Tips for Writing a Scientific Manuscript
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Different strategies between paper writing, grant applications, and talks?

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- Scientific papers form the permanent record of science, needs to be detailed, and meticulously checked for scientific accuracy. Conclusions should not be over-stated.

- Grant applications are in some sense “sales documents”, they are written for the reviewer

- Talks are written for the audience you are presenting to. The big picture and take-home messages are key here, other details (e.g., controls) can be removed but these are necessary in scientific papers

General Thoughts - Overview

- Scientific papers form the permanent record of science: preparing such a paper deserves your best effort
- Writing should not be drudgery, change your mindset and make it engaging even exciting (cup of coffee?)
- Find the right environment for you to write
  - Quiet room? Café (not for me but works for some others)?
- Papers are not written in the sequence they appear. Start with the Figures and write clear legends, then write the Methods followed by the Results, Introduction, and Discussion. Abstract can be written at different stages depending on the situation, sometimes at the very end
- Become expert in the use of a reference management system (EndNote)
  - Note I am not a fan of leaving out references until the very end because I find it important that as you are writing you know what you can and cannot cite, and where. Oftentimes what I write is dependent on what I can cite (except for the Results section).

General Thoughts – the Stages of Writing

- Consider an outline (makes the writing seem a less formidable task)
- I like to get a first, albeit imperfect, draft of individual sections down on paper ("sketches") that I can then begin perfecting
  - I like to re-read completed sections of a paper with a fresh mind (e.g., the next day or the next week) like I'm reading it for the first time as an outsider. This is where a lot of my self-editing happens. I also do this at the very end of a final draft.
- Save multiple drafts (particularly if an earlier draft has a section that you decide to delete; sometimes you may want that section back)

General Thoughts – the actual writing

- Write in simple clear sentences that convey a single idea. Short is, almost without exception, better than long
- Avoid redundancies (and definitely no verbatim phrases repeated)
- Don’t allow acronyms and abbreviations to kill the readability of your paper. Abbreviations should only be introduced once, at the first mention of the abbreviated word(s)
- Sometimes it helps to read a sentence out loud to assess whether it is a readable sentence
- Try to use active voice (present tense) in all sections except in the Methods and Results (there is an exception: Results wrap-up sentence of each experiment is usually conveyed in present tense)
- How to improve general writing skills?
  - READ READ READ
  - When someone edits a sentence in a way you think is better, think about how/why the sentence is improved. Eventually you can then make those edits yourself, or write in a way that incorporates the improvement

Paper title (I)

- Better to have this done earlier rather than later
- Oftentimes have multiple options
  - May go through many revisions during your writing process.
- Aims to attract interest of potential readers – attention grabber
- Helps you keep your focus when writing your Introduction and Discussion sections
- Succinct is almost always better than verbose
  - Articles with shorter titles are cited more often
- Encapsulates the article’s main conclusion

Paper title (II)

- Preferable to state what was discovered (or the most important thing that was discovered), rather than what was done (e.g., “scRNAseq of lymph node specimens from viremic people living with HIV”)
- Mentions the key players—cell type, animal model, genes, organ, technology (for a methodology paper)
- Avoids abbreviations that will not be familiar to the target readers
- Needs to adhere to the sometimes strict length limit imposed by the journal

Abstract

- Consider this your baited hook in the water……will your abstract form a compelling synopsis that catches the attention of readers and persuades them to continue?
- The abstract serves as a mini—version of the paper and should be organized as such. State the problem, the hypothesis, give results at the 30,000 foot level and summarize importance of the findings
- The abstract is not the place for an intensive review of the literature or a detailed description of all of the experimental results

Figures

- Try to prepare Figures that essentially stand on their own and can be understood without referring to the legends
- The figures form the story board of your paper
- Figures should be called out in sequence in paper (never Fig. 4 before Fig. 3)
- Use color in figures to improve clarity; be consistent in your color assignments and your labels
- Align figure components, use same font style, remove unnecessary text (minimalistic/clean approach: don’t repeat labels if do not have to)
- Learn the basics of Adobe Illustrator (do not create figures in Powerpoint)
  - Work with vectored files (e.g., SVG), and know how to ungroup
- Consider use of graphic artists
  - Always carefully check graphs/figures returned from graphic artists

Figure Legends

- Title of the legend should summarize the key conclusion of the Figure
  - Preferably what was found rather than what was done (e.g., Western blot of XYZ)
- Legend provides essential details of the experiment and information on reproducibility of results (statistics)
- Legends are becoming more and more minimalistic
- Spell out all components of the figure, don’t assume something is obvious. E.g., “Arrows point to nuclei; arrowheads to mitochondria”, and “Red corresponds to X, Blue corresponds to Y” (unless already labeled in the figure). “

Methods (I)

- I find this the “easiest” part to write. Requires least brainpower, is purely technical, but is tedious. Don’t skimp here.
- Key part of the manuscript - provide sufficient detail that your experiments can be repeated; that is how your work is validated - is it repeatable
- STAR methods becoming popular with increased emphasis on Rigor and Reproducibility—these Methods are comprehensive including identification of every reagent including supplier and catalogue number
- Methods commonly broken into subsections—titles of subsections often written without verbs
- Methods usually written in past tense (passive voice)

Methods (II)

- If your manuscript includes the generation of a new dataset (e.g. genome or RNAseq data), describe where these data are deposited, and give the accession number (we often use Dryad for CyTOF data)
- Include a section that describes the methods of statistical analysis used, including any analysis software. Explain how significance was determined, inclusion and exclusion criteria, and whether experiments were conducted in a randomized fashion or analyzed in a blinded manner

Results (I)

- Construct the description of your experiments and observations in a manner that conveys a logical story (satisfy reader anticipation)
  - This is oftentimes not the order in which experiments were conducted
- Use Headers (written in present tense) to organize and create logical flow through the Results section
- Each section typically starts with a sentence framing the experiment followed by the results and a wrap up sentence that summarizes the experimental result, with references to figures in the middle
  - Results are described in past tense but summarizing statements should be in present tense.
- Do not allow Discussion material to enter into your Results, present ”just the facts”

Results (II)

- Be able to define the topic sentence of each paragraph (typically but not always first sentence)
- Ensure there is flow between sentences in each paragraph, and between adjacent paragraphs
  - Try not to surprise the reader, take them down a path that is logical
  - Link sentences logically: A-->B. B-->C. C-->D. Or A-->B. A-->C. A-->D
- It can help to include words like “Accordingly”, “As Expected”, “Surprisingly”, etc, to help the logical flow of the results
- Don’t be repetitive
  - E.g. “We next sought to determine whether compound X inhibits HIV infection of CD4+ T cells. We found that compound X inhibited HIV infection of CD4+ T cells in a dose-dependent manner.”
- The results is *not* a place to showcase a long laundry list of results with no hint as to their purpose or interpretation

Introduction (I)

- Sets the stage for the body of work you are presenting-needs to convince the reader you are studying an important problem/question
  - This is the place to cite prior studies leading up to what you are doing
- Often starts broad highlighting what is known and not known, then hones in on the key question that will be addressed; often generates a hypothesis that forms the basis of the paper
- Organize information logically: move from known to unknown, familiar to novel, established to controversial, to set the stage for the problem/question/unknown your work tackled
- Not the place to summarize the results of your study, although oftentimes can briefly summarize at the end of the introduction (preferable to just say what you did in this study)
- Be generous in your referencing
- Don’t get trapped into spending too much time describing what is known instead of moving into what is not known
- Get the reader excited about your study

Introduction (II) – Typical Components

- Foremost, the introduction tells the readers the hypothesis, question, or problem that your paper addresses (Hypothesis/Goal statement)
- It provides the readers with the background information they need to understand the premise and purpose of your work (Background)
- It needs to convince the readers of the importance or significance of the question you are tackling, or of the novelty or promise of your approach (Significance)
- It highlights current unknowns or technical limitations that motivated your work (Gap in knowledge/technical limitation)
- It gives an overview of the approach you took, and, if necessary, a justification of this approach (Approach)

Discussion (I)

- Here you have some poetic license - you can offer an opinion or speculate
- Write this section in the present tense
- Can be helpful to start discussion by stating the original hypothesis for your study and then describe whether or not that hypothesis was supported
- Results can be briefly summarized (typically 1st paragraph) to support the discussion but they should not dominate this section…they are merely the springboard
- This section should bring the entire story to a logical and hopefully compelling conclusion
- Best to avoid referring to figures in Discussion

Discussion (II)

- Common discussion topics
  - How to interpret your data in context with prior results?
  - Any surprises?
  - Are your data consistent or not with prior similar studies? If not consistent, what are the potential reasons why? (don’t leave reader hanging)
  - How has this set of studies changed our understanding?
  - What is new and why is it important? (the ”Who cares?” question)
  - If appropriate, can end with a “Limitations” sub-section

Questions?

Comments? What have folks here found that work or don’t work for them?