



**Proper Use of Four-Letter Words  
in Technical Writing**

**Grammar**  **Police**  
Celia M. Elliott Commissioner

Department of Physics  
University of Illinois at Urbana-Champaign  
cmelliot@illinois.edu



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This lesson is **not** about those short, pithy, Anglo-Saxon words we say when we bump our heads or drop something on our feet. It is about the short, pithy, Anglo-Saxon words that cause ambiguity in scientific writing and send Ms. Particular into low-earth orbit.

We've already talked about "with" and "only," but we'll review them today. And we'll look at some more problem-causing four-letter words.

## **With**

**Don't use *with* when you mean *having* or *using***

**“A single impurity in one-dimensional bosonic systems will be explored, with particular emphasis on accessing a hitherto unobserved phase *with* density-wave correlations.” (???)**

**Is the author using density-wave correlations as a tool to “access” this new phase, or is the phase characterized by density-wave correlations (unlike other phases, which don't have such correlations)?**

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Unless you really mean “along with” or “simultaneously with” or “associated with,” ***don't*** use *with*; use *having* or *using*.

## Only

**Only is the most commonly misplaced modifier in English**

**Only immediately preceding a verb is usually in the wrong place**

- ☹ “However, these forms are only obtained at the expense of additional auxiliary symmetries and particles, with the use of nonrenormalizable operators.”
- ☹ “For the present slab calculations, we only applied the constant pressure algorithm to the two lattice vectors parallel to the surface, leaving the third unchanged during the simulation.”
- ☹ “The remaining forward scattering terms as well as backscattering and Umklapp terms arising from the Coulomb interactions only lead to weak deviations (on the order of a few percent) to the gaps...”  
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All examples were taken from one issue of a 2011 *Physical Review Letters*.

The third example is also desperately in need of two commas, but where to put them is debatable.

A comma is clearly needed to set off the dependent phrase, “as well as backscattering and Umklapp terms,” but then what do you do with “from the Coulomb interactions”? Does it modify “remaining forward scattering terms” or only the Umklapp terms?

Both edited examples shown below are grammatically correct, but the meaning is different:

“The remaining forward scattering terms, as well as backscattering and Umklapp terms arising from the Coulomb interactions, lead only to weak deviations...”

“The remaining forward scattering terms, as well as backscattering and Umklapp terms, arising from the Coulomb interactions lead only to weak deviations...”

If the second example is what is meant, the sentence would be much clearer if the modifier (“arising from the Coulomb interactions”) was moved to where it belongs, i.e.,

“The remaining forward scattering terms, which arise from the Coulomb interactions, as well as backscattering and Umklapp terms, lead only to weak deviations...”

## This

Avoid naked “this”es—they are invariably ambiguous



“In some pellet designs, the average ionic charge,  $Z$ , and the laser intensity,  $I$ , are large enough that the distribution function is predicted to be non-Maxwellian (flat-topped). **This** has important consequences: reduction of the absorption rate, electron heat flux, and modification of the continuum x-ray emission rates.”

## WHAT???

the pellet design,  $Z$ ,  $I$ , the distribution function,  
the non-Maxwellian distribution???

Here’s another example:

“Single photons can represent quantum systems of  $d$  states (qudits) by occupying  $d$  different modes [10–13]. The projection of two such photonic qudits of  $d > 2$  onto a maximally entangled state is impossible without the use of auxiliary photons. **This** is because only two particles are involved, while the Schmidt number of the projected state is larger than 2 [30].” PRL **106**, 130502 (2011).

Presumably, this *this* means “everything I said in the previous two sentences.”

Ms. Particular (with the approval of the author)\* would revise thus:

“Single photons can represent quantum systems of  $d$  states (qudits) by occupying  $d$  different modes [10–13]. The projection of two such photonic qudits of  $d > 2$  onto a maximally entangled state is impossible without the use of auxiliary photons. Because only two particles are involved, additional photons are required when the Schmidt number of the projected state is larger than 2 [30].”

\*The author always trumps the editor. Sad but true.

## That

### Use *that* to define

“Chen et al. [28] have developed a BCS—Bose—Einstein crossover theory of short-coherence-length superconductors *that* exhibit a pseudo-gap, as do BEDT materials.[29]

### Use *which* to expand

“The Coffey—Clem theory, *which* generalizes the relation to include thermally assisted flux flow, was tested experimentally.”

### What does the following sentence *mean*?

“We have calculated the ground state energy and pairing gap for pure neutron matter in the low-density regime *which* is relevant for the inner crust of neutron stars.”

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*That* is used to introduce *restrictive* clauses—subordinate clauses that are integral to understanding the meaning of a sentence.

*Which* is used to introduce *nonrestrictive* clauses—subordinate clauses that introduce additional, interesting, ancillary information that is ***not*** integral to the meaning.

*Which* clauses are always set off from the rest of the sentence with commas. Think of the commas as handles; they allow you to lift the nonrestrictive clause out of the sentence without changing its meaning.

If you can remove the dependent clause and still have the remaining sentence make sense, it's a nonrestrictive clause. Introduce it by *which* and set it off with comma-handles.

If the removal of the clause changes the meaning of the sentence or leaves it senseless, it's a restrictive clause and should be introduced with *that* (no commas).

For a more comprehensive discussion of *which* and *that* (you know you want it), see <http://online.physics.uiuc.edu/courses/Phys496/Spring11/MsParticular/WhichisThat.pdf>

## **Need**

**Inanimate objects don't *need* anything**

**Replace *need* with *must* or *should* or *require*  
every time you write it**

**“The dial *needs* to (must) be set at “0” prior to  
turning on the high-voltage power supply.”**

**“The desired emittance would *need* (require)  
approximately seven damping intervals.”**

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Assigning human traits or abilities to animals or inanimate objects is known as anthropomorphism and is considered a flaw in scientific writing.

Here is another example of anthropomorphism:

“The substrate *tells* the YBCO how to align during growth.”

What's going on here is really much more complicated than this simple sentence implies, and good scientific writing should communicate *exactly* what is happening, not some parable that substitutes for the facts.

While such simplification might be acceptable when writing a popular article for a general audience, it has no place in most scientific writing.



## Ones

**Busy, anonymous *ones* frequently do all sorts of things in stilted technical writing—avoid this trite construction**

**Recast the sentence in the passive voice to put the emphasis where it belongs**

**“Knowing the mass, *one* can use the following relation to calculate the radius:**

$$m = 4\pi\rho\frac{a^3}{3}.”$$

**“*From the mass, the radius is calculated by ...*”**

**“This report describes the process by which *one* can create still-frame images...”**

**“*A process to create still-frame images from data files is described...*”**

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Getting rid of the *ones* should make your writing more concise and direct—always a goal in good writing.

## Also

**Sentences beginning with a marooned *also* often sound like an afterthought; avoid this construction**

**Provide a transitional phrase or a simple conjunction (*and, but, because*) and tie the *also* sentence to the one preceding it**

**Attach the *also* sentence to the one preceding it with a semi-colon if the ideas are closely related**

**The dark reaction ( $\text{CO} + \text{O}_2$ ) does not yield any  $\text{CO}_2$  on either of the substrates. *Also*, in the presence of UV but the absence of  $\text{O}_2$ , no reaction was observed.**

**The dark reaction ( $\text{CO} + \text{O}_2$ ) did not yield any  $\text{CO}_2$  on either of the substrates, and no reaction was observed in the presence of uv light when  $\text{O}_2$  was absent.**

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In the correction, note that the *UV* in the original is changed to *uv* (AIP Style Manual), and *light* is added to clarify. If *UV* is actually an acronym for something besides *ultraviolet*, more readers than Ms. Particular may be confused.

The verb tense was also changed in the edit so that both clauses were written in the past tense. *Toujours* witless consistency!

“In addition,...” is only marginally better than “Also,...” and will be dealt with accordingly.



## From

**Do not use *from* or *between* before a range—it is meaningless**

from 1993 to 1997, ***not*** from 1993–1997  
between 11 and 17, ***not*** between 11–17

## **Data**

***Data* is a plural noun and requires a plural verb**

“The data shows...”  
“The data was taken...” are both wrong

“The data *show*...”

“The data *were* taken...”

**The singular is *datum* (but don't use it;  
it sounds extremely pretentious).**

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If you *really* mean “one data point,” say “one data point.” But beware of basing much of an argument on it.

## **Very**

**Avoid this wimpy qualifier\***

**Instead, choose a precise word that correctly  
conveys the degree**

### Wimpy

### Precise

<b>very small amount</b>	<b>less than 15 <math>\mu\text{g}</math></b>
<b>very important</b>	<b>crucial, essential</b>
<b>very precise</b>	<b><math>\pm 5 \text{ nm}</math>; <b>&lt;10 ppm</b></b>
<b>very rapidly</b>	<b>simultaneously, in <b>&lt;2 <math>\mu\text{s}</math></b></b>

**\*Other wimpy qualifiers: rather, little, pretty (meaning "sort of")**

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What is *very* large to you may be only moderately large to one reader and enormous to somebody else. Don't expect a reader to divine what's in your mind and assign the correct size to a qualitative description.

Take Mark Twain's advice:

"Substitute "damn" every time you're inclined to write "very;" your editor will delete it and the writing will be just as it should be."

## **Less**

***Less* is used for quantities that have been measured or calculated**

***Fewer* is used to describe quantities that have been counted**

**“All quantum cryptography schemes to date have a necessary upper limit to the efficiency of the scheme, i.e., (less than/fewer than) 50 percent of the photons sent can contribute to the final key.”**

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This example has caused a good deal of angst to Ms. Particular, who could argue either way. (Such contrariness comes as no real surprise to people who know Ms. Particular. )

On one hand, the photons were probably initially counted, which would give the nod to *fewer than*. On the other hand, percentages are calculated, not counted, which would argue for *less than*.

Ms. Particular has a preference for *fewer than*, because it sounds better.

## **Lead**

***Lead* is a present-tense verb (to lead) or an element (Pb)**

**The past participle of “to lead” is “led”  
(not to be confused with LED, a light-emitting diode)**

**“The clues *led* to Colonel Mustard with the *lead* pipe in the library.”**

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The “Clue” example will be replaced with a proper physics one in the next edition.

## **Like**

***Like* means *similar to***

**Do not use *like* when you mean *such as* (or e.g.)**

**“The student will practice each technique on well-known and well-understood materials *like* lead, aluminum, and silver.”**

***Like* excludes; in this example, the student is not practicing on Pb, Al, or Au, she’s practicing on a well-understood material *similar to* Pb, Al, or Au**

***Such as* includes**



## **Most and Best**

### **Some words denote absolute qualities**

adequate, best, certain, complete, critical, entire,  
equal, essential, favorite, final, finished, perfect,  
unique, vital, worst

### **Do not use most comparative modifiers with absolutes**

comparatively, more, most, rather, somewhat, very

### **Some comparative modifiers that “back off” from the absolute are okay, but use them judiciously**

almost, less than, nearly

“more unique” 😞 “almost finished” 😊 “nearly essential” 😞

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Modifiers that emphasize or intensify the absolute (surely, absolutely, completely) are grammatically correct but should be used judiciously.

Modifiers that indicate less than the absolute (almost, nearly, perhaps, not entirely, in some respects, not quite) are correct but wimpy.

## **Over**

**Don't use *over* when you mean *compared with***

**“When distilled water was used, sample impurities were reduced by 8 percent *over* (compared with) the samples prepared with tap water.”**

**Don't use *over* when you mean *more than***

**“*Over* (More than) half the samples were unusable.”**

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And it's ALWAYS “compared with” in science writing.

## **Fact**

**A *fact* is undisputed and immutable**

**Do not use *fact* when you mean**

<b>observation</b>	<b>finding</b>	<b>effect</b>
<b>phenomenon</b>	<b>result</b>	<b>value</b>

**“The fact that” should be edited out of every sentence in which it occurs<sup>1</sup>**

<b>owing to the fact that</b>	<b><i>because</i></b>
<b>in spite of the fact that</b>	<b><i>although or despite</i></b>
<b>unaware of the fact that</b>	<b><i>clueless<sup>2</sup></i></b>

<sup>1</sup>Strunk and White

<sup>2</sup>Colloquial, and probably ill-advised in science writing (you never know who is going to be reviewing your proposals...)

Science writers should also beware of *factual*, as it has two meanings in English: (1) of or relating to facts, and (2) true.

My analysis might be factual (i.e., an interpretation of facts) and completely erroneous (untrue).

## Hope

**Be positive to be persuasive; don't say what you *hope* to do, say what you *will* do**

**~~“We hope~~ the new frazzlejammer will allow us to increase the sensitivity of our measurements by a factor of 2.”**

## Get rid of hopefully too

***Hopefully*, this work will lead to some new applications (and make us all a lot of money).**

***hopefully* means “full of hope” or “in a hopeful manner”; it does *not* mean “it is to be hoped” or “we hope”**

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In the immortal words of Master Yoda, “Do or do not. There is no try.”

And there is no *hope* in science.

## Them thar

**Avoid starting a sentence or a clause with *there* and a *to be verb*—use the passive voice and plunge right in**

...when *there is* a temperature gradient present.

...*when a temperature gradient is present.*

*There is* the added complexity of pressure in the gas...

*The pressure in the gas adds complexity to the calculation...*

If the focal points do not coincide, then *there will be* no interference pattern...

*If the focal points do not coincide, an interference pattern will not occur...*

**Better:** *If the focal points coincide, an interference pattern will occur.*

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Sometimes, there's just no way around starting a clause with *there*. (Try it with this sentence.) But many sentences can be improved by eliminating *them thar* preambles and putting the subject at the beginning of the sentence.

The third example demonstrates another truism in writing—phrasing a statement as a positive is usually more concise and always easier for the reader to understand than expressing the same thought as a negative.

Here are two examples:

Although some data supported the hypothesis, it could not be concluded that luminosity scaled linearly with current. (negative, 17 words)

BETTER: Data showing linear scaling of luminosity with current were inconclusive. (positive, 10 words)

Arcing under high-current operation could not be avoided without the use of the insulated feedthrough. (negative, 15 words)

BETTER: The insulated feedthrough prevented arcing, even during high-current operation. (positive, 9 words)

## **Due<sup>2</sup>**

**Should be used as an adverbial phrase following  
a *to be* verb**

**Other uses blur the distinction between *caused  
by, because of, owing to, and associated with,*  
which have distinct but subtle gradations in  
the degree of causality**

**If you cannot substitute *attributable to,*  
replace *due to***

**If *due to* is used to begin a sentence,  
it is probably wrong as well as inelegant**

**Writing “due to the fact that” is an  
egregious abuse of readers’ sensibilities**

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Editors have a deep and abiding aversion to *due to*. Scientists should too, because it's sloppy.



### **Another due2 example...**

**“Previous work has shown that tips made from softer magnets, such as nickel or cobalt, significantly enhance spin relaxation rates *due to* thermal fluctuations of the magnetic moment.”**

**What’s meant here?**

**Do the softer magnets affect only *some* spin relaxation rates (only those caused by thermal fluctuations)?**

**Or are the thermal fluctuations (a feature of the softer magnets) the cause of the enhanced spin relaxation rates?**

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Careless writers often use *due to* as a shorthand to compress complex causal relationships into one easy six-character phrase. Avoid this temptation.