Third Edition

Writing Scientific Research Articles

Strategy and Steps

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WILEY Blackwell

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Writing Scientific Research Articles

Strategy and Steps

Third Edition

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Preface to the first edition

Writing Scientific Research Articles is designed for early-career researchers in the sciences: those who are relatively new to the task of writing their research results as a manuscript for submission to an international refereed journal, and those who want to develop their skills for doing this more efficiently and successfully. All scientists are faced with pressure to publish their results in prestigious journals and all face challenges when trying to write and publish. This book takes a practical approach to developing scientists' skills in three key areas necessary for success:

- developing strategy: understanding what editors and referees want to publish, and why;
- developing story: understanding what makes a compelling research article in a particular discipline area; and
- using language: developing techniques to enhance clear and effective communication with readers in English.

The skills required for successful science writing are both science- and language-based, and skill integration is required for efficient outcomes. We are an author team of a scientist and a research communication teacher who have combined our perspectives and experience to produce an integrated, multidisciplinary approach to the task of article writing.

We have written the book both for those who write science in English as their first language and those for whom English is an additional language (EAL). Although a very

high proportion of the research articles published worldwide currently appears in English, scientific research is an intensely international and intercultural activity in the twenty-first century, and authors come from a wide range of language and cultural backgrounds. This situation adds another layer to the challenges facing authors themselves, journal editors and referees, and those who teach and support EAL scientists. We hope the book will be relevant to all professionals involved with the practice of research article writing.

The book is designed for use either by individuals as a self-study guide, or by groups working with a teacher or facilitator. Readers can prepare their own manuscript step by step as they move through the book, or use the book as a preparation phase and return to relevant parts when the time comes to write their own paper and navigate the publishing process.

The book has arisen out of fruitful collaborations at the University of Adelaide over many years, and especially out of our work with the Chinese Academy of Sciences since 2001. There are many people to thank for their contributions both to the approach and the book. First on the language end of the continuum must be Robert Weissberg and Suzanne Buker, whose 1990 book *Writing Up Research: Experimental Research Report Writing for Students of English* laid such an effective foundation in using the insights of the worldwide community of genre-analysis researchers as the basis of effective teaching about research article writing. Next are John Swales and his colleagues over the years, for their research output, their teaching texts, and their modeling of humble and rigorous curiosity as an effective way into the worlds of other disciplines. Then the team at Adelaide that has built from these bricks a context where the book could emerge: especially Kate Cadman, Ursula McGowan, and Karen

Adams, and so many scientists over the years. For bringing the perspective and experience of scientists, particular thanks go to those who have taught with us in China: Andrew Smith, Brent Kaiser, Scott Field, Bill Bellotti, Anne McNeill, and Murray Unkovich. We also thank those who have supported the training programs where we have refined our practical teaching approach, particularly Yongguan Zhu and Jinghua Cao. And, of course, the many early-career authors, in Australia, Vietnam, Spain, and China, who have participated in our workshops and contributed their insights and enthusiasm to the development of the book.

Our warm thanks go also to the people who have helped with the production of the book itself: Sally Richards, Karen Adams, Marian May, and our editors at Wiley-Blackwell, Delia Sandford and Ward Cooper. Remaining errors and omissions must be down to us.

Margaret Cargill
Patrick O'Connor
September 2008

Preface to the second edition

The first edition of *Writing Scientific Research Articles: Strategy and Steps* has been taken up with enthusiasm worldwide, both by novice authors themselves and by those who help prepare them for the publishing component of a science career in the 21st century. This second edition incorporates suggestions from users, additional insights we have gained in teaching from the book, and several additional sections designed to extend the book's approach to some topics not previously covered. Firstly, we have incorporated an additional article structure in Chapter 2 – one frequently used in fields such as physics, computer science, and some types of engineering – and an additional provided example article that uses it, from the field of remote sensing. These additions mean that the book now covers the full range of macro-structures commonly used in scientific research articles, extending its usefulness across a wider range of discipline areas.

The second addition is a chapter on the writing of review articles. Here, we apply the principles set out in the first edition to the challenge of writing a review article suitable for publication in an international journal. We suggest that most of the advice remains completely applicable if the term "data" is re-conceived as the author's evaluations of the work being reviewed, and the article's "take-home message" is new synthesis or conclusions that advance understanding of the field in question.

We take a similar approach for the third new feature, one that has been requested by many readers – a chapter on the writing of applications for grant funding. Although the specific requirements of funding bodies differ, the underlying process of understanding and responding

effectively to a set of criteria remains the same. We have focused on applying the principles from the rest of the book to provide guidelines and strategies that will be relevant in contexts ranging from small grants for travel or conference attendance all the way to large national or international funding opportunities.

Once again we express our thanks to colleagues who have contributed to the developments included in the second edition, especially Holly Slater, Andrew Smith, John Harris, Peter Langridge, Matt Gilliham, and Michelle Picard, and to our editors at Wiley-Blackwell, Ward Cooper, Carys Williams, and Kelvin Matthews. We also thank the many users of the first edition whose ideas and questions have spurred us on. As before, any remaining problems are our own.

Margaret Cargill
Patrick O’Connor
September 2012

Preface to the third edition

The second edition of *Writing Scientific Research Articles: Strategy and Steps* has continued to be used widely, by authors and by those supporting them to develop their articles and their article writing skills. However, there have been numerous changes in the international journal publishing landscape since it was released. The online evolution of science publishing has continued, with consequences for all aspects of the submission, publication, and promotion of published work. The changes brought about by online publishing and digital sharing present some new challenges but also deepen the need for understanding of the basics of communication in this genre. This third edition responds to the major changes and incorporates further suggestions from readers and from colleagues in many places who have used the book in their teaching and mentoring of novice authors. Some new sections and exercises have been added to develop user skills – we hope they are useful!

We have included new material in Chapter 12 on review articles, focusing on systematic reviews; in Chapter 11 on visual abstracts and highlights; and in Chapter 7 on publishing Methods papers. In Chapter 5, you will find new material on visualising results, handling supplementary material, and archiving data.

To enhance its usability by its many audiences, we have listed suggested pathways through the book at the end of Chapter 1: for students in the preparation phase before writing a manuscript; for researchers with data ready to start writing their manuscript; for authors using English as an additional language (EAL); for scientists instructing or mentoring students or junior colleagues; and for language

professionals teaching science research students or providing advice on draft manuscripts. An enhanced reference list provides access to recent published work that has informed the updates we've made.

Once again we express our gratitude to all who have contributed to this third edition, and especially to our editors at Wiley, Rosie Hayden and Julia Squarr. As ever, remaining errors and omissions are down to us!

Margaret Cargill
Patrick O'Connor
April 2021

SECTION 1
A framework for success

CHAPTER 1
How to use this book

1.1 Getting started with writing for international publication

This book is for all authors who want improved strategies for writing effective scientific papers in an efficient way, including those new to the task. The focus is on writing in English, but many of the strategies are equally effective for writing science in other languages. Plurilingual authors – those using English as an additional language (EAL) – will find their situations and needs addressed alongside those of authors with English as a first language (EL1), as well as those common to both groups.

In this book, we will use other terms as well as *paper* for what you are aiming to write: it may be called a *manuscript*, a *journal article*, or a *research article*. (See Chapter 2 for comments on other types of scientific articles, Chapter 12 for writing review articles, and Chapter 18 for how to apply the book's approach to writing funding grant proposals.) All of these terms are in use in books and websites providing information and advice about this type of document: this *genre*. The concept of genre is important for the way this book works, as we have based our approach in writing it on the findings of researchers who work in the field of genre analysis. These researchers study documents of a particular type to identify the features that make them recognisable as what they are.

One of the key concepts in use in this field of research is the idea of the *audience* for a document as a key factor in helping an author write effectively. Whenever you write any document, it is helpful to think first about your audience: whom do you see in your mind's eye as the reader of what you are writing? The idea of audience belongs as part of a "communication matrix" made up of four elements: *audience* (as described in the previous sentence), *purpose* (what do you want the document to achieve?), *format* (how will the required format constrain how you write the document?), and *assessment* (what criteria will be used to decide if the document is successful?). We will use all the elements of this matrix to guide our discussion of

the genres we will analyse in the book, and we begin now by thinking about the audience for a scientific research article.

Who is your audience?

Often the audience that you think of first is your scientific peers – people working in areas related to yours who will want to know about your results – and this is certainly a primary audience for a research article. However, there is another "audience" whose requirements must be met before your peers will even get a chance to see your article in print: the journal editor and reviewers (also called referees; see Chapters 3, 13, and 14 for more information). These people are often thought of as gate-keepers (or as a filter), because their role is to ensure that only articles that meet the journal's standards and requirements are allowed to enter or pass through. Therefore, it can be useful from the beginning to find out and bear in mind as much information as you can about what these requirements are. In this book, we refer to these requirements as reviewer criteria (see Chapters 3 and 14 for details), and we use them as a framework to help unpack the expectations that both audiences have of a research article written in English. We aim to unpack these expectations in two different but closely interrelated ways – in terms of:

- the content of each article section and its presentation; and
- the English language features commonly used to present that content.

To do this, the book uses an interdisciplinary approach, combining insights from experienced science authors and reviewers about content with those from specialist teachers of research communication in English about the language. Elements of language that are broadly relevant to most readers of the book will be discussed in each chapter. In addition, Chapter 17 focuses on ways in which users of EAL can develop the discipline-specific English needed to write effectively for international publication. This chapter can be studied at any stage in the process of working through the book, after you have completed Chapter 1.

1.2 Publishing in the international literature

If you are going to become involved in publishing in the international literature, there are a number of questions it is useful to consider at

the outset: Why publish? Why is it difficult to publish? What does participation in the international scientific community require? What do you need to know to select your target journal? How can you get the most out of publishing? We will consider these questions in turn.

Why publish?

We have already suggested that researchers publish to share ideas and results with colleagues. Other reasons for publishing include

- to leave a record of research which can be added to by others;
- to receive due recognition for ideas and results; and
- to attract interest from others in the area of research.

However, there are two additional reasons that are very important for internationally oriented scientists:

- to receive expert feedback on results and ideas; and
- to legitimise research; that is, to receive independent verification of methods and results.

These reasons underscore the importance of the review process we discussed earlier. However, there are difficulties associated with getting work published – difficulties that operate for all scientists, plus some that are specific to scientists working in contexts where English is a foreign or additional language.

Why is it difficult to publish?

In addition to any language-related barriers that spring to mind, it is also important to realise that writing is a skill, whatever the language. Many of the points covered in this book are equally important for EAL and EL1 scientists. In addition, because most science research contexts are now multilingual and multicultural wherever they are located, an overt focus on the role of language in writing for publication will benefit all players, from novices to mentors.

Getting published is also a skill: not all writers are published. Some reasons for this fact include the following:

- not all research is new or of sufficient scientific interest;

- experiments do not always work – positive results are easier to publish; and
- scientific journals have specific requirements which can be difficult to meet – publishing is a buyer's market.

These issues will be addressed as you proceed through the book.

Another reason that researchers find the writing and publication process difficult is that communicating your work and ideas opens you up to potential criticism. The process of advancing concepts, ideas, and knowledge is adversarial, and new results and ideas are often rigorously debated. Authors facing the blank page and a potentially critical audience can find the task of writing very daunting. This book offers frameworks for you to structure your thinking and writing for each section of a scientific article and for dealing with the publishing process. The frameworks provided will allow you to break down the large task of writing the whole manuscript into small tasks of writing sections and subsections, and to navigate the publishing process.

What does participation in the international scientific community require?

A helpful image is to think about submitting a manuscript to an international journal as a way of participating in the international scientific community. You are, in effect, joining an international conversation. To join this conversation, you need to know what has already been said by the other people conversing. In other words, you need to understand the "cutting edge" of your scientific discipline: what work is being done now by the important players in the field internationally. This means:

- getting access to the journals where people in the field are publishing;
- subscribing to the e-mail alert schemes offered by journal publishers on their websites so that you receive tables of contents when new issues are published; and
- developing effective skills for searching the Internet and electronic databases to which you have access.

Without this understanding, it will be difficult to write about your work so as to show how it fits into the progress being made in your

field. In fact, this knowledge is important when the research is being planned, well before the time when the paper is being written: you should try to plan your research so it fits into a developing conversation in your field.

Active involvement in international conferences is an important way to gain access to this international world of research in your field. Therefore, you need confident skills in both written and spoken English for communication with your peers. This book aims to help with the written language as used in international journals, and some ideas for developing spoken science English are given in Chapter 16. As you become a member of the international research community in your field in these ways, you will develop the knowledge base you need to help you select the most appropriate journal for submission of your manuscript: we call this your *target journal*.

What do you need to know to select your target journal?

Choosing the right journal for your manuscript will influence the chance of getting published relatively easily and quickly. You should be thinking about the journal you want to publish in from the beginning of your research, and should have made a choice by the time you begin to write the Introduction and Discussion sections of your paper.

The right journal for you is the journal which optimises the speed and ease of publication, the professional prestige you accrue, and the access for your desired audience. These factors are interwoven, and it can be helpful to develop a publication plan to maximise your publication success. The journal of your choice may not choose to accept your article, and you are advised to have a list of preferred journals to turn to if you are rejected from your first choice. Here, we set out some issues to consider when choosing a journal for your manuscript:

- Does the journal normally publish the kind of work you have done? Check several issues and search the journal website. It is helpful if you can cite work from the journal in the Introduction of your manuscript, to show that you are joining a conversation already in progress in the journal. Examine some of the key articles you refer to in your Introduction, and check which journals are cited in the Introductions of these articles. By

following back through the literature, you should be able to develop a mind-map of the journals in the field of your research. The journals that are most often cited in the Introduction and Discussion sections of your manuscript will be most likely to accept work in your field.

- Do the aims and scope of the journal match the content and the level of impact of your work for the field? Check the websites or issues of potential journals to identify those with scope and aims most appropriate for your manuscript. In this way, you can try to ensure that your article will reach the audience you want to read it, once it is published.
- Is the journal of an appropriate standard for your needs? First, does it referee its papers? This is absolutely imperative for enhancing the international credibility of your work. It may also be important to check the journal's impact factor, if this measure is important for assessing research outcomes in your country or research context. (See Appendix for more information on impact factor, citation index, and other similar measurements.)
- Does the journal publish reasonably quickly? Many journals include the dates when a manuscript was received and published underneath the title information, so you can check the likely timeline. Others include this information on their websites. Journals which publish online versions of papers before the print version will usually have a faster time to publication. Journals want to publish submissions quickly to ensure they attract authors who are doing innovative and new work. You may also want to publish your research quickly to ensure that others do not publish similar work before you, and to increase your publication and citation record for promotions and grants.
- Are there charges associated with publishing in the journal? Some journals charge authors a fee to publish, or to publish coloured illustrations. Check whether this is the case. If so, you can ask whether the journal is willing to waive these charges for authors in some parts of the world. You may also want your research to be accessible to a wide range of readers who do not have access to libraries or other subscriptions to journals in your field. Many journals now offer to provide Open Access to papers (i.e. to make them accessible for free download without subscription to the journal) if the authors pay an upfront fee. Check whether the journal of your choice offers this service if you