

Scientific Writing

Easy When You Know How

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BMJ Books

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Introduction

*True ease in writing comes from art, not chance,
As those who move easiest have learnt to dance.*

Alexander Pope (1688–1744)*

Everything is easy when you know how! The skill of scientific writing is no exception. To be a good writer, all you need to do is learn and then follow a few simple rules. However, it can be difficult to get a good grasp on the rules if your learning experience is a protracted process of trial and error. There is nothing more discouraging than handing a document that has taken hours to write to a coworker who takes a few minutes to cover it in red pen and expects you to find this a rewarding learning exercise.

Fortunately, there is a simple way into the more fulfilling experience of writing so that readers don't feel the need to suggest corrections for every sentence in every paragraph. Once you can write what you mean, put your content in the correct order, and make your document clear and pleasurable for others to read, you can consider yourself an expert writer. By developing good writing skills, you will receive more rewarding contributions from your coauthors and reviewers and more respect from the academic community. If you can produce a document that is well written, the review process automatically becomes a fulfilling contribution of academic ideas and thoughts rather than a desperate rescue attempt for bad grammar and disorganisation. This type of peer review is invaluable for improving the quality of your writing.

If your research is important for progressing scientific thinking or for improving health care, it deserves to be presented in the best possible way so that it will be published in a well-respected journal. This will ensure that your results reach a wide range of experts in your field. To use this process to promote your reputation, you will need to write clearly and concisely. Scientific writing is about using words correctly and

*The opening quote was produced with permission from *Collins Concise Dictionary of Quotations*, 3rd edn. London: Harper Collins, 1998: p 241.

finding a precise way to explain what you did, what you found, and why it matters. Your paper needs to be a clear recipe for your work:

- you need to construct an introduction that puts your work in context for your readers and tells them why it is important;
- your methods section must leave readers in no doubt what you did and must enable them to reproduce your work if they want to;
- you must present your results so that they can be easily understood, and discuss your findings so that readers appreciate the implications of your work.

In this book, we explain how to construct a framework for your scientific documents and for the paragraphs within so that your writing becomes orderly and structured. Throughout the book, we use the term “paper” to describe a document that is in the process of being written and the term “journal article” to describe a paper that has been published. At the end of some chapters, we have included lists of useful web sites and these are indicated by a reference in parenthesis (www¹) in the text.

We also explain how the review and editorial process functions and we outline some of the basic rules of grammar and sentence construction. Although there is sometimes a relaxed attitude to grammar, it is important to have a few basic rules under your belt if you want to become a respected writer. To improve your professional status, it is best to be on high moral ground and write in a grammatically correct way so that your peers respect your work. You should not live in the hope that readers and editors will happily sort through muddled thoughts, struggle through verbose text, or tolerate an uninformed approach. Neither should you live in the hope that the journal and copy editors will rescue your worst grammatical mistakes. No one can guarantee that such safety systems will be in place and, to maintain quality and integrity in the research process, we should not expect other people to provide a final rescue system for poor writing.

The good news is that learning to write in a clear and correct way is easy. By following the guidelines presented in this book, the reporting of research results becomes a simple, rewarding process for many professional and personal reasons. We have

tried not to be pedantic about what is right and what is wrong in pure linguistic or grammatical rules but rather to explain the rules that work best when presenting the results of scientific studies. We hope that novice writers will find this book of help to start them on a meaningful path to publishing their research, and that seasoned scientists will find some new tips to help them refine their writing skills.

Acknowledgements

We extend our thanks to the researchers who were noble enough to allow us to use their draft sentences in our examples. None of us writes perfectly to begin with or expects to see our first efforts displayed publicly. We are extremely grateful to the many people with whom we have worked and learnt from and we hope that they, in turn, receive satisfaction from helping others to become better writers.

8: Writing style

There are two good reasons why it is desirable to write clearly: first, to be sure that you yourself know what you mean and second, to be sure that you get your message across to your readers.

Mimi Zeiger¹

The objectives of this chapter are to understand how to:

- begin each paragraph with a purpose
- understand the basic format of sentences
- achieve clarity, brevity, and precision in your writing
- create an easily readable paper
- avoid common problems in sentence construction

The style in which you write and present your paper is of fundamental importance for achieving brevity and clarity. To convey messages effectively in written form, it is essential to have organisation both between and within your paragraphs. In this chapter, we outline some tips of how to achieve this. Further resources on how to write clearly and effectively and educational material additional to the information presented in the following chapters can be found on the web (www¹⁻⁵).

Plain English

Prose – like food – is more easily taken in small bits.

Australian Government Publishing Service²

Plain English is “the art of using language that the intended audience can understand and act upon from a single reading” (www³). This concept has been widely adopted by many

government and legal organisations, and, in some countries, new laws must now be drafted in plain English. At Cambridge University, there is even a Professor of Plain English. The Plain English Campaign that began in 1979 has promoted the use of crystal clear language and campaigned against jargon, gobbledygook, and other confusing language. The campaign also recognises that appearance matters and that the design, typeface, and layout of a paper can be as important as the language for conveying meaning. The campaign website provides free guides to plain English, details of training courses and a range of example material including a collection of gobbledygook entitled “Utter drivel”. The website also includes advice about scientific writing. In the following sections, we outline our own tips and examples of how to write in plain English.

Topic sentences

Effective writing is writing that works. It does the job without anyone having to ask for further explanation. If it informs, it does so clearly – the reader does not have to ask for more information.

Elizabeth Murphy³

Before you begin writing a paragraph, you must have a clear concept of what it is going to be about. A paragraph can be beautifully constructed but can be difficult to understand if it is not organised around a defined topic. Organising your thoughts in each paragraph can be easily achieved by using a topic sentence. Topic sentences begin a paragraph and explain what it will be about. The topic sentence creates the expectation of what the paragraph will be about and the supporting sentences fulfil that expectation.⁴ For this reason, topic sentences are an essential tool for organising paragraphs and for improving the readability of your paper. Once the topic sentence has been correctly framed, the paragraph is completed with supporting sentences that give all the remaining information that the reader needs to know. Topic sentences are especially useful for writing the introduction and discussion and, to an extent, the results section. In the

methods and abstract, the standard subheadings tend to replace the need for topic sentences.

If a paragraph begins with a clear topic sentence, you immediately get a good idea of what information will follow. For example, a sentence such as *Enterovirus infections in the neonatal period are common and are associated with significant morbidity and mortality* makes the paragraph content clear.⁵ If you cannot write in one clear sentence what your paragraph is going to be about, then perhaps you do not need to include the paragraph at all. If you have multiple messages in your paragraph, you will need to deconstruct it into multiple paragraphs or tie the messages together in a single theme. Box 8.1 shows how the topic sentence, which is underlined, summarises the context of the paragraph and is followed by a number of sentences that support it.

Box 8.1 Example of writing a paragraph by using topic sentence followed by supporting sentences

It is unlikely that bias or confounding would account for a large proportion of the clinically important differences that we found between our study groups. The participants were selected randomly from the electoral role, we achieved a high response rate, and we used objective measurements to collect our main outcome data. Although, for safety reasons, our observers could not be blinded to the health status of the participants, objective measurements are more reliable than self-reported symptom history that is subject to recall bias. Moreover, by using multivariate analyses, we were able to adjust for any effects of major confounders. In these ways, we were able to minimise selection bias and measurement error, and we were able to control for confounding.

Topic sentences not only let the reader know what a paragraph is about but also force you, as a writer, to organise your material logically. In organising your ideas into separate thoughts and in writing topic sentences to describe the content of your paragraphs, you instil a clear and purposeful structure to your writing. Topic sentences are like mini-subheadings that act as signposts to direct readers to the part of the journal article that they are trying to find. Simply by

scanning down the topic sentences, you should be able to see what information is contained in the section. Organising a paper in this standard pattern is akin to taking your reader by the hand and leading them through your thoughts. Box 8.2 shows the topic sentences in the order presented from the paragraphs of a discussion section. By scanning down the topic sentences you get a clear idea of the main issues that are discussed.

Box 8.2 Example of topic sentences adapted from a discussion section⁶

This study has important implications for both the prevention and treatment of asthma.

To estimate allergen exposures, we analysed dust from homes using an immunoassay that is sensitive and specific for measuring housedust mite allergens.

The data from the current studies add strength to the evidence that there is a causal relation between housedust mites and asthma.

We have been able to evaluate the independent effects of exposure to housedust mites by presenting the data as adjusted odds ratios that take account of sensitisation to other common allergens.

The evidence that housedust mite allergens have an important association with asthma morbidity continues to accumulate.

There is encouraging evidence that reduction of housedust mite allergen exposure can reduce asthma morbidity.

Because the prevalence of asthma has increased substantially in recent years, it is important that all avenues of preventing asthma are explored.

Subjects, verbs, and objects

Drama is life with the dull bits cut out.

Alfred Hitchcock (1899–1980)

The simplest and most easily understood sentences are constructed in a subject–verb–object format. The subject is a

noun or noun cluster that begins the sentence and the object is the noun or noun cluster that ends the sentence. The two parts are then joined by a verb or verb cluster in the centre. If we take the sentence *However, cases are difficult to ascertain through retrospective population studies*, you will see that this is made up of a conjunction (*However*), a subject (*cases*), a verb cluster (*are difficult to ascertain*) and an object (*through retrospective population studies*) that is a noun cluster. Similarly, the sentence *Hospital statistics show that respiratory infections occur mostly in winter*, has a subject (*hospital statistics*), a verb (*show*) and an object (*that respiratory infections occur mostly in winter*). Both the subject and object are noun clusters.

It is important to understand this construction for analysing sentences to make them work better and flow together nicely. Of course adjectives, adjectival phrases, and clauses can be thrown in, but, if you deviate too far from the *subject-verb-object* format, your sentence will be weighed down by too many messages. Sentences become more complicated when they are made up of two simple sentences strung together or when additional phrases and clauses are added to make a compound sentence. The construction of these types of sentences is discussed in more detail in the following chapters.

Eliminating fog

One of the really bad things you can do to your writing is to dress up the vocabulary, looking for long words because you're maybe a little bit ashamed of the short ones. This is like dressing up a pet in evening clothes.

Stephen King⁷

It is essential to eliminate any fog, which is the dubious art of using vague thoughts and woolly words rather than short, direct ones. You can minimise fog by keeping every sentence simple and by saying exactly what you mean. To do this, you need to analyse each sentence, eliminate the unnecessary phrases and inspect the words that you have chosen.

Non-foggy writing means using simple sentences without jargon and with as few words, phrases, and clauses as possible. Readers do not want to read sentences over and over again or go in search of further information before they understand what you were trying to tell them. Few readers enjoy sifting through poor writing, pondering over ambiguities, and vainly trying to work out what they think you thought when you committed your words to paper.

Eliminating foggy writing has many benefits. The most fundamental benefit will be that you clarify your own thinking. At the beginning, you may think that you know what you want to say, but writing it down clearly can be hard. However, by working through your thoughts and by putting them in writing, you should quickly discover what you want to say and why. You may also discover that you have some inconsistencies in thinking and some incoherent ideas. In trying to write without fog, you will clarify your own ideas and be able to express what you mean more clearly to others.

You need to ensure that you do not confuse your reader by writing ambiguous sentences or by writing sentences that do not reach a proper conclusion. These types of sentences leave the reader's thoughts in mid-air.

To eliminate fog, you need to remove any fuzzy writing and unnecessary jargon. Box 8.3 shows some examples of taking the “fog” out of a sentence. In the first example, the word count is reduced from 39 to 28 words and in the second example from 36 to 20 words (in both cases a 28% reduction). By eliminating the fog, the meaning of the sentence becomes much clearer. In the third example, the two long word clusters can be written more directly. In the fourth example, 16 words (46% of the original sentence) are removed to achieve a short, clear sentence. In examples five and six, 57% and 32% of words are removed respectively. In all examples, the corrected sentence is shorter and more direct.

Most of us can think more clearly if we have to explain a concept to another person in verbal rather than in written form. If you are unsure of what you are trying to write, it is best to leave the keyboard and find someone with whom you can discuss your thoughts. Alternatively, try closing your eyes

Box 8.3 Eliminating fog (shown underlined)

- 1 ✖ Bias is likely to occur if the only subjects who are enrolled are those who are chosen specifically on the basis of the presence or absence of disease so that potentially “false positive” or “false negative” cases are excluded.
 - ✓ Bias can occur if participants are chosen on the basis of the presence or absence of disease so that potential “false positive” or “false negative” cases are excluded.

- 2 ✖ Although adults with severe obesity reported more symptoms of wheeze and shortness of breath, this was not associated with an increase in the prevalence of atopy or AHR suggesting that the prevalence of asthma is not increased in this group.
 - ✓ Although severely obese adults experienced more wheeze and shortness of breath, this was not associated with a higher prevalence of atopy or AHR, suggesting that this group does not have a higher prevalence of asthma.

- 3 ✖ Observer variation is due to the inability of researchers to administer tests in a standardised way.
 - ✓ Observer variation is caused by differences in the ways in which researchers collect data.

- 4 ✖ In considering diseases that might be ameliorated by gene therapy, a setting in which a selective advantage is conferred by a transgene expression in association with long-lived transduced cells such as T-lymphocytes may prove critical.
 - ✓ The selective advantage conferred by transgene expression and long-lived transduced cells may be critical to the success of gene therapy.

- 5 ✖ The results of this randomised, double-blind, placebo-controlled trial demonstrated that this drug is effective for the treatment of seizures in children and adults. This is the first study to demonstrate a statistically significant effect of this drug compared with a placebo in patients with seizures.
 - ✓ This is the first time that this drug has been shown to be effective for the treatment of seizures.

- 6 ✖ Patient compliance with medication regimens is an area that is seen as being important because of the relationship between health-related behaviours and the short- and long-term outcomes of disease.
 - ✓ Compliance with medication regimens is an important research area because health behaviours are related to short- and long-term disease outcomes.

to imagine how you would explain what you want to say to a colleague or to family or friends who know nothing of your work. Once you have spoken your thoughts in a simple and straightforward way, it is often much easier to write them clearly. For this reason, studies that have been presented at conferences are more easily written up as papers than studies that have not had this advantage.

Say what you mean

There goes the man that writ a book that neither he nor anybody else understands.

(A student remarking on Sir Isaac Newton and his monumental book on mathematics called *The Principia*)

As scientists, we always need to convey a clear and precise meaning. Although we all know what we mean and can describe what we mean when questioned, writing can be more difficult. In scientific writing, it is important to select words that have a clear meaning and that are not open to different interpretations. You may know what you mean when you write *being exposed to environmental tobacco smoke and sex were important risk factors for childhood infections* but the words *gender* or *being male* would have been a better word choice than *sex*. Also reordering the phrases would help so that the sentence is *Gender and being exposed to environmental tobacco smoke were important risk factors for childhood infections*.

As shown in Box 8.4, you need to use phrases that are unambiguous. In each example, you can see how the meaning becomes clearer when the correct words are used. In the first example, diagnosis is not an event that can recur in an individual and so the term *less often diagnosed* is inappropriate. The second example suggests that a rat can be culled more than once, which is clearly impossible. The third example suggests that atopy, symptoms, and asthma increase in adults as they put on more weight rather than saying that overweight people have a higher prevalence of symptoms, as is intended.

Box 8.4 Saying what you mean

- 1 ✖ Dermatitis in the first year of life was less often diagnosed in the active intervention group.
 - ✓ A diagnosis of dermatitis in the first year of life was less prevalent in the active intervention group.

- 2 ✖ Professor Jones has agreed that we can have access to some of his rats that are culled on a regular basis.
 - ✓ Professor Jones will provide a regular supply of tissue from culled rats.

- 3 ✖ Although adults with severe obesity reported increased symptoms of wheeze and shortness of breath, this was not associated with an increase in atopy or asthma.
 - ✓ Severely obese adults have a higher prevalence of wheeze and shortness of breath but do not have a higher prevalence of atopy or asthma.

- 4 ✖ After five days, the symptoms had improved.
 - ✓ After five days, the symptoms had abated.

- 5 ✖ Not all cases of this illness occur in the presence of a family history and these sporadic cases present some further difficulties to the clinician.
 - ✓ Sporadic cases of this illness that occur in the absence of a family history may be difficult to diagnose accurately.

- 6 ✖ This test has long been used as a surrogate estimate of disease severity and despite being called into question has remained in widespread use.
 - ✓ This test has been used to measure disease severity since the early 1970s and, despite having poor prognostic value, remains in widespread use.

- 7 ✖ The calves are thin due to muscle hypertrophy around the lower leg, although adipose psuedohypertrophy has also been reported in rare cases and should be considered when evaluating the clinical picture.
 - ✓ Muscle hypertrophy and, in rare cases, adipose psuedohypertrophy result in thin lower legs and are important clinical signs for making a diagnosis and evaluating prognosis.

- 8 ✖ Positive controls have been a problem for all units around the world.
 - ✓ All research units have found it difficult to recruit positive controls.

- 9 ✘ As a comparator between cases, family history and the frequency of symptoms are not well correlated with clinical disease severity.
- ✓ Because family history and the frequency of symptoms are not related to disease severity, they cannot be used to identify subtypes of this disease.

In examples 4 to 8 in Box 8.4, the underlined words are open to interpretation and are replaced with more precise and unambiguous terms. In example 9, the word *correlated* is not a good verb to use. The word *correlate* has a specific statistical meaning and should only be used in this context. The word should not be used in a general sense to suggest that two factors are related in some way.

Word order

For your born writer, nothing is so healing as the realization that he has come upon the right word.

Catherine Brinker Bowen
(www.bartelby.com)

The correct sequencing of words within a sentence is of paramount importance. If you don't put your words in the correct order, your messages will not flow logically and your sentence will not make sense at first read. The following classified advertisement which appeared in a local newspaper is a good example of incorrect word order: *Stock horse stallions standing at stud: Reverlee and Freckles Oak. Foals can be viewed by the above stallions.*

Readers should not have to reorganise words to decipher the correct meaning. Neither should readers have to get to the end of a sentence to find out what they needed to know at the beginning. Box 8.5 shows examples of sentences that read more clearly when the words are reordered. In the first example, the word *asthma* is used incorrectly as an adjective and, because the increase in prevalence is the topic of the sentence, this phrase is better placed at the beginning. This sentence benefits from making the sentence into one main clause and from removing some of the prepositions.

In the second example, the sentence works better when the word *less* is used correctly to describe the word *prone* rather than the error. In the third example, the essential phrase, *In indigenous people who attended the emergency department*, is better placed at the beginning of the sentence so that you don't have to read all the way to the end of the sentence to discover to which group the results apply.

In the fourth example, the transition word *however* is misplaced within the sentence. Transition words or conjunctions do their job in maintaining flow better if they are used at the beginning of a sentence rather than interrupting the subject–verb–object flow. Also, the word *current* is better used as an adjective to further describe the type of information than as the adverb *currently* to describe the verb.

Box 8.5 The order of words is important

- 1 ✘ Although it is well recognised that asthma prevalence is increasing, this has occurred only in children and not in adults.
✓ An increase in the prevalence of asthma has been documented in children but not in adults.
- 2 ✘ Because objective measurements are prone to less observer error and reporting bias, they are preferred for use as primary outcome measures.
✓ Because objective measurements are less prone to observer error and reporting bias, they are preferred for use as primary outcome measures.
- 3 ✘ The prevalence of atopy to rye grass pollen was 24% in indigenous people who attended the emergency department.
✓ In indigenous people who attended the emergency department, the prevalence of atopy to rye grass pollen was 24%.
- 4 ✘ There is, however, currently no information about the burden of cerebral palsy in NSW.
✓ However, there is no current information about the burden of cerebral palsy in NSW.

The order in which you present the information in each sentence also depends on the context in which you are writing and the audience you are writing for. Sentences that work best

are those in which the subject of the sentence is the main topic of your study. In this way, you provide the most important information at the beginning of the sentence and you set the context correctly. For example, you may have conducted a cross-sectional study in which you measured the risk of children developing gastrointestinal infections and investigated whether this was associated with breastfeeding. Box 8.6 shows how you might change the topic of your sentence according to whether you are reporting your study for a gastrointestinal journal, a paediatric journal, or an epidemiological journal. The data may be from the same study but your choice of word order is important for delivering a clear message to your audience.

Box 8.6 Changing the order in your topic sentences

Gastrointestinal context	Gastrointestinal infections were less common in infants who were breastfed.
Infant feeding context	Breastfeeding significantly reduced the incidence of gastrointestinal infections in infancy.
Epidemiological context	There was a lower incidence of gastrointestinal infections in breastfed infants.

Rearranging words can be just as much fun as rearranging numbers. One fun thing to do with numbers is to arrange 1 to 9 in a magic square so that the rows, columns and diagonals all have the sum of 15. Try it – it doesn't take long (the answer is at the end of this chapter). This magic square is called the *Lo Shu*.⁸ If arranging numbers can be fun and satisfying, so can rearranging your words.

Creating flow

Writing, when properly managed, ... is but a different name for conversation.

Laurence Sterne (1713–1768)

Clarity depends on a smooth flow of ideas and a smooth transition between sentences and between paragraphs. In addition to making your paragraphs look nice, it is important to create flow because this allows the mind to travel along a path to instant understanding. Fellow researchers and clinicians need to be able to read your text once and understand what it means without their thoughts being left in temporary suspension at unexpected junctions. No reader wants to endure endless “stop and think” pauses to decipher how an idea in one sentence links to the ideas in the next. Writing that flows and is easy on the mind will always be appreciated.

There are two main methods for maintaining a flow of ideas from one sentence to the next. One method is to use conjunctions or transition words to link sentences. Classical transition words, such as *although*, *therefore*, *however*, *for example*, etc., are useful for joining things together. Nevertheless, you cannot keep using transition words throughout a paragraph. Box 8.7 shows a paragraph in which a transition word is used to begin each sentence. The messages of the paragraph are reasonably clear but the overload of transition words reduces rather than aids readability. Although transition words work occasionally, other skills are also needed to create flow.

Box 8.7 Using transition words to begin sentences

In addition, it is widely recognised that most cases of child sexual abuse are not reported to authorities. Therefore, prevalence rates that include reported and unreported cases more accurately describe the extent of the problem of child sexual assaults in communities. However, cases are difficult to ascertain through retrospective population studies. For example, there is an inverse association between study response rates and the estimated prevalence of child sexual abuse.

Another method to create flow between sentences is to link the beginning (or subject) of the sentence to the end (or object) of the previous sentence. Linking subjects to objects between sentences helps to maintain ideas in the reader’s mind because it avoids any abrupt change of thoughts when a full stop is reached.

The examples in Box 8.8 show that by simply reordering the words and creating an *object-to-subject* flow between

sentences, the ideas are carried forwards and do not jar the mind. In examples 1–3, the second sentence is simply reordered. Even if the linking word can't be moved to the very beginning of the second sentence, moving it as close as possible still helps. In example 4, the reference to *prevalence* is moved closer to the beginning of the second sentence and the new concept, *incidence*, is moved to the end, clarifying the message.

Box 8.8 Creating flow between sentences

- 1 ✘ Obesity is a key risk factor for cardiovascular disease. In Australia, over 50% of adults are overweight or obese.
 ✔ In Australia, over 50% of adults are overweight or obese. Being overweight is a significant risk factor for the development of cardiovascular disease.
- 2 ✘ We conducted a study of children of whom 10% had diabetes. We found a higher incidence of obesity in children with diabetes.
 ✔ We conducted a study of children of whom 10% had diabetes. Children with diabetes have a higher incidence of obesity.
- 3 ✘ We found that 43% of parents smoked. Children were at a higher risk of having respiratory infections if their parents smoked.
 ✔ We found that 43% of parents smoked. Children with a parent who smokes are at higher risk of having respiratory infections.
- 4 ✘ Prevalence is calculated from the total number of cases of disease in a population at a specified time. Unlike the incidence rate, the number of remissions and deaths that occur influences the prevalence rate.
 ✔ Prevalence is the proportion of a population with a disease at a specified time. The number of remissions and deaths influences prevalence rates but not incidence rates.

In addition to creating continuity by using good transitions, repeating key terms throughout a paragraph can also help to maintain thought processes. However, it is a good idea to avoid using the same word twice in one sentence because this becomes boring. Also, repeating a word in a sentence usually signals a construction problem because it does not make sense for the same word to be both the subject and the object of a

sentence. The examples in Box 8.9 show how sentences become neater and more interesting when the words are reorganised and the repeated term is removed.

Box 8.9 Avoiding repetitions

- 1 ✖ We need reliable screening procedures for identifying the signs and symptoms to identify children who are at greatest risk.
✓ We need reliable screening tools to identify children who are at greatest risk.
- 2 ✖ No adequate clinical measures for quantifying back abnormalities in the clinical setting are currently available.
✓ There are no adequate methods for quantifying back abnormalities in clinical settings.
- 3 ✖ The results of this study suggest that control of neonatal infections is possible through good infection control practices.
✓ The results of this study suggest that neonatal infections are being reduced by current infection control practices.

Tight writing

Cutting dross allows your information to shine more clearly. In the early 1900s, Professor William Strunk used to tell his students: "Omit needless words, omit needless words, omit needless words." (Once should have been enough, but he was keen.)

Martin Cutts⁹

Tight writing is the art of achieving brevity by using short, concise sentences. Given that every book or article on writing recommends this style as a matter of course, it is surprising that so few writers aspire to this ideal. Readers love sentences and paragraphs that have a minimum number of words and that only include the information that they really need.

You must write tightly if you want to please your readers. Readers are busy people who want to be able to understand your paper quickly and do not want to spend time sorting out meanings from meandering text. Tight writing is a simple process. All you have to do is put your thoughts down in a sentence, then be your own best critic and see how many words

you can leave out. Finally, when you have a series of short, concise sentences, you need to arrange them in a logical order and join them up to create flow. In doing this, you suddenly have a neat way to tell your story. This is a skill that is certainly worth perfecting if you would like to publish productively. If you follow this formula, you will automatically please your readers, reviewers, and publishers. In doing this, you will also earn yourself respect as a “good writer”, which is a reputation worth striving for. Box 8.10 shows how removing long or redundant phrases improves readability.

Box 8.10 Removing long or redundant phrases

- 1 ✘ Sexual assault against a child presents a significant problem to society and there is much evidence that sexual assault impacts negatively on the psychosocial development of children.
 - ✓ Sexual assault has a negative impact on the psychosocial development of children.
- 2 ✘ It may be expected that the prevalence of relatively mild asthma could be underestimated.
 - ✓ The prevalence of mild asthma could have been underestimated.
- 3 ✘ The severity of this disease has been demonstrated to be associated with age.
 - ✓ The severity of this disease increases with age.

If you are finding it hard to write tightly, it is a good idea to put your draft away for some time and then revisit it when you can be more objective. When you are ready to revise it, begin with a plan to keep your sentences as precise as possible. Inspect your long sentences and decide whether they are overburdened with adjectives, adverbs, prepositions, and pronouns. However, if you cut a sentence into two, ensure that each short sentence stands alone in that its meaning is clear even when it is isolated from its neighbours or from the remainder of the paragraph.

If you are having problems in trying to shorten your sentences, a good trick is to first identify the main “subject–verb–object” section and then prune away at the remainder. After you have done this, inspect your verb construction and

ask yourself if it could be shorter. For example, constructions such as *has been shown to be* can often be replaced by *is* if the evidence is definitive or *may be* if the evidence is less certain. When the extraneous words and repetitions are removed, the readability of the sentence suddenly improves.

In shortening sentences, do not go to extremes. You must resist deleting necessary details simply to cut words. If you oversimplify a sentence so that the true meaning is lost, you will achieve brevity at the expense of clarity. For example, it is better to say *We are planning to conduct a study of preventive health services for children with Down syndrome* than to say *We are doing a study of preventive health services for children with Down syndrome*. The latter is shorter but suggests that you are working on it at this present moment whereas the first sentence is factually correct.

Box 8.11 shows how reducing words, simplifying messages, and omitting needless phrases can achieve brevity and clarity and improve the readability of both the title and the text. The mean number of words per sentence is only reduced from 29.6 with a range of 19–37 words in the original version to 29.0 with a range of 22–35 words in the revised version. However, the total word count has been reduced from 220 to 118 (a 46% reduction) and the number of sentences from 7 to 4 (a 43% reduction). It all depends on what you want to achieve. Tight writing creates text that is easy and enjoyable for your audience to read and displays a high regard for both your peers and reviewers, who are almost always busy people.

Box 8.11 Example of reducing words to achieve brevity and clarity

✱ Original version

Development of a composite, criterion-based, observational, clinical rating system for the quantification of back posture

There are a number of existing methods for assessing back posture in the clinical setting but all have significant limitations. Many measures have been criticised for poor reliability, and few have been subjected to adequate validation, furthermore most extant measures are based on quantification of a single plane or segment. While such

measures are widely used, they cannot describe the complexity of back function, and there is a consensus in the literature that there is not an adequate, quantitative method for assessing back posture in routine clinical practice. The 1997 report of the Research Council of the American Physical Therapy Society rated development of such outcome measures as the third most important research area out of 40 separate categories. This study represents the second of six stages in constructing such a clinically applicable tool, the Back Posture Rating (BPR). Emphasis has been placed on clinical measures that could be conducted easily, are time-efficient, do not require costly technology, are readily understandable to the clinician, and yield quantitative data at a minimum of ordinal level. The combination of measures comprising the BPR is also sensitive to posture in all of the three body planes and can provide separable information on the high, mid, and lower segments.

✓ Revised version

Clinical assessment of back posture

Methods for quantifying back problems have lacked reliability, have not been validated and, because they are based on a single plane or segment, do not take account of the complex nature of back function. As a result, the American Physical Therapy Society rated the development of a back function measurement as its third most important research goal. The aim of conducting this study was to test the reliability of a new Back Posture Rating (BPR) that is practical to administer in a clinic setting. Because this rating measures movement in all three planes, it is a sensitive measure of back posture and can provide separate information about the high, mid and lower back segments.

In tight writing you only say things once. The practice of saying something twice in one sentence is known as tautology and is described in the *Oxford English Dictionary* as “a fault of style”. For example, there is no need to say that you studied *the subsequent development of infection*. Since development can only be subsequent, the word *subsequent* is unnecessary. Also, do not describe something as being *equally as important* since the word *equally* is redundant. Similarly, in the sentence, *There is no need to repeat the tests again*, the word *repeat* can be replaced by *conduct*, or the word *again* can be deleted. It is amazing how often scientists use extraneous words, and how much clearer their writing would be if they didn't.

Box 8.12 shows some examples of sentences that include unnecessary words. In the first example, cross-sectional

studies are large random population studies by definition, so only one of the two phrases is needed. The sentence also benefits from being rearranged so that the descriptor *obese* is not separated from its noun *adults*.

In the second example, the word *very* is not needed because there are no degrees of inaccuracy. Moreover, the sentence is better written with the topic, which is the measurement of diet, as the subject. In the third example, time can only be a period so *a considerable period of* is redundant. It always pays to be precise in scientific writing so the more specific phrase *for 12 years* is even better. In the fourth and fifth examples, the tautologies can simply be removed.

Box 8.12 Examples of tautologies

- 1 ✘ In adults, cross-sectional studies in large random population samples have shown a higher prevalence of asthma among obese subjects.
✓ Evidence from cross-sectional population studies suggests that the prevalence of asthma is higher in adults who are obese.
- 2 ✘ This questionnaire is likely to produce very inaccurate estimates of dietary intake.
✓ Most dietary measurements will be inaccurate if this questionnaire is used.
- 3 ✘ We studied our subjects over a considerable period of time.
✓ We continued to follow our participants for 12 years.
- 4 ✘ When designing a study, the primary key issue is to articulate the aims.
✓ When designing a study, the key issue is to articulate the aims.
- 5 ✘ To date, no recent information is available about children who present to hospital with this condition.
✓ No information is available about children who present to hospital with this condition.

Chopping up snakes

The writer's aim should be to be understood at first reading. It is your responsibility to be clear – not your reader's to unscramble your muddled message.

Elizabeth Murphy³

Short sentences are the crux of good scientific writing. Sentences with few words convey their meaning clearly at the first reading. If you are prone to writing long, snake-like sentences you will have to learn to chop them up.¹⁰

Instead of making a single point, long sentences usually try and convey too much information in one go. Long sentences quickly exhaust thinking capacity and are hard work to read. Snakes overload the reader who has to search for the main message while trying to remember and place all of the subtopics and asides. If a sentence has too many phrases and clauses, readers will not be able to maintain all the ideas until they reach the full stop. Long sentences may occasionally be needed but they should be the exception rather than the rule.

It's hard to generalise how long is too long. One rule of thumb is that sentences that stretch to more than two printed lines and/or more than 30 words are too long. Sentences longer than this suddenly become tedious and difficult to read whereas sentences with less than 20 words are usually very readable. Simply by chopping up the snakes, you make your paragraphs more digestible. Cut long sentences into little ones, shorten verbs, delete unnecessary clauses, or put points in a list. It doesn't matter how you achieve shortness, but for clear writing it is important that you do.

Box 8.13 shows that by removing unnecessary words and by including a full stop in the middle of the sentences and starting again, you give your readers a breather to digest the latest point

Box 8.13 Chopping up snakes

- ✘ We did not collect any precise information about infections but we found that having bronchitis before the age of two was a strong, independent risk factor for both wheeze and diagnosed asthma in indigenous children although it is possible that indigenous children who had bronchitis in early life were more likely to be diagnosed with asthma than non-indigenous children who had bronchitis.
- ✓ We did not collect objective information about infections but we found that bronchitis before the age of two was a strong risk factor for wheeze and diagnosed asthma in indigenous children. Although we have no evidence, it is possible that indigenous children who have bronchitis in early life are more likely to be diagnosed with asthma.

and prepare themselves for the next. The long snaky sentence of 63 words can easily be cut into two sentences, one of 32 words and one of 25 words (total 57 words).

Parallel structures

To be easy to read, your text has to be clear and say what you mean in a simple and straightforward way. It has been said that clear text is easy to read but hard to write.

JS Lilleyman¹¹

By using the same sequences of word clusters both within and between sentences, you create “parallel sentence structures”. Parallel structures improve readability by creating a smooth, organised flow of thought. By establishing repetitive patterns, you introduce good structure to your writing because you present your ideas in a consistent way.

Sentences that have an inconsistent, or non-parallel, structure inhibit thought patterns. By giving too many ideas that are presented in different word orders from one another, non-parallel sentences can become brain-teasers. Box 8.14 shows how to make sentences parallel simply by changing the grammatical construction.

Box 8.14 Examples of parallel sentences

- ✘ To study mechanisms and investigate risk factors will provide useful information.
 - ✓ Studying mechanisms and investigating risk factors will provide useful information.
 - ✓ To study mechanisms and to investigate risk factors will provide useful information.
- ✘ Dr Smith's idea is brilliant, original, and will work.
 - ✓ Dr Smith's idea is brilliant, is original, and will work.
 - ✓ Dr Smith's idea is brilliant, original, and practical.

In the first example, different forms of the two verbs (to study and to investigate) are used. By standardising the verb form, the sentence becomes parallel. In the second example,

the list needs to be standardised. You can write a list in which each item has a verb or you can write a list in which no items have a verb, but the list must be consistent.

Box 8.15 shows some examples of non-parallel sentences with suggestions about how to amend them. The first example is difficult to understand because the two different methods of describing the data from men and women are inconsistent. By simply making *overweight* the object of the sentence rather than an adjective in the first clause and by standardising the way in which results from the two studies are described, the message becomes much easier to comprehend.

In the second example, there are four items in the list. The first two and the final item are each reported in a consistent “subject–verb–object way.” However, the third item has the verb at the end in a subject (*follow up*)–object (*cohort*)–verb (*are undertaken*) structure that is non-parallel to the other items. This confuses readers who expect to be able to process the words in the same order in each clause. The sentence becomes clearer when the third item becomes parallel by moving the verb to the centre and when two items with the same subject (*follow up assessments*) are merged. Finally, the phrase *during the study* is redundant and can be omitted. The sentence is reduced by only four words but the parallelism and therefore the flow and the readability are improved significantly.

Similarly, in the third example, the sentence becomes clearer when the percentage is placed before the verb in both clauses rather than at the beginning of one clause and end of the next. If you are comparing two groups, always make one group the comparison group as shown in the fourth example. In the corrected sentence, indigenous children are the group of interest, and non-indigenous children, in the context of the study, are the control group. This avoids confusion in trying to understand which illnesses were more or less prevalent in which group.

Parallelism can also be achieved between sentences by making them match one another in construction. If you are comparing data from two groups, then always cite the groups in the same order. For example, if you are comparing the prevalence of a disease in children and adults then always cite the data for children before the data for adults throughout your paper.

Box 8.15 Making sentence structures parallel

- 1 ✖ One study found that only 15% of overweight men and 5% of overweight women considered their weight to be acceptable and the other study found that 25% of men and 45% of women of acceptable weight considered themselves to be overweight.
 - ✓ In one study, 15% of men and 5% of women who were overweight considered their weight acceptable whilst in another study, 25% of men and 45% of women with acceptable weight considered themselves overweight.

- 2 ✖ Longitudinal studies are most useful if the cohort is selected as a random sample of the general population, if follow up continues from childhood to adulthood, and if several follow up assessments of the cohort are undertaken during the study and if the outcomes include objective measurements.
 - ✓ Longitudinal studies are most useful if the cohort is selected as a random sample of the general population, if follow up assessments continue from childhood to adulthood and are conducted at regular intervals, and if the outcomes include objective measurements.

- 3 ✖ Disability was reported by 58% of the respondents as interfering with their professional capacity and to be restricting leisure activities in 70% of the group.
 - ✓ In this study, 58% of participants reported that their disability interfered with their professional capacity and 70% reported that their disability restricted their leisure activities.

- 4 ✖ The prevalence of asthma was higher in non-indigenous children but the prevalence of infections was higher in indigenous children.
 - ✓ The prevalence of asthma was lower but the prevalence of infections was higher in indigenous children.

Style matters

Proper words in proper places make the true definition of a style.

Jonathan Swift, (1667–1745, in *Letter to a young clergyman*)

Table 8.1 Style table for scientific writing

Tip	Action
Write the topic sentence	✓ Begin each paragraph with a topic sentence and use the main subject of the paper as the subject of the sentence
Draft the remainder of the paragraph	✓ Follow the topic sentence with supporting sentences
Put the sentences in the correct order	✓ Check for logic in the order in which you present ideas
Eliminate fog	✓ Simplify your thoughts and your sentences ✓ Avoid jargon and acronyms ✓ Use everyday words
Say what you mean	✓ Inspect word orders and word meanings
Ensure flow between sentences	✓ Link end of one sentence to beginning of next or use transition words
Write tight	✓ Delete all non-essential words, phrases, and clauses
Chop up the snakes	✓ Use short sentences of about 20–30 words
Check for non-parallelism	✓ Maintain consistent viewpoints and orders within and between sentences
Think of your audience	✓ Imagine you are explaining your work to a fellow researcher
Make your paper look attractive	✓ Chop up walls of text and keep changes of topic visual (new paragraph) and verbal (new topic sentence)

In summary, a few simple writing rules can help you to achieve clarity and brevity in your writing. The tips that have been discussed in this chapter are summarised in Table 8.1. By following a few simple rules, you can improve your writing style. As a result, your work will be more publishable and you will receive greater respect from your colleagues.

Solution to magic square

The answer to the magic square puzzle is as follows:

4	9	2
3	5	7
8	1	6

Acknowledgements

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Websites

- 1 Bartelby Online Books
<http://www.bartelby.com>
Access to online books such as the *American Heritage® dictionary*, *American Heritage® book of English usage*, *Roget's thesaurus*, *Strunk's elements of style*, *Gray's anatomy*, etc.
- 2 Modern Language Association (MLA) of America
<http://www.mla.org>
http://www.mla.org/main_stl.htm#sources
Information about the MLA style manual which documents the style recommended by the Modern Language Association for preparing scholarly manuscripts and student research papers. Concerns itself with the mechanics of writing, such as punctuation, quotation, and documentation of sources. Also includes guidelines for citing sources from the World Wide Web
- 3 Plain English Campaign
<http://www.plainenglish.co.uk>
Guides to writing medical information, letters, reports, alternative words, etc. for writing in plain English
- 4 The Writing Program, University of Pennsylvania
<http://www.sas.upenn.edu/writing/services/docs.html>

Access to online reference texts and resources including *Grammar Style and Notes* by Jack Lynch, *Strunk's Elements of Style*, *Oxford English Dictionary*, *Webster's Dictionary*, *Roget's Thesaurus*, citation styles, etc.

- 5 Yahoo
http://dir.yahoo.com/Social_Science/Linguistics_and_Human_Languages/Languages/Specific_Languages/English/Grammar_Usage_and_Style/
 Access to resources for grammar, English usage and style, including books and rules of grammar, common errors, and tips to improve your writing

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10: Word choice

Like all art forms, writing is a craft and takes practice. The sooner you start, the sooner you will become more proficient in choosing your words and arranging them on the page in a way that best expresses what you have to say. It's not easy, but the effort is immensely rewarding.

Irina Dunn¹

The objectives of this chapter are to understand how to:

- choose the correct words
- avoid the wrong words
- write neat sentences that mean what you want them to mean

Because most of us think in groups of words, we need to be able to write in groups of words for the benefit of our readers. To achieve this, every scientist needs to become something of a wordsmith. The words that we choose for our purpose must be selected and assembled using correct syntax and grammar. In this chapter, we explain how to choose words that are appropriate for scientific writing and how to avoid some common mistakes.

Label consistently

The reader's job is to follow the author's thinking and to agree or disagree; it is not to decode and reconstruct the paper. Thus, if you want your readers to get your message, you will have to make it abundantly clear to them.

Mimi Zeiger²

When you are writing about the participants whom you enrolled in your study, the equipment that you used, the outcomes you measured, or the results that you found, always use terms in your paper consistently. This seems a fairly

obvious thing to say, but it is surprising how often writers freely switch between different terms to mean the same thing. For example, it is common to see the words *children*, *participants*, *respondents*, *persons*, *cases*, and *controls* all used interchangeably. However, chopping and changing suggests that you are talking about many different groups of participants and leads to confusion. The example in Box 10.1 shows how much clearer the text becomes when standardised terms are used to describe the study participants. In the corrected version, the term *children* to describe the study group is defined and used consistently.

Box 10.1 Standardising terms

- ✘ Meningococcal disease is most prevalent in children under 2 years of age. Approximately 400 healthy toddlers aged 12–15 months will be enrolled in this trial. Children will be randomised to receive either the new vaccine or a standard immunisation schedule. Children who are randomised to the control group will be offered the new vaccine at completion of the study.
- ✓ Meningococcal disease is most prevalent in children under 2 years of age. Approximately 400 healthy children aged 12–15 months will be enrolled in this trial. Children will be randomised to receive either the new vaccine or a standard immunisation schedule. Children who are randomised to the control group will be offered the new vaccine at completion of the study.

If you use different terms, they should mean different things and should be afforded separate definitions accordingly. Never be tempted to switch and change between different terms to describe the same outcome. For example, terms such as *atopy*, *allergic sensitisation*, *skin prick test positivity*, *allergen reactivity*, and *clinical allergy* all mean much the same thing but should not be used interchangeably. For indexing in databases such as MEDLINE®, it is better to select the most commonly used term, define it in the methods, and use it consistently. This is essential, even when quoting work from the literature in which the authors have used different terms to the ones you are using. For example, if you use the phrase *airway*

hyperresponsiveness, then use it throughout and do not switch to *bronchial hyperreactivity* even if the researchers that you are quoting have used that term in their publications.

In standardising your terms, you need to select the appropriate term for your audience. If you are writing for a journal that specialises in allergic diseases, you would use the term *allergic rhinitis*, but if you were submitting the same paper to a general journal, you would use the term *hay fever*.

Even more importantly, you must always stick to the same point of view and use the same way of presenting data. It becomes quite confusing if you compare, for example, mortality rates in one group with survival rates in another. Also, do not compare risk factors for being underweight from one study with risk factors for being overweight from another study. This switching does not add interest but merely creates confusion. Always reword the work you are citing from other researchers' papers or rework their results if necessary, for example by changing mortality rates to survival rates, so that direct comparisons can be made.

Participants are people

Individual. A yucky word. Usually unnecessary. Use *person* or *someone*. Use *individual* only when you mean to distinguish an individual from a group or corporation.

Jack Lynch (www¹)

Participants are people not “things” and must always be described as such. The terms *subjects* and *individuals* are widely used, but the term *participants* is more politically correct because it reflects the role of people in the research process.³ In clinical studies, it is important to refer to your participants as a *child* or a *patient* rather than a *case*. Be careful not to write sentences such as *Three cases were admitted to hospital*. A *case* is an episode of a disease; a *patient* is admitted to hospital.

It is also important to avoid pejorative terms such as *psychotics* or *schizophrenics* or other labelling of participants with their illness conditions, for example *asthmatics* or *diabetics*. For example, it is better to write *patients with diabetes* rather than *diabetic patients*. Also be careful not to dehumanise your participants by using the wrong noun or pronoun. For example, it is correct to write *participants who* and dehumanising to write *participants that ...*

Box 10.2 Using the correct pronouns or descriptors for participants

- 1 ✘ There was an increase in the proportion of children that reported having asthma over the study period
 - ✓ There was an increase in the proportion of children who reported having asthma over the study period
 - ✓ The proportion of children with asthma increased during the study period
- 2 ✘ At present we have two patients who are waiting for testing that would be suitable
 - ✓ We have two patients waiting for testing who would be suitable
- 3 ✘ Neonatal infections affected babies that were smaller and born more premature
 - ✓ Neonatal infections affected babies who were smaller and more premature
 - ✓ Small and premature babies were more susceptible to neonatal infections
- 4 ✘ The wheezy infant remains a conundrum for both primary care teams and hospital paediatricians
 - ✓ Treatment for wheezy infants remains a problem for primary care teams and hospital paediatricians
 - ✓ Consensus treatment strategies for wheezy infants have not been developed

Box 10.2 shows how the wrong pronoun can sneak into a sentence and how it can be corrected. In example 1, the pronoun *that* refers to children and should be *who*. The sentence can also be shortened by replacing the phrase *who reported having* with the preposition *with*. In the second example, the pronoun *that* has become separated from its antecedent *patients*. When rejoined, it becomes clear that the

pronoun is incorrect. In the third example the pronoun *who* is more appropriate than the word *that* and the sentence benefits from some rearrangement. In the fourth example, better words can be chosen to describe infants who present to hospital with a wheezing illness. It is the choice of appropriate treatment that is a challenge for physicians, not the infant itself.

Word choice

Never use a long word where a short one will do.

George Orwell (1903–1950)

In striving to write in an unambiguous way, you need to select the correct words. Ideally, use short words instead of long words. Sometimes long words are chosen in a thinly veiled attempt to appear academic. This is a big mistake. In fact, it is scholarly to choose a short word with the correct meaning rather than choose a long word with the wrong meaning. Most readers are busy people who will not appreciate having to find a dictionary to look up the meanings of obscure words or expressions. Making your readers work to decipher your message is an unfriendly act. Always choose short, clearly understood words. Table 10.1 shows some long words and word phrases with some alternative shorter versions that can be used.

Long words can clutter up a sentence. When you are choosing words, shorter ones are always better. For example, in the sentence *The centre has established an agreement with the museum to utilise either information collection system*, the phrase *has established an agreement* can be replaced with *has agreed*, and the term *utilise* with *use*. Thus, the sentence becomes simpler and more factually correct written as *The museum research committee has agreed that we can use their information collection systems*.

Sometimes a long word is not only long but may have the wrong meaning. For example *methodology* means *the study of methods* not *the methods used in the study*. If you use the word *dosage*, you mean the total amount of medication to be taken in a given period and not the amount to be taken at one time. Also, be clear about the different meanings of terms such as *prevalence* and *incidence* and do not use them interchangeably to mean the same thing.

Table 10.1 Using the correct word.

Long or incorrect version	Shorter or more correct version
Determine, detect	Assess, measure, investigate
Correlated (as an adjective or verb)	Associated
Due to the fact that, for the reason that, on account of, owing to the fact that, on the basis that	Because
Level	Concentration
Documentation	Documents
Taken into consideration	Considered
Dosage	Dose
Elucidate, clarify	Explain
Functionality	Function
In the event of, in the eventuality of	If, when
Alleviate, moderate	Lessen, ease
Methodology	Methods
In close proximity to	Near
At the present moment, at this point in time	Now
The majority of	Most
Dyads	Pairs
Prioritise	Rank
Relationship	Relation
Adjuvants	Risk factors
Symptomatology, complaints, events, clinical picture	Symptoms
Terminology	Term
In order to	To
Usage, utilise	Use

Avoid emotive terms

Why is it that night falls but day breaks, and that the third hand on a watch is called the second hand?

Taken from an internet bulletin board

Emotive terms are strictly off limits to scientific writers, who must be circumspect in their writing. We need to be factual and describe what we think or what we saw in a non-emotive way. In this quest, there is no place for jazzing up the human interest in your story. It is important to write about participants who *have back pain*, not participants who *suffer back pain*, or patients who *have HIV* or who *have anorexia nervosa* rather than

patients who are *HIV sufferers* or *anorexia nervosa sufferers*. When the *P* value gets below 0.001, it is also best to limit your enthusiasm and describe something as a *strong* rather than a *powerful* risk factor. Some uses of emotive terms and suggestions of how to remedy them are shown in Box 10.3.

Box 10.3 Removing emotive terms

- 1 ✖ In order to capture clinically significant effect sizes with a power of 80% and a significance of 5%, 21 participants will be necessary in each group
 - ✓ To show that the effects are significant at the 5% level with a power of 80%, 21 participants are required in each group
- 2 ✖ Surprisingly, it appears that feather pillows may protect against asthma
 - ✓ There is good evidence that feather pillows protect against asthma
- 3 ✖ To plan effective interventions to arrest and reverse this trend, we need a better understanding of the risk factors that are involved
 - ✓ To plan interventions to reverse this trend, we need a better understanding of the risk factors involved
- 4 ✖ Unfortunately, with our questionnaire, we had no way of knowing if subjects had wheeze only on exertion
 - ✓ Our questionnaire did not allow us to identify participants who only experienced wheeze on exertion
- 5 ✖ It is unethical to mislead others by broadcasting results that turn out to be a mistake at a later date
 - ✓ It is unethical to mislead others by reporting results that may turn out to be incorrect
- 6 ✖ Yet it is precisely those children who reap the greatest benefit from treatment and have the highest risk of treatment failure
 - ✓ The children who may receive the greatest benefit from the treatment have a higher risk of treatment failure

A common word used is *reveal* as in *The present study reveals that more than half of the children studied were exposed to tobacco smoke in their homes*. *Reveal* is a funny word that suggests something was found perhaps by magic – like the rabbit in the hat when the magician sweeps his cloak away. Clothing is also described as *revealing* when it shows something that is

probably best not shown. As such, the word *reveal* has connotations of disclosure rather than of demonstrating a scientific finding. It is much better to select a more straightforward word such as *showed* or *indicated* to describe your research results.

Because

In fact, really bad writing is rarely a matter of broken rules – editors can clean these up with a few pencil marks. It's more often the result of muddled thought. Bad writers consider long words more impressive than short ones, and the use of words like usage instead of use or methodologies instead of methods without knowing what they mean. The facts get buried under loads of useless words ...

Jack Lynch(www¹)

In addition to avoiding long or emotive words, it is important to use small words correctly. In recent times, there has been an increasing trend to use the word *as* incorrectly. Examples of incorrect uses of the word *as* are shown in Box 10.4. In these sentences, the word *as* should be replaced by the word *because*. The *Oxford English Dictionary* describes the meaning of *because* as *for the reason that*. In the first example, the use of *cases* and *controls* to describe participants is dehumanising and also needs to be changed.

Box 10.4 Using “because” to mean “because”

- ✘ There may be bias as the cases were visited more regularly than the controls
- ✓ There may be bias because participants in the case group were visited more regularly than participants in the control group
- ✘ It is the general belief that the complex needs of these children, both in acute crisis and long term, are not being met as there is a lack of available and appropriate services
- ✓ The complex needs of these children, both in acute crisis and long term, are not being met because appropriate services are not available

The use of *as* to mean *because* began quite recently. This use is not listed in many dictionaries and is an exceedingly minor interpretation in others. The *Pocket Oxford English Dictionary* has only a very minor, subsidiary reference for *as* as follows:

As. "since, seeing that" as in "as he refuses, we can do nothing"

This restores conviction. *Since* conveys an element of time, which is not quite correct for the scientific sentences in Box 10.4 and *seeing that* conveys an element of vision, which is not appropriate either. In the full *Oxford English Dictionary*, there is almost a half a page of microscopic text, as you might expect, to describe the correct meaning of *as* as an adverb in, for example, *They stood as one man*. However, half way down the second column, there is the following brief statement:

As. Of reason. It being the case that; inasmuch as; since

This interpretation is reminiscent of the romantic writing of Jane Austen and does not validate the use of *as* to mean *because* in concise, scientific writing.

Scientific writing is the art of presenting research ideas clearly, documenting results precisely, and drawing implications correctly. In this, the word *because* is the superior word to use to convey reason, simply because its meaning is both clear and grammatically correct. The word *as* should only be used as an adverb, a relative adverb, or a relative pronoun in the following phrases in which *as* cannot be replaced by *because*:

- *it occurred as a result of*
- *as quiet as a mouse*
- *act as you think best*
- *he fulfilled his duty as a research assistant.*

Admittedly, constructs such as *as if* or *as cheap as* are new, stand-alone, colloquial statements. The words are used correctly in a grammatical sense, the minimalism conveys impact, and the unspoken ending is understood. In addition, our computers now ask *save as*, although they omit the question mark. It is interesting to ponder whether Shakespeare was correct when he wrote *As you like it*, but then artistic licence and scientific writing are entirely different.

Levels and concentrations

Using “level” to mean “concentration” may be colloquial but is hardly scientific. This is a matter that is best contemplated at leisure in the bath where you have time to consider the difference between the level of the water in the tub and the concentration of the bath salts in the water.

Jeff Aronson⁴

Another word that is widely misused in the scientific literature is the word *level* instead of *concentration*. For example, immunologists often describe *blood levels of protein* and *plasma levels of IgE* and allergists often describe *housedust mite allergen levels*, thus using the word *level* to mean *concentration*. *The Oxford English Dictionary* sheds some light on this problem. The meaning of the word *concentration* was a relatively late entry into the dictionary. Although the word *level* has been there a long time, none of its meanings has the sense of *concentration*.⁴ If the word *concentration* is correct, then this word should be used. It is prudent to remember this the next time that you describe a concentration that you have measured in your study. It is better to be grammatically correct than follow new fashions in writing.

Untying the negatives

If the basic idea is too complicated to fit on a T-shirt, it's probably wrong.

Leon Lederman (physicist, 1984)

It is important to use negatives carefully and to use them only when they can't be avoided. Everyone knows the basic rule of mathematics that two negatives make a positive. The same rule applies to sentences. However, instead of using two negatives, it is better to be straightforward and use positive terms in your sentence. For example, the advertising slogan *Don't let Australia down* is a double negative that would be more positively phrased as *Take Australia forward*. A politician recently said in a radio interview, *I am not ready to disagree with that*, which is poli-speak for *I agree*. Although advertisers may regret the loss of alliteration and politicians the loss of air space, these types of

negative constructs have no place in scientific writing. After all, who can make any sense of writing that says *Diet was not a risk factor for asthma in adults but was not in children*.

The meanings of sentences often become clearer when negative words are omitted. For example, writing that *We did not find a statistical interaction between the outcome and exposure variables* could suggest that you did not even look for one. Rather, it is clearer to write that *There was no significant interaction between the outcome and exposure variable ($P = 0.91$)*. The direct expression and the inclusion of the P value shows that you tested for an interaction and found that it was statistically non-significant.

Similarly, try not to use negative sentence constructions such as *We did not find that weight loss was related to age* that suggest that you may not have tested for a relation. It is much better to say that *There was no relation between age and weight loss*, which describes exactly what you mean. In the same vein, phrases such as *We found no evidence that* are often better rephrased with *We did not find any evidence that*. No one can find nothing, although you can demonstrate that something is not present.

Box 10.5 Switching from negative to positive

- 1 ✖ Two patients were excluded from the intention-to-treat analysis because they received no study drugs
✓ Two patients were excluded from the intention-to-treat analysis because they did not receive the allocated treatment
- 2 ✖ No mechanism was observed between airborne fungal concentrations and emergency department attendance
✓ Emergency department attendance was not related to airborne fungal concentrations
- 3 ✖ While the majority of cases onset in the first two weeks of life, later onset is not unknown
✓ The majority of cases have their onset in the first two weeks of life but later onset sometimes occurs
✓ In the majority of cases, the disease is evident in the first two weeks although some cases are not diagnosed until later in life
- 4 ✖ This drug will not only be invaluable in the treatment of children but may be valuable in adults also
✓ This drug will be valuable in the treatment of children and may be valuable in adults also
✓ This drug is effective for treating children and may also be effective in adults

- 5 ✘ A single outcome measurement will often be inadequate to assess the risks, costs and diverse benefits that may arise from the use of a new treatment
- ✓ The diverse benefits that may result from the use of a new treatment can rarely be measured by a single outcome variable
- 6 ✘ Authors of published abstracts were significantly less likely to believe that a journal would not publish their manuscript than authors of rejected abstracts
- ✓ Authors of published abstracts were significantly more likely to believe that a journal would publish their manuscript than authors of rejected abstracts

Some examples of unclear uses of negatives are shown in Box 10.5. In the first example, patients cannot receive *nothing* and, in the second example, you cannot observe *no mechanism*. Both sentences benefit from being rewritten to remove the inappropriate negative and express a more exact meaning. Example 3 shows a typical double negative phrase. In this example, which was used to describe the recognition of a genetic disease, the term *onset* was also inappropriate. Genes do not change over time, although it may be a while before the identifying symptoms are recognised. The sentence needs to reflect this even if extra words are needed.

In the fourth example, the double negative is better removed and the word *valuable* exchanged for a more specific and unambiguous term. This sentence does not work well because the two phrases that include the stem word *valuable* are constructed in a non-parallel way. In addition, the terms *valuable* and *invaluable* may mean different things to different people, whereas the term *effective* has a precise scientific meaning. In examples 5 and 6, the use of negatives is unnecessary and the sentences are better phrased using positive words.

Abbreviations

A place for everything, and everything in its place.

Samuel Smith (1812–1904)

Abbreviations should also be avoided whenever possible. Unless your abbreviation refers to a standard measurement,

Table 10.2 Standard and non-standard abbreviations.

Standard abbreviations: define and use	Non-standard abbreviations: do not use
DNA (deoxyribose nucleic acid)	DD (doubling dose)
ECG (electrocardiogram)	PAR (perennial allergic rhinitis)
IgE (immunoglobulin E)	FUO (fever of unknown origin)
SIDS (sudden infant death syndrome)	OPT (optic pathway tumour)
BMI (body mass index)	TAI (total allergy index)
FVC (forced vital capacity)	VPI (very preterm infants)

such as cm or mm, the full term for which it stands should precede its first use in the text. Once an abbreviation is defined, then you must use it throughout your paper in preference to the full expression.

The uniform requirements for manuscripts⁵ states that only standard abbreviations should be used in the text and that abbreviations should not be used at all in the abstract and in the title (www²). This is excellent advice. It is certainly not a good idea to invent your own abbreviations that the reader has to remember while reading your paper. It is even harder for readers when you invent two or three new abbreviations and use them throughout the paper. This practice of creating alphabet soup detracts from clarity and readability. Table 10.2 shows some standard and non-standard abbreviations.

Spelling

Why is the word dictionary in the dictionary and if it was misspelled, how would we know? Where did Webster look up the definitions when he wrote the dictionary? Why can't you make another word using all the letters in "anagram".

Taken from an internet bulletin board

Poor spelling must be avoided at all costs because it annoys readers, can be confusing if another meaning is attached to a word and, with the advent of computer programs with dictionaries and spell-checking facilities, is no longer excusable. Although some sympathy is often extended to

researchers who have to write in English rather than their own language, most reviewers find incorrect spelling irritating. If you know that you are prone to spelling a word incorrectly, then you should search your paper for that word and replace it correctly.

Be aware that the spell checker may not pick up an incorrectly spelt word if the form you have used is a valid sequence of letters. For example, you may type *you* instead of *your* or *rates* instead of *rats*. There is no substitute for careful proofreading, and careful peer reviewers and copy editors. You will also have to choose a spelling standard that is appropriate for the journal that you send your paper to. Some journals are quite specific about which dictionary to use, for example the *BMJ* recommends *Chambers 21st century dictionary* for general use and *Dorlands dictionary* for medical terms and the *Australia and New Zealand Journal of Psychiatry* requests that papers are spell-checked using the *Macquarie dictionary*.

One hitch with spelling is that the Americans and English spell some words differently. For example, Americans use *z* instead of *s* in words such as *minimise* and *organise*, and drop the *a* from words such as *aetiology* and *paediatrics* and the *o* from words like *oestrogen*. They also write *mold* not *mould*. The differences are endless. You have two choices. Either spell consistently in American or spell consistently in English but do not chop and change between the two. Most word-processing programs allow you to choose whether you want to use an American or English dictionary to spell check your work.

Words matter

Parameter. Use this nasty vogue word and I'll forgive you only if you're a mathematician, a scientist, or a computer programmer. (Even then, I'll probably forgive you only grudgingly.) The rest of the world can safely do without.

Jack Lynch (www¹)

The words that you choose and the ways in which you use them are the crux of good writing. The tricks that will help you to become an expert wordsmith are shown in Box 10.6.

Box 10.6 Word tips

Standardise all terms
Maintain consistency in orders and viewpoints
Check that the words mean what you want them to mean
Adhere to humanising and non-emotive terms
Avoid double or unnecessary negatives
Only use standard abbreviations
Spell check and proofread your paper

Acknowledgements

The Smith quote has been produced with permission from *Collins Concise Dictionary of Quotations*, 3rd edn. London: Harper Collins, 1998 (p 299). the Lederman quote has been produced with permission from Horvitz, LA ed. *The Quotable Scientist*. New York: McGraw-Hill Companies, 2000 (p 23). The Orwell quote has been produced with permission from the Orwell estate (Secker and Warburg). All other referenced quotes have been produced with permission.

Websites

- 1 The Writing Program, University of Pennsylvania
<http://www.sas.upenn.edu/writing/services/docs.html>
Access to online reference texts and resources including *Grammar style and notes* by Jack Lynch, *Strunk's elements of style*, *Oxford English Dictionary*, *Webster's dictionary*, *Roget's thesaurus*, citation styles, etc.
- 2 International Committee of Medical Journal Editors (ICMJE)
<http://www.icmje.org>
Uniform requirements that provide instructions to authors on how to prepare manuscripts to submit to biomedical journals, including links to sites about sponsorship, authorship, and accountability

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- 1 Dunn I. *The writer's guide*. Sydney: Allen and Unwin, 1999; p 5.
- 2 Zeiger M. *Essentials of writing biomedical research papers*. Maidenhead: McGraw-Hill, 1991; p 2.
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