

Guidelines for manuscript preparation

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A manuscript is a way for you to share a research story with the scientific community. Remember, it is a story, but with a certain structure that has been agreed upon by the scientific community. It is also important to keep in mind that although there may be sequels, each manuscript/paper should be able to tell a stand-alone story. It can be useful to keep this in mind when collecting your data and writing up the manuscript.

There are many points at which you can start writing up your story. Some people start the process at the beginning of a project, knowing what the state of the art is in the field and what the goal of the project is. If you choose to start here, it will be especially important to look at your data from a critical perspective. We always have to be aware of confirmation bias in science, and especially under these circumstances. It is also common to start writing when results are piling in or most or all of the results are already there. Under both circumstances, it is important to look at the data and the manuscript before submission and ask oneself: *Does this manuscript tell a good stand alone story? Are there (m)any plot holes and/or loose ends? If there are, are they of such a nature that they can be left to a sequel or should the story be adapted to wrap them up first?*

When it is ready, make sure all co-authors have had a chance to read, comment and approve of the manuscript before submitting it. Here below follow some ethical considerations along with guidelines for each section of the paper. It is also useful when reading papers, to think about how they are written and make a note of what you feel is a well written paper and what in a paper might make you feel it could be better. Aim to write a paper that you would enjoy reading yourself. For me personally, I like it when papers tell a good story in a concise manner.

Ethical considerations

It is extremely important to maintain good ethics in all aspects of our research. Your ethics impact your reputation and credibility within the scientific community so keep a high standard for yourself and aim for good integrity in all of your work. A few notes to keep in mind here.

- *„Give credit where credit is due“* – always make sure to give proper credit, both through citations, on the author list, and in acknowledgement, depending on the credit that is due.
- *Never falsify data* – it is never acceptable to falsify data. In science we are searching for the truth and any falsification of results hinders or delays us, as a scientific community, in our search for the truth.
- *Do not practice data selection* – we should never try to pick and choose results to fit our theories. The data is what it is, it is our job to interpret it properly. If the data has clear outliers or if you suspect that an error was made in the experiment, make a note

¹ but influenced by many collaborators through the years as well as papers read.

of it. Occasionally circumstances may justify omitting a datum, but „uncomfortable“ data should not be omitted just because we cannot explain it yet.

In general, guard your integrity, reputation, and credibility within the scientific community.

Title

The title should give a clear idea about what the paper is about. There is a balance between having it too vague or having it overly detailed. Aim for somewhere in between those extremes.

Abstract

It is good to write the abstract last as it should be a mini-version of the story. It should provide a succinct overview of the problem being tackled, research question, hypothesis, methods used, and main results, and conclusions. The first abstracts that I wrote were not very good, and as a consequence I received advice that was along these notes: *The abstract should be written in a way that I should not have to read the rest of the paper to know its story.*

Introduction

The goal of the introduction, in my opinion, is primarily three-fold:

- 1) to provide sufficient background for the story so that a reader *from the same field*, or a closely related one, will not have to refer to other papers simply in order to understand what is going on. At the same time, it is important to have proper citations throughout the introduction so that reader could learn more about the background if they wanted to, especially if they are new to the field. Think about the target audience from your perspective as well as from your journal's perspective and write it for them.
- 2) to set up your story and define why we want to embark on it. What is the problem we are trying to solve? Why should we care about it? What is the research question that we are looking at? What hypothesis was tested?
- 3) to capture the reader's attention from the start, making them interested in your story. A great advice that I received once was to put extra work in the first sentence of the paper to work towards this objective.

Experimental section / Materials and methods

It varies what this section is called and where it appears. It usually comes 1) after the introduction, 2) at the end of the paper, or 3) is put into supplementary information (SI). In notes/letters and other short papers, it is generally saved for the SI section).

The main goal of this section is to provide enough information for the reader to reproduce your results should they choose to do so. A good test of whether this section is ready, is to read it over or get a friend to read it over with the mindset „could I reproduce this research based on the information provided herein?“ Therefore the following information needs to be provided herein:

- *Materials*: The purity and sometimes the source of materials can affect the results. In biochemistry/biology this can be more common and there are examples of results changing when a researcher received a new batch of serum that was from different

cows. It is therefore important to list all the materials that were used and where they were obtained from.

- *Instruments:* If there are any specialized instruments that were used, it is important to make a note of them here. Specialized instruments can vary in quality, e.g. when it comes to NMR instruments, the reader should be able to know the manufacturer, and more importantly, how strong the magnet is (giving the instrument's MHz information in order to convey that information). When using chromatographic instruments (HPLC, GPC, GC), it is also important to know the type of detectors used so that the interested reader can better reproduce your experiments.
- *Methods:*
 - *Synthetic methods:* All synthesis needs to be described here. If you are reproducing the synthesis of a specific compound from the literature (it needs to be for exactly the same compound), you can list that compound in the materials section and say that it was synthesized by previously reported methods and make sure to include the proper reference. The description of the synthesis should provide sufficient detail for a researcher in your field to reproduce it. For each compound, it is also important to provide the analytical results that were used to determine what compound
 - *Analytical methods:* If there are any non-standard specific protocols on an instrument that are being used, e.g. for HPLC runs, they should be described here.
 - *Computational methods:* When running computations and/or simulations, it is important to provide information about the method used. It should be sufficient information for a reader competent in the field can understand what you were doing, but you do not need to go over everything. If you want to share any code used, that should be left for the SI section.

Results

The results section is sometimes a stand alone section and sometimes combined with the discussion section. Its goal, especially when it is stand alone, is to provide the reader with the results obtained so that they can draw their own conclusions about it.

The relevant and necessary data needed to share a comprehensible story should be included in this section, but additional data that is not necessary for the story can be included in the SI section. Think carefully about the clearest and most efficient way to present your data and use that method. Should it e.g. be presented in a table, a graph, a synthetic scheme, or is it simple enough that it can be presented in the text? The text in this section should also guide the reader through it. If it is a stand alone section, it is important to wait with interpretations of the data until later.

Figures, tables, and schemes

Often a reader might look over all the figures, tables, and schemes before deciding whether to read the paper or not. These might even end up being the only thing that someone looks at in your paper. Therefore it is important to make a special effort to have these as clear as

possible, so that the reader can get as much as possible out of it as possible. Remember, you want your story heard and even if someone does not want to take the time to read it all, try to make it such that they can still get something out of browsing through the figures/tables/schemes.

Discussion

This is your opportunity to interpret the data for the reader. What does it mean and how does it relate to your research question and hypothesis? Does it confirm your hypothesis, or do you have to reject your hypothesis. Point out observed trends and if you can provide a plausible explanation. It is important to be able to rationalize all conjectures made with the data and/or previously published and accepted literature results. While it is important to provide interpretation of the data, be careful not to overinterpret it and state something as fact that is not backed up by the data. It is alright to provide hypothesis about how the data might be interpreted, and if there are more than one plausible explanation that you can think about, it is usually worth noting them, but there is a difference between stating those as fact or hypothesis. Keep in mind also, that research has a strong tendency to lead to new questions. It is therefore all right if we do not have all the answers yet. The goal is to learn at least something new from each story, and sometimes our research is only a small step toward the final answer, that may then belong to a sequel later on.

It can often be nice to have results and discussion together, so that if there are several different parts of your story, that you can wrap up each and every one of them without the reader having to go back and forth between sections.

Conclusion

This is your opportunity to wrap up the take away message of the whole paper in a neat manner.

References

Make sure to give credit where credit is due. Never use direct quotations without it being clear that it is a direct quote, and paraphrase properly where appropriate giving the proper citation for your source. Aim for using primary sources, but barring access to the primary source, review articles can also be useful when giving a broader/more general background about a certain topic.

Use the technology that is available to us now, and find a citation software early on that can help you when writing papers. I personally use Mendeley, but I have also heard good things about Zotero and both of these are free. The citation style can vary between journals, but these softwares make it easier to change between citation styles. Just make sure that you double-check your reference list and everything before final submission, as these softwares can make mistakes.

Supplementary information

If the paper itself does not have an experimental section/materials and methods, it is crucial to provide that in the supplementary information. You can also provide more detailed experimental information here.

This section also gives you an opportunity to provide more data that was a part of your story but was not deemed „necessary“ to be included in the manuscript itself. This can include some NMR spectra that show clearer how you got the „processed data“ that may have been presented in the paper itself.

Acknowledgements

Here is an opportunity to thank those that helped with the research but not to the extent that they belong on the author list. It is also crucial to acknowledge any and all funding sources that made the research possible!

Other notes

When it comes to publication, make sure to familiar yourself with the author guidelines, use the proper template, and fill in other sections, that are not covered in this document, appropriately.