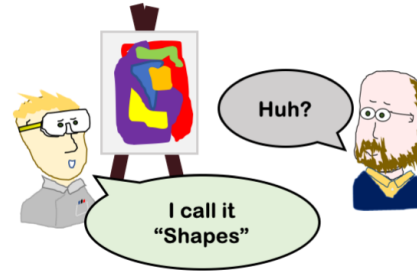
7.4 Scientific Abstracts

An abstract is a short overview of the whole paper. It's not so much a teaser, but rather the complete story told in fewer words. Your abstract needs to capture the question you asked, the motivation that drove you to ask that question, the methods you employed, the results you obtained, and what conclusions you can draw from those results. It's a lot of content, and you have very few words to do it in.



The abstract is a mini version of the whole paper: Motivation, Aim, Method, Results, Conclusions

First impressions matter

Every part of your paper matters. However, the abstract is the first time your reader, marker or reviewer will encounter your writing and learn about your story. When people search the literature, it's the abstracts that they will read. The quality of your abstract might make the difference between a person choosing to read the rest of your paper or dismissing it as uninteresting. The abstract certainly will make a difference about whether your paper gets cited or not.

Big Tip

Always ask a non-expert to read your abstract before you submit.

Like all the rest of your document, your abstract will need multiple drafts before it is perfect. Abstracts are usually the last thing I write in my first draft but sometimes I find it helps to have a really early draft in place early. Irrespective when it gets drafted, the abstract gets read every single time I read and edit the paper. Ultimately the abstract ends up being the part that I spend the most time getting right.

It is always worth getting someone who is completely naïve to your study to have a look at your abstract. Abstracts should be able to stand alone and, because they are quite short, most people will willingly do this for you (and you should be willing to do it for others). Ask your peers if the abstract makes sense. Do they understand everything? Would they want to go on to read the rest of the paper?

Types of Abstract – Check your Instructions

Whether writing for an assignment or a manuscript for a specific journal, your first step is to check the rules and requirements.

Style: Structured or Freeform

Many journals are prescriptive in the layout of their abstracts, requiring specific subsections. Usually, these are background or introduction, aim, methods, results, and conclusions. Each section gets one or two sentences, with most of the abstract focused on the results of the experiments.

Freeform abstracts, in contrast, can take on more of a narrative, storytelling style. Overall, you should follow the same core structure, but you have the flexibility to tweak

the order to improve the rhythm and thereby make your abstract more enjoyable to read. The most obvious way to take advantage of the freeform option is to combine the methods and results for each stage of the experiment and then use better linking phrases to smooth your transitions between the stages of the project. For example, phrases like "next we asked" can serve useful links to transition into the next piece of work.

Structured abstracts are usually easier to write as removing the option for creative flexibility also takes away some of the decisions that you as the writer will need to make. You cannot go too far wrong. Indeed, it can be a good idea to use the subsections from a structured abstract to put together a first draft irrespective of whether they are needed or not. However, the advantage of the freeform version is that those abstracts should be less disjointed and enjoyable to read.

Length

Check the word or character count limits for your target journal. These can vary a lot from journal to journal but are usually somewhere between 200 and 350 words. In the rest of the writing sections, I won't focus on length as, if you follow the guide layout, you usually naturally reach approximately the right length. Moreover, if your first draft is too long, it is easy to reduce the word count. However, the difference between a 200 and a 350-word abstract is quite large in terms of style and content. I recommend that you make yourself aware of your target length before you start, then aim to be within 50 words in your first draft. If there are no specific requirements or you don't yet know the target journal, then 300 words is a good length to aim for.

The box below has some suggestions on balance. These values will vary a lot depending on your story but are a good place to start.

Recommended proportion of word counts

Motivation and Background	~20%
Hypothesis and Aims	~10%
Methods	~20-30%
Results	~30-40%
Conclusions	~10%

Help getting started with your abstract

One way of writing the first draft of an abstract is to think of each sentence as the answer to a question.

Sentence	Question
1	Why should the reader care about the topic?
2	What key things does the reader need to know to understand your study?
3	What specific thing was **not** known about your research area before you started? What question did you address?
4, 5	How did you do your experiments?
6, 7, 8, 9	What results did you get?
10	What do your findings mean?

Introduction: Context, Background and Motivation

Your first sentence should be about the "big picture" and should be accessible to a scientist of any discipline. Start reasonably wide but on message. You are telling the reader *why they should care about the topic*.

Follow the big picture sentence with one sentence of more detailed background in which you set up your specific question. Here your goal is to tell the reader what *wasn't* known about your research area before you started and what value you are providing by filling that research gap. Remember that just because something is new doesn't mean it intrinsically has value, your sentence should *emphasise why it is worth knowing this new thing.*

Phrases to establish value

It is not yet known…
It has yet to be established…
Little is known….
… has never been confirmed.
It remains controversial…
This raises the question…

Question: Aims or hypothesis.

Use one sentence to state, in as clear a way as possible, the problem that *your* work addressed. This sentence can be framed as an aim, an objective or an hypothesis, but works best if you construct the phrase as a single entity that all your experiments point toward, rather than a vague series of questions. If your goalposts moved as your work progressed and you followed the science, then write the aim sentence as the starting point of what became the final story.

What's the difference between a hypothesis and an aim? Hypotheses are discrete testable statements; an experimental series will test hypotheses. The results of the experiments will either cause the hypothesis to be rejected or will support it. In contrast, aims are what you want to find out. You do not necessarily need to write the words aim or hypothesis in your abstract. Be aware, your instructions or the journal may define what style of phrasing they want you to use.

Aims vs Hypotheses

Hypothesis: "Treatment X reduces Y."
Aim: "Determine if X reduces Y."

Methods and Results

If you are writing a structured abstract, the results and methods sections may be broken up into two distinct subheadings. If so, the methods can be short and to the point, "X was investigated using Y". If using a narrative style, you can combine methods and results into one; "using (the approach) we determined that (the results).

For most papers, the results should be the longest part. Summarise your main findings, not necessarily everything, focusing on the parts of the story that answer the main study question. Indicate the magnitude of effects, the strength of your inferences (i.e. p values)

and the statistical tests used. In other words, you should include actual results in your abstract. Draw attention to anything unexpected and indicate where your data support or refute your initial hypothesis. The results will read better if you can tie the individual findings together with link phrases so that it flows into a coherent narrative.

Big Tip

Don't only summarise your findings. Also define why your results are interesting and important, and connect them to the wider world

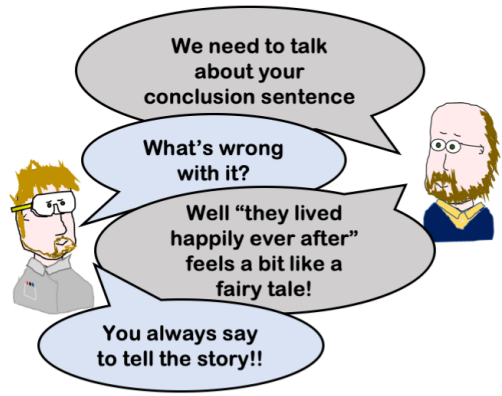
Conclusions: "These findings have implications for…"

Your goal at the end of the abstract is to put your work back into a real-world context. Make your conclusions as specific and as generalisable as your data can support while making sure they aren't an overreach. Your main conclusions should reflect your title (assuming you used a statement), and later in your discussion you will expand this conclusion statement into a fleshed-out paragraph to complete the manuscript. Use different phrasing between the abstract, discussion and title but make sure all three deliver the same core message.

The conclusion as a proportion to the whole word count depends on how big, complex or impactful your findings are, but usually one or two sentences is all you will need. Some journals have different requirements; for example, Nature expect the conclusions section to be the biggest part of your abstract; high impact journals are all about the message and wow factor!

References

Usually, *don't* use references in an abstract. The only time you might have to do so is if your whole story is derived from a single previous finding. On the rare occasions when you must cite something, you should be aware that there will be different rules for how to format the citation in the abstract than in the rest of your document. You need to provide a near-complete citation including titles, authors and page numbers within the abstract. Abstract citations use up a lot of word count, so try to avoid them unless you absolutely must!



Use your conclusion sentence to put your work back into context with the real world.

Keywords and search engine optimisation

It's all very well writing a great abstract, but if no one reads the abstract in the first place, then you are no better off. Your title will do some of the work, but you still need your work to appear whenever people are performing literature searches. Think about who you want to read your paper and how they will use search engines (not just PubMed

and Scopus but also Google, Bing and other search engines are often used to locate papers). Test out some search terms and see what comes up.

Search algorithms keep improving and changing how they work; however, here are some general tips you could consider:

- Place your main keywords in the first two sentences
- Be consistent in terminology throughout your manuscript, including subheadings.
- Don't overuse keywords; too much repetition ('keyword stuffing') may result in search engines 'un-indexing' your article.
- Don't go too far in your edits, keywords are important but certainly you should not compromise on the reader experience for the sake of search engine optimisation.

For biomedical work, you can use resources like the library thesaurus (National Library of Medicines) to help you find effective keywords. Google AdWords keyword planner or Google trends can also be good sources of information. The keywords you use in the abstract are also the keywords you should provide on your title page.

Big Tip

Don't let the quest to include keywords distract from the delivery of your story!

Thesis / Dissertation abstract

The concept of an abstract for long-format writing like a PhD thesis or Masters dissertation is the same as for a paper, except you will have a lot more work to cover and a proportionally bigger word count to play with. You will not be able to discuss everything; therefore, the abstract is an opportunity tell your examiners which parts are the most important. You have a chance to set the scene for all the work to follow. Most importantly, this is a good chance to very briefly highlight the value, extent and novelty of your work as a whole.

As always, step one is to check the instructions. If there are no word limits, then set yourself a limit of one single-spaced page, any longer than that, and it's a sign that you haven't been very discerning about what you have selected to highlight. You don't want to frustrate your examiners before they have even seen a single data point. In terms of structure, it is quite similar to a manuscript abstract. Long-form abstracts are almost always freeform, so you have flexibility to do whatever works.

As usual, start with the motivation and rationale, then a clear statement of the problem that your work addressed. Limit this to about 20% of the words, usually one paragraph of a one-page abstract. For methods and results, you have two main options. If you used a single model system or a limited range of approaches throughout the work then describing the experimental system using its own paragraph might make sense, with the results then described in order. This can work, for example, if you have generated a new transgenic mouse model or a genome-edited line, and then characterised it in the rest of the thesis. If instead, you have results chapters that are a bit less connected, then an option is to use one paragraph per chapter with a brief overview of the methods and major results together in each paragraph. Together the methods and results should make up about 60% of the

abstract. The final 20% should be dedicated to conclusions. This might sound like a lot, but you should cover what the data mean, whether they answer the problem statement, and how they have advanced the field. I don't recommend including any future directions in the abstract, you don't need anything to distract from what you have done. End with a sentence that wraps up the story by saying what your work means in relation to the original motivation.

What to check when editing

Balance

The most common problems I encounter in new writers' abstracts are to do with balance. Mostly the issues are that early drafts include too much background information and therefore don't focus enough on the actual findings. You probably don't need as much introductory material as you think! When editing your draft, aim to cut down any waffle and get to the meat of the story as soon as possible.

Conclusions

Your conclusion is vital, don't forget it! It is required to round out your abstract and make it a complete stand-alone entity. If word count is tight you have to choose between one extra results sentence and including a conclusion, always pick the conclusion!