

Written Communication

Conveying Scientific Information Effectively

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Outline

- Objectives of (scientific) writing
- Important issues in writing
- Strategies for effective writing
- Considerations for dissertations
- Considerations for journal articles
- Remarks

Objective of (Scientific) Writing

Why write?

- Written material (books, articles, reports, etc.) is a *primary mechanism* by which information is disseminated
- In general, written material is used to *inform, convince, entertain*
- In science in particular, written material is the *primary mechanism* by which *new advances* (the results of research) are disseminated. . .
- . . . and from which *inspiration* for *further advances* is derived

Obviously: If writing is “*good*,” all of this will be done *efficiently!*

Effective writing: It is not enough just to *write down* information

- *How* information is conveyed in writing is critical to how well these objectives are met!
- You generally know “*good*” writing when you encounter it (similarly for “*bad*” writing)
- *Fact* – in science in particular, where difficult concepts must be communicated, the *quality* of writing can “*make or break*” an advance!

Thus: The ability to produce quality writing is an *essential skill* you *must* master!!

Important Issues in Writing

What makes scientific writing “good?”

- “Tell a Story!!”
- Organization and logical flow
- Accessibility and scope
- Completeness
- Clarity

“Tell a Story!!” Whenever you write, this is *always* your goal

- *Why?* – What is the motivation for a reader to bother reading this?
- *What?* – What’s the story?
- *Why?* – What should the reader have gotten out of reading it?
- To every story, there is a *beginning*, a *middle*, and an *end*
- “... and they lived happily ever after.”

In the words of a great philosopher:

“Tell ’em what you’ll tell ’em, tell ’em, and tell ’em what you told ’em.”

Organization and logical flow:

“A common failing in writing is to include things in one place which should be in another. Indeed, one of the most difficult tasks is to get everything into the most effective order.” – R. Barrass

Organization and logical flow:

- Motivate, excite the reader at the *beginning*
- Build up the story in a *logical sequence*
- Do not refer to ideas until *after* they have been introduced
- Use *sections* and *subsections* to organize and highlight the key points and flow of ideas
- Try to give each paragraph *one main point*
- Sentences within a paragraph should *lead into one another* in a logical way

Organization and logical flow: A basic template

- *Introduction* – motivation, background, purpose
- *Background* – summary of what is already known that is related, important
- *Main ideas* – the material central to the message
- *Supporting evidence/documentation* – Simulations, examples
- *Conclusion/Discussion* – restate purpose, recap and summarize the message, highlight the key points, mention possible topics/ideas for future

Accessibility and scope: Make it *easy* on your reader!

- *Define terms* that are likely to be unfamiliar; for that matter, define them even if you think they will be familiar!
- Use as little “*jargon*” as you can
- Do not use symbols, terms, notation until *after* you have defined them, and define every symbol you use!
- *Identify your audience* – whom are you trying to reach?
- *Know your audience*; e.g., if you are writing for novices, do not include very theoretical results!

Accessibility and scope:

- Relate concepts to concrete examples or familiar special cases
- *Step into your reader's shoes often* – would I follow this?
- Realize that you can't say it *all*
- Say too much, and you *overwhelm*; say too little, and your reader will *give up*
- Consider: What can I reasonably hope to communicate *clearly* in XX pages?
- Include anything that is central and necessary to understanding your message, but not more!

Accessibility and scope: For most writing

- Communicating the *main ideas* is the goal
- Thus, do not interrupt the flow with *technical details*, as the reader may become distracted from your *overall message*
- *Technical details* should probably be deferred to an appendix
- *Example* – if the result of a theorem is central to your message, lead up to the need for the theorem, state it, and discuss why it is important, presenting the messy and distracting proof later

Completeness:

- *Everything* that is needed to understand your message should be covered or cited
- *Step into your reader's shoes* – would I be able to understand what comes next given what has been presented so far?

Clarity:

“If men would only say what they have to say in plain terms, how much more eloquent they would be.”

– S. Coleridge

Clarity: Make every sentence and every equation *understandable* and *unambiguous*

- Use *simple* rather than flowery language
- *Short, direct* sentences are better than long, complicated ones
- Define *all* terms and symbols
- *Parsimony* – avoid redundancy, run-on sentences, tendency to repeat yourself, which distract a reader and make it difficult to focus attention

Clarity:

- Paraphrase and *interpret* mathematical results in English to give a general sense of what results mean and imply
- A *concise, clear* presentation is always more effective than a long-winded, wordy one!
- *Step into your reader's shoes often* – would I understand this?

Strategies for effective writing

How to begin?

- Consider: *What do you want to say? What message do you want your reader to take away?*
- An *outline* (informal or formal) can help you establish an initial, basic organization and structure
- Do not worry about all the details at first; you can fill in the holes *later*. Get the main ideas down in whatever form comes to mind.

How to begin?

- Do not try to start at the beginning and write everything in order! Write what you can first. The *introductory* material is often the *hardest* to write!
- Don't let yourself *get stuck* agonizing over a word or detail; make a note to come back to it and continue

Refinement: No good writer produces a *perfect* first draft!

- Once you have rough draft, review it carefully
- *Reorganize* to improve logical flow
- Fill in the holes
- Consider each paragraph and sentence for *clarity*; revise to make each sentence say *exactly* what you mean

In the words of a great philosopher:

“*Write it, and write it again*”

Criticism:

- Be your own critic – *put it aside* and read later
- Ask *others* for *honest* comments!
- Have you cited the *relevant literature and material*?
- Are there *gaps in your logic*?
- Are there parts that are *confusing* or *unclear*?
- Is the overall *message clear*? Is the *evidence convincing*?
- *Grammar? Style? Spelling and punctuation?*

Dissertations

Styles:

- *Traditional* – formal literature review, chapters
- *Series of papers* – short introduction, papers form “chapters,” details probably excluded
- *Hybrid* – short introduction, material in papers divided into “chapters,” appendices to chapters with technical detail too lengthy for papers

Traditional:

- *Audience* – Your committee; other students, researchers who come after you
- *Unlimited space*, so full details may be included
- However, resist the temptation to overwhelm the flow with details!
- What would your committee, other students and researchers *want/need* to know?

Series of papers and hybrid:

- *Short introduction* – motivate, recount what is known and why it is not adequate, review what you will do and how it will add to knowledge in the area
- Papers should follow the guidelines coming next. . .
- *Appendices* – present proofs, arguments, additional explanation, relating them back to the papers/chapters and making it clear where they fit in

Journal Articles

Know your audience:

- Does the journal publish mainly *theoretical* or *applied material*?
- Do articles in the journal follow a certain *style? structure/organization? level of detail?*
- We will discuss this in *gory detail* in a future lecture!

Remarks

- Some people are just *naturally-born* good writers!
- *Most of us* must *learn* the skill of good writing over a *lifetime*
- Good writing *can* be learned!
- The most *brilliant* ideas can be obscured by *bad writing!*
- Being a good writer is part of being an *effective researcher*