptable it will make it quicker and easier to proceed.

- Make sure you have the **full consent** of all your co-authors and the head of department or institute (if required). Then submit the paper to just one journal of your choice, usually accompanying it with a short letter stating that all authors have consented, drawing attention to any 'conflict of interests', and explaining anything the editor might need to know (for example, whether it has been rejected by another journal; in that event you might need to say why it was rejected, e.g. unsuitable choice, wrong subject area). You might also want to indicate why this particular journal seems the most suitable.

B.3 A Note on Ethics before Submission

Ethics will be covered more fully in Part C of this Introduction and Outline, but before submission you must accord with good ethical practice in presenting a scientific paper for publication. This means that you must know what is not permissible (ignorance is no defence):

- Most importantly, you cannot send a paper to several journals at one time.
- You must not submit a paper that substantively resembles an already published article, yours or anyone else's; in brief, you article must be original. It cannot contain pieces from already published work (including your own) without permission (copyright).

There is much more to be said about publication ethics (see Chapter 16), but these are the two crucial points.

Part C Getting Published

C.1 What Is Required

Many authors are unaware of how the publishing business works, or of the desiderata, e.g. the author's and editor's contributions to making the process quicker, simpler and more efficient by adhering strictly to the publisher's requirements. Being familiar with the practices of referees,

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

editors and publishers can be very valuable for smoothing the path of an article to publication. These topics will be covered in detail from Chapter 13 onwards; here, the significance of each will be outlined.

- **Online, open access or conventional (hard copy):** there are different modes of publication, with modern practice moving inexorably towards the online option, although many journals also publish hard copy. Soon virtually all will be open access online.
- **Costs and waivers:** you need to know who will pay and what for. The alternatives are (i) the author (or his/her funding system) pays upfront on acceptance of a paper for publication; (ii) the reader pays – the individual, but more usually the institute, has to subscribe in one way or another.
- **Instructions to authors:** guidelines to authors from journals and publishers are highly prescriptive; compliance is the best policy, right down to punctuation, units, reference styles and abbreviations. The better ones provide their checklist, which may differ from your own; be alert to any differences.
- **Checks for duplication, plagiarism, ethics, etc.:** there are ethical and moral issues in scientific publishing. Ever-improving software identifies unethical practices, and it is important to be aware of what can and cannot be done.
- **Publication management:** it is helpful to learn the roles of people in editorial offices and publishing houses. Modern submission systems usually allow authors to track the latest version of a paper from submission to the final publication step.
- **Permissions, copyright, corrigenda, etc.**: there are problems with reusing other people's words and data, correcting mistakes as a paper enters print, withdrawing or retracting claims, etc. These will be considered in detail in Chapter 15. There is also the issue of ownership of the published paper (who retains copyright).

C.2 What Is Not Permitted

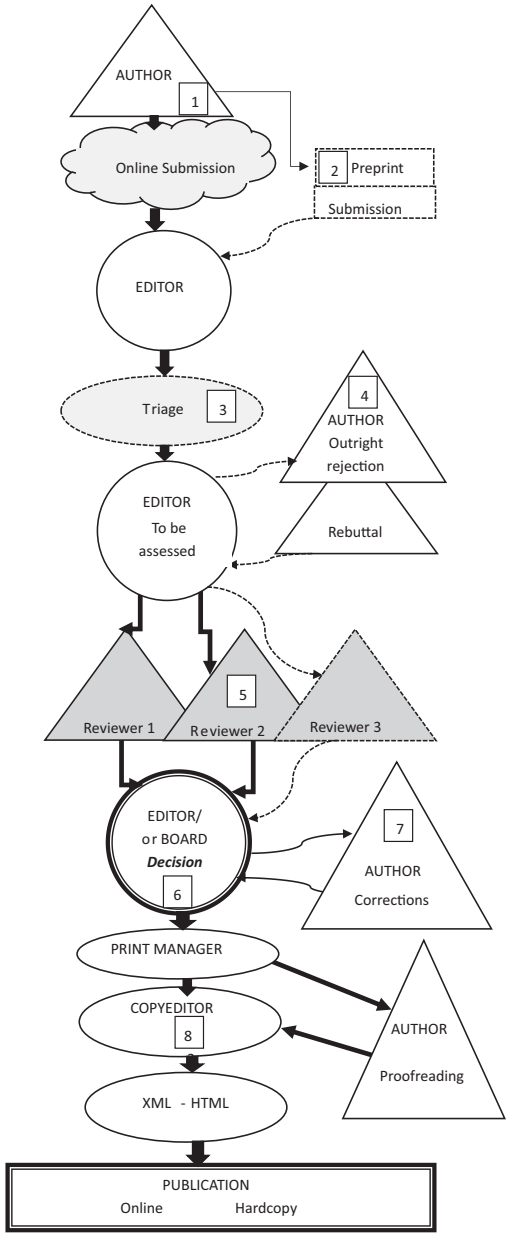
- **Fabrication** of data is a cardinal sin. It can lead to summary rejection of any future work by the author(s). In some flagrant cases it has led to criminal proceedings and imprisonment.

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press

- **Plagiarism** is the theft from previous papers – an infringement of copyright – of text, figures, tables, indeed any part of other peoples' intellectual property seen as published articles. It also refers to ideas stolen from others. It is highly unethical and should be avoided at all cost. There is in fact no excuse for it because permission can usually be granted by authors and publishing houses who hold the copyright, as long as acknowledgement is made and references given to any part of an article you might wish to include in your own paper. This is free of charge. Modern editing software is sophisticated enough these days to detect plagiarism.
- **Removal of data** that fail to conform to a pattern apparent in tables or figures is unethical. This also applies to omission of data that ought to be included. This practice is an act of deception and can also be self-defeating: 'rogue' points in a graph can sometimes be explained and even uncover an important but unsuspected aspect of the problem. It is possible to detect manipulation, e.g. 'airbrushing' of images; such practices should be avoided.
- **Multiple submission** is totally unacceptable. Editors can easily check for it these days. Submit to only one journal at a time.
- **Duplicate publication** is also a serious error and can be detected very quickly with modern software. Very minor modifications to a paper by the same (group of) authors, without change of substance, is usually treated as duplication.

Before going on to an example of a paper (Chapter 2) and details of the way in which to assemble a paper (Chapter 3), there is one essential matter to discuss – the **hypothesis** – for you must have a crystal clear hypothesis on which all you have to write hinges. As you begin to write your paper, it is worthwhile making a note at the very top of the first page of the hypothesis under test. Stating it succinctly is an exercise in itself, but well worth the effort, even if you need to modify its wording as you proceed. More detailed advice can be found in Appendix 5.1 of Chapter 5.

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press



MAJOR STEPS FROM SUBMISSION TO PUBLICATION

NOTES:

1. Corresponding author submits manuscript (MS); no need to be the senior author, but all authors must have approved the article before *submission*.

2. *Preprints* - a quick way to get an article out in a DIY manner, but not always a good way of claiming prior publication. Preprints might be of full paper submitted to a learned journal.

3. *Triage* depends on the policy of the journal. In some cases, the editorial board will have agreed that all submissions should be sent out for review.

4. Outright rejection – often due to content being inappropriate for the chosen journal, the content not being novel, the science weak and/or the presentation being unacceptable. However, if the author feels aggrieved, a *rebuttal* can be lodged with the editor.

5. When two *reviewers'* reports are quite contrary, one (or more) independent expert(s) will be called upon to assess the submission.

6. *Acceptance* can be taking the article 'as it is', or after minor/ major corrections. Otherwise it is rejected. The editor's decision is final. At this point the author will know whether he/she will be charged (author pays) for the article proceeding to publication.

7. Article *corrections* by the author for errors, amendments, etc., as requested/suggested by the reviewers and editor.

8. Copyeditor checks the article for every detail relating to the *final format* for the journal in which it is to be published.

Simplified flow chart illustrating the paths from submission to publication.

https://doi.org/10.1017/9781108891899.002 Published online by Cambridge University Press