On scientific writing

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Objectives

- The many challenges of writing
- The many challenges of scientific writing
- What to do, what not to do

The many challenges of writing

> *We are all apprentices of a craft where no one ever becomes a master.*
>
> — Ernest Hemingway

Writing and parallel programming are similar in that they are both easy to do if you don't care about doing them well.

Writing well is likely one of the greatest challenges you will face in your research career.

As with most things, it is possible to be an adequate (perhaps even good) writer through sheer determination and work.

Unfortunately, as with most things, many people (especially students) think they are inherently gifted to the point that they can skip over all the hard work and still be good or perhaps "good enough".

The many challenges of writing

The typical student starts off as a sub-standard writer.

Sadly, many graduate not being much better.

There are many potentially acceptable reasons for this, including

- writing in a non-native language
- reading other poorly written papers
- never being taught formally how to write well

However, there are also many *unacceptable* reasons for this, including

- not using a spell-checker
- not carefully proofreading
- jumpy logic

The many challenges of scientific writing

Scientific writing is important! It is the primary way people will learn about your research (and one way you will build your reputation as a researcher).

In the grander scheme, it is an enduring way you can pass your knowledge and experience on to others.

Scientific writing is mainly about communicating information; the writer's goal is to convey the most information in the least amount of reading time.

However, data must generally be interpreted (and not simply dumped); the writer's goal in this case is to present a logical argument in a convincing manner.

Also, scientific writing can be entertaining; although not a primary goal, the best writers, perhaps through brilliant insight, memorable language, or levity of subject matter, leave the reader feeling genuinely satisfied from their experience.

Where to start

Roughly speaking, the first thing that needs to be clear is the storyline about which you are going to write.

If you cannot summarize this in a sentence (or two) to yourself, the idea may not be clear enough in your mind or there may be too many messages for one paper.

After deciding the storyline, one turns to the details:

- What background does the reader need to have?
- Why is your study important?
- What is the take-home message?
- What is the contribution or insight?
- What are the details of the analysis, experiments, ...
- How about on-going/future work or open questions?

Where to start

Many papers/theses can roughly play out as a classical five-act play but with some critical differences.

In drama, having the audience not know the ending is often good.

In scientific writing, it is absolutely not.

The strategy in scientific writing is much more like:

1. Tell the audience what you are going to tell them.

2. Tell them.

3. Tell them what you have just told them.

Not all readers make it past the abstract.

You also don't want your readers wondering what the message is or where the paper is headed while they are only partway through.

Where to start: the big picture

1. *Exposition* corresponds to the introduction, i.e., where the stage is set and the important background information is given.

   However, even at this early stage, the final message of the paper must nonetheless be abundantly clear.

   This section generally concludes with an outline of the paper, again partly so the reader knows what to expect, but also to provide pointers for readers who wish to jump to specific parts (or stop reading).

2. *Rising Action* corresponds to where the theoretical or other motivational background is given so that the audience can not only understand the result but also to appreciate its impact or what it took to achieve it.

   Similar to drama, this act can be viewed as building toward the greatest point of interest or climax of the paper.

Where to start: the big picture

3. *Climax* corresponds to where the deepest insights of the paper are revealed.

   In drama, it is usually some kind of turning point.

   In scientific writing, it could be seen as the point where readers are meant to really understand the origin of the result and could potentially draw their own conclusions as to the impact.

   However, not all readers will approach this in the same way.

   Some of the more skeptical may reserve judgment on what they think of your study until they see the next act.

Where to start: the big picture

4. *Falling Action* corresponds to the verification of theory or discussion of experimental results.

   Quite often this is make-it-or-break-it point.

   In drama, this final outcome can remain in suspense.

   In scientific writing, it is a foregone conclusion.

5. *Conclusion* actually corresponds to more of a re-iteration of the message of the paper, as opposed to presenting the conclusions for the first time.

   Some authors take this opportunity to discuss on-going or future work or suggest open problems.

   Unlike dramas, there are typically no comedic or tragic endings in scientific writing.

   Scientific writing is mainly about describing positive results; negative results are a much harder sell.

   For better or worse, this may explain why so few negative results are ever published.

Where to start: key points

1. *Audience.* It is hard to overstate the importance of keeping the audience in mind while writing. The audience does not change the data, but two different papers containing the same data can look markedly different.

   Aspects of writing that depend critically on the target audience include

   - the notation used,
   - the amount of detail presented,
   - how the data are interpreted,
   - what the message and how it is delivered.

Where to start: key points

2. *Format.* Format refers to the physical layout of the text, e.g., font type and size, how references are cited, etc.

   With your target audience (journal) in mind, it is also invaluable to have an accurate picture of what the finished product might look like. Aspects like length of paper cannot be determined well without the proper format. How figures, paragraphs, and even sentences appear on the printed page is important; e.g., dangling words can be missed.

   It is useful to read recent relevant articles in the target journal to determine things like appropriate length, notation, and style (language).

   Psychologically, it helps some to envision the paper in its published state, thus motivating them to do a better job.

Where to start: key points

3. *Mechanics.* Mechanics in this context mainly refers to grammar and punctuation.

   Sadly, but perhaps understandably, there are few hard-and-fast rules regarding this.

   There are subtle differences between countries.

   There are even differences in philosophy between those who believe "English is what English does" and those who believe there are rules for a reason.

   In scientific writing, given its precise nature and the fact that it must be read by so many for whom English is not their first language, I tend to strike a balance closer to the latter philosophy, erring on the side of formality rather than colloquialism.

   Nonetheless, consistency and flexibility are generally the keys to success.

Where to start: key points

4. *Culture.* Culture relates to the purpose of the document for the audience chosen.

   Naturally it is imperative that what you report is completely honest.

   Perhaps ideally, this should be sufficient.

   However, all readers read through their own lenses.

   This may impose upon you a different choice of words or style than your would otherwise choose if the audience were different.

   For example, when writing for the popular press, one must eschew technical details and focus on impact or other practical matters the average person can understand or appreciate.

   When writing for government or other policy makers, one must imagine writing to the level understandable by a (typical?) twelve-year-old.

Getting in the mood

This is clearly a highly personal aspect of writing.

It is safe to say there are a number of common themes that seem to work for most people, but there are no guarantees any of them will work for you.

However, here are some ideas to help overcome writer's block and other impediments to writing successfully, including procrastination.

Writing well is hard and demands focus.

Distractions are deadly to good writing, especially until one is well practised.

It helps to be in a suitable environment, whether that be quiet, well-lit or

Feeling rushed is also a deadly distraction.

Getting in the mood

It is fairly evident that one must be relaxed and thinking clearly while writing.

Therefore, often the best time for this is first thing in the morning, especially after a good night's sleep[1].

Others may prefer to write after exercising.

Most people do need to build themselves up to write.

Often this can consist of just re-reading what you have already written.

Sometimes it can be to read a particularly relevant piece of literature or other motivational material.

The truth of the matter is that writing also takes discipline; it is very easy to rationalize why the job is not getting done.

[1] This was Hemingway's strategy.

Getting in the mood

Many successful professional writers adhere to schedules, and they structure their environments and other tasks to facilitate their writing and not to distract from it.

For example, Hemingway wrote for 8 hours per day, 6 days per week.

Isolating yourself from the outside world is often a necessary part of getting a certain amount of writing done in a given period of time.

Many studies have shown the cost of interruptions is generally much longer than the interruptions themselves; you will need time to get back in the groove, as it were.

But an equally important aspect is to have a dedicated block of time for writing.

Without it, it will be harder to relax and focus.

The first draft is the hardest

Arguably the first draft is the hardest to create, although sometimes fixing up a poor draft can come in a close second.

When writing first drafts, it may pay to simply start from scratch.

It is also common for one look back at one's past writing and notice obvious improvements.

The bottom line is that a practical balance must be between good enough and perfect.

Perfection is rare; it is usually not practical to pursue it beyond a certain point.

On the other hand, where the bar is set for "good enough" must be sufficiently high.

The fact that perfection is not achievable is not a justification for not getting above the bar.

Other useful tips

When writing, put yourself in the audience's shoes.

Become a critic of your own work.

Read your work as if someone else wrote it.

Actively solicit feedback from trusted sources; avoid the ivory-tower syndrome.

Revise, revise, revise.

When you think you have revised enough, go back and revise some more.

When to write the abstract

The classical advice to write the abstract last.

The idea is that one cannot accurately write the abstract until the paper is complete.

However, it is difficult to write a paper without a plan, and an abstract would serve well as this plan.

This suggests it may be best to write the abstract first.

So regarding the question as to whether to write the abstract first or last, my response is "yes".

I write the story of the paper as the first draft of the abstract to serve as the plan for the rest of the paper.

Then after the paper is completed, I revise the abstract to ensure it does accurately reflect the contents.

Sometimes things change (e.g., new ideas come to you) while writing.

What to do when it comes to writing

Do:

- use the fewest words possible to convey a given concept
- be consistent
- be precise
- proof-read without distraction
- proof-read with some (but not too much) distance between sessions
- use an on-the-fly spell-checker
- solicit and give serious consideration to trusted feedback

What to do when it comes to writing

Do:

- learn from your mistakes
- have a willingness to learn and improve
- be somewhat paranoid about being misinterpreted
- think in the language in which you are writing
- be formal and use good grammar
- hyphenate compound adjectives
- separate **all** items in a list with commas
- use uniform terminology
- do it right the first time

What to do when it comes to writing

Do:

- give enough detail to make your work reproducible
- ensure each sentence can stand up to scrutiny on its own
- read all references you cite
- label your figures and tables clearly
- punctuate equations
- read your entire article in one sitting before considering it to be finished
- use version control for your manuscripts
- know your audience
- make the reader's life easy (even enjoyable)

What not to do when it comes to writing

Do not:

- transcribe words as if you are talking to someone
- treat your editor like a compiler
- use “which” when you mean “that”
- use “since” when you mean “because”
- use “while” when you mean “although” or “whereas”
- overuse acronyms
- translate from other languages
- use contractions

What not to do when it comes to writing

Do not:

- use different words for the sake of variety
- use the word "very"
- settle for mediocre
- be distracted while proofreading
- cite figures and tables before they appear
- list references not cited in the text
- undermine your own authority (e.g., typos)
- give referees gratuitous reasons to reject your work
- label equations that are not referenced in the text

Summary

- Why writing is a challenging endeavour
- How to get started
- Some things to do and some not to do when it comes to writing