Revising Technical Manuscripts to Improve Coherence, Clarity & Conciseness

Celia M. Elliott
University of Illinois
cmelliot@illinois.edu

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

The goal of the scientific writer:
clarity, coherence, conciseness

"Perfection is achieved, not when there is nothing left to add, but when there is nothing left to take away."

—Antoine-Marie-Roger de Saint-Exupery

Distill, distill, distill...

Because we think in words, the act of expressing observation in language—of distilling amorphous thoughts into words—is a powerful tool for clarifying your thinking.

Translating your thoughts into words so that you can communicate them to someone else forces you
- to question your assumptions.
- to look for holes.
- to fill in gaps in your thinking.

"The act of composition disciplines the mind; writing is one way to go about thinking, and the practice and habit of writing not only drain the mind, but supply it too." Strunk and White, The Elements of Style, 3rd ed., p. 70.

"It's also through writing that we learn to articulate our thoughts clearly; our critical thinking is strengthened and clarified by our expression of it in writing." J.L. Craig, "Writing strategies for graduate students," Proc. ASEE Ann. Conf. & Exposition (Nashville, TN, ASEE, 2005).

Antoine Marie Jean-Baptiste Roger, comte de Saint Exupéry, *Mort pour la France*, was a French aristocrat, writer, poet, and pioneering aviator. He became a laureate of several of France's highest literary awards and also won the U.S. National Book Award. He is best remembered for his novella *The Little Prince* (*Le Petit Prince*) and for his lyrical aviation writings, including *Wind, Sand and Stars* and *Night Flight*.

Effective editing incorporates four distinct elements

1. Clarifying the selection and presentation of ideas, tailored to the audience
2. Organizing the narrative logically
3. Using language precisely and concisely
4. Correcting "mechanical" errors that detract from a professional presentation

Editing should proceed in three separate steps

1. **Reading for content (the science)**
2. **Editing for style (language, tone, emphasis)**
3. **Proofreading for mechanics (spelling, punctuation, and grammar)**

Allow sufficient time for each step!
(it will always take longer than expected)

The Elliott editing equations:

$$t = 4h + \varepsilon \qquad [1]$$

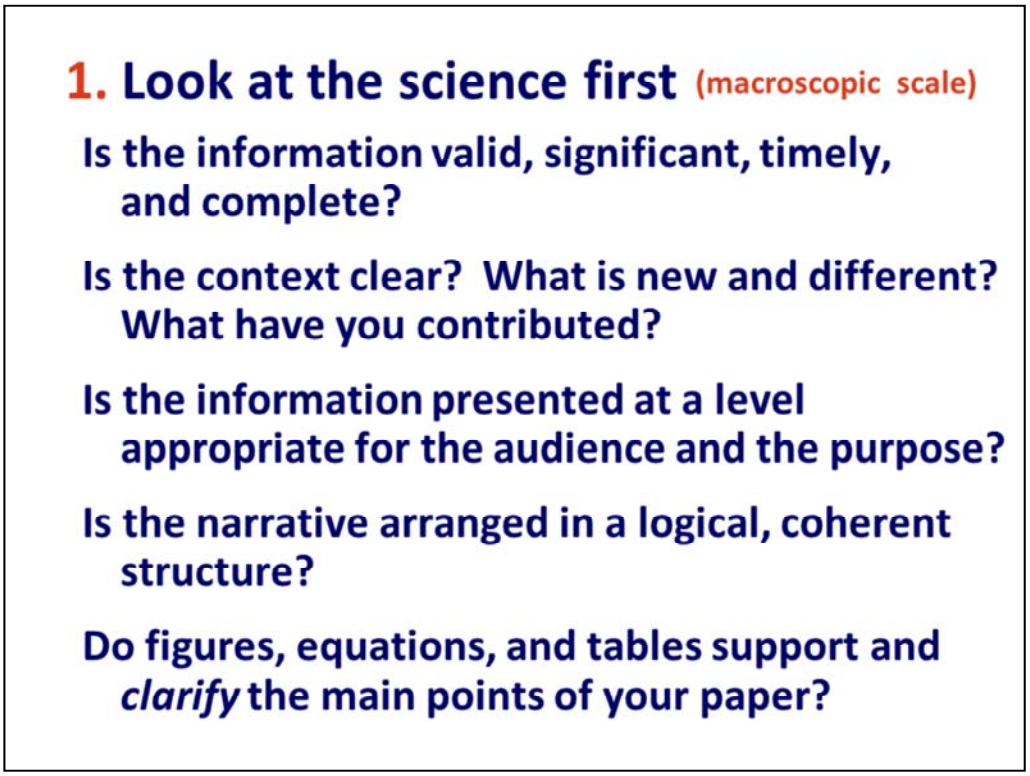
$$t = 5(h + a) + \varepsilon \qquad [2]$$

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.

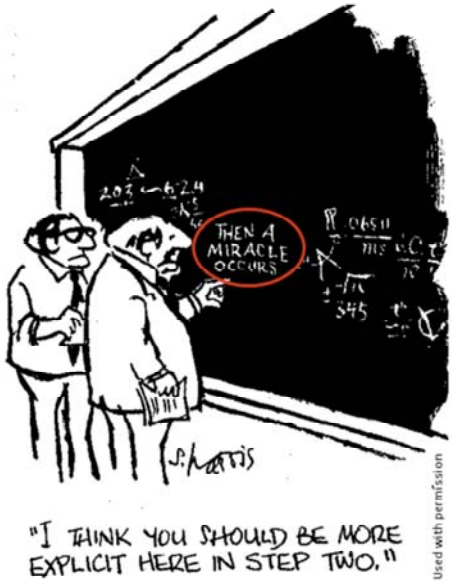
Equation 2 is the expression for the time it takes to edit a paper that has multiple authors, where t is the time it actually takes, h is the number of hours you think it should take, a is the number of authors, and ε is not necessarily trivial.



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?

Narrative must be clear and logical



- Reveal the underlying relationships of ideas and data
- State assumptions and inferences explicitly and provide supporting evidence
- Avoid gaps in logic or unwritten assumptions

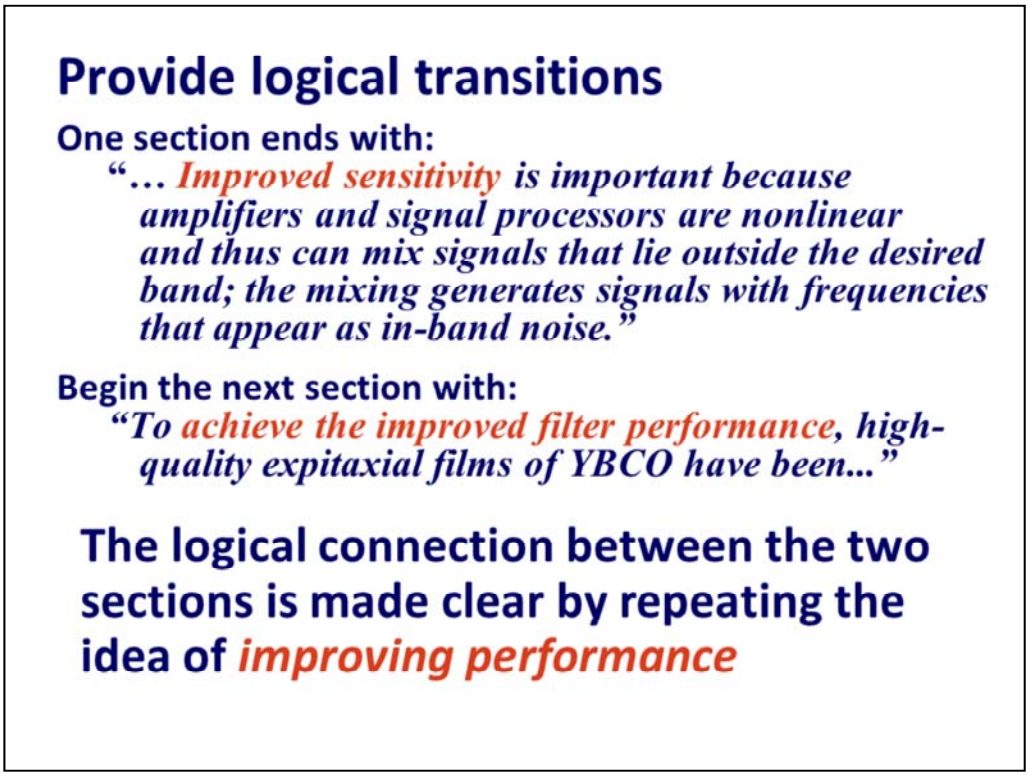
Scientists and engineers tend to be highly skeptical about “miracles.”

Provide transitional statements to tie ideas together.

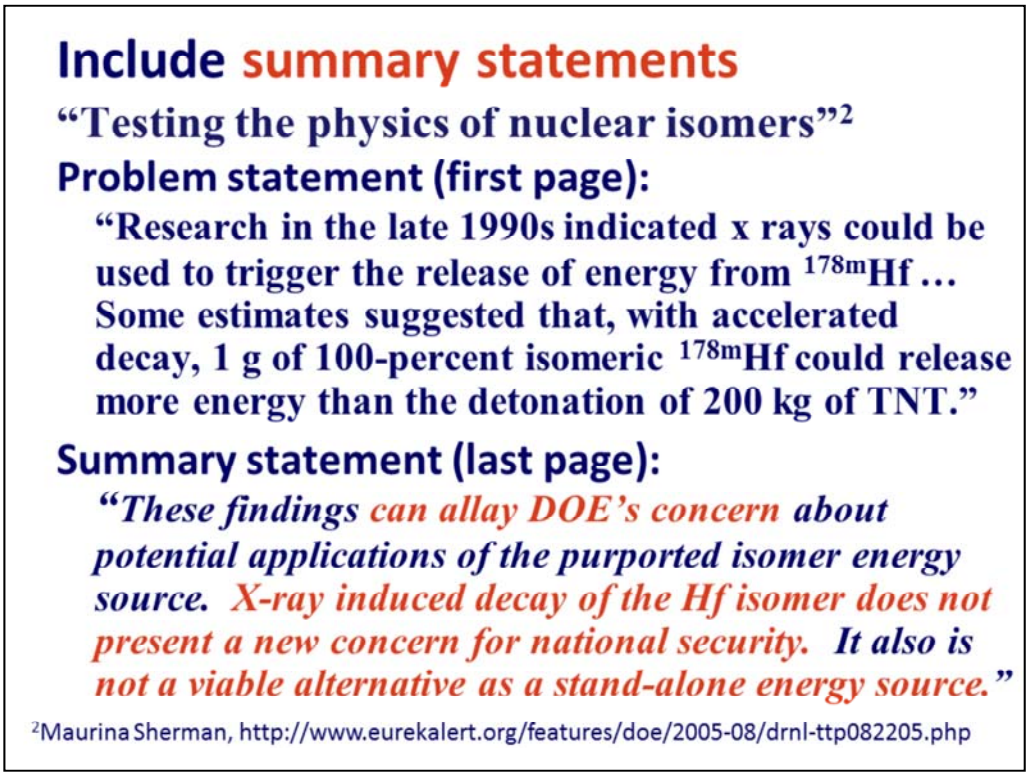
State assumptions and inferences explicitly and provide supporting detail.

Add authority to your arguments by citing previous work.

Arrange your narrative in a logical structure.

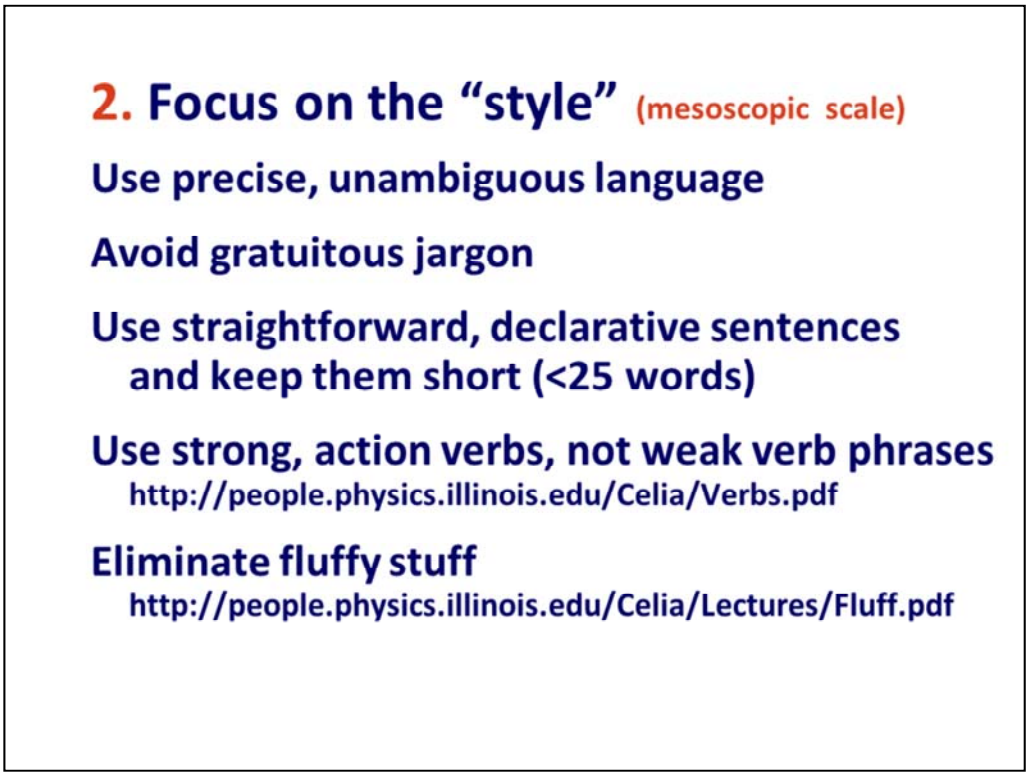


If you've followed my outlining and paragraph-building advice (http://people.physics.illinois.edu/Celia/SciWriter_Advice.pdf), you'll already have an organically organized, logical narrative line. Reinforce that underlying structure by using transitional statements to tie paragraphs and sections together.



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.



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?

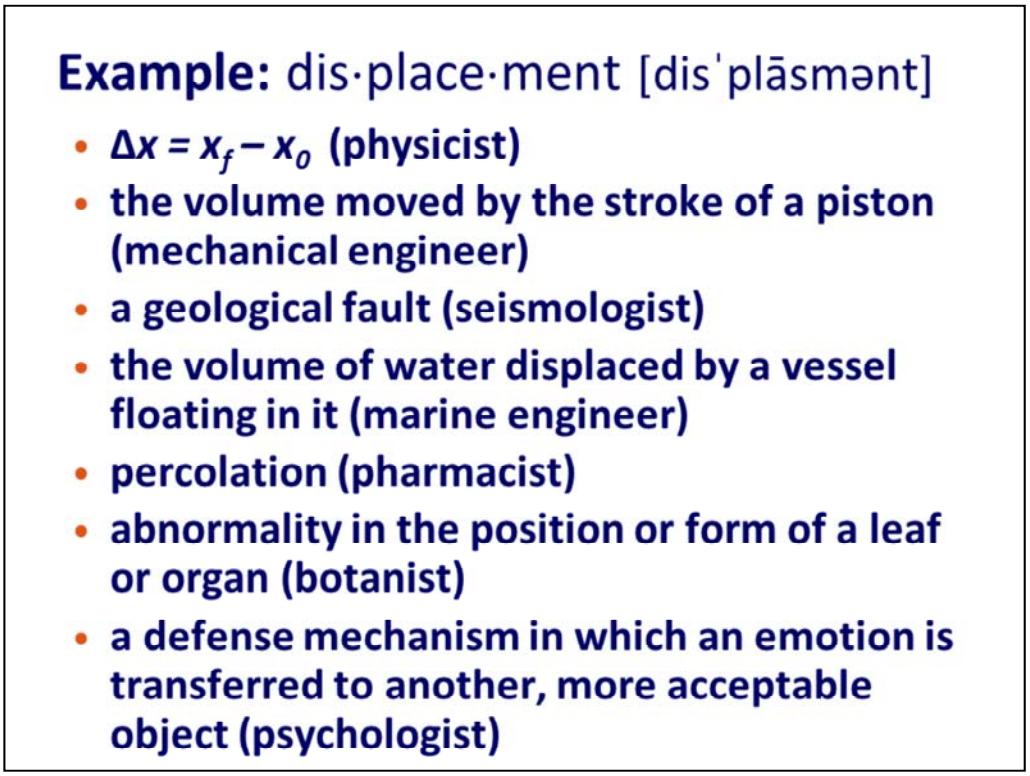
Semantics and syntax control clear communication

"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

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”

"Syntax" is the way words are put together to form sentences

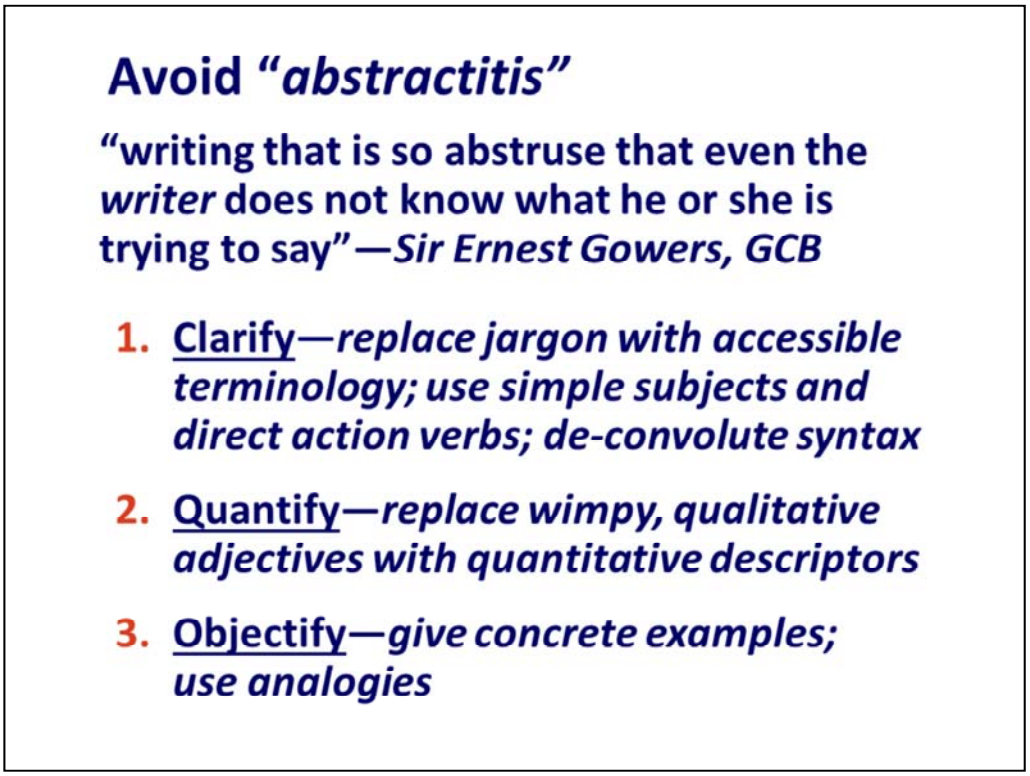
Sloppy syntax can lead to confusion:

"Two months later, in late January of 1957, Bob wrote down the wave function *for the superconducting state on a New York subway train.*"

s-wave *d*-wave *p*-wave

Subway trains in New York are *superconducting?*

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

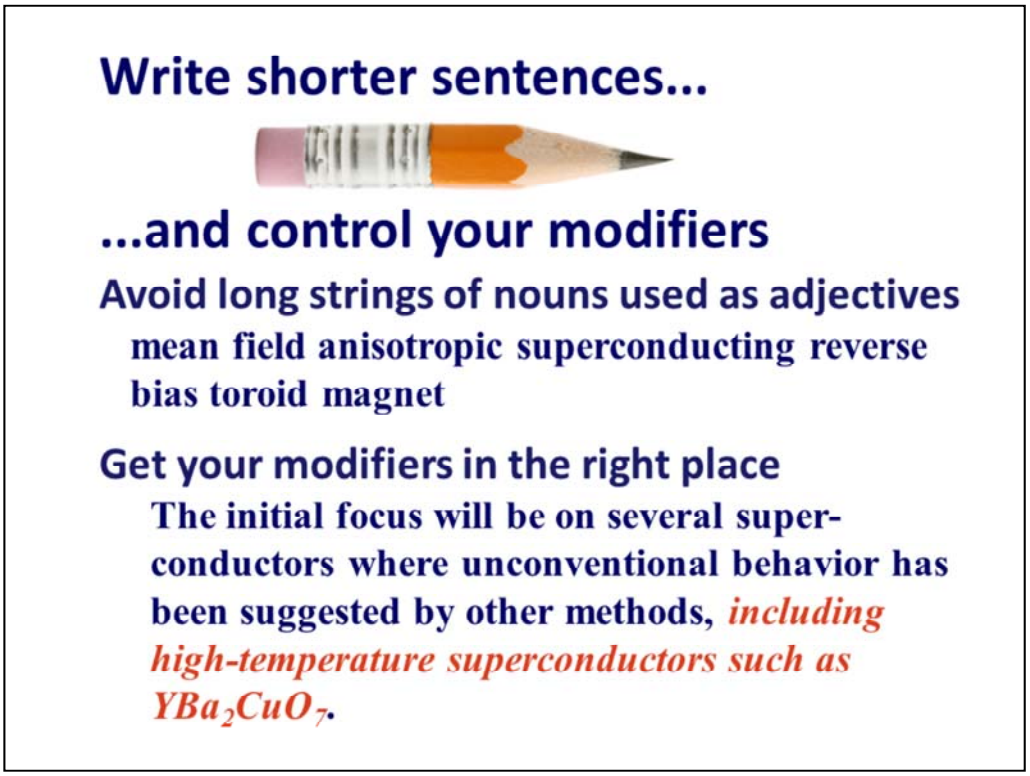


As defined by Ernest Gowers and quoted by Bryan Garner in *Garner's Modern American Usage*, *abstractitis* is writing that is so abstruse that even the writer does not know what he or she is trying to say. Here's a description of the phenomenon:

"The words …dance before my eyes in a meaningless procession: cross-reference to cross-reference, exception upon exception—couched in abstract terms that offer no handle to seize hold of—leave in my mind only a confused sense of some vitally important, but successfully concealed, purport, which it is my duty to extract, but which is within my power, if at all, only after the most inordinate expenditure of time." (*Yale L.J.* **167**, 169 [1947]).

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.



Write short sentences—less than 25 words.

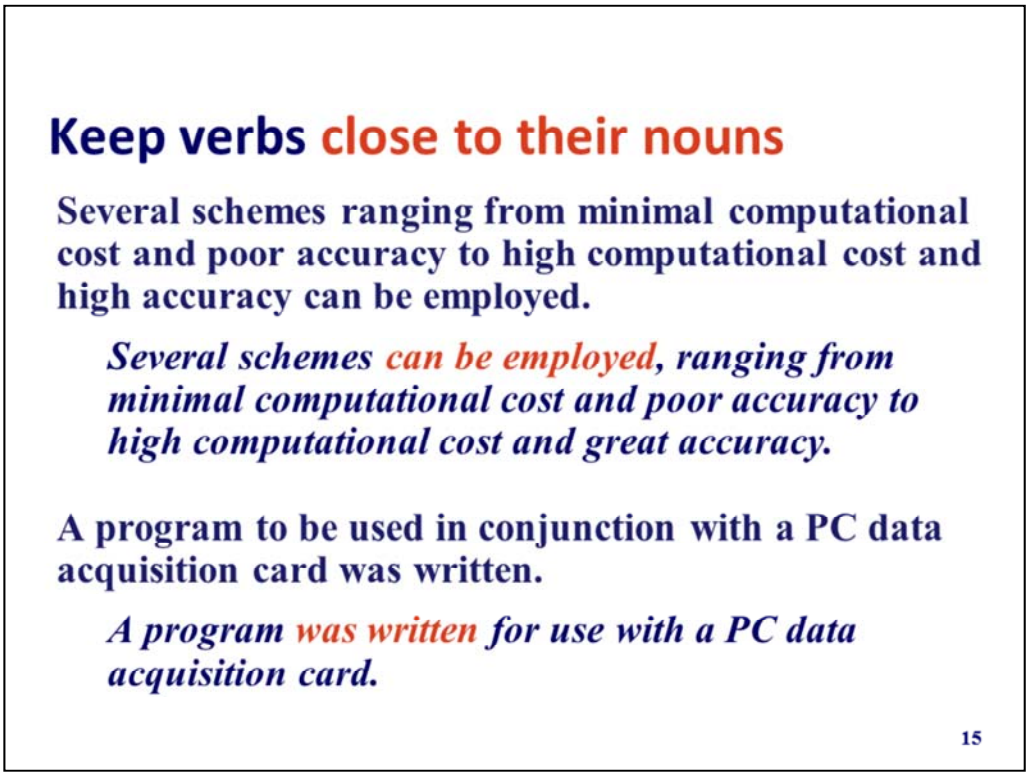
Avoid long strings of nouns used as adjectives—"mean field anisotropic superconducting reverse bias toroid magnet" (or MASRBTM, to its fans)

Follow the "three preposition" rule.* If you have a sentence that contains more than three prepositions, 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, 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.

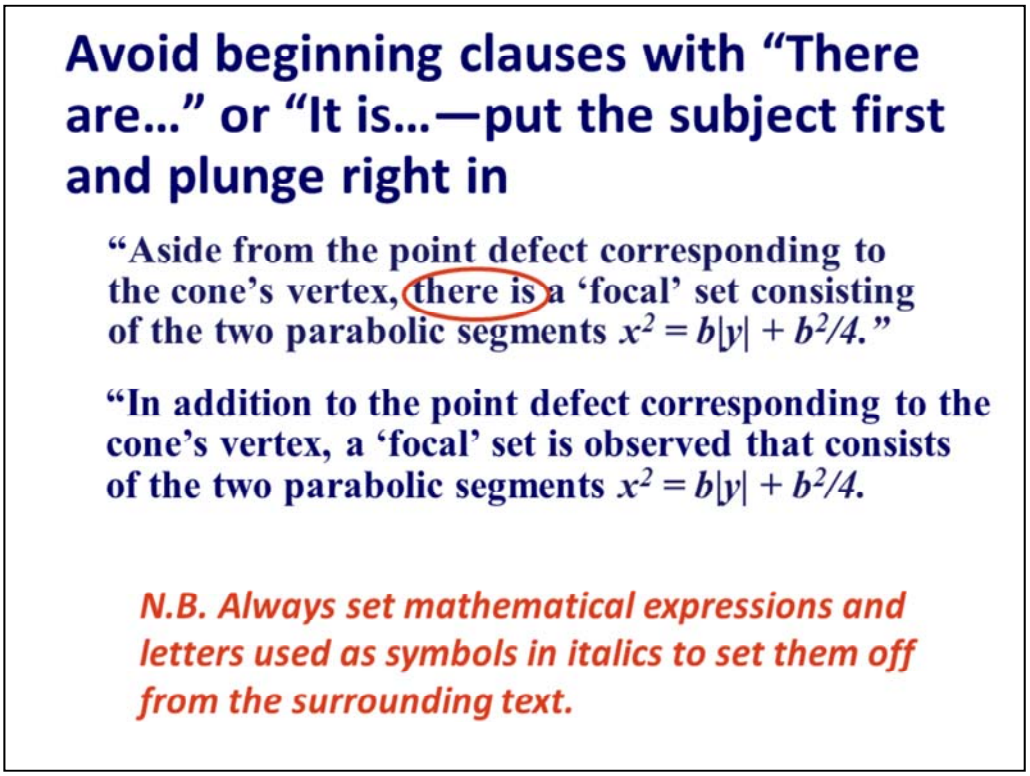
Recast *negative expressions*— a positive is easier to understand and is usually more concise

Although some data supported the hypothesis, it could not be concluded that output scaled linearly with current.

Output appeared to scale nonlinearly with current.

Arcing under high-current operation could not be avoided without the use of the insulated feedthrough.

The insulated feedthrough prevented arcing, even during high-current operation.



Train yourself to spot "There 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 *indefinite 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…

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 …

Be sure to use the right word

Alternate or alternative?

Ability, capacity, capability?

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)

Eliminate commonly abused *FLWs**

"only"

The linear relationship in the plots at $T \geq 1340$ K *only agreed with experimental data when* $t \leq 10$ ns.

"with"

We show that solitons undergo a strong blueshift in fibers with a dispersion landscape that varies along the direction of propagation.

"etc."

~~*It is well known that*~~ *localized magnetic moments and the couplings between them are two indispensable factors to induce long-range spin ordering in solids, exhibiting ferromagnetism (FM), antiferromagnetism (AFM), ferrimagnetism, etc.*

*http://people.physics.illinois.edu/Celia/MsP/FLWs.pdf

No more naked "*this*"es—just don't

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 flux, and modification of the continuum x-ray emission rates.

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*

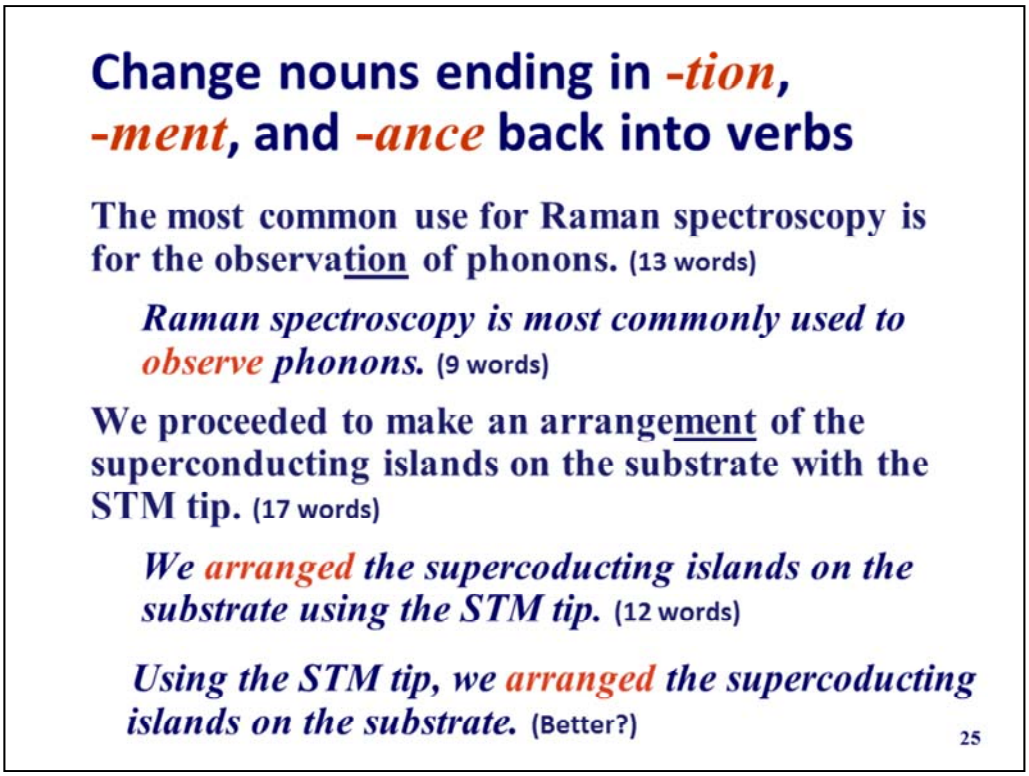
Eliminate *unnecessary* words

the results *tend to* suggest
they are *both* identical
estimated to be about 0.75 mg
such as copper, iron, *and etc.*
divided into two equal halvesd
bright yellow *in color* and elliptical *in shape*
$\Lambda = \lambda/2\theta$, *and vice versa*
given *the fact that* $\tau_\alpha = \sigma q_\alpha \int n(s)ds$
were reexamined *in order* to confirm the presence
It is known that nanocrystallites can form shear bands

"A phrase such as "*it is interesting to note that*"
adds no information and only delays getting to
the point of the sentence." *Scientific Style and Format*

Replace *wordy expressions*

due to the fact that	**because**
on the order of	**about**
in the near future	**soon**
a very limited number of cases	**few**
it appears to be indicated that	**apparently**
in spite of the fact that	**although, despite**
subsequent to	**after**
at the present time	**now**
in consequence of this fact	**thus**
as compared with	**versus**
in combination with	**with**



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*—**

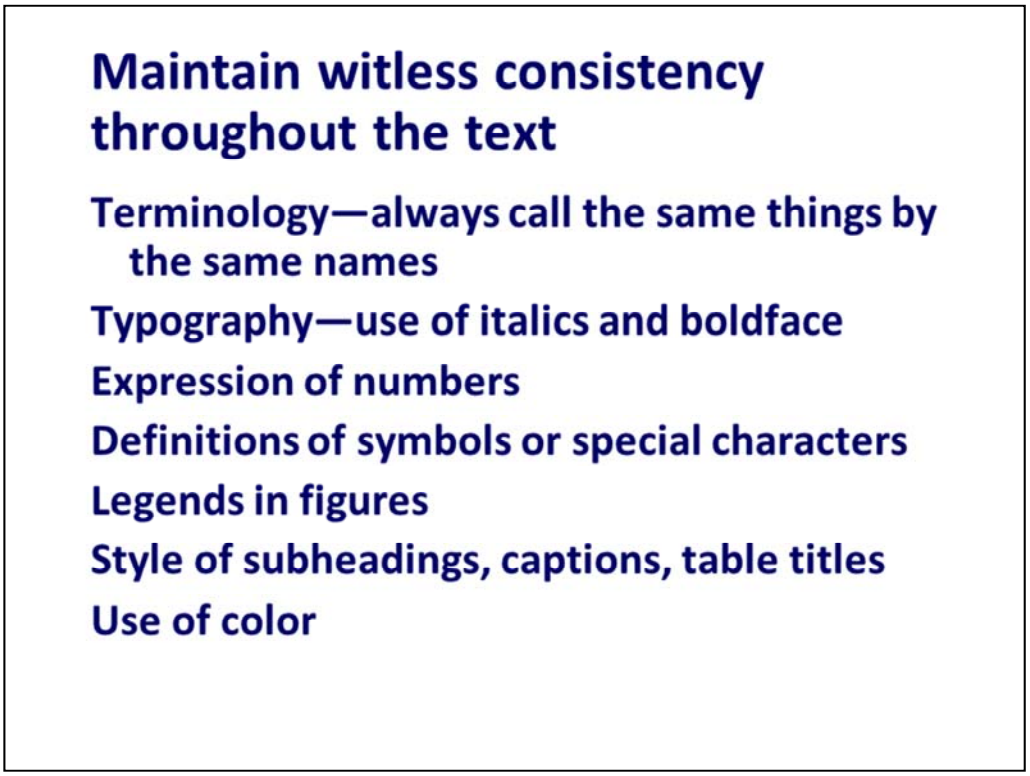
- Spelling
- Grammar
- Punctuation
- U.S. English usage
- Scientific writing conventions

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



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
- Select an attractive page layout
  - Adequate white space
  - Clean, uncluttered appearance

To recap:

Focus on important ideas,
logical structure,
precise language,
"mechanical errors"

Editing should proceed in three steps:
content, style, proofreading

Pay attention to transitions and reader cues

Make your own editing checklist and use it

Distill, distill, distill…

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