

Chapter 3

Core Rules for Better Writing

*If we are facing in the right direction,
all we have to do is keep on walking.*

Zen Proverb

3.1 Introduction

Writing well is not a gift: it is a skill that can be learned. The words that we use in our writing are the same words with which we think. As we improve our writing skills, we also improve our ability to think—to organize arguments, to frame issues in compelling ways, to avoid irrelevant issues and to arrange the facts into a smooth and complete story. Improving your writing skills will help you not only to become more successful in publishing your research, but also to become a better researcher.

3.2 What is Good Writing?

*Present to inform, not to impress.
If you inform, you will impress.*

Fred Brooks

Good writing is easy to read. A good paper educates the reader without frustrating him or her. As Fred Brooks indicates in the above quotation, we should write to be understood, not to impress. Use clear, simple words and sentence constructions; avoid fancy words and “academic” usage. Be concise: use just enough words to convey your meaning clearly, but don’t waste

the reader's time with extra words. Thus, the "golden rule" of writing is that, as an author, your job is to ease the job of the reader. If in doubt about how to choose between two ways to express something, choose the one that makes the job of the reader effortless, even if it is more work for you.

Enlist readers to help you make this choice. The core difficulty of good scientific writing is that to explain something simply, you have to know a great deal about it. And once you know a great deal about it, it's hard to remember how ignorant you were when you didn't know anything about it. But you must try, for your job is to write for the reader who does *not* already know.

3.3 The Core Rules of Writing

*Words have to be crafted, not sprayed.
They need to be fitted together with infinite care.*

Norman Cousin

The "Core Rules" in this section will help you write better. The rules don't cover everything you will need to know, and they certainly don't try to capture all of the details that you will find in a writing style guide, but they will help you build a firm foundation on which you can develop other skills. If you are not already following these rules, they can make a dramatic difference to your writing.

3.3.1 Use Active Verbs

It used to be traditional for scientific works to be written in passive voice. Because the passive voice makes it easy to avoid saying what caused an action, it was thought to somehow be more objective. This is no longer the case, certainly in computer science. Active voice is more specific, and therefore more informative and clearer than passive voice; it is also frequently more concise. Moreover, active voice is more direct and forceful. If you do nothing more than concentrate on using active voice, your writing will improve.

What is Passive Voice?

First, let's remind ourselves what passive voice is. Take a look at this passive voice sentence:

The file was initialized by the experimenter.

Who is doing the action in this sentence? Clearly, it's "the experimenter", even though the grammatical subject of the sentence is "the file". However, "the file" is *passive*: it isn't *doing* anything. Phrasing the sentence in the active voice — "The experimenter initialized the file" — places the actor as the grammatical subject, and replaces the verb "to be" by the active verb "to initialize".

Train yourself to spot passive voice constructions. They are characterized by some form of the verb "to be" (*am, are, is, was, were, have been, will be, will have been*) followed by a "past participle". What's a past participle? It's the form of the verb that typically ends in "-ed", such as "initialized", or "improved". (English being English, there are irregular verbs whose past participles *don't* end in "-ed": "break", for example, has "broken" as its past participle, not "broke", and "thrust" stays as "thrust" and does not become "thrusted".)

Here are some examples that illustrate the benefits of active voice.

Active voice is more informative

In the passive voice, the subject is missing. In the active voice, the subject is explicit, so the sentence is more informative.

Passive voice:

Active voice:

- | | | |
|--|---|--|
| It is felt that you should re-write your research proficiency paper. | → | Professor Black feels that you should rewrite your research proficiency paper. |
| To get advice, an expert must be consulted. | → | To get advice, you must consult an expert. |
| Speech features can be mapped using a probabilistic approach. | → | Stylianou et al. [22] map speech features probabilistically. |

Active voice is more concise and more forceful

Passive voice:

Active voice:

- | | | |
|---|---|--|
| The glass was broken by Tim. | → | Tim broke the glass. |
| My first visit to Boston will always be remembered by me. | → | I shall always remember my first visit to Boston. ¹ |
| There were a great number of dead leaves lying on the ground. | → | Dead leaves covered the ground. |

The reason that active voice is more concise and forceful is that in English, we expect verbs to be *action* words. Taking an action and turning it into a noun weakens the the structure of the sentence.

noun form:

verb form:

There was a prohibition against the export of Rubles. → The Russian government prohibited the export of Rubles.

Anna made a translation of the poem from Polish into English. → Anna translated the poem from Polish to English.

Josephson obtained confirmation of these results. → Josephson confirmed these results.

The first example is conventional passive voice. The second and third examples are not: “Anna made” and “Josephson obtained” are, grammatically, active constructions. However, the verb forms are more forceful, because in these forms the action that we are interested in—translation and confirmation—is represented by a verb rather than by a noun. They are also more concise, because the auxiliary verbs “made” and “obtained” have been banished.

3.3.2 Put Key Ideas in Lead Position

*“Begin at the beginning,” the King said, gravely,
“and go on till you come to the end; then stop.”*

Lewis Carol,
Alice’s Adventures in Wonderland [1].

Putting key ideas in lead position helps to prepare the reader for what’s coming, and also allows the reader to skim efficiently. You can use this technique to organize paragraphs in a section, sentences in a paragraph, and phrases in a sentence.

Start each section a paper with the key ideas that you will discuss in that section. Don’t do this in the introduction, though: there you should start a little more gently. Elsewhere, the first paragraph in a section should act as an introduction to that section and summarize its key ideas. The following paragraphs should provide the details of the key ideas. Thus, the paragraphs within a section move from the general to the more specific, from the most important to the least important.

You should also use the technique of putting the key ideas in the lead position within each paragraph. The first sentence in a paragraph should explain the purpose of the paragraph; subsequent sentences explain or develop

the topic in more detail. In general, sentences within a paragraph move from the general to the more specific.

However, there are some exceptions. The major exception is that the *trailing* positions also powerful: the conclusion of an article, the last paragraph of a section, and the last sentence of a paragraph. Don't waste these positions by filling them with digressions or unimportant details; instead, use them to restate your key ideas, or to state an important consequence of these ideas.

C.A.R. Hoare is particularly good at finding apt conclusions for his papers. His "Hints on Programming Language Design" [2] ends with the following paragraph:

A final hint: listen carefully to what language users say they want, until you have an understanding of what they *really* want. Then find some way of achieving the latter at a small fraction of the cost of the former. This is the test of success in language design, and of progress in programming methodology. Perhaps these two are the same subject anyway.

Another exception to leading with your key idea is when you're trying to persuade your audience to accept something radical or surprising. In such a situation, you can lead them along and give them the key idea at the end, like the punchline to a joke. This is frequently used in a mathematical development. Here is an example.

Consider Newton's second law:

$$F = m \frac{dv}{dt} \tag{3.1}$$

and integrate both sides over a displacement x

$$\int_0^x F dx = m \int_0^x \frac{dv}{dt} dx \tag{3.2}$$

substitute ...

Hence we have shown that work equals the change in kinetic energy.

Don't overuse this format, particularly when the argument is long. If you do use it for a mathematical development, it helps the reader if you use the lead sentence in the paragraph to tell them what you're about to do. That is, it helps to give away the punchline! Remember that, unlike the stand-up comedian, your job as a writer is not to appear clever: it's to help your audience to understand. Here is the same example, re-written in this style.

Now we show that work equals the change in kinetic energy.

Consider Newton's second law:

$$F = m \frac{dv}{dt} \quad (3.3)$$

and integrate both sides over a displacement x

$$\int_0^x F dx = m \int_0^x \frac{dv}{dt} dx \quad (3.4)$$

substitute ... You will see that the term on the left, the force multiplied by the change in distance, represents the work done ...

3.3.3 Don't make Unsubstantiated Statements

In a scientific paper, statements of belief or of fact must be backed up. It is not OK to simply claim that "Refactoring tools are underused": you must substantiate that statement. This can be done in one of three ways:

1. referring to a specific result of the current work, for example "In Section 3 we show that refactoring tools are underused", or
2. citing your own prior work, for example, "We showed in our 2009 ICSE paper [3] that refactoring tools are underused", or
3. citing the literature, for example, "Dig and Delany showed that refactoring tools are underused [5]"

Don't use phrases like "It is common knowledge ..." or "It is generally believed ...", or "Several researchers have shown ...". Instead use constructs like "Hartman [23], Goolickan [24], and Brotman [25] show that ..." or "Recently, several researchers have shown that ... [23,24,25]" or "Many researchers (see for example, references 23, 24 and 25) believe that ...".

The exception is for things that really *are* common knowledge. It's OK to say that the sun rises in the East without giving a citation, but there is no need to say that "It is common knowledge that the sun rises in the East". If you think that the reader might not know that this is common knowledge, then you should give a citation: saying that it is common knowledge is just one more unsubstantiated statement!

3.3.4 Be Concise

Avoid wordiness. Here are some examples:

<u>Instead of these</u>	<u>Use these</u>
due to the fact that	because
in light of the fact that	since
in order to	to
in view of	since
on behalf of	for
after this is accomplished	then
in case	if
along the lines of	like

3.3.5 Be simple

Avoid “fancy” words. Here are some examples:

<u>Instead of these</u>	<u>Use these</u>
subsequently	next
modification	change
necessitate	require
endeavor	try
demonstrate	show
utilize	use

3.3.6 Use a Consistent Lexical Set

Use the same word to refer to a concept throughout the paper. For example, don't use “swoondigger” in one place, and “pomponicator” in another place, unless they are generally accepted synonyms. Although it may be obvious to you that these are synonymous, it may not be obvious to the reader.

When you make an exception and use several terms to refer to the same concept, make sure you tell your reader that you are using the terms synonymously: “Here we use a swoondigger (also referred to as a pomponicator), to force coherence between ...”

Note that this insistence on a consistent lexical set is just the opposite of what we might do in “literary” writing, where we use synonyms to give our writing more interest and color. It's not that interest and color are bad in scientific writing, just that clarity is more important. If you refer to “goals” in the introduction, and “objectives” in the discussion of results, at least some of your readers will ask themselves where the authors told the reader about their “objectives”.

3.3.7 Define terms when first used

Don't make the reader guess what you mean until the last section of the paper, where you finally get specific about the meaning of a term. Define your terms when you first use them.

There are two types of definitions.

- Full sentence definitions, such as

The *calibration constant* for a processor is the ratio of its measured I/O speed to that of a reference processor.

Use a full sentence definition when the term has more than one meaning, the audience probably does not know the term, or there is no agreed-upon standard definition.

- Phrase definitions, such as

The caller must supply a *convergence criterion* (a bound on the residual error).

Use a phrase definition when the term has more than one meaning and you are clarifying which meaning you adopt. In this case the audience probably knows the term, but you are including a definition to avoid ambiguity.

3.3.8 Avoid "Ones"

Avoid one-word sentences, single sentence paragraphs, and sections that contain only a single paragraph or single sub-section. Single sentence paragraphs are usually an indication that there's a problem with organization. Figure out where the idea belongs. It may be that it's not important enough to develop into its own paragraph, but doesn't fit in one of the existing paragraphs. If that is the case, then remove it!

In a similar way, a section that contains only a single paragraph or a single sub-section reveals a structural problem. Are there other cases that deserve their own sub-sections? If not, what is the purpose of the sub-section?

This section originally started with "Never use" rather than "Avoid". Are there situations when you might break this rule? Yes! Occasionally, breaking this rule can give your writing exceptional force. If you choose to break it, do so sparingly, and after considering the alternatives and the implications.

3.3.9 Re-write

All good writing is rewriting. When you re-write (especially a section, paragraph, or sentence that you know is difficult to read), keep asking yourself “what do I really mean?”. Allow yourself several passes to get rough spots really concise, really simple, and really clear. A good way to get more concise is to ask yourself if words in a sentence, or sentences in a paragraph are helping you make the key points, or whether they can be discarded.

3.4 Chapter Summary

This chapter discussed core rules for writing better articles. Pin them to your monitor so they are in front of you as you write! Here are the core rules.

- Use active verbs.
- Put key ideas in the lead position of sections and paragraphs.
- Don’t make unsubstantiated statements.
- Be concise.
- Be simple.
- Use a consistent lexical set.
- Define terms when first used.
- Avoid single sentence paragraphs.
- Rewrite with an intent to make things simpler, more concise, and clearer.

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References

- [1] L Carroll. *Alice’s Adventures in Wonderland*. MacMillan Publishing Co, London, 1865.

- [2] C.A.R. Hoare. Hints on programming language design. Memo AIM-224, Stanford Artificial Intelligence Laboratory, 1973. Invited address, 1st POPL conference.
- [3] William Strunk. *Elements of Style*. Press of W.P. Humphrey, Geneva, N.Y., 1918. Republished by Bartleby.com, 1999.