Revising Technical Manuscripts

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With thanks to the fabulous Physics faculty at the University of Illinois

Today we are going to look at techniques to revise and polish technical manuscripts.

Plan for time to reflect and revise

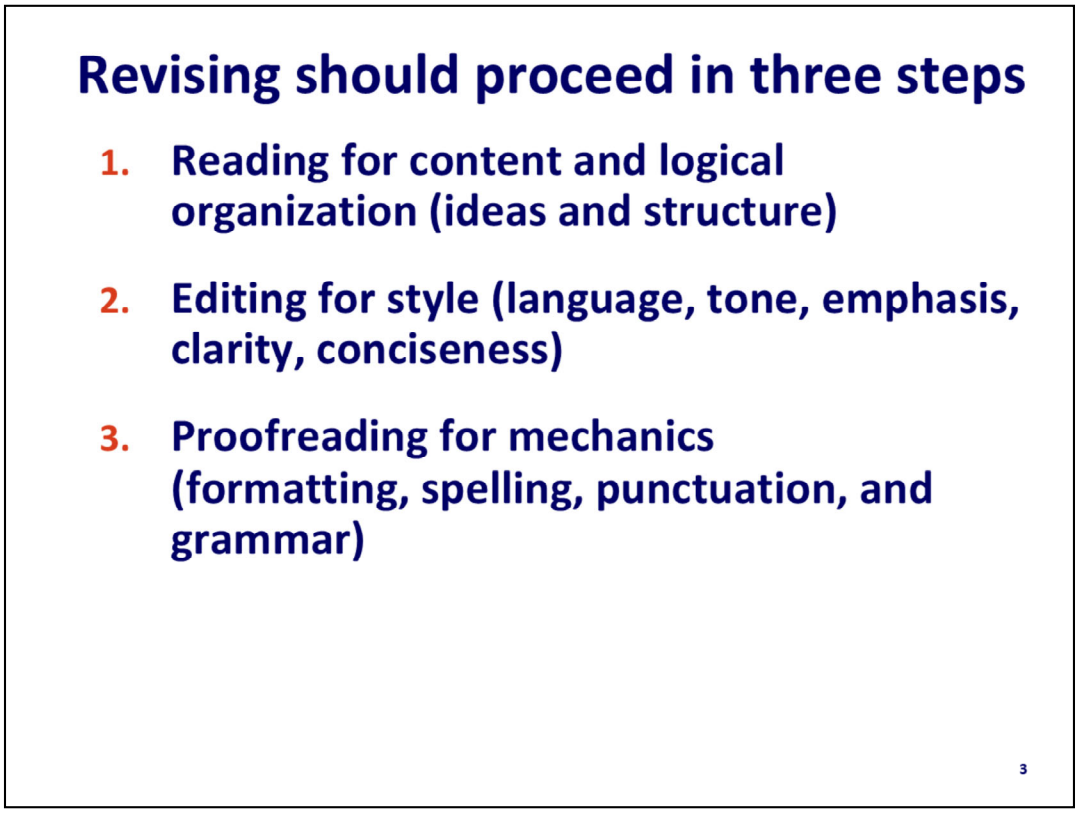
You should allow as much time for revision as you did for writing your paper in the first place

Revising concentrates on three elements

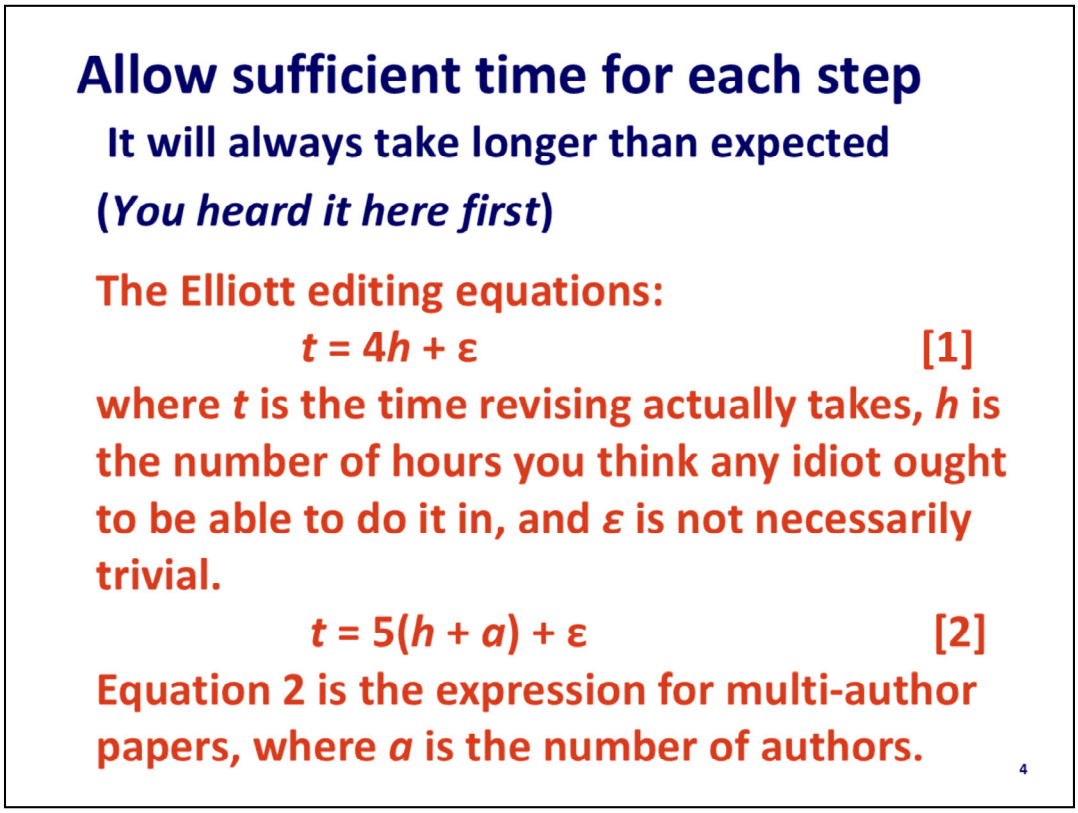
1. **Clarifying the selection and logical presentation of ideas, tailored to the audience**
2. **Evaluating the use of language (emphasis, tone, vocabulary)**
3. **Proofreading for mechanical errors**

Rewriting often takes more time than writing. As you are planning your timeline for completing your paper, build in sufficient time for getting feedback from others and revising the manuscript.

The probability that a first-draft paper, ripped off the printer 30 ns before the deadline, will be acceptable work asymptotically approaches 0.



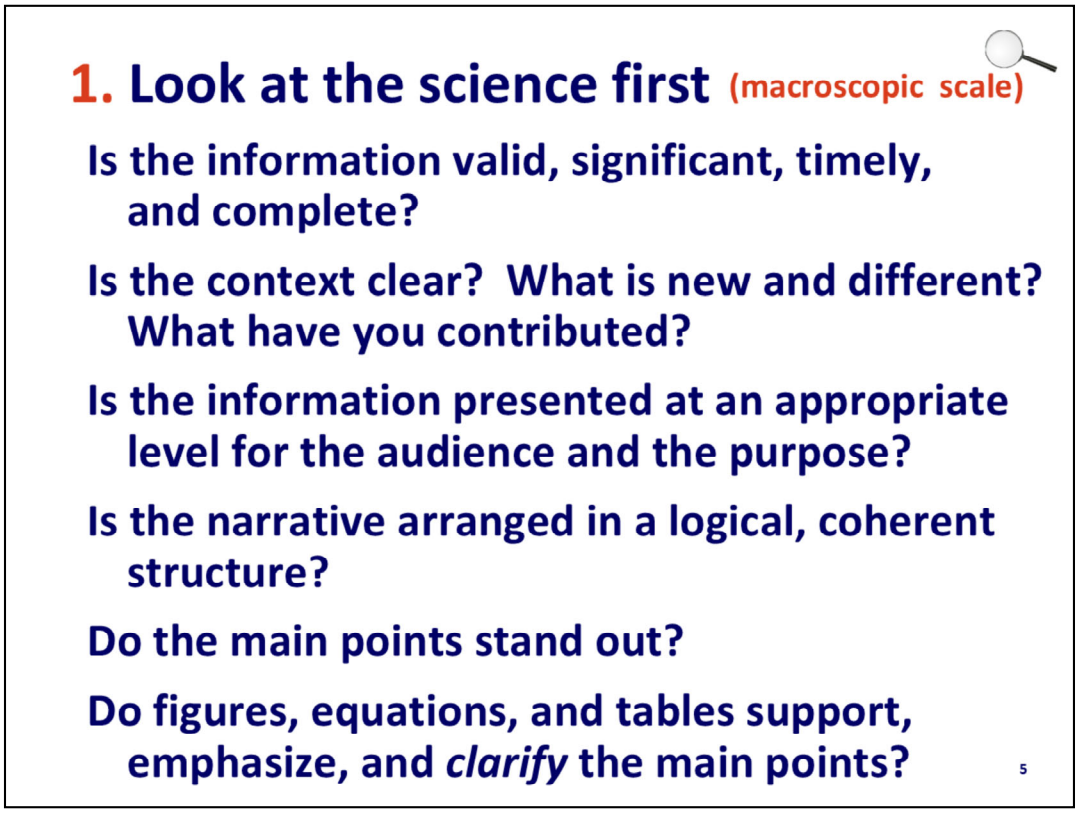
Think of the process as zooming in on the manuscript.



I have learned that you can talk and talk and talk to physicists, but if you really want to get their attention, show them an equation. Hence the Elliott editing equations given above.

In Eq. 1, t is the time it actually takes to edit a manuscript, h is the number of hours you think any idiot should be able to do it in, and ε is not necessarily trivial.

Equation 2 is the expression for the time it takes to edit a paper that has multiple authors, where t is the time it actually takes, h is the number of hours you think it should take, a is the number of authors, and ε, again, is not necessarily trivial.



The first pass is from the **macroscopic** (section) level—look at the ***science***.

- Are the main points clearly identifiable and given appropriate emphasis?
- Do figures and tables support and enhance the main points?
- Is the narrative coherent—is there a clearly defined progression from background to hypothesis to method to results to conclusions?
  TIP: Cut and paste the first sentence of each paragraph into a new document. Read it aloud. Does it adequately tell your story? Are there gaps or omissions?
  See http://people.physics.illinois.edu/Celia/Lectures/Paragraphs.pdf for tips on how to build effective paragraphs to incorporate an organic, logical structure in your writing.
- Have you supplied sufficient background so that the reader can understand the significance of your work? Have you provided appropriate context through adequate referencing of prior work?
- Have you made your case? Have you justified your assumptions, anticipated reader questions and objections, and supported your arguments?
- Is it clear what you have contributed?

Provide logical transitions

One section ends with:

"… Improved sensitivity is important because amplifiers and signal processors are nonlinear and thus can mix signals that lie outside the desired band; the mixing generates signals with frequencies that appear as in-band noise."

Begin the next section with:

"To achieve the improved filter performance, high-quality expitaxial films of YBCO have been…"

The logical connection between the two sections is made clear by repeating the idea of *improving performance*

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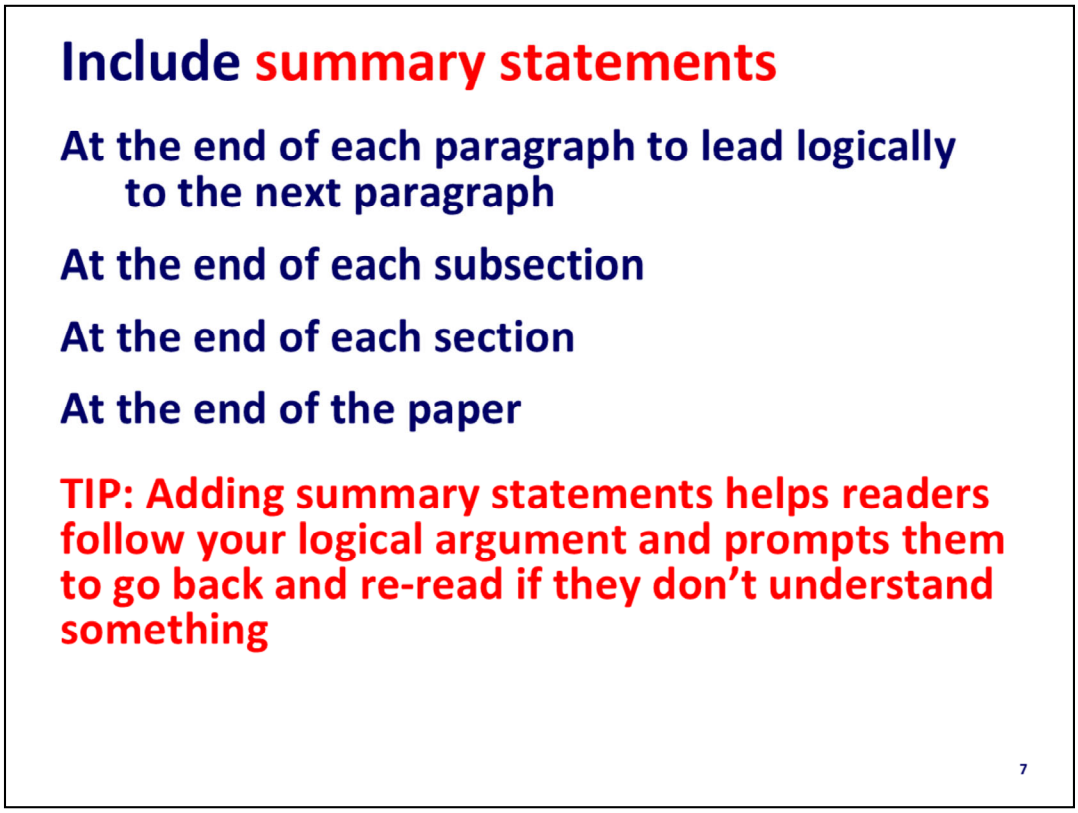
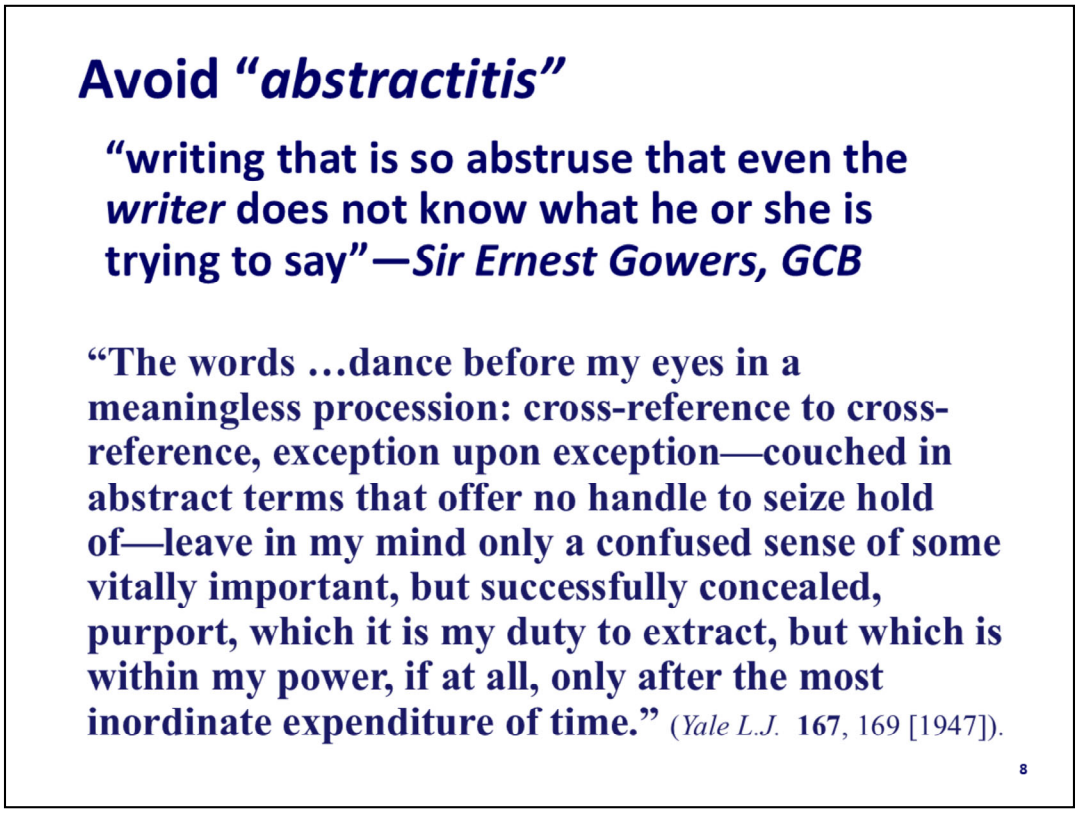


Provide summary statements at the end of each major section of the paper.

The old speaker's rule is "Tell them what you're going to tell them. Tell them. Tell them what you told them." That advice is just as valid for paper and reports. Take if from a mother—telling somebody something important three times is *not* overkill.



As defined by Ernest Gowers and quoted by Bryan Garner in *Garner's Modern American Usage*, *abstractitis* is writing that is so abstruse that even the writer does not know what he or she is trying to say.

While Gowers in this case was talking about the U.S. Internal Revenue Code, he could easily have been describing many physics papers.

Gowers' use of a 68-word sentence is a rant for another day.

How to avoid "*abstractitis*"

1. Clarify—*replace jargon with accessible terminology; use simple subjects and direct action verbs; de-convolute syntax*
2. Quantify—*replace wimpy, qualitative adjectives with quantitative descriptors*
3. Objectify—*give concrete examples; use analogies*

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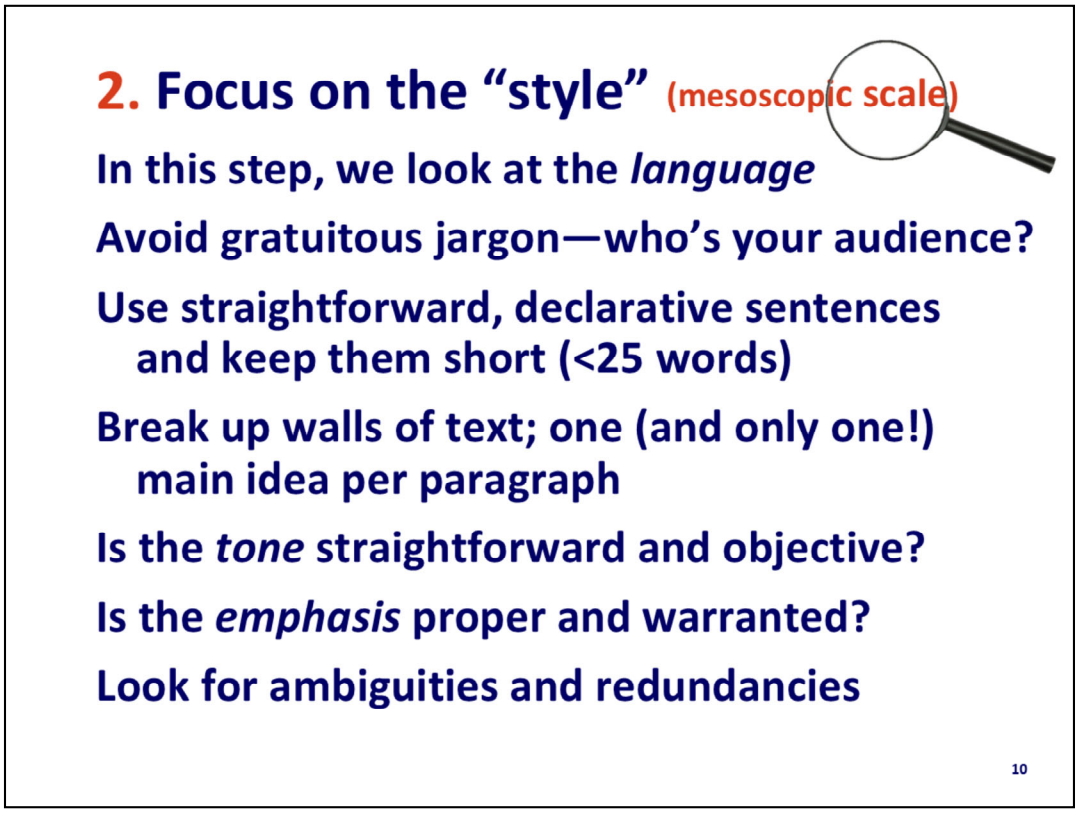

Next, zoom in to the **mesoscopic** (intermediate) level—look at the ***words***.

- Is the language clear and unambiguous?
- Have you defined all acronyms and technical jargon that may be unfamiliar to your audience?
- Have you used the simplest word to unambiguously convey your meaning?

Semantics and syntax control clear communication

"Semantics" is the meaning of words; you must have a vocabulary adequate to describe things precisely

The difference between the right word and the *almost*-right word is the difference between *lightning* and *lightning bug*.
—*Mark Twain*

Scale your use of jargon to the intended audience

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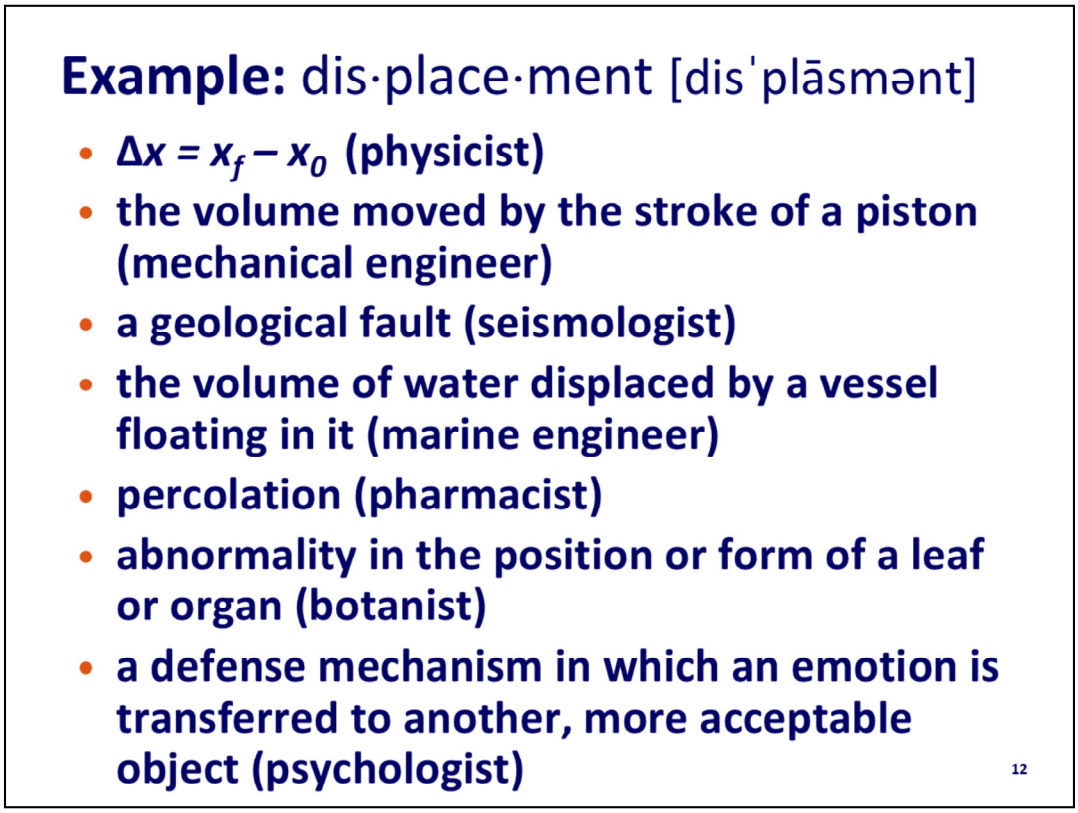
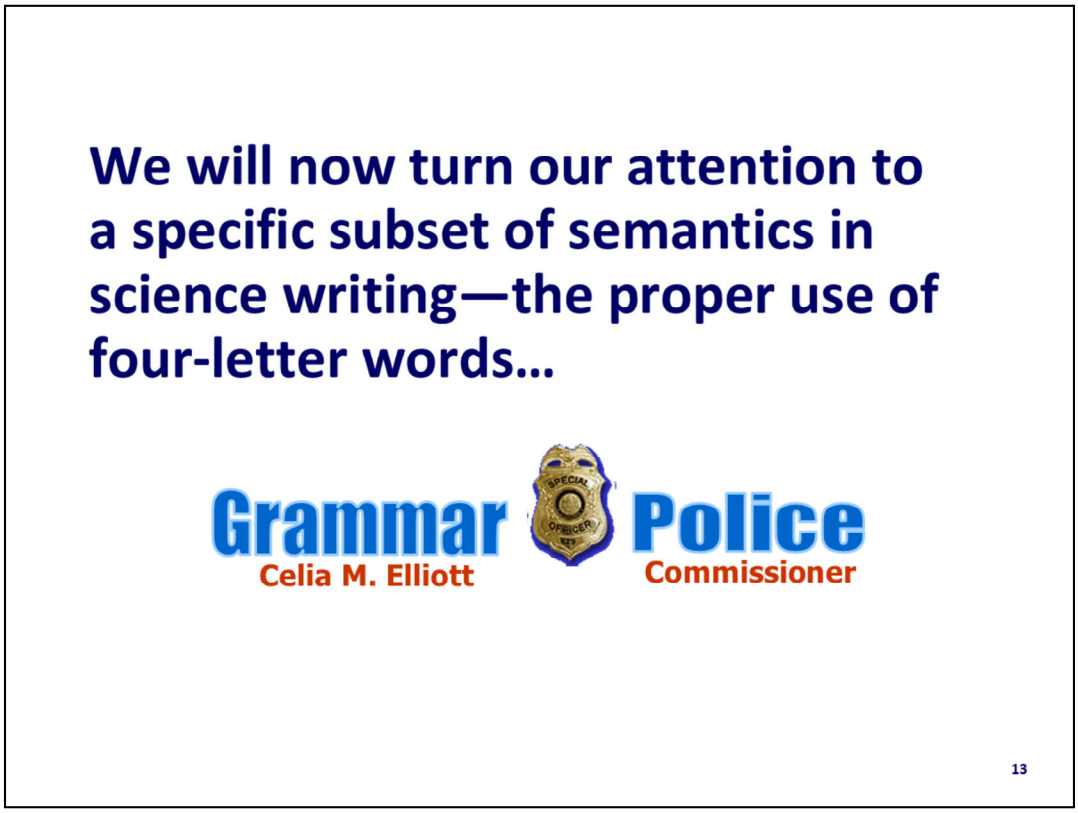
Note that words have connotations (overtones of associated ideas or emotions) beyond their literal dictionary meanings, which also affect the appropriateness of word choice.



Semantics—the indirect relation between words and meaning; note that words have different connotations in different contexts; e.g., “displacement.”



This section 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.

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???

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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]."

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.

No more naked "*this*"es—just don't

A certain amount of energy is required to cause an electron to spin flip when it is beside another electron. Thus, the energy required is double this and is provided by the incident photons.

"This means that…" → *i.e., or thus*

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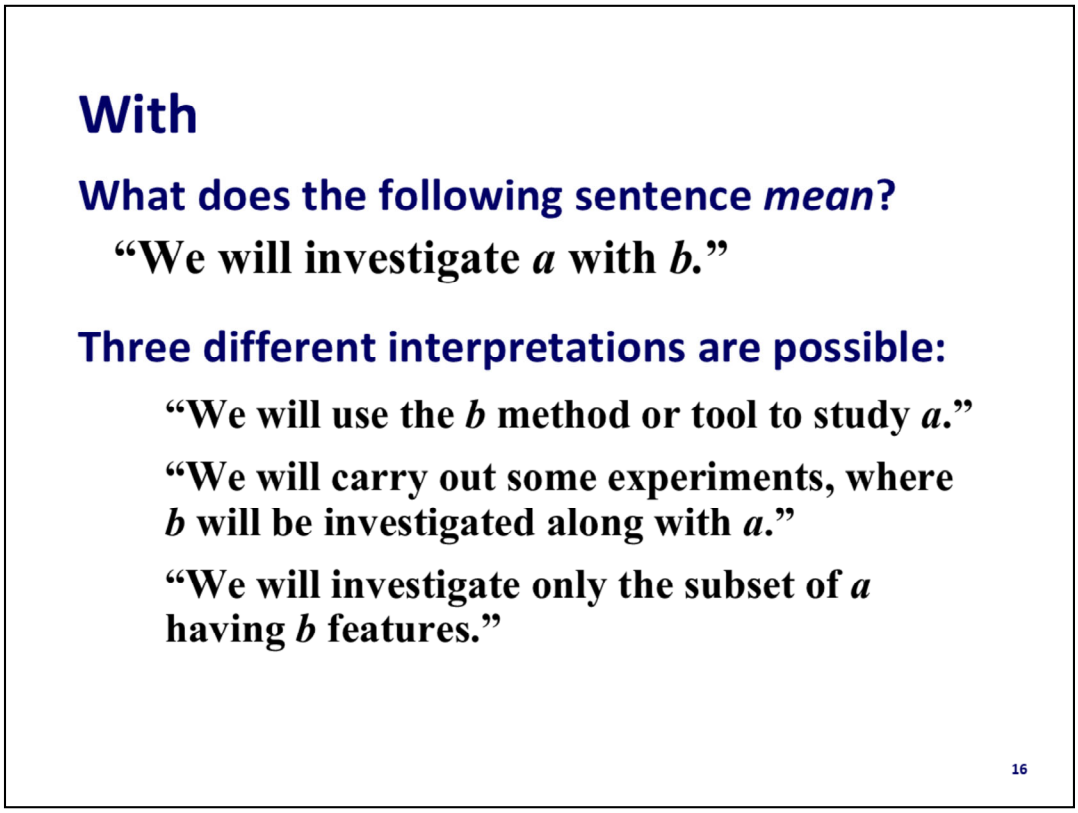
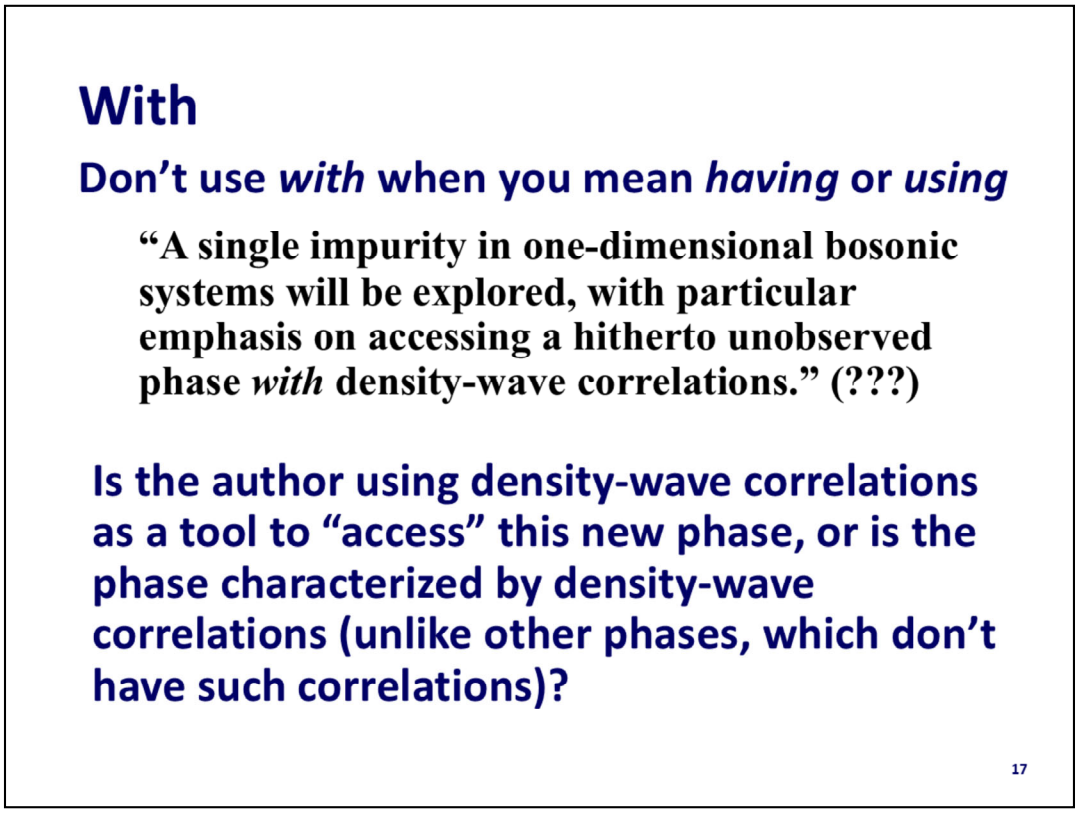
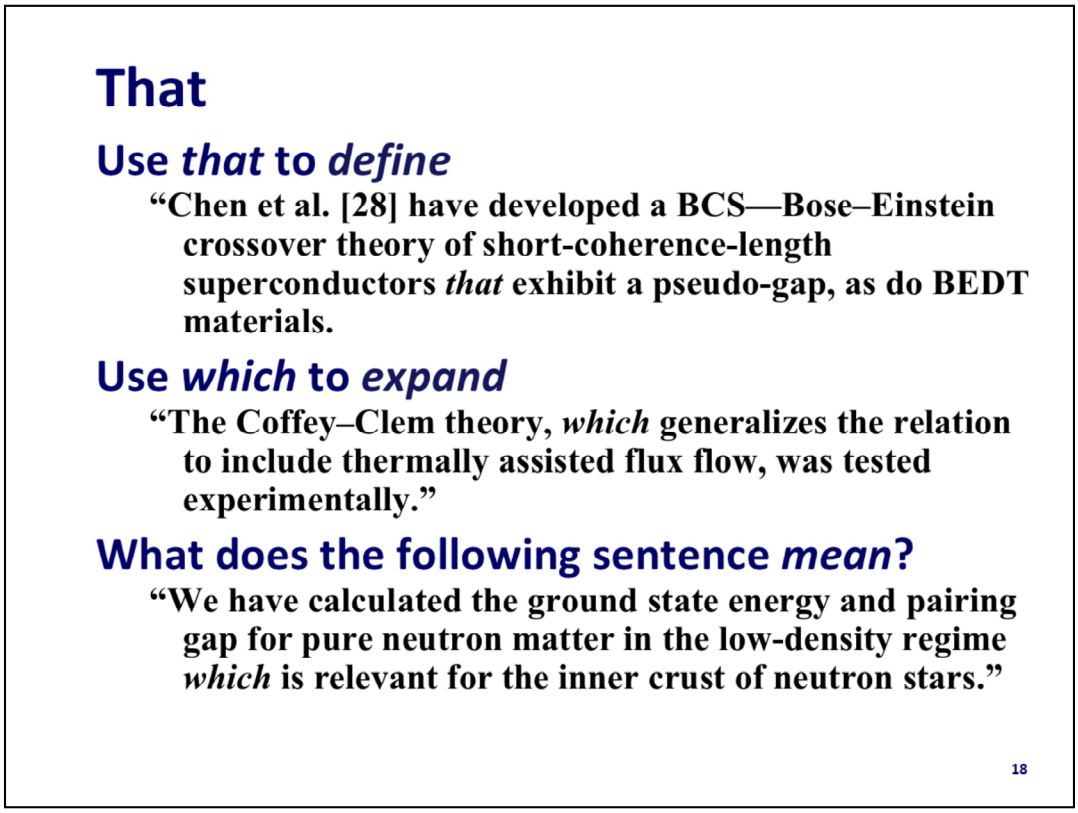


Scientists often use "with" as a sloppy substitute for the more precise "having" or "using."

Using an all-purpose "with" indiscriminately may lead to an ambiguous statement that is difficult for a reader to interpret correctly.



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



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

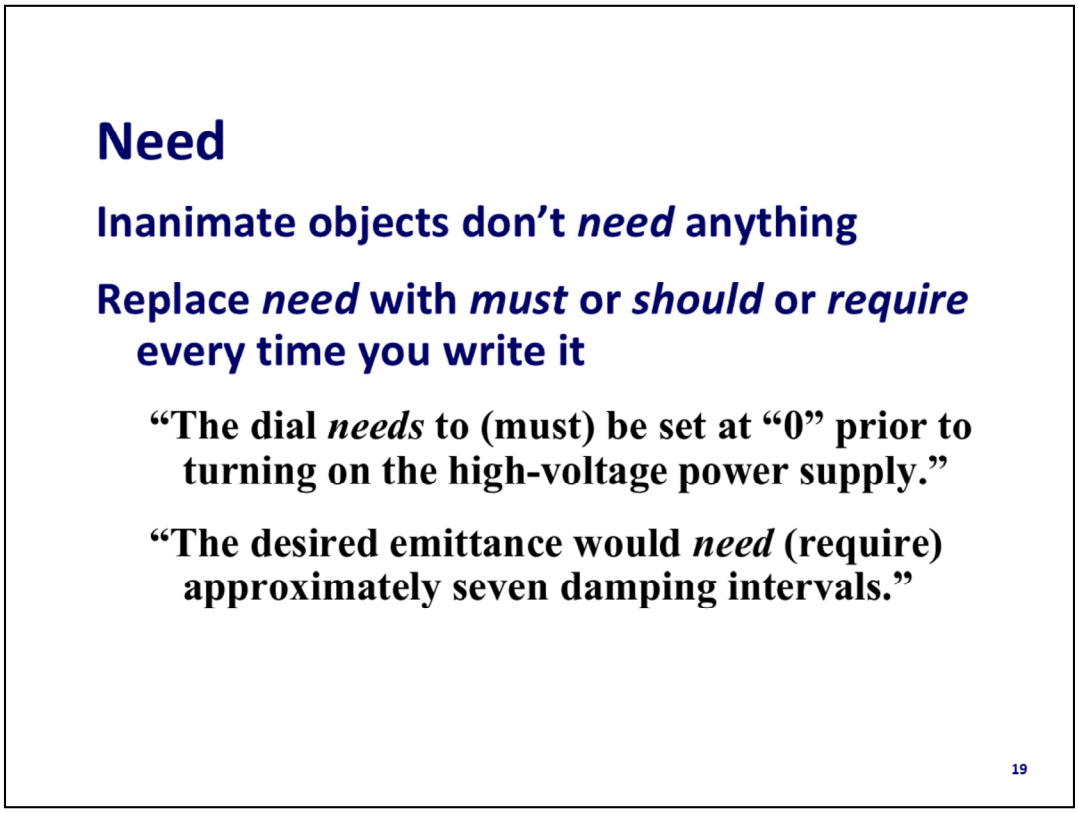
Which is used to introduce *nonrestrictive* clauses—subordinate clauses that introduce additional, interesting, ancillary information that is ***not*** integral to the meaning.

Which clauses are always set off from the rest of the sentence using 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, the clause is nonrestrictive. 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, the clause is restrictive and should be introduced with *that* (no commas).

For a more comprehensive discussion of *which* and *that* (you know you want it), see http://people.physics.illinois.edu/Celia/MsP/WhichisThat.pdf.



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

Here is another example of anthromorphism:

"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 is described to create still-frame images from data files …"

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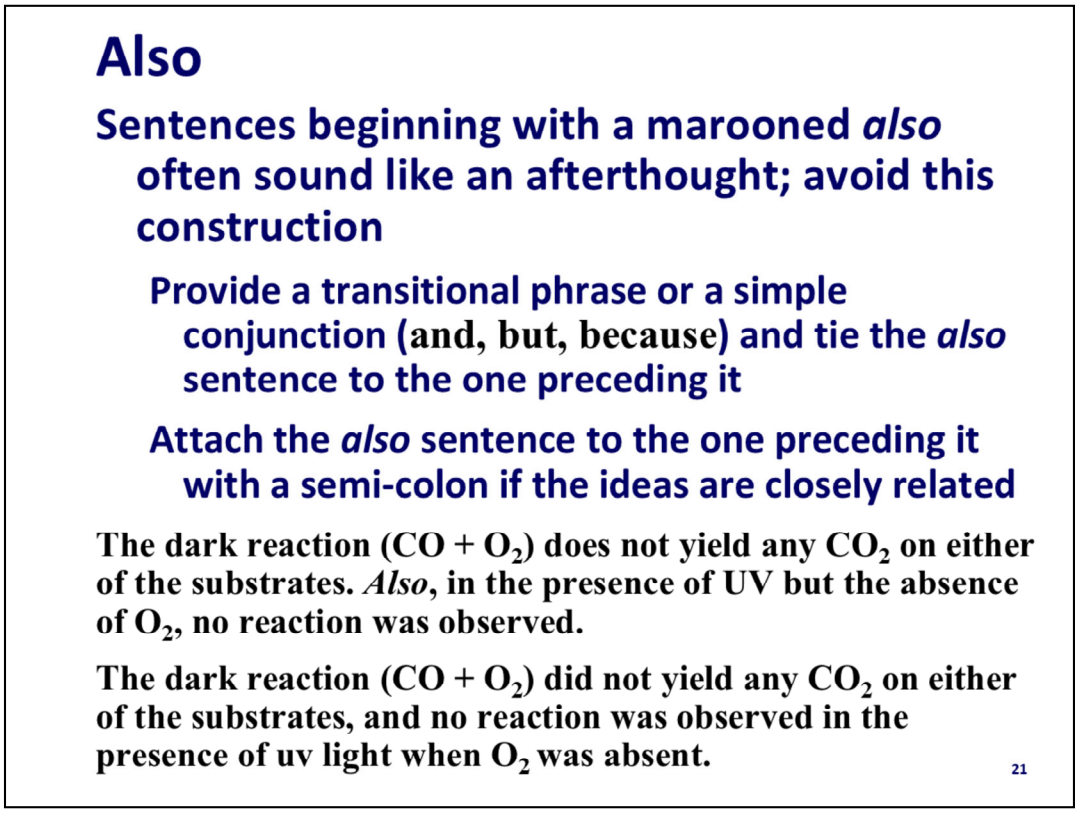
Getting rid of the *ones* should make your writing more concise and direct—always a goal in good writing.



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 2012 to 2015, *not* from 2012–2015
between 11 and 17, *not* between 11–17

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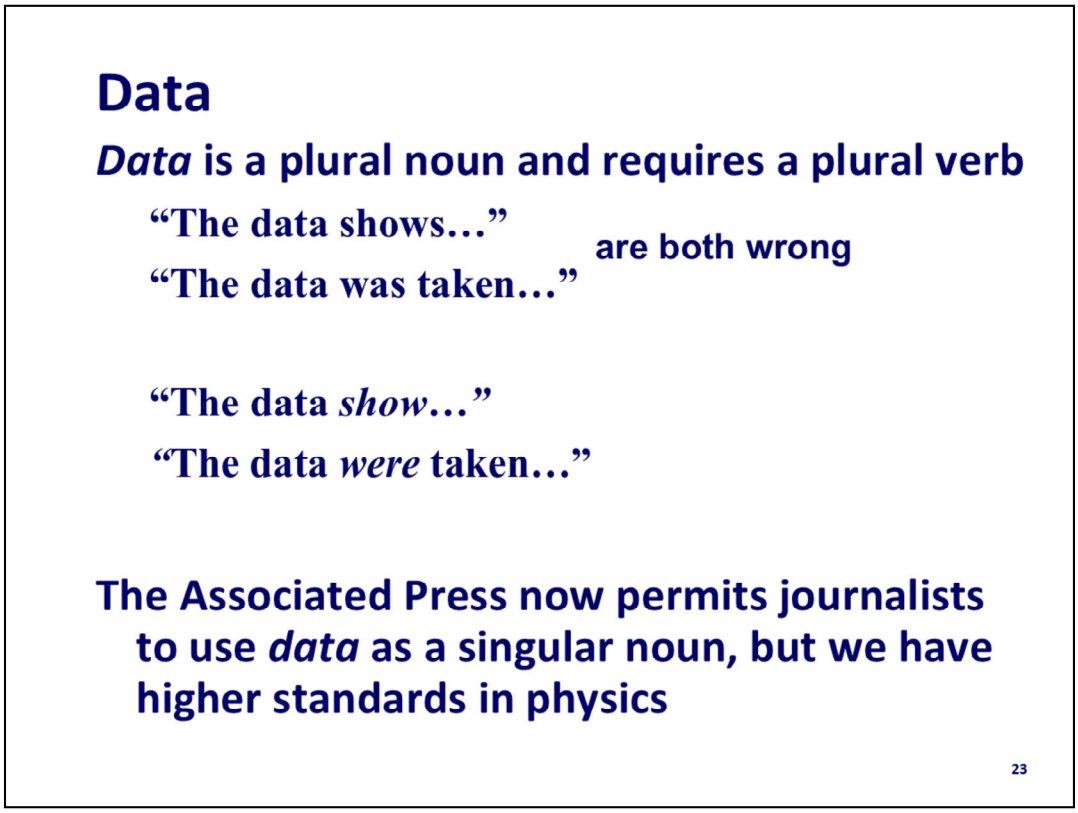
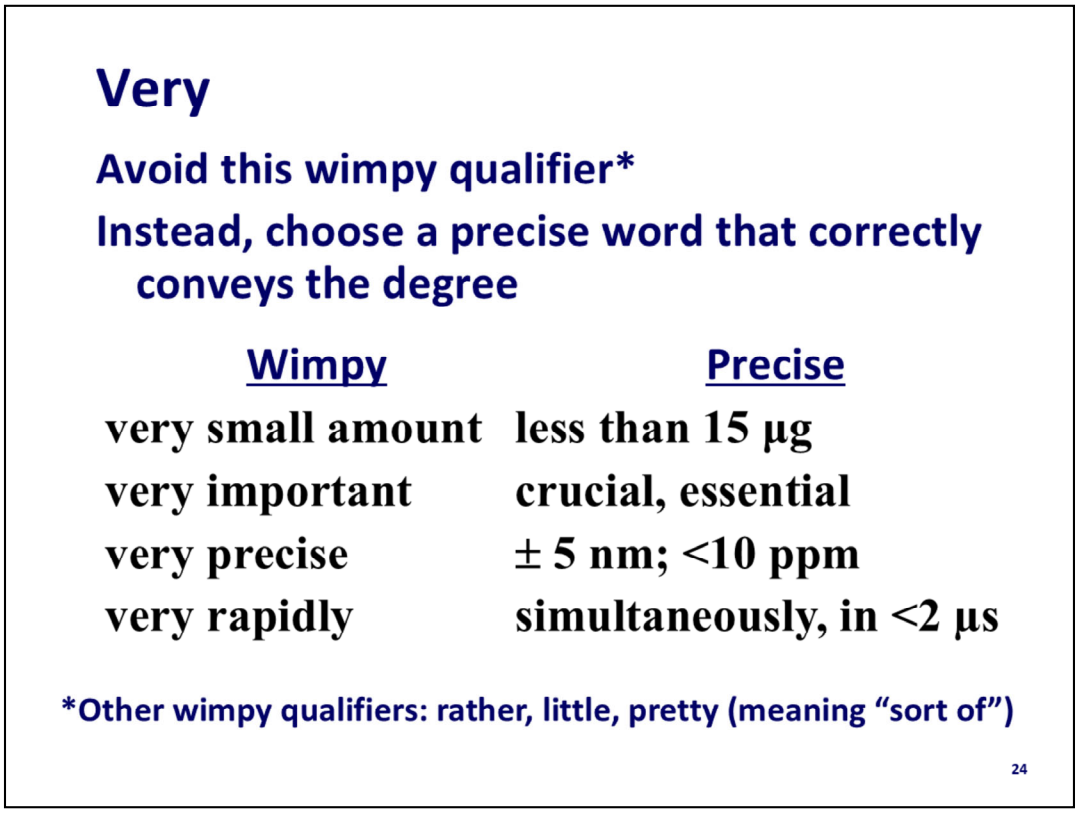


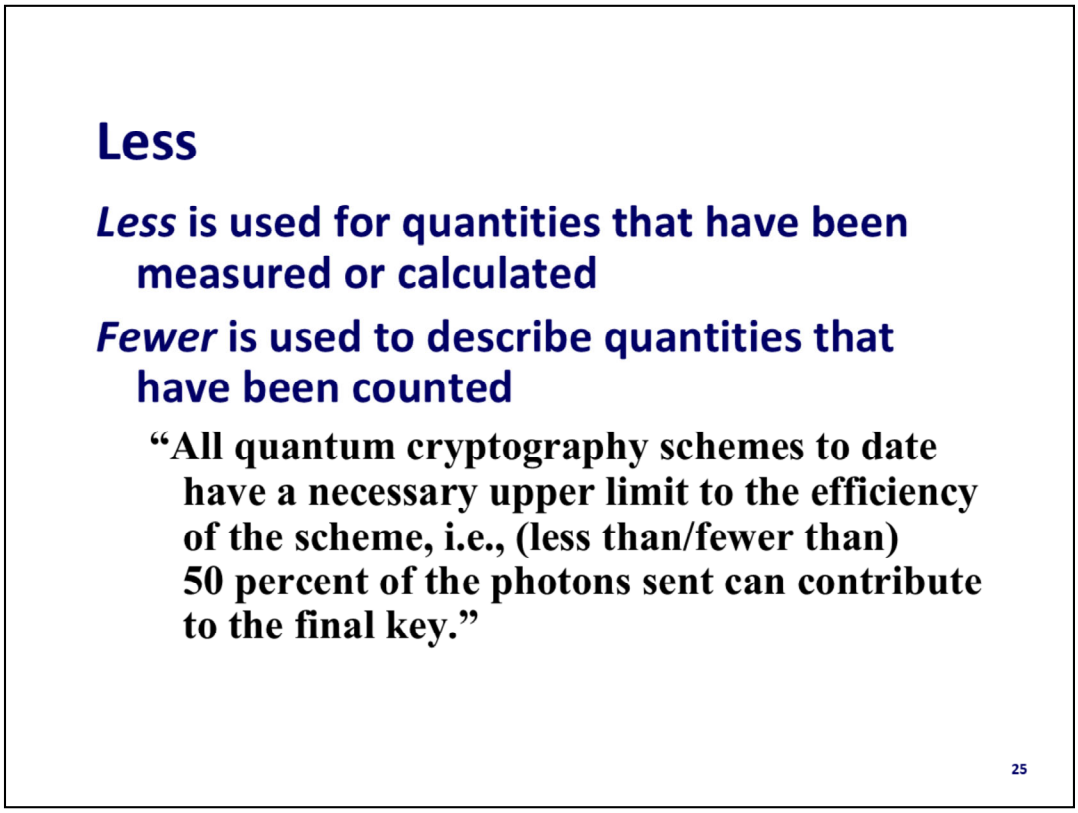
If you *really* mean "one data point," say "one data point." But beware of basing much of an argument on it.



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:

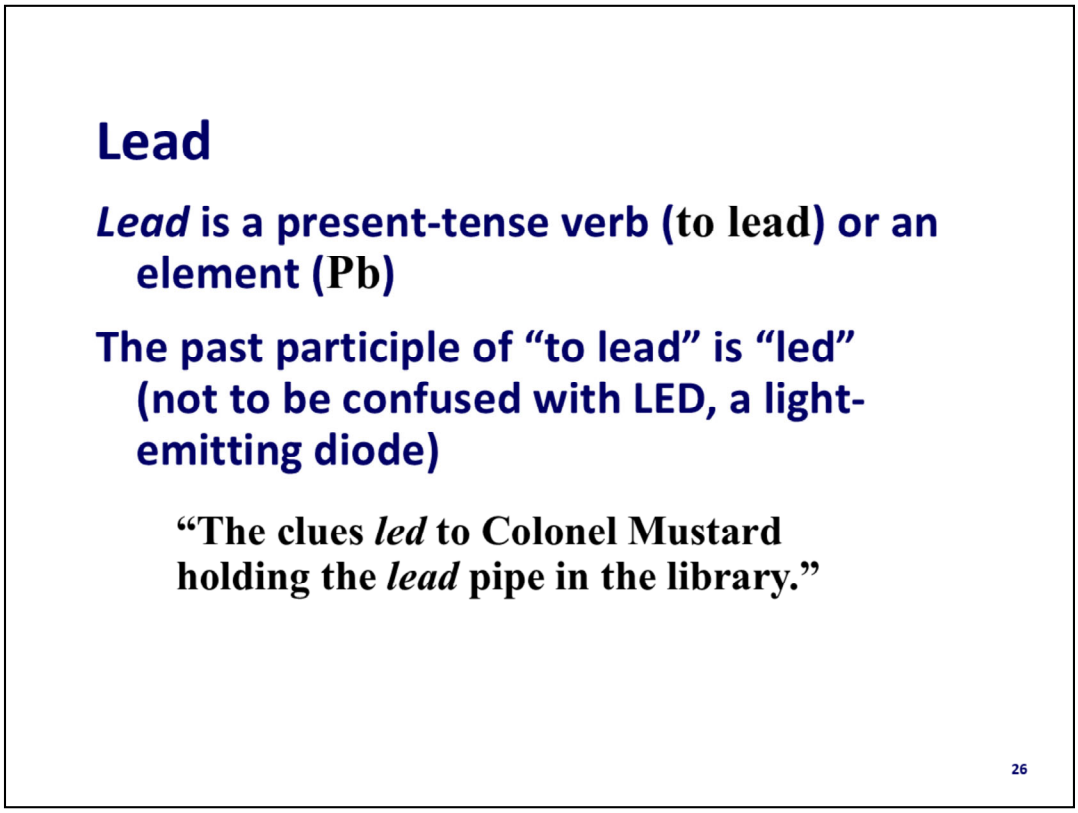
"Substitute "damn" every time you're inclined to write "very;" your editor will delete it and the writing will be just as it should be."



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 *less than*, because it sounds better.



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 Ag, she's practicing on a well-understood material *similar to* Pb, Al, or Ag**

***Such as* includes**

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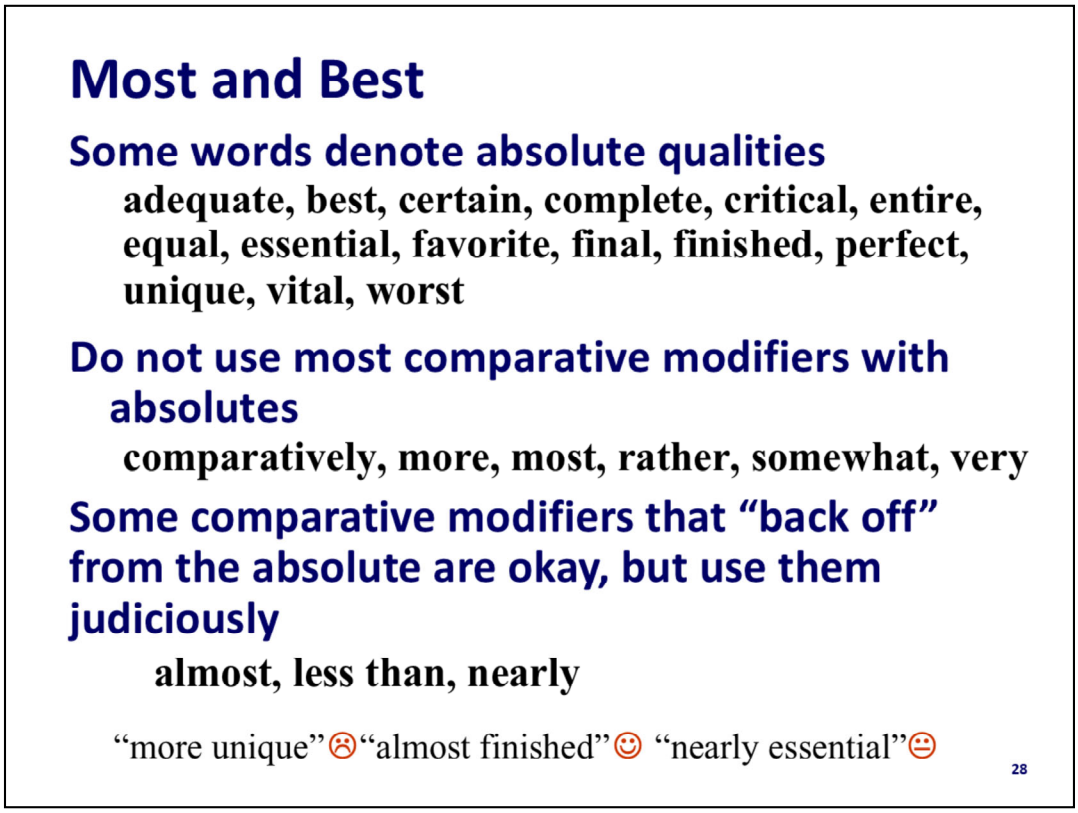
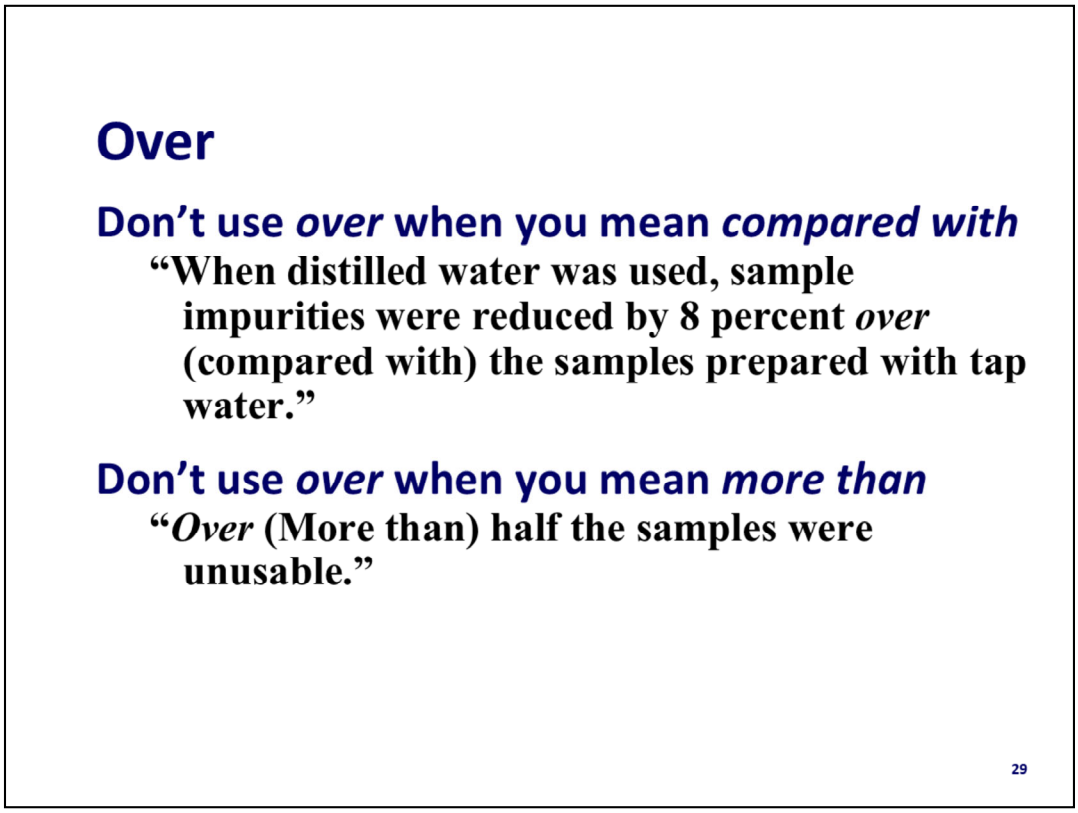


Modifiers that emphasize or intensify the absolute (surely, absolutely, completely) are grammatically correct but should be used judiciously.

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



And it's ALWAYS "compared with" in science writing.

Fact

A *fact* is undisputed and immutable

Do not use *fact* when you mean

observation	finding	effect
phenomenon	result	value

"The fact that" should be edited out of every sentence in which it occurs[1]

owing to the fact that	*because*
in spite of the fact that	*although* or *despite*
unaware of the fact that	*clueless*[2]

[1]Strunk and White
[2]Colloquial and probably ill-advised in science writing (you never know who is going to be reviewing your proposals...)

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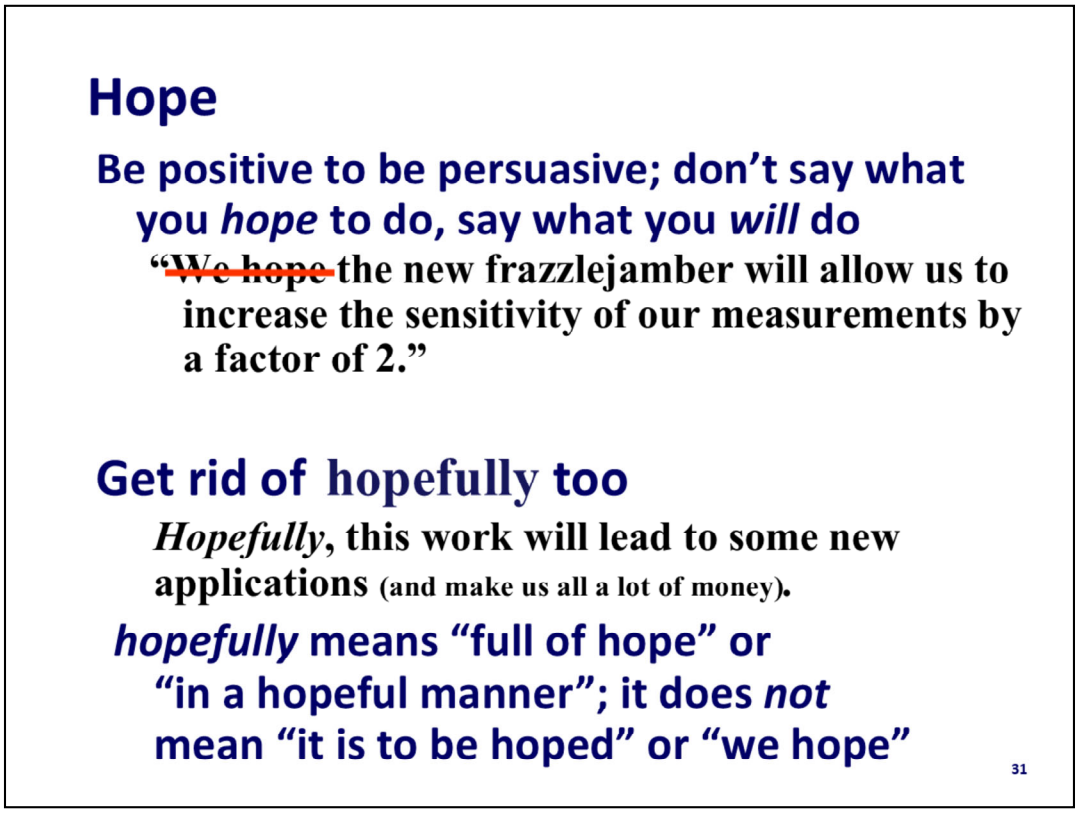
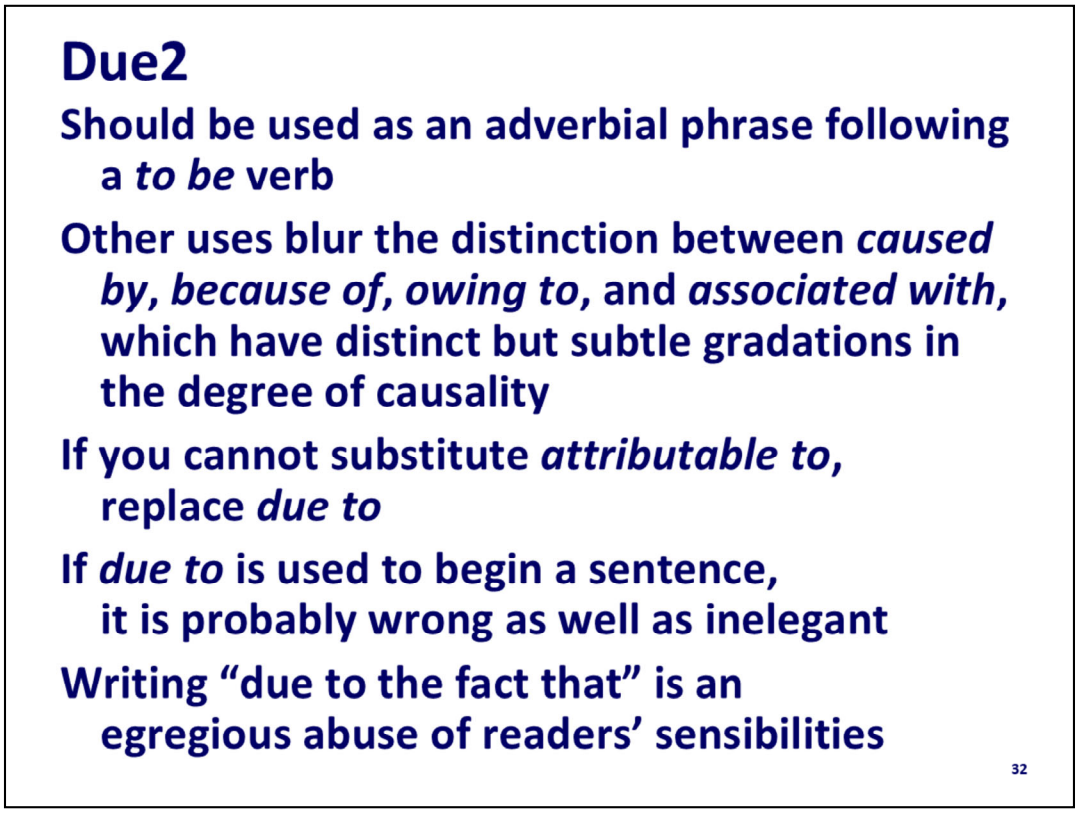
Science writers should also beware of *factual*, as it has two meanings in English: (1) of or relating to facts, and (2) true.

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



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

And there is no *hope* in science.



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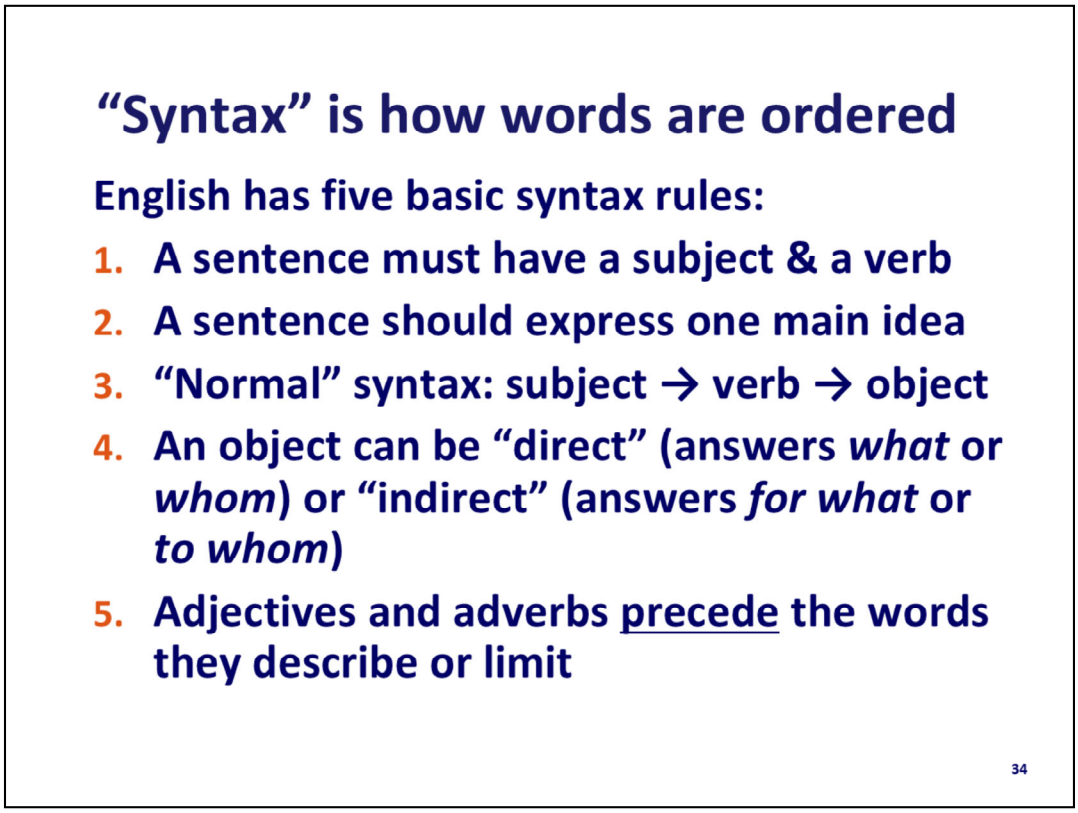
Careless writers often use *due to* as a shorthand to compress complex causal relationships into one easy six-character phrase. Avoid this temptation.



Of course, English has many more "rules" than these five, and about as many exceptions as rules. But adhering to these rules will go a long way toward your goal of clear, unambiguous communication.

Careless syntax can change the meaning of a sentence

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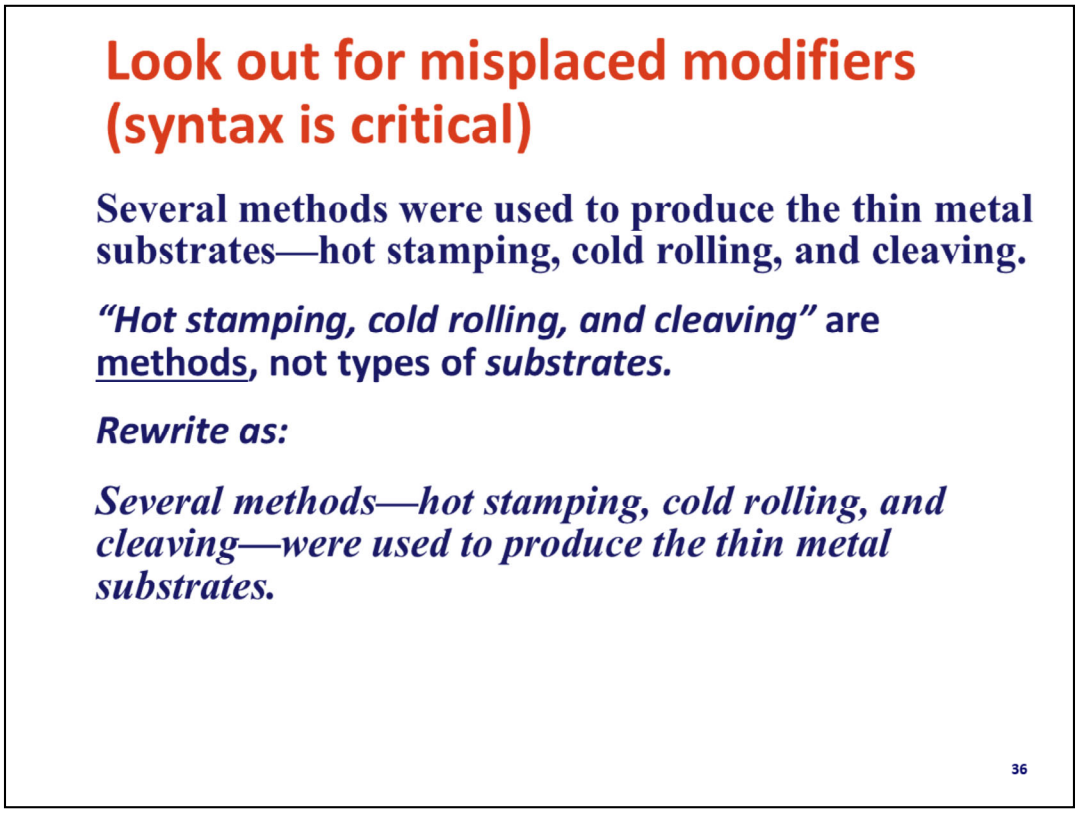
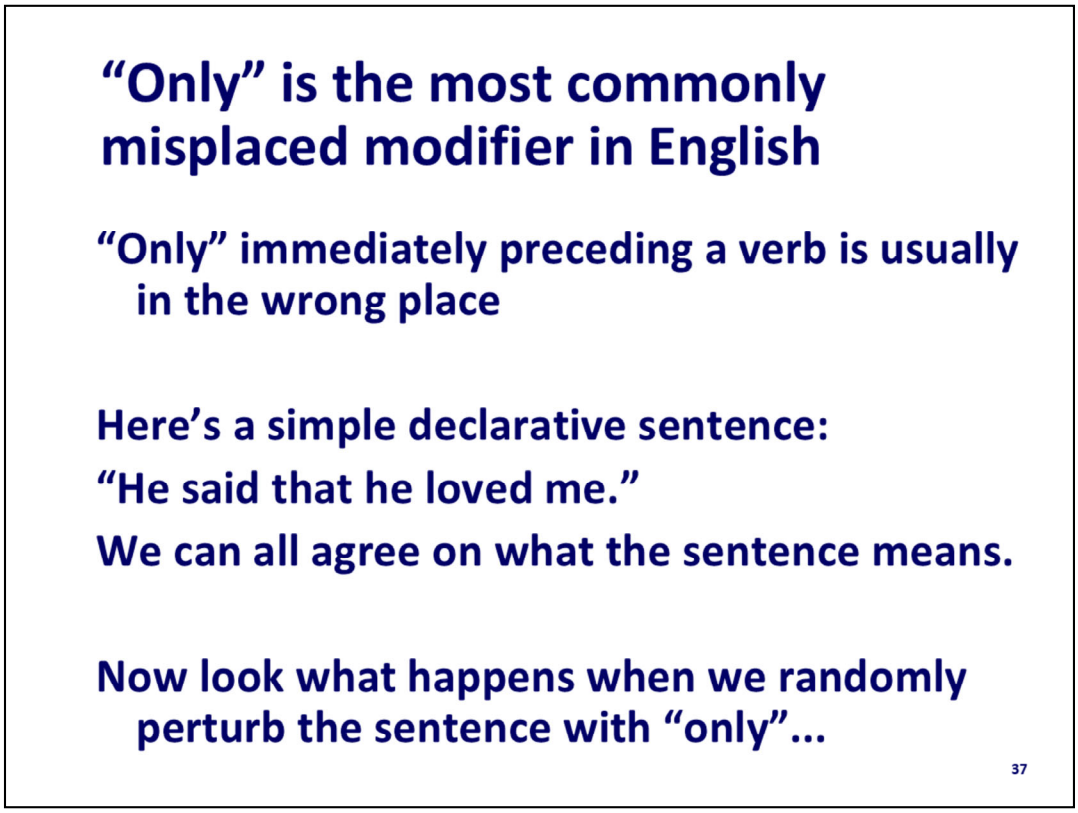


One way to avoid sloppy syntax is to write shorter sentences and control your modifiers. We'll see how and why in a minute…



Only is a limiter, and usually what is being limited is some condition, ***not*** the action of the verb.

"He said that he loved me."

Only he said that he loved me.
Everybody else stood around and looked awkward.

He _only_ said that he loved me.
He didn't really mean it; he only said it.

He said _only_ that he loved me.
He didn't say a word about marriage.

He said that _only_ he loved me.
He doesn't know about Serge.

He said that he _only_ loved me.
He doesn't respect me.

He said that he loved _only_ me.
He thinks I don't know about Clarice.

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Here's a science example:

"A transition only occurred at 130 K in underdoped samples."

Did the transition only *occur* (it didn't persist)?

Or did it occur only at 130 K?

Or only in the underdoped samples?

Only the author knows…

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"Only" immediately preceding a verb is probably in the wrong place

☹ "Thus a single phase slip center *only* occurs at $I=I_C$, and its dissipative size is $\lambda_Q \geq L$."

☹ "The occupied electronic states *only* show features associated with the carbon lattice of the SWNT cage."

☺ "At last, we will be able to directly probe the TeV energy scale, where it is believed that some new physics should be lurking, although we can *only* speculate about what form it will take."

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But it's not only verbs you have to watch out for

☹ "Extensive shielding ensured that *only* scattering from the marked regions was detected."

☹ "Usually, the analytical evaluation of $J(X_f, t; X_i, 0)$, even for time-independent systems, is *only* possible in very few cases."

Be careful of your "only"s—
they can get you into a lot of trouble!

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Use these techniques to revise for clarity and conciseness

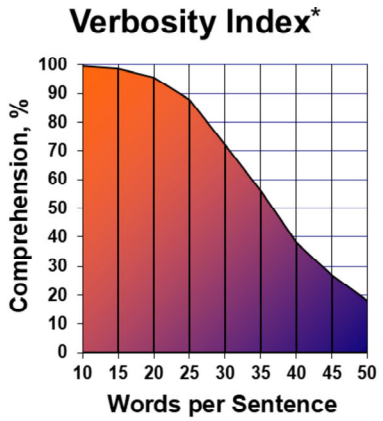

*Illustration only, does not represent actual data.
(But it could.)

- Write shorter sentences
- Limit the number of modifying clauses & prepositional phrases
- Keep verbs close to subjects
- Express ideas in positives, not negatives
- Avoid indirect constructions; put the subject first
- Eliminate unnecessary words
- De-nounify verbs

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We'll look at how to apply each of these editing techniques next.

Write shorter sentences (<25 words)

The following sentence (63 words), while grammatically correct, is impossible to understand on the first reading

"A program of chemical analysis and receptor modeling is proposed in which samples obtained at the EB ENTEK sites will be used to estimate the sources and/or source regions of trace elemental deposition into the area and the effects of specific urban areas on the airborne particulate matter compositions and thus, their potential contribution to the contamination of the area's water supplies."

Avoid long strings of nouns used as adjectives, too

mean field anisotropic superconducting reverse bias toroid magnet <sigh>

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Write short sentences—fewer than 25 words.

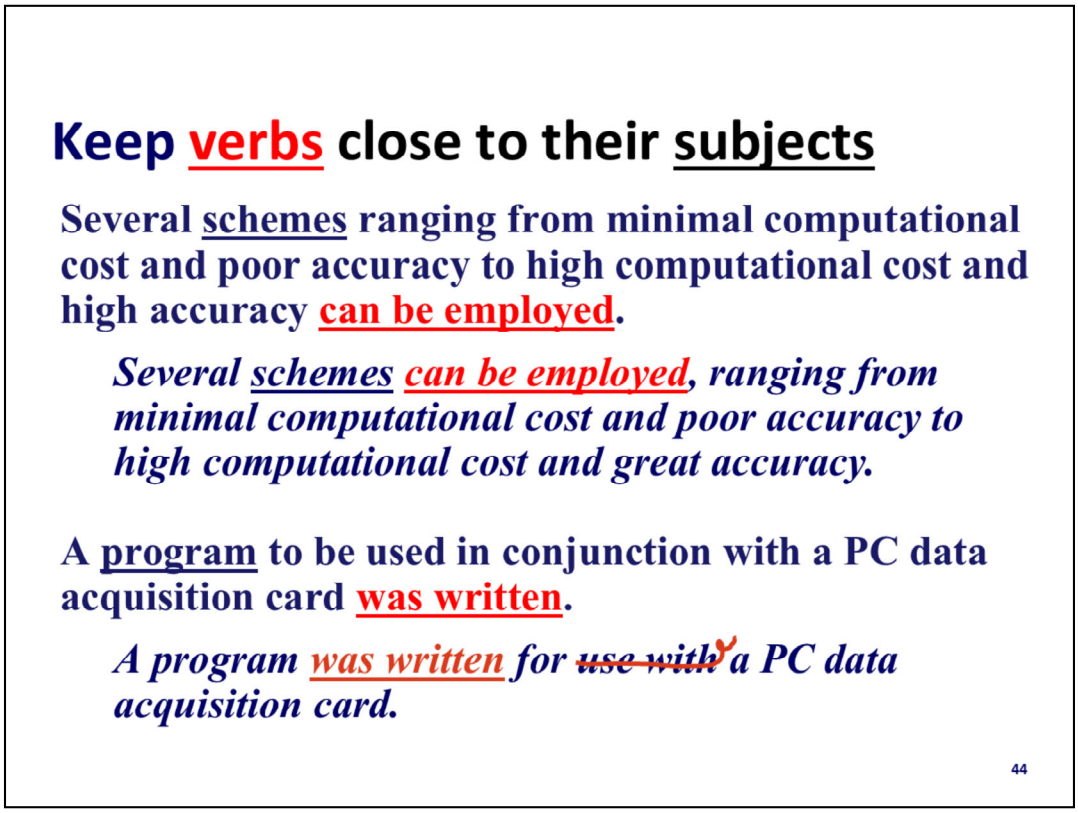
Avoid long strings of nouns used as adjectives—"mean field anisotropic superconducting reverse bias toroid magnet" (or MASRBTM, to its fans)

Observe the "three-preposition" rule.* If you have a sentence that contains more than three prepositional phrases, rewrite it before it wanders off to die.

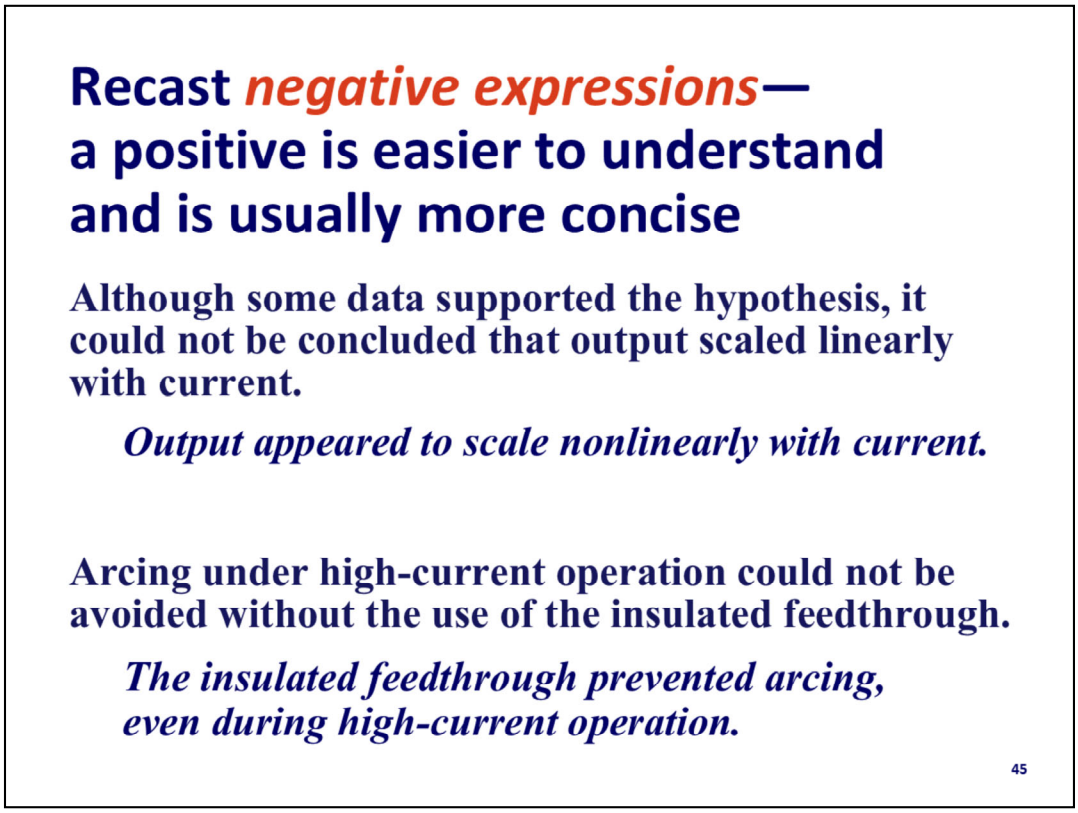
Writing shorter paragraphs will also help your reader follow the logic of your narrative. For more information on how to write strong paragraphs, see

http://people.physics.illinois.edu/Celia/Lectures/Paragraphs.pdf.

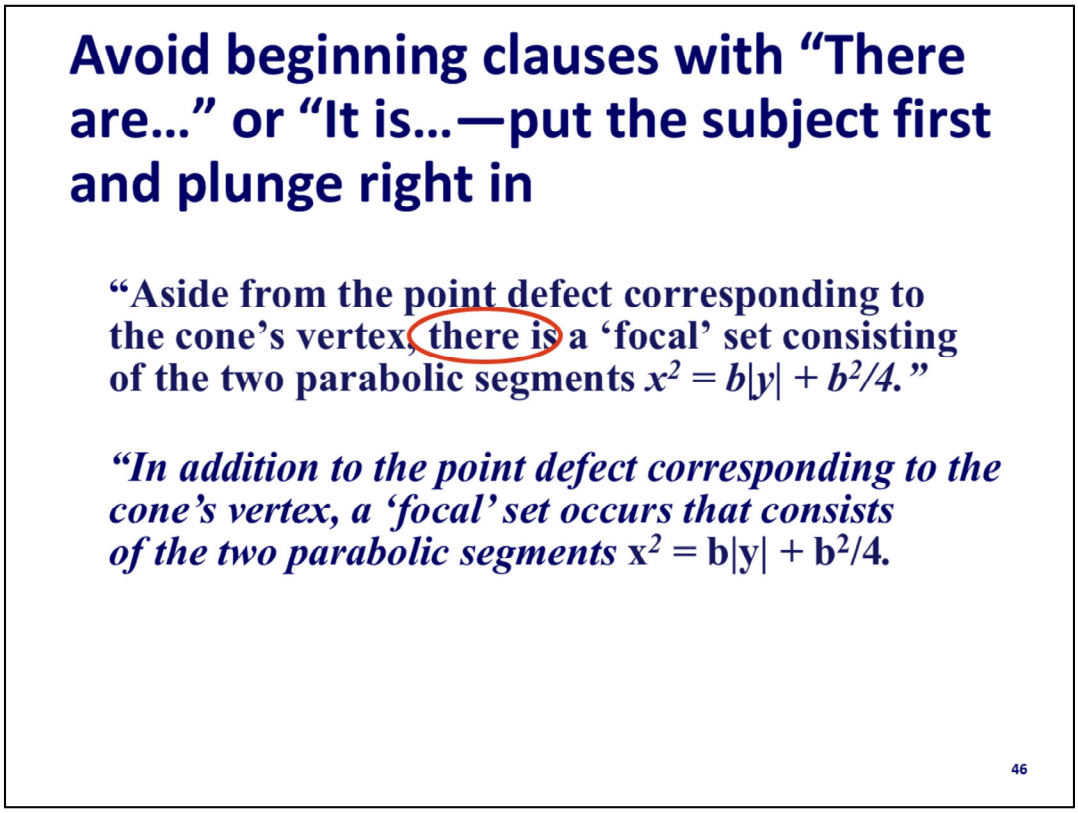
*With thanks to Stephanie Teich-McGoldrick of Sandia National Laboratories, who first introduced me to the three-preposition rule.



One of the pitfalls of using the passive voice is the tendency by amateurs to maroon the verb at the end of the sentence. Avoid this practice.



Ideas expressed as positives are almost always easier to process and grasp quickly. Readers must undergo a second step of deciphering ideas presented as negatives; they have to backtrack to figure out what something *is*, if you tell them what it is *not*. Don't make your readers work this hard.



Train yourself to spot "It is..." and "There are..." sentences and rewrite them in the passive voice, which puts the important point first in the sentence ("front loads").

Make sure *pronouns* refer to the correct antecedent

Non-commutative geometry is obtained when the latter equation fails and is replaced by another equation, as in the case of the quantum Hall system. The interpretation of this effect in superstrings is startling, however, because *it* is a fundamental theory of spacetime, and *it* means that we cannot think of spacetime in terms of ordinary smooth geometry, as in general relativity.

or *any* antecedent…

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Ideally, a pronoun should refer to the noun immediately preceding it. Don't make the reader go back several sentences to determine what "it" you mean. By the same token, you may not use a pronoun until you have first used the noun to which the pronoun refers.

Avoid the big A's—amphibologies and anthropomorphism

Beware of words with multiple meanings

- A sintered mixture for the experimental heating rod was prepared from martensitic steel and 5% nickel. *This element* proved to be unsatisfactory.
- A subtle but important *point* about the series of *points* generated is that they are not statistically independent *points*.

Don't give human traits to inanimate objects

- The substrate *tells* the YBCO how to align during growth.
- The dial *needs* to be set at …

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The dial doesn't care…

Be sure to use the right word

Alternate or alternative?

Ability or capacity?

Affect or effect?

Principle or principal?

Optimal or optimum?

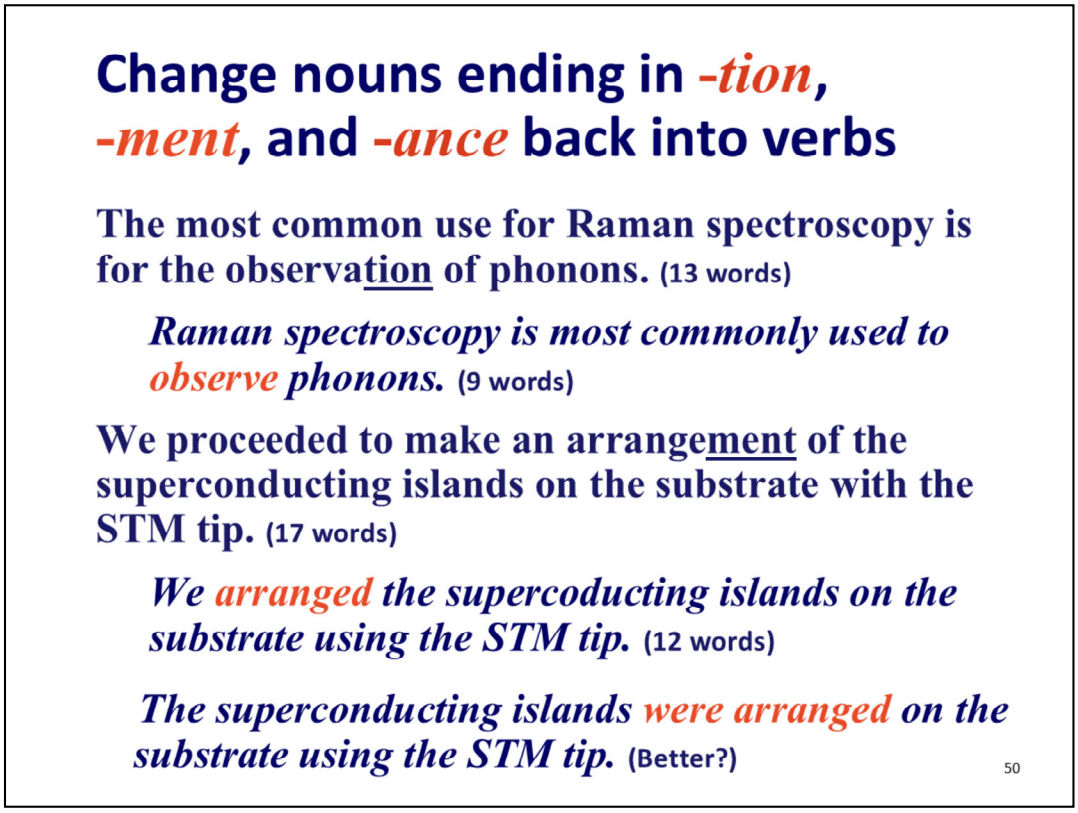
Biannual or biennial?

Compliment or complement?

Bryan A. Garner, *Garner's Modern American Usage*
(New York, Oxford University Press, 2003)

Theodore Bernstein, *The Careful Writer*
(New York, Atheneum, 1965)

Ms. Particular's Micro-Lectures on Style and Usage
(http://people.physics.illinois.edu/Celia/MsP/MsParticular.htm)[49]



Many English words derived from Latin change verbs into the nominative form by adding –*tion*, –*ment*, and –*ance* suffixes to the verbs. Thus *act* (v.) becomes *action* (n.), *arrange* (v.) becomes *arrangement* (n.), and *perform* (v.) becomes *performance.*

An easy way to improve the conciseness and vigor of your writing is to be on the alert for these nouns and change them back into the verbs they came from.

3. Now for proofreading (microscopic scale)

Editing **concentrates on *ideas* and *expression***

Proofing **concentrates on *mechanics***

The importance of *proofreading* cannot be overstated

VOLUME 76, NUMBER 17 PHYSICAL REVIEW LETTERS 22 APRIL 1996

Effect of Filamentation of Brillouin Scattering in Large Underdense Plasmas Irradiated by Incoherent Laser Light
[Phys. Rev. Lett. 75, 4413 (1995)]

T. Afshar-rad, L. A. Gizzi, M. Dessleberger, and O. Willi

We regret that in the printed version of the manuscript, Figs. 2(a)–2(c) were interchanged with Figs. 3(a)–3(c). In addition, the published Fig. 3(d) was incorrect. As the principal conclusion of the article was based upon a comparison of Figs. 2(a) and 2(b) to Figs. 3(a) and 3(b), this error may have prevented many readers from comprehending the Letter. We are therefore reprinting it correctly below.

You do not want to be these authors. Believe me.

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Proofreading examines the manuscript one word at a time

- Acronyms, mathematical symbols, and special characters are defined at first usage
- Format and typography are consistent and conform to manuscript preparation rules
- Technical writing conventions are observed
- Grammar and usage are flawless
- Punctuation and spelling are *perfect*

TIP 1: Always proofread from a hard copy

TIP 2: Start at the bottom right-hand corner and read backwards and up

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Maintain witless consistency throughout the text

- Terminology—always call the same things by the same names
- Typography—use of italics and boldface
- Expression of numbers
- Definitions of symbols or special characters
- Legends in figures
- Style of subheadings, captions, table titles
- Use of color

People expect differences to *mean* something!

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If you talk for four pages about a “solar collector” and suddenly introduce a “solar absorber” on Page 5, a careful reader will wonder if something qualitatively different is being described.

Present a professional-looking document

- Select an appropriate font and size
- Use no more than two font styles
- Automatically hyphenate the document to avoid annoying white spaces in fully justified lines
- Position graphics strategically, and after they are discussed in the text
- Select an attractive page layout
  - Adequate white space
  - Clean, uncluttered appearance

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To recap:

Assess important ideas,
logical structure,
precise language,
"mechanical errors"
—in this order

Focus on semantics and syntax—simplest word and most direct sentence structure

Eliminate digressions and redundancies

Pay attention to transitions and reader cues

Proofread from a hard copy

Allow enough time!

cmelliot@illinois.edu
http://physics.illinois.edu/people/Celia/

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Notes: