

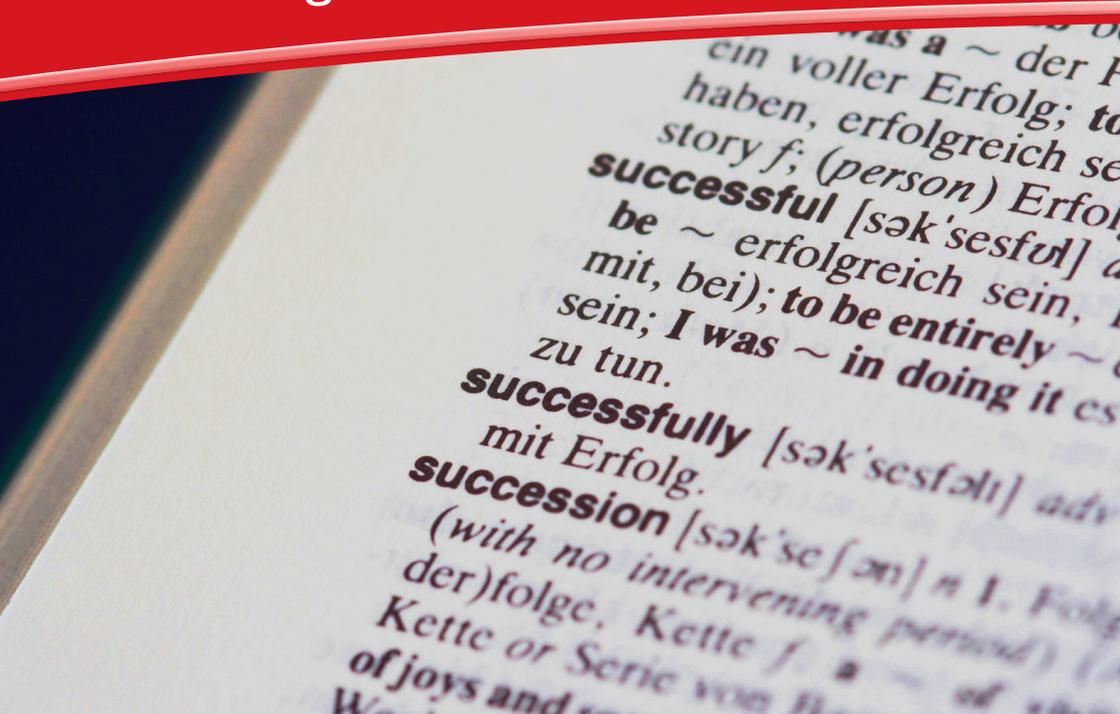
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Tim Skern

Writing Scientific English

A Workbook

3. Auflage



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W

Tim Skern, a native English speaker, studied biochemistry in Liverpool and London. Now working at the Max Perutz Labs, he has been teaching scientific English at the University of Vienna and the Medical University of Vienna since 1992. In 2018, he became Editor-in-Chief of Archives of Virology. Tim Skern is the author of “Coffee House Notes on Virology” (Facultas Verlag) and “Exploring Protein Structure: Principles and Practice” (Springer).

In Memoriam Ernst Kückler, der mir
das wissenschaftliche Schreiben beibrachte:

Da hapert's! Da hat's was!

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In 1992, I started to teach “Writing and Speaking Scientific English” at the University of Vienna. My qualifications included English as a native tongue as well as experience of writing my own scientific manuscripts and correcting those of others. I had also given some scientific talks and listened to considerably more. That was all. I was ignorant about how to begin teaching scientific English. I had no idea about the specific problems faced by the students, whether I should take their scientific and cultural backgrounds into account or how I should go about improving their standard. Somehow, the students and I survived and profited from the first course. During that first course and later in subsequent ones, I came to recognise that the students, independent of their various scientific and cultural backgrounds, shared many common problems in writing scientific English. To address these problems, I developed a series of guidelines and exercises to turn, as rapidly as possible, the students’ school English into the formal English required for scientific texts. These guidelines and exercises, modified over the years to incorporate ideas on avoiding plagiarism, form the first part of this workbook.

The second part of this book uses work from former students to illustrate how to improve the first draft of a scientific text. This skill, essential to scientific writing, is one that almost every student who has taken the course needed to reflect on and to practise. I know from my own experience how difficult it is to improve a text written in a language other than one’s native tongue. I hope that the exercises will be an asset to the reader in becoming proficient in improving scientific texts in English.

I would like to take this opportunity to thank all of the students, colleagues, friends and family members without whose support both course and workbook would not have seen the light of day. A very special thank-you goes to the 21 students who responded so quickly and positively to my request to be able to use their work. Their texts add an unconventional feature to the book. Without them, this would be just another book on writing scientific English. Special mention also goes to my colleagues Rainer Prohaska, who first suggested that I teach a course on scientific English, and Hannes Klump, who suggested writing a workbook.

I would like to express my gratitude to Tanja Kostić, Brooke Morriswood and Petra Schlick whose efforts greatly enhanced the quality and scope of the book. Tanja typed in the work of the former students and was

6 instrumental in finding a way to show how the texts had been improved. She also made a significant contribution to the content and appearance of the model manuscript in chapter 4. Brooke did his best to make me kick the professorial habit of preaching and ensured that I remained steadfast in omitting needless words. Petra very carefully proofread the exercises and their improvements and put forward other numerous suggestions to strengthen the book. All three corrected innumerable errors and blunders. Those that remain are entirely my responsibility.

I also would like to specifically thank the following for their important contributions to the book: Martin Breuss, Susanne Dormayer, Maria Kalyna, Martina Kurz, Sergei Lapato, Julia Leodolter, Zdravko Lorković, Christiane Mair, Elisabeth Malle, Evelyn Missbach, Anna Mitterer, Angelika Mühl-ebner, David Neubauer, Sanda Pasc, Marianne Popp, Lucia T. Riedmann, Betty Skern, Marina Skern, Margarita Smidt, Lena Sokol, Jutta Steinberger, Friederike Turnowsky, Graham Warren, Philippa Warren, Junping Zhu and Melanie Zwirn.

Christian Kaier of Facultas AG efficiently shepherded the book through the production stages. Michael Karner performed wonders with the layout and remained commendably patient with my sometimes impossible requests. Robert Chionis not only carefully proofread the manuscript but also contributed to the clarity of the book and eliminated numerous Germanisms. I am grateful to all of you.

The idea for the content of the model manuscript was conceived during various visits to Cape Town. In return for this inspiration, all of my proceeds from this book will go to support Monwabisi Magoqi, a teacher on HIV and counsellor to AIDS patients in Khayelitsha near Cape Town. Supporting Monwa is a more effective way of fighting AIDS than any research I might ever do.

Tim Skern, Cape Town, August 2008

*His speech is like an entangled chain; not impaired,
but completely disordered.*

W. SHAKESPEARE (A Mid-Summer Night's Dream)

Amongst the feedback from the first edition were two suggestions for material for the second edition. The first was to expand on the idea that the writing of a scientific manuscript begins during the planning and execution of the experiments. The new chapter 6 grew out of this suggestion and contains more of my thoughts on this theme. The second idea was to provide support for pronouncing scientific English and giving scientific presentations in English. My hints and guidelines on these topics can be found in the DVD at the back of the book.

Alwin Köhler, Tanja Kostic, Brooke Morriswood, Ortrun Mittelsten Scheid, Ulrike Seifert and Graham Warren gave invaluable support in the development of the new chapter. I am grateful to Christian Kaier, Walter Größbauer and Josef Wagner for their professional production of the DVD, to Jennifer L. Boots for the audio file with the American pronunciation and Lucia T. Riedmann for the drawings that form the background to the credits. Very special thanks go to Martina Dötsch who was such an enthusiastic partner in the dialogue on speaking scientific English. I am grateful to the Medical University of Vienna for permission to film my lecture on “Communicating Science in English”.

Tim Skern, Vienna, August 2011

The videos from the second edition are now available via the following QR code:



Lecture, Interview, Pronunciation(UK), Pronunciation(US)

In the ten years since the publication of the first edition of this book, I have substantially refined and harmonised the comments that I make when correcting the assignments of my students. The third edition takes these changes into account. Two new manuscripts in chapter 5 use these harmonised comments; the list of the comments themselves can be found in box 7.2. This edition also contains four new abstracts that illustrate specific problems that constantly recur in the students' assignments. Chapter 8 contains eight new exercises that are based on texts that I use in my class to provide practice in summary writing and data analysis. In addition, six new videos were made for this edition in order to demonstrate my approach to supporting students in giving scientific talks in English. I hope that you will find the approach useful for preparing your presentations. The first video sets the scene and introduces the speakers. Videos two to five contain three minute speeches given by former students of my courses; at the end of each speech, the student receives a brief feedback. In the sixth video, one of the students interviews me on how best to obtain a place in a laboratory for an Erasmus stay abroad. The videos can be accessed via the QR code in section 7.4.

A further change in the third edition is the absence of the two texts that were reprinted from the journal *Nature*. This change resulted from an enormous increase in the copyright fees that *Nature* now charges compared to 2011. The texts should however be available to most readers through an institutional subscription to *Nature*.

I thank the six students who so readily gave their permission to use their work. William Dundon and Gijs Versteeg kindly offered excerpts from the reviewers' comments on their manuscripts. Peter Wittmann and Carina Glitzner from *Facultas AG* provided invaluable support in the production of this new edition. Special thanks to Barbara Füzi, Ralf Jansen, Helene Mössl and Tomaž Rozmarič for their enthusiastic participation in the videos and to Walter Größbauer and Istvan Pajor for their professional expertise in producing them.

Tim Skern, Vienna, April 2019

Chapters 1 and 2 of the workbook comprise guidelines and a basic scientific lexicon that will support you in writing the English employed in scientific texts. Familiarise yourself with them and then practise their application by carrying out the exercises in chapter 3. Compare your responses to the exercises to those of former students. Look at the suggestions (sets of comments and commands with blue numbers) for improving these texts and then try to strengthen your work in the same way. At the end of the first three chapters, you should be more confident in writing formal English and able to ask critical questions about your own written work.

Taking the material from the first three chapters as its basis, chapter 4 generates a model manuscript based on imaginary experiments to illustrate how to write and strengthen a scientific manuscript. Chapter 5 proposes themes for writing your own texts and model manuscripts so that you can apply the ideas from chapter 4. Again, compare your manuscripts with those of the former students and note how they have been further modified. Correct your work in the same way. Chapter 6 offers an alternative approach to start writing your manuscripts and shows how experimentation and communication are linked.

At this point, your English should be approaching the style found in scientific texts and manuscripts and you should be gaining in confidence. It is important, however, that you continue to polish your English and that you appreciate that writing skills can always be sharpened. Chapters 7 and 8 are both designed with this goal in mind. Chapter 7 presents several suggestions how readers can continue to consolidate their scientific writing. Chapter 8 lists the pages of the book on which words marked in italics are printed. These comprise the basic scientific lexicon in chapter 1, important linking words from box 1.4 as well as a further hundred or so useful words for scientific writing. Browsing through chapter 8 and carrying out some of the exercises in this chapter should greatly increase the number of words at your disposal. There is also space at the end of chapter 8 for you to add words that you meet during your reading.

Chapter 1

An introduction to scientific English	15
1.1 Advantages and disadvantages of English	15
1.1.1 British or American?	19
1.2 Formal English, the language of science	21
1.2.1 Complete sentences	21
1.2.2 Punctuation marks	22
1.2.3 Write out all verb forms	25
1.2.4 Avoid starting sentences with “and”, “but”, “because” or “so”	25
1.2.5 Avoid ending sentences with “too”, “also”, “though” or “yet”	26
1.2.6 Avoid “get”	27
1.2.7 Avoid vagueness, sensationalism and exaggeration	27
1.2.8 Using “the” and “a”	28
1.3 Words for writing scientific English	31
1.4 Take-home messages from Chapter 1	34
1.5 References	34
1.6 Improvements to exercises	34

Chapter 2

Writing clear scientific English	37
2.1 Eight guidelines for improving your writing technique	37
2.1.1 Make a plan	37
2.1.2 Use a clean and legible layout	38
2.1.3 Use paragraphs	39
2.1.4 Write simple sentences	39
2.1.5 Write positive sentences	41
2.1.6 Write active sentences	43
2.1.7 Omit needless words	43
2.1.8 Read and think about your work	45
2.2 Just to make you feel better	45
2.3 Take-home messages from Chapter 2	48
2.4 References	49
2.5 Improvements to exercises	49

Chapter 3

Applying the fundamentals 51

3.1	Summarising the text “Fighting for Breath”	51
3.2	Improving four summaries of “Fighting for Breath”	54
3.3	Writing abstracts for scientific presentations	63
3.4	Improving four abstracts	64
3.5	What is science?	74
3.6	Improving four texts on “What is science?”	78
3.7	The five most common commands and comments from improved texts in Chapter 3	86
3.8	Take-home messages from Chapter 3	87
3.9	References	87

Chapter 4

Constructing a scientific manuscript 89

4.1	The process of publishing original data in a scientific manuscript	89
4.2	Planning a scientific manuscript	95
4.3	Writing a scientific manuscript	99
4.3.1	Prepare the figures and tables	100
4.3.2	Describe the figures and tables	104
4.3.3	Write a first draft of the “results”	105
4.3.4	Write a first draft of the “discussion”	108
4.3.5	What about writing a combined section entitled “results and discussion”?	110
4.3.6	Write a first draft of the “introduction”	113
4.3.7	Write a first draft of the “title”, the “abstract” and the “keywords”	114
4.3.8	Write a first draft of “materials and methods”	117
4.3.9	List and sort the references	119
4.3.10	Write the “acknowledgements”	121
4.3.11	Write the “abbreviations”	121
4.4	Assembling and improving the model manuscript	122
4.4.1	First draft of the model manuscript	124
4.5	Editing and refining a scientific manuscript	129
4.5.1	Improved model manuscript	130
4.6	Take-home messages from Chapter 4	134
4.7	References	135

Chapter 5**Practising writing and improving scientific manuscripts 137**

5.1	Improving the quality of bread	137
5.2	Your views on human activity and global warming	147
5.3	Measuring biodiversity	151
5.4	Stereotypic Man	157
5.5	Searching for the best firewood to reduce global warming	163
5.6	Is there a connection between eating organic food and cigarette smoking?	168
5.7	The six most common commands and comments from improved texts in Chapter 5	175
5.7	Take-home messages from Chapter 5	175
5.8	References	176

Chapter 6**Easing the pain: writing whilst researching 177****Chapter 7****On your own 181**

7.1	Resources	184
7.2	The comments that I use to correct texts in my course	187
7.3	A reading list to improve your vocabulary and your scientific writing	188
7.4	Some tips for oral presentations	199
7.5	References	199

Chapter 8**The scientific vocabulary of this book 201**

8.1	Linking words	201
8.2	Words from the basic scientific lexicon	202
8.3	Words that extend the basic scientific lexicon	204
8.4	Exercises using texts from Nature and Science	205
8.5	References	209
8.6	Words that you wish to add	209

1.1	Terminating difficulties in English spelling	18
1.2	Fooling a spellchecker	19
1.3	Names of musical notes	21
1.4	Words for linking sentences in scientific writing	26
1.5	Guidelines for using “a” and “the”	29
1.6	Practising the use of the articles “the” and “a” in English	30
1.7	A basic lexicon for scientific writing	32
2.1	Shortening sentences by splitting them into two	41
2.2	Positive and negative sentences	42
2.3	Omit needless words!	44
2.4	Vocabulary of “A word in your ear” (Campbell, 1998)	48
3.1	Summarise the text “Fighting for breath”	52
3.2	Identifying problems in written work	55
3.3	Who takes part in a clinical study or trial?	73
3.4	„What is science?“ Answer this question in less than 300 words	75
3.5	Scientists on science	76
3.6	Using the words „prove“ and „disprove“	78
4.1	The steps in constructing and publishing a scientific manuscript	94
4.2	What is an impact factor and how is it calculated?	95
4.3	Sections of a scientific manuscript and the information they contain	96
4.4	A manuscript without sections	99
4.5	Suggested order for planning and writing the sections of a scientific manuscript	99
4.6	Figures 1 and 2 for the model manuscript	103
4.7	Figure legends	105
4.8	Results	107
4.9	Arranging the figures, figure legends and results for cohesive writing	108
4.10	Discussion	110
4.11	Results and discussion	112
4.12	Introduction	114
4.13	Two versions of the abstract	116
4.14	Title and keywords	117
4.15	Materials and methods	118
5.1	Stereotypic man	157
5.2	Number, amount, volume and concentration	172
6.1	Explaining an experimental problem to a colleague	178
7.1	Words from Shakespeare for use in scientific writing	183
7.2	My current thirty-three comments for correcting texts	187

It is well-known that, in grammatical terms, languages are more perfect the older they are and that they always become gradually worse, from high Sanskrit down to English jargon, this patchwork cloak of thoughts stitched together from rags of heterogeneous material.

(Bekanntlich sind die Sprachen, namentlich in grammatischer Hinsicht, desto vollkommener, je älter sie sind, und werden stufenweise immer schlechter – vom hohen Sanskrit an bis zum englischen Jargon herab, diesem aus Lappen heterogener Stoffe zusammengeflickten Gedankenkleide.)

ARTHUR SCHOPENHAUER

The chapter begins by looking at the advantages and disadvantages of English as the language of scientific communication, presents some guidelines on how to write the formal English found in scientific writing and ends by suggesting a basic vocabulary for written scientific communication.

1.1 Advantages and disadvantages of English

English has become today's language of science through historical events, not through any inherent characteristics that make it better suited to the task. Fortunately, English does have many positive characteristics that make it suitable for scientific writing. However, some negative ones also make it less than ideal. The positive characteristics include a relatively straightforward grammar and an enormously rich vocabulary; the irregular pronunciation and the inconsistent spelling are two negative ones.

The straightforward grammar makes it relatively simple to construct sentences. The order of words is uncomplicated and there is no need to worry about the gender of nouns or about the appropriate ending of an adjective. Changes in the verb endings are also *limited*. Nevertheless, it is the verbs, with their large number of tenses, that do cause the most difficulty in applying English grammar.

English's richness of vocabulary gives writers a tremendous flexibility in the words they can choose. Where does this wonderful richness of vo-

cabulary originate? One source lies in English's French, German and Scandinavian roots. As a consequence, English often has both a French- and a German-based word for the same thing or concept. The pairs of words "infancy" and "childhood", "judicious" and "wise", "malady" and "sickness" and "transmit" and "send" are just a few examples. A second source of variety in English is the habit of English-speaking people to absorb words from other languages. For instance, the word "robot" originates from the word in many Slav languages for work; in contrast, the words "alcohol" and "elixir" have an Arabic origin. The excellent website www.krysstal.com/borrow.html lists the hundreds of words that English has *assimilated* over the centuries. Schopenhauer was quite *correct* in describing English as a patchwork language.

In his book "Mother Tongue: The English Language", Bill Bryson states that this richness of vocabulary gives English an advantage over many other languages. He proposes that a language with a wider vocabulary has more ways to express the same thought. This may be true, but a wide vocabulary is not necessary to express one's ideas. The writer Ernest Hemingway was famous for using a limited range of words. *Nevertheless*, he was still *able* to articulate powerful emotions and describe profound thoughts.

The two negative characteristics of English mentioned above do, however, place it at a distinct disadvantage compared to other languages. The irregular and often seemingly perverse pronunciation means that even native English speakers will have no idea how to pronounce a word with which they are unfamiliar. How difficult is it then for non-native speakers to learn to pronounce English correctly? How can one explain that the important scientific words "mature" and "nature" are pronounced differently? How could a young person who had lived for a year in Hollywood as a teenager and who spoke English with an excellent American accent mispronounce the words "nitrogen" and "oxygen"? These two gases are not normally words that teenagers frequently use. Without having heard their pronunciation, it is hard to know that they rhyme with Ben and not with bean. This book is, however, only concerned with writing. A discussion on the vagaries of pronunciation can wait for another day.

Spelling is, in contrast, *essential* for accurate scientific writing. It is vital that students are *aware* of the problems. The most *frequent* ones are presented in box 1.1, with suggestions how a famous native German speaker might terminate them. Perhaps these changes will one day become reality. Until then, spelling will remain an item to be considered carefully in

scientific manuscripts. One way of reducing the difficulties is to switch on a spellchecker and set it to correct when typing. Special words or abbreviations that are specific to a *particular* field can be constantly added to the main dictionary. In this way, the spellchecker can be trusted to correct spelling during typing. If it cannot correct a word, then that word will need attention. If you do not like your spellchecker to make decisions itself, turn off this option and manually check the words marked by the spellchecker. There is nothing wrong with this; you may even learn something. It is simply more time-consuming.

A spellchecker is, however, not perfect. At present, a spellchecker will fail to determine whether a word should be written in the singular or plural. Furthermore, it cannot deal with words that do exist in a language but that are used incorrectly. The thirteen sentences in box 1.2 provide twelve such words. See if you can find them. Remember to keep an eye open for such errors when you read your work.

The grammar checker of Word 2019 is also a useful tool. It *detects* repeated words, sentences that do not start with a capital letter and unnecessary spaces. Its range also extends to more complex difficulties such as highlighting incomplete sentences, marking a lack of agreement between the subject and verb (e.g. “the majority of scientists is conservative”, not “the majority of scientists are conservative”) and highlighting *incorrect* tense constructions.

Like spellcheckers, grammar checkers are not foolproof and are to be used with care. Nevertheless, even if they are inaccurate, you still have to work out why the grammar checker has queried your writing. Anything that makes you contemplate what you have written and consider other possibilities will positively contribute to the quality of your text.

Box 1.1 Terminating difficulties in English spelling

This text lists most of the peculiarities of English spelling and offers some humorous suggestions to eliminate them. The text circulated by email at the time of ex-Governor Schwarzenegger's inauguration and can still be found in many internet forums. I am grateful to the anonymous author. Read it out aloud to hear how it sounds!

A New Language For California

The new Californian Governor has just announced an agreement whereby English will be the official language of the state, rather than German, which was the other possibility. As part of the negotiations, the Terminator's Government conceded that English spelling had some room for improvement and has accepted a 5-year phase-in plan that would become known as "Austro-English" (or, perhaps even better, "Austrionics"). In the first year, "s" will replace the soft "c". Certainly, this will make the sivil servants jump with joy. The hard "c" will be dropped in favour of the "k". This should klear up konfusion, and keyboards kan have one less letter. There will be growing publik enthusiasm in the sekond year when the troublesome "ph" will be replaced with the "f". This will make words like fotograf 20% shorter. In the 3rd year, publik akseptanse of the new spelling kan be expekted to reach the stage where more komplikated changes are possible. Governments will enkourage the removal of double letters which have always ben a deterrent to akurate speling. Also, al wil agre that the horibl mes of the silent "e" in the languag is disgrasful and it should go away. By the 4th yer peopl wil be reseptiv to steps such as replasing "th" with "z" and "w" with "v". During ze fifz yer, ze unesesary "o" kan be dropd from vords kontaining "ou" and after ziz fifz yer, ve vil hav a reil sensibl riten styl. Zer vil be no mor trubl or difikultis and evrivun vil find it ezi tu understand ech oza. Ze drem of a united urop vil finali kum tru. If zis mad yu smil, pleas pas it on to oza pepl.

Word 2010's spellchecker considers the spelling of all the words below as being *correct*. Nevertheless, each sentence except one possesses a word that is spelled wrongly because it is used in an incorrect context. Find these twelve misspelled words and identify the one *correct* sentence without a spelling mistake. The solutions are given in section 1.6.1.

1. You must proof that two plus two equals four!
2. A prove that two plus two equals four is given on the first page.
3. Vaccines safe lives.
4. Spellcheckers chance the way we read our texts.
5. The theory of global warming remains to be proven.
6. Spellcheckers effect our ability to spell.
7. How do tortoises remain a life when hibernating?
8. Only a few scientists have received two Nobel Prices.
9. The affect of technology on the environment is substantial.
10. We loose the loose screw.
11. We judge how we live our lives form our own perspective.
12. The ability to write concisely and accurately is not heredity.
13. The price of the prize was a surprize.

1.1.1 British or American?

Students have many questions at the beginning of a new course. The above question concerning the English to choose for their spellchecker is the most common. A *frequent* variant, often posed by post-graduate students and post-docs, is whether American English must be used to write a manuscript that will be submitted to an American journal. The answer to both questions is that it is not important which variant of English you choose. It is far more important that your English is clear, comprehensible and concise. An editor of a journal will not reject a manuscript because the spelling, vocabulary and punctuation are from an English-speaking person situated on another continent. Setting commas in the American way or writing “sulphate” instead of “sulfate” will not affect the fate of your manuscript. Once a journal accepts a scientific manuscript for publication, the production department will use its own spellchecker and software to put the manuscript into the style of the journal.

If you are just beginning to write scientific manuscripts, consider using American English. Two characteristics make it easier to learn and to use. First, spelling in American English is simpler and less perverse than in British English. Second, American English is younger than British English. The grammar of American English has, as predicted by Schopenhauer, become less perfect than British English. One example of this greater simplicity is the *absence* from American English of *certain* prepositions that British English absolutely requires. Thus, the British journal “Nature” might write “On Monday, the students protested against the removal of scientific writing from their curriculum.” In contrast, the American journal “Science” would structure the sentence with two fewer prepositions: “Monday, the students protested the removal of scientific writing from their curriculum.” The use of prepositions in any language is usually tricky. Anything which eliminates two of them at a stroke must make a writer’s life easier.

Further evidence to support the hypothesis that American English is simpler than British English comes from a comparison of the names of musical notes (box 1.3). The American system is straightforward and logical. The British system is complicated and not very informative. Three of the words say nothing about the property of the note. The word “semi-breve” seems to *indicate* half of something, but it *actually* describes a full note. The word “breve”, meaning two notes, did exist, but it has become obsolete. There are many other examples of illogical words in British English. Non-native speakers may even have the feeling that the team of Monty Python’s Flying Circus was involved in developing British English. The habitually bizarre and unpredictable nature of British English was perhaps one of the reasons why Monty Python’s Flying Circus could only have originated in Great Britain.

In summary, do not waste time thinking about your choice of English. Concentrate *instead* on the guidelines and suggestions in this and the following chapter. They are much more likely to improve the quality of your manuscript than your choice of English. Readers will remember the quality of your manuscript and its advance in knowledge. They will not remember whether your manuscript contained American or British English.

Musical note	American English	British English
	full note	semibreve
	half note	minim
	quarter note	crotchet
	eighth note	quaver
	sixteenth note	semiquaver
	thirty-second note	demisemiquaver
	sixty-fourth note	hemidemisemiquaver
	hundred twenty-eighth note	semihemidemisemiquaver

1.2 Formal English, the language of science

Formal English is quite different from the English found in novels, newspapers, emails and social media accounts. In formal English, words are chosen to fit a *certain* style and are written out in full. In addition, all sentences are complete, linked together and properly punctuated. This section provides guidelines on writing this type of English.

1.2.1 Complete sentences

What is a complete sentence? A complete sentence relates a finished thought or action. An incomplete sentence leaves the reader searching for the full meaning or with the impression that something vital has been omitted. The exercises 3.6.2, 5.2.1 and 5.3.1 provide examples of incomplete or *poorly* constructed sentences for you to identify and improve.

Scientific manuscripts may, however, contain incomplete sentences as part of their title. Titles such as “Measurement of the speed of the expansion of the Universe” or “Discovery of a new gene linked to Alzheimer’s disease” are quite common. *Similarly*, the titles of the figures showing the data are often incomplete sentences. There are two reasons why titles are sometimes written in this way. The first is that they sound punchier, in the same way that newspaper headlines are often not complete sentences. The second is to reduce the number of characters required. Many journals often have quite strict limitations on the number of characters in the title.

Punctuation marks are *essential* information signs for the reader. They include: full stops (.), commas (,), semi-colons (;), colons (:), question marks (?), exclamation marks (!), quotation marks ("") and brackets (). Full stops, signifying the end of a sentence, are relatively straightforward to use. In contrast, the other punctuation marks are often a source of uncertainty. This section contains some suggestions that should ensure that most of your punctuation marks are *correct*. Do not worry about the remainder. A journal will not return your manuscript just because some commas are in the wrong place.

1.2.2.1 The comma

Commas are perhaps the greatest source of difficulty. Life can, *however*, be simplified by the realisation that there are basically only three situations in scientific English in which commas are necessary. There is also one *situation* in which a comma is not necessary. These four situations are outlined below.

Use commas when making a list such as “u, v, x, y and z”. British English does not require a comma before “and” whereas American English does. The presence or absence of a comma before the “and” will not affect the success of your manuscript. In the related list “p, q, r as well as t”, neither British nor American English requires a comma before “as well”.

Use commas as weaker brackets to show material that is not central to the sentence. You might want to write the following sentence.

“Our latest results, obtained using a recently developed technique, also support our overall hypothesis.”

The information between the commas provides extra information which is not *essential* to understand the meaning of the sentence.

Use a comma after a linking word (that is words such as “however”, “furthermore”, “additionally”) at the start of a sentence, or after a phrase that qualifies or introduces the main part of the sentence. This will tell the reader where to look for the main part of the sentence. For instance, look *closely* at the following sentence.

“As expected, levels of bacterial growth increased during the course of the illness.”

Try reading the sentence without the comma and you will notice how the meaning changes. Here are further examples of this comma in scientific writing:

“To investigate this idea, we performed the experiment in Figure 1.”

“Although these guidelines do not show every possible use of the comma, they are very useful.”

“Provided that you are careful in its use, a spellchecker is a valuable tool.”

Do not use a comma before “that” in a sentence such as “We showed that this hypothesis is false.” Unlike some other languages, this is one situation in which a comma in English is not needed.

1.2.2.2 The semi-colon

The semi-colon should be used to divide a sentence into two halves when the second half expands upon or qualifies the first. When should you use a semi-colon and when a full-stop? A semi-colon is necessary when the two halves of the sentence are part of the same thought. If they are not, the two halves of the sentence are *bona fide* complete sentences and a full-stop is necessary. Never use more than one semi-colon per sentence.

1.2.2.3 The colon

Use the colon only in the following two circumstances. The first is to introduce a list, as the next sentence illustrates.

“We measured the following physiological parameters of competitive skiers: pulse rate, blood pressure, oxygen consumption and lactate concentration.”

The second circumstance in which a colon can be used is to divide the title of a manuscript into two halves. The first half of the sentence introduces the global subject area. The second half states the part of this area under investigation. This strategy eliminates the verb and saves characters. Examples might be “Global warming: the contribution of deforestation” or “Biodiversity: the *impact* of abolishing lawn mowing”. These titles are further examples of incomplete sentences that are allowed in scientific writing.

1.2.2.4 The question mark

Question marks are used frequently in scientific manuscripts because asking questions is a fundamental scientific activity. The “introduction” section to a manuscript may pose a specific question that the experiments in the results are designed to answer. The “results” section may use questions to introduce why specific avenues of investigation were taken. Posing questions in the “discussion” section is a lively way of bringing in a new interpretation or moving to a related topic.

1.2.2.5 The exclamation mark

Exclamation marks, expressing surprise or an order, are almost completely absent from scientific writing. You may need them in your emails, blogs and text messages, but you can forget about them in your thesis and your manuscripts.

1.2.2.6 Quotation marks

Quotation marks are used in scientific English to indicate that you have taken a phrase or sentence from a piece of work and have used it directly without any modification. Direct quotes from written work by another author should always contain a reference to that work. There is no law which says how many or how long direct quotes should be. If you have read some scientific manuscripts, you will have noticed that direct quotes are rare. Scientists prefer to *describe* the work of others in their own words and give a reference to the original paper. Such sentences take the form of “Smith and Jones (Smith and Jones, 20xx) reported that A is converted into B” or “Li and Yu provided evidence that X can be generated from Y (Li and Yu, 19xx).” It is a sign of scientific maturity when you can express the work of others in your own words.