

Words

In literature, the ambition of the novice is to acquire the literary language; the struggle of the adept is to get rid of it.

—GEORGE BERNARD SHAW

As I said in chapter 11, words are to sentences what atoms are to molecules. They control the chemistry and “voice” of your writing—how it sounds and feels. Some atoms are inherently dense and toxic, like lead. With others, toxicity comes from their specific combination; carbon, hydrogen, and oxygen can produce fresh and fruity aldehydes but with just a slight tweak become rancid acids. So, too, with words. You can poison your writing with toxic words and toxic combinations.

Choosing words is not easy. English has amassed words from many sources, and different words convey different impressions of what you are saying and even of who you are. Just consider “fornicate” and its four-letter synonym, “f---.”

Academics have an almost proverbial fondness for long, heavy words. Some use them because they think it makes writing sound more scholarly or because they want to show off their erudition, as Dennis Dutton, editor of *Philosophy and Literature* once accused the author of a notably convoluted piece of academic writing: “This sentence beats readers into submission and instructs them that they

are in the presence of a great and deep mind. Actual communication has nothing to do with it.”¹

More of us, perhaps, learn to write in a heavy academic style because we imitate what we read and strive to “acquire the literary language.” Over time this style becomes ingrained habit, creating a self-sustaining cycle. Writing this way also identifies us as members of the club, but one increasingly isolated from broader society.

The other reason we write “heavy” is because written and spoken English are different. We think differently when we write compared with when we speak. Written language is more formal, and our papers will outlast us, reinforcing a formal writing style. We lean toward longer and more elaborate words than we might otherwise choose.

But scientific writing can have life and energy—you can be professional without being pedantic. In earlier chapters, I’ve included examples of lively writing and discussed some ways to achieve that. The last method is to choose good words.

Written English is different from spoken English, but the difference should be primarily in sentence structure, not vocabulary. When you write a big word, ask yourself: “would I use it if I were talking to a friend?” For example, medical papers use language such as: “the therapy was efficacious.” Education researchers write about “students with different learning modalities.” Would you say either in normal conversation? I wouldn’t. I would say, “the treatment worked” or “students with different learning styles.” To most of us, these alternatives mean the same thing. Or maybe not—to some, “learning modality” might mean nothing at all, whereas “learning style” is clear as a bell.

Why not impress your readers with the sophistication of your vocabulary, showing that you can write technical-sounding language with the best of them? As a simple answer let me pose a question: when you last read a paper that was hard to read, were you impressed by how scholarly the authors were? Or were you frustrated trying to figure out what they were saying? We notice language when it’s awkward, and may blame ourselves for not being smart enough to figure it out. When the writing is good, we notice the ideas and the data, and those are what make the science.

15.1. JARGON

Many describe science as filled with jargon, by which they usually mean arcane and uninterpretable terms that obfuscate our ideas. Naturally, most books recommend avoiding jargon as critical for clear writing. Yet science is technical and

1. Dennis Dutton, On Philosophy and Literature’s annual “Bad Writing Contest,” *Wall Street Journal*, February 5, 1999.

requires many specialized terms. When is a term avoidable jargon, and when is it a necessary and irreplaceable technical term? I distinguish them as follows:

Jargon: (A) A term that refers to a schema the reader does not hold. (B) A term for which there is an adequate plain language equivalent.

Technical term: (A) A term that refers to a schema the reader *does* hold. (B) A term for which either there is no plain language equivalent or where using it would be confusing.

This distinction is fuzzy and fluid and depends on the reader's knowledge. In one context, a word may be a technical term, but in another it may be jargon. If you use a term without defining it, it may be jargon, but if you define it in language understandable to your readers, you may transform it into a useful term. If you define a word that is well known to your readers, however, you may appear ignorant. A chemist would never define "mole" in a research paper, and a molecular biologist would never define "gene." Even high school science students should know those terms.

As an illustration of the fluid boundary between technical terms and jargon, consider the phrase "net primary production" (NPP). This is a measure of plant growth—the live biomass produced in an ecosystem. If I were giving a public talk and discussed NPP, the audience would be confused, so I would just say "plant growth." But if I said "plant growth" to an audience of ecologists, they would be confused—did I mean NPP, gross primary production, net ecosystem production, or some other measure of plant growth?

You need to use the terms that work for your audience. When you are trying to expand that audience, be sensitive to language and whether your technical terms are their jargon. Can you use simpler terms that will expand your audience without annoying the experts?

15.1.1. Avoiding Jargon

How and where you introduce a term may determine whether readers react to it as jargon. Remember the old/new information structure readers expect in your sentences? If you introduce a term in the topic position, readers interpret it as something they are supposed to know and are more likely to see it as jargon. If, however, you introduce a term in a sentence's stress, you dejargonize it. It will feel like you are defining the term, which might be good or it might be overkill. I illustrated this in example 12.3 about N mineralization.

What do you do with a term that might be too well known to put it in the stress but not well enough for the topic? See how the authors handle this in example 15.1; this is from a paper about the role of solvents in regulating the thermodynamics of chemical reactions. The authors discuss linear response theory, a theory most readers would probably know. However, the authors didn't make that assumption.

Example 15.1

This idea that excited states relax with rates determined by the solute-solvent system's ordinary energy fluctuations, commonly called linear response theory, is a critical component in the success of transition-state theories of chemical reaction rates in liquids.²

If you have studied basic chemistry, you should know that chemical reactions go through a high-energy transition state that breaks down into the final products; it should be an easy step to accept that the solvent can affect this transition. Voilà! You've learned what linear response theory is about. If you are a physical chemist and already knew the theory, this definition would merely feel like a comfortable reminder. This paper manages to reach out to and educate the broadest possible audience without alienating the core. I don't understand the details of the paper and the title is gobbledygook to me, but I do understand generally what it is about and why it is interesting.

Note how the authors achieved this balance—they use topic and stress positions to control where they introduce information. The topic introduces concepts that are known to any chemist. Then they put the theory's name in the stress of a clause set off by commas. By putting the name at the end of its own clause, they put it in a local stress position and give it some emphasis, but by putting that clause in the middle of the sentence they limit the emphasis, making it feel like a reminder, rather than a new definition. They effectively used Clark's 2-3-1 rule of emphasis that I introduced in chapter 12.

Introducing the term this way required a longer sentence (37 words) than most reading ease calculators recommend, but it actually made comprehension easier. Long sentences aren't necessarily bad—you just have to write them well, as Moskun and coauthors did. Example 15.1 was both clear and sensitive to the readers—excellent writing.

Here is another example of using the 2-3-1 approach of embedding potential jargon in a parenthetical clause (the 3-position) to remind you of the term.

Example 15.2

Programmed cell death, or apoptosis, is prominent in neural progenitors and appears to play an important role in the development of the cerebral cortex.³

These authors placed the word *apoptosis* in a short clause where it reminds readers of the term but doesn't feel like they are defining it for everyone.

2. Moskun et al., "Rotational Coherence and a Sudden Breakdown in Linear Response Seen in Room-Temperature Liquids," *Science* 311 (2006): 1907–11.

3. J. N. Pulvers and W. B. Huttner, "Brca1 Is Required for Embryonic Development of the Mouse Cerebral Cortex to Normal Size by Preventing Apoptosis of Early Neural Progenitors," *Development* 136 (2009), 1859–68.

Together these examples suggest a general pattern for using technical terms in different places in a sentence:

Beginning of the sentence: You assume that *every* reader knows and understands the term. You run the risk of it appearing to be jargon if they don't.

End of the sentence: You define a new term for everyone. You run the risk of appearing ignorant if it is already an accepted schema in the field.

Middle of the sentence: You assume that most readers know the term. You are also indicating that the term itself isn't critical to your story. You run the risk of people missing the term.

There is no single perfect place to introduce terms. You have to evaluate your audience and what they know. If you err, err on the side of overdefining. Any irritation an expert might feel at seeing a term defined unnecessarily would be slight and short-lived. The confusion a novice might feel at not having a term defined could be large and permanent—they might stop reading your paper.

15.1.2. Jargon and Acronyms

The worst form of jargon has to be undefined abbreviations and acronyms (at least you can look up words you don't know). In searching for examples, I occasionally ran into papers that had opening sentences like the following: "DCs are APCs that initiate immunity." In this sentence, DC stands for dendritic cell, a term used in the title, so I was able to figure it out, but APC was not defined anywhere in the paper. It was only by going online that I was able to figure out that it stood for "antigen presenting cell"; another definition for APC—"armored personnel carrier"—seemed unlikely. Tossing around a field's jargon is a fine way to show that you are part of the in-crowd, but you should be making your work accessible to the largest community practical. That is why the *Chicago Manual of Style* dictates that "terms must be spelled out on their first occurrence." Using an undefined abbreviation assumes that everyone who might ever read the paper already knows what it means. How likely is that? Most people reading a paper in immunology presumably knew what DCs and APCs are, but making the abbreviations the opening words of an entire paper excludes new readers, rather than reaching out to them. It isn't harder to write: "Dendritic cells (DCs) are antigen presenting cells (APCs) that initiate immunity."

Spelling out your acronyms and abbreviations the first time you use them takes a few more words but makes the paper easier for everyone involved. It won't offend an expert because you're not defining a term they don't need defined, and it will help the novices. The only exception to this rule is abbreviations that are so common that every reader knows them. You don't need to spell out DNA; your aunt knows what DNA is but would be baffled by deoxyribonucleic acid.

When we create acronyms and shorthand names, we almost always do it for our own convenience. Then we get so used to using our terms that we start to assume that they are obvious. They usually aren't. Remember principle 1 is to make the reader's job easy. Name things for their convenience, not yours. For example, if you studied two forests, one deciduous and one coniferous, you might label them DEC and CON, not ASP and HBR after the places you sampled. We have to learn many terms to do science—don't add unnecessarily to the list.

15.2. UNNECESSARILY TECHNICAL

Using jargon that readers don't know actively excludes them. A lesser evil is using terms readers do know, but where a nontechnical word would do the job more powerfully. Frequently this type of jargon results from being overly specific and as a result, undercommunicative. Consider the following example.

Example 15.3

Current models suggest that climate warming could release 200 times more nitrogen from soils than is taken up annually by terrestrial autotrophs.

This statement argues that the potential N release from soils is huge. But using the phrase "terrestrial autotrophs" weakens that message. Plants are a subset of autotrophs; others such as lichens and algae take up N as well. So 200× terrestrial autotrophs is actually a bigger number than 200× plants, but it would have been better to write "200 times the amount of nitrogen taken up annually by plants." The common word is more powerful—it engages a stronger schema.

The following is another case of adding words ostensibly to create precision.

Example 15.4

California has a Mediterranean climate regime, in which the heaviest storms occur when moist subtropical air is entrained by major Pacific storms.

The word I have an issue with here is *regime*. A regime is a pattern of conditions, but climate is a pattern of weather conditions (i.e., a regime). So a climate regime is no more than a climate! "Climate" for some, sounds too common, it's something everyone understands, whereas "climate regime" sounds technical. But that's the problem—it sounds like it means more than just climate and so it can be confusing.⁴

Example 15.5 shows a different reason for creating an overly qualified term. I think these authors were so caught up in the habit of avoiding action verbs that they created an elaborate nominalization to avoid it.

4. Climatologists use *regime* as a technical term, that is, a shift in the Pacific decadal oscillation is a regime shift, but that isn't how it's used here. This is putting on a more complex implication to clutter a simple term.

Example 15.5

This suggests that SRT may be a causative agent of chronic pain syndrome (CPS).

Why not say “SRT may cause chronic pain syndrome (CPS)”? We know that SRT is an “agent,” so identifying it as one adds nothing. We get trained to think that noun expressions like this are somehow more specific or technical than action verbs, but they are not.

15.3. EMOTIONAL WEIGHT

Technical terms define the characters of the story—specific objects, organisms, and processes. Choosing them well is important. But it is also important to choose the words you use to describe what those characters are doing. Good choices can make them soar, bad choices can make them land, painfully.

It may seem surprising, but an important issue in choosing words in English is their origin. Academic English takes words from three main sources, Anglo-Saxon Old English, Norman-French, and Latin. As modern English was developing in the Middle Ages, Old English was the peasants’ language, Norman-French the nobles’ (brought in with William the Conqueror), and Latin the scholars’. That legacy endures. Anglo-Saxon words feel comfortable and casual. French words feel formal. Latin words inevitably feel like jargon; they were originally coined to show off the writer’s education.

My field is soil science. *Soil* is from French; the Anglo-Saxon word, of course, is *dirt*. While people occasionally say “huh?” when I say I’m a soil scientist, at least they understand I’m an academic. If I say I study dirt, they are baffled—dirt seems too common to study. We call it soil science because we want to play on the positive connotations of the French word—soil grows plants, and the word has an elegant, flowing sound. Soil is good. That is why people use it as a euphemism: “the baby soiled its diaper” is a polite way of describing a messy event. Dirt, on the other hand, is what we get under our fingernails. The word is short, clipped, and one of the more generally negative words in the English language—calling something “dirty” is always an insult. Dirt derives from “drit,” the Old Norse for “excrement,” and it still carries a bit of the emotional legacy of that origin.

There are many times where we have a choice of French or Latin words and perfectly good Anglo-Saxon alternatives, as illustrated in table 15.1. Not only are the Anglo-Saxon words emotionally lighter, they also usually shorter. Even when both words came from French, the one assimilated earlier is generally shorter and feels more common.

Despite the benefits of short, light words, academics routinely fall into the centuries-old trap of choosing long, heavy Latin words. Many of us are still showing off instead of communicating. Given a choice of starting an experiment or initiating one, we go for the Latin and “initiate.” Why use a long Latin word when a short Anglo-Saxon one will do the same job?

Table 15.1. EXAMPLES OF LONG FRENCH/LATIN VS. SHORT ANGLO-SAXON WORDS

| Long French or Latin Word | Short, Anglo-Saxon Word (unless otherwise noted) |
|-----------------------------------|---|
| Duration (French.) | Length or time |
| Consume (French) | Eat |
| Mortality (French) | Death |
| Permit (French) | Let |
| Necessary (French) | Need |
| Demonstrate (Latin) | Show |
| Donate (Latin) | Give |
| Initiate (Latin) | Start |
| Attempt (French) | Try (from Old French <i>trier</i>) |
| Utilize (French) | Use (from Old French <i>user</i>) |
| Methodology (Latin combined form) | Method (Latin borrowed into English) |

Example 15.6

We performed a study of six-months duration on the mortality rate of rats following exposure to elevated levels of lead. [20 words/119 characters]

Why write this sentence when you can write the following? “We did a six-month-long study of the death rate of rats exposed to high levels of lead. [18 words/84 characters]”

These sentences say the same thing, yet the second one is easier to read and 20 percent shorter as well. Proposals have page limits—you can’t afford to waste space.

As a guideline, words ending in *-ate* are derived from Latin and sound heavy and full of themselves. Words ending with *-ion* are French. If you’re not sure about a word, consult the *Oxford English Dictionary*—it gives the word’s origin and meanings. It’s worth noting that all the fuzzy verbs I listed in the last chapter are French or Latin. That is not surprising—common language is concrete, so when scholars reached for fuzzy verbs, they reached for Latin.

Sometimes, of course, you should use the French or Latin because the Anglo-Saxon word has a different connotation. Let me go back to example 14.6 about herbivores and exotic grasses. I suggested writing that sentence as: “Herbivores preferentially eat native plants.” I think many would write this as “Herbivores preferentially consume native plants.” because the Anglo-Saxon “eat” seems too visceral and too common to use in technical writing. Yet herbivores do, in fact, eat, and there is nothing wrong with saying so. In this context the words are synonyms, so use the shorter word. In other contexts, however, they are not synonyms and you could not switch them interchangeably; for example you can say

that a fire “consumed the fuel,” but not that it “ate the fuel.” *Eat* implies mouths and nutrition, whereas *consume* carried its definition “to destroy” from Latin into English. Animals eat, fires don’t.

Another alternative to saying “Herbivores preferentially eat” might be “Herbivores preferentially forage on . . .” *Forage*, however, carries the definition “to collect from” and so implies a hunting strategy, rather than a taste test. If that nuance is desired, use the longer Latin word, but be careful about relying on nuance; some readers may not understand the distinctions.

If you are struggling with word choice, a thesaurus is valuable, but you need to back it up with a good dictionary. So-called synonyms can have different implications, such as “consistent” and “coherent.” My thesaurus lists these as primary synonyms for each other. Yet “consistent” suggests constancy, maybe even when it isn’t desirable. In the words of Ralph Waldo Emerson, “A foolish consistency is the hobgoblin of little minds.” So occasional inconsistency is desirable, but is it ever good to be incoherent?

15.4. PREPOSITIONAL PHRASES VERSUS COMPOUND NOUNS

A prepositional phrase, such as “rate of reaction” is made up of an object (reaction) and a modifier (rate) tied together with a preposition (of, in, on, etc.). The alternative is to use an expression such as “reaction rate” in which one noun directly modifies another: this is a compound noun (table 15.2). Prepositional phrases are usually nasty—longer and clunkier than the compound noun. They also have a strange attraction for nominalizations and passive verbs.

Table 15.2 lists some representative prepositional phrases and the alternative compound forms.

I’m not sure why so many people default to the prepositional over the compound noun. I think for some it sounds more precise. Others learned that compound nouns can cause problems (see below) and should always be avoided, as opposed to only avoiding them when they do cause problems. Others use them because we are being careless (as I often do in my first drafts).

Usually the compound noun is better, and for many things, we can’t even imagine breaking them up—consider English without such expressions as “stone wall,” “science fiction,” or “Air Force”; or science without such terms as “benzene ring” or “nitrogen fixation.” These expressions are short, clear, and effective ways of combining two things to build a more complex idea. You should generally turn prepositional phrases around to condense them, as illustrated in the following examples.

Example 15.7

- A. The rate of the reaction increased sixfold when pH was decreased to 4.5.
- B. The reaction rate increased sixfold when pH was decreased to 4.5.

Table 15.2. PREPOSITIONAL PHRASES VS. COMPOUND NOUNS

| Prepositional Phrase | Compound Noun |
|---------------------------|-----------------------|
| Source of water | Water source |
| Supply of nitrogen | Nitrogen supply |
| Distribution of resources | Resource distribution |
| Kinetics of enzymes | Enzyme kinetics |
| Burning of fossil fuels | Fossil fuel burning |
| Cancer of the lung | Lung cancer |

Example 15.8

- A. This paper presents a new procedure for synthesizing complexes of iron and benzoate.
- B. This paper presents a new procedure for synthesizing iron-benzoate complexes.

Example 15.9

- A. Assembly is a stepwise process, starting with binding of Red22 to the coding region followed by binding of Red25 and Blu17 to the control region.
- B. Assembly is a stepwise process, starting with Red22 binding to the coding region followed by Red25 and Blu17 binding to the control region.

In each case, the second version is a little shorter and a little tighter. In the last case, flipping the prepositional phrase turned “binding” from a nominalization back into a verb—a double win.

15.4.1. When to Leave a Prepositional Phrase

I’ve argued, as a principle, that every tool in English has value, and that includes prepositional phrases. So, when *should* you use one? As an example, consider the following sentence.

Example 15.10

These results suggest that modification of resource allocation allowed *Vaccinium* . . .

You could remove the prepositional phrase “modification of resource allocation,” which would convert the sentence to the following: “These results suggest that resource allocation modification allowed *Vaccinium* . . .” But “resource allocation modification” is a jumbled mouthful of words, all the worse because they are

nominalizations modifying each other. This is heavy, clunky, and hard to figure out. Such overdone compounds are sometimes known as noun clusters, but my colleague Ruth Yanai calls them “noun trains,” a lovely term. Noun trains are worse than prepositional phrases. You can break them up into manageable pieces by using the occasional preposition.

How do you decide between a clunky prepositional phrase and a clunky noun train? If there are only two nouns, a compound is almost certainly better. If there are four nouns, break it up. Three is trickier; for example, “resource allocation modification” is awkward, yet “science fiction writer” is not. Several things make one a nasty noun train whereas another is fine. First is the complexity of the words: big words strung together form an undigestible mass. Second is whether we intuitively lump two of the words into a single unit—we read “science fiction” as one unit, so we see “science fiction writer” as only two units (a writer of science fiction); that’s okay. We read “growth allocation modification” as three separate units and awkward.

Such extended noun trains can create confusion as to which is the core noun and which is the modifier. For example, is “Arctic system science” the science of studying the Arctic system, or is it system science done in the Arctic? The former focuses on the integrated system; the latter includes studies on individual systems that comprise part of the larger Arctic system. This is not a purely semantic debate—it has at times controlled major research directions and funding decisions by the National Science Foundation.

A noun train can even create confusion as to whether a word is a noun or a verb. Consider the expression “microbial community composition influences” in the following sentence.

Example 15.11

Current theory suggests that microbial community composition influences are most likely to be observed for physiologically narrow processes.

“Influences” is a nominalization, but it could be a verb, were the sentence “microbial composition influences soil processes.” As someone reads the word, they will unconsciously assume one or the other. There is a 50 percent chance that they’ll guess wrong and get pulled up short when they read the next word and have to back up and reinterpret. Any time you break the flow, you create problems. Here the prepositional phrase adds words but makes the idea clearer: “Current theory suggests that the influences of microbial community composition are most likely to be observed for physiologically narrow processes.”

One final way you can use prepositional phrases is to control which word lands in a sentence’s stress position. Consider the following two sentences:

Example 15.12

- A. Ecosystems can be managed to limit the effects of global warming.
- B. Ecosystems can be managed to limit the global warming effects.

In this case, the first sentence puts the strong phrase “global warming” into the stress, and is probably preferable.

As a last example, I want to go back to example 7.3 about signaling in visual transduction. That included the following sentence: “Despite the tantalizing evidence for DAG and/or its downstream products in visual transduction and the synergistic role of calcium, in no instance has application of such chemical stimuli fully reproduced the remarkable size and speed of the photocurrent.”

I argued that these authors used topic and stress effectively to put emphasis in the right places. But look at what they had to do to put the stress on “remarkable size and speed of the photocurrent.” They used the phrase “in no instance has application of such chemical stimuli reproduced.”

Wow. A passive-feeling, nominalized, prepositional phrase—the verb is “has,” and the action is the nominalization “application.” That’s a lot of no-no’s packed into a mere six words. But it worked. This is a long, complex sentence, but its meaning is clear and it doesn’t sound bad.

They could have written this as: “Applying such chemical stimuli has never fully reproduced . . .” That would have made the key word “application” into the verb “applying,” but it would have put the critical word “never” in the middle of the clause. Instead, they put “never” up at the front of the clause to highlight it—they were using the 2–3–1 rule within a clause. Breaking some of the rules allowed the authors to put the right information in the right place to make the story flow.

This chapter covers only a selection of issues involved in choosing words to write clearly and engagingly, but it illustrates the principles. You are working to become an adept, so struggle to get rid of the literary language. Use the necessary technical terms, but avoid unnecessary jargon—and be aware of the difference! Remember that there are ways to remind readers of terms they may be unfamiliar with. Choose short, active words and phrases over long, ponderous ones. If you can do these things, your readers will be happy, and you may have more of them.

EXERCISES

15.1. Analyze published papers

Go to the papers you’ve been reading. Pick a paragraph or two and analyze the words the authors use. Go through each issue raised in this chapter and see whether you can lighten up the writing by avoiding jargon, picking shorter words, and eliminating prepositional phrases.

15.2. Write a short article

Go through your short article, and lighten up the words you use wherever possible. Can you do a stronger job of avoiding jargon, picking shorter words, and eliminating prepositional phrases?

15.3. Revise

Lighten up the following sentences:

- A. The ability of animals to arrive at solutions to problems has been undervalued because studies have not been done that are considered to have scientific reliability.
- B. Rats that had been maintained under varying environmental conditions demonstrated improved cognitive ability relative to the control group, which had been maintained in conditions that were invariant.