7.8   Discussions

On first impression, it is much more difficult to identify a general formula for the discussion part of a manuscript. Discussions tend to vary more dramatically between different projects, and, because of this, they are an area where new writers often struggle. However, good news! In this section we'll discuss some general concepts and establish a framework to use as a starting point. You can then build upon or tweak this to suit your project. Hopefully this will make writing your first draft easier.

What is the point of a discussion?

The primary purpose of the discussion is to give readers guidance about what was accomplished in the study, the scientific meaning. It is important to remember that you (should) know more about your subject than your readers. This includes knowing more of the relevant surrounding and preceding literature. Therefore, the discussion also serves the important role of

> **Big Tip**
> The discussion is not a second results section. Discuss don't repeat.

defining how your findings fit in context with what has gone before, so that your readers can appreciate how your work connects with the wider body of knowledge and how it advances the field.

Discussion Do's and Don'ts

Do
Describe the value of your work (without exaggerating).
Stay focused on the core message of your manuscript.
State if your conclusions support your hypotheses.
Consider other ways to interpret your data.
Attempt to explain unexpected results.
Present potential reasons for differences compared with published work.
Try to take a holistic view as far as possible.

Don't
Don't just repeat your results.
Don't refer to data figures.
Don't discuss each experiment as an independent result.
Don't go on too long, stay focused on the message!
Don't make it too short: address all the things you need to.
Don't overreach in your claims.
Don't introduce new terms or deep ideas.
Don't focus too much on limitations.
Don't ignore any controversial findings.

Discussion Structure

The discussion is the most flexible section of a manuscript, its length, structure and flow will be driven by how complex your story is and what your data mean in relation to the wider literature. Surprising or controversial findings will need more discussion than those were exactly what you expected. However, with those caveats, I have put together structure below, which will work for most studies and should be a good place to start.

Synopsis	~130 words*	Short recap of key findings (if necessary)
Biggest Finding	~190-300 words	One or two paragraphs addressing the most important aspects of your work in relation to the wider published literature. This should be your largest section
Other important findings	~150 words each	Shorter sections on any secondary findings (if necessary)
Limitations	~150 words	Acknowledge anything that restricts your ability to draw robust conclusions, and/or address alternative interpretations
Wider implications	~170 words	Describe what your work means in a broader sense
Conclusions	~100 words	Short, focused ending that captures the key message of the whole paper

*Word counts are indicative only!

Paragraph 1: Synopsis

Summarise the goal of the study and how your data addressed that goal. I know this sounds like I am saying to repeat your results but what you should do here is combine your key findings into a simple message. It should be short. A two or three sentence paragraph

> **Big Tip**
> If your synopsis is over 150 words, it probably is too long.

should do it. **You should not refer to data figures or specific data numbers** here, or indeed elsewhere in your discussion, the synopsis is about themes and generalisations**.**

Connect your synopsis with the rest of the discussion by using phrasing that emphasises the points that you will delve deeper into the following paragraphs. Be aware that if your study is quite short or simple, you might not need a synopsis at all. However, if you are delivering seven figures plus supplementals, with five plus panels per figure, then this first paragraph plays an important role in bringing all your findings together into a single message, reminding the reader how the pieces of the story build on each other, and setting up your big hitting paragraphs to follow.

As usual, try to finish this paragraph with forward-looking wrap sentences to lead your readers into the next point. Now, let's move onto delivering the big stuff (see what I did there?).
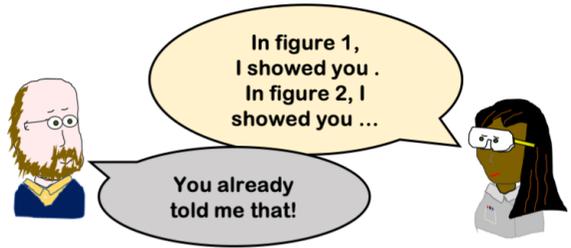
Don't direct your reader back to the data figures!
Advance the story onto discussing what the data means!

Paragraphs 2 (& 3): Discuss your biggest finding
Paragraph 4: Discuss secondary findings

Next, you bring out the big guns; what have you discovered and how do those discoveries fit with the literature? Assemble these points in order of importance; the most biologically meaningful or the most impactful finding first followed by any secondary, but still interesting, findings. This should mean that the second paragraph of your introduction directly discusses the title or the hypothesis that you stated in the introduction. This is a reason why it is best to write the intro and discussion alongside each other. Aim to devote space in proportion to relative importance. If your paper is quite simple, then don't add extra paragraphs here for no reason, discuss your major finding and move on.

Follow the usual rules: one key point per paragraph, fully supported with a clear topic sentence and a wrap sentence to connect to the next paragraph. When you are planning what to write, focus your early energies on identifying the key messages you want to deliver, then write accessible and, ideally, relatively short sentences to use as your lead-in for each paragraph. After your short, punchy topic sentence, stay on the same message for the rest of the paragraph. Doing this, will make ensure that you focus your work on what you want your reader to take

Big Tip

You don't necessarily have to discuss everything! Focus on the most import and impactful findings.

away rather than going off on a tangent.

Content

The meat of the "big finding" paragraphs is where you deal with whether your data supports or refutes your hypotheses *and why*. Take a holistic approach and try to consider the whole data set together, rather than focusing on individual experiments. Before you attempt to write your own version, do some focused reading of good quality papers to identify different ways to deal with this.

Structure your the major findings paragraphs to emphasise why your findings are *important* or *useful*. State how have they changed or advanced what we as the scientific

community think about the topic. The biggest killer to a paper, which will get it rejected from any decent journal, is if the work doesn't add anything of value. Be careful not to go too far. A paper from 1980s may have already established the paradigm using earlier technology. Your study might still be an improvement as it adds mechanism or robust validation in a more physiologically relevant system (validation is valuable), but don't try and sell it as bigger step forward than it is. Use these second and third paragraphs to highlight the advance. Remember that novelty isn't the same as value. Also, don't forget that you will need to set up your discussion points in your introduction; you don't want to be surprising the reader with something completely new here.

In these paragraphs it is essential that you cover your competitors' work. One thing for sure; your reviewer won't appreciate it if you have ignored their seminal work in the field. Wherever your data fits with or disagrees with other people's findings cite that work

Be careful with assertions of novelty! Your reviewers should know the literature and will spot where you have exaggerated!

and discuss why any differences may have occurred. What have you added/changed? Why is your study better? Has been anything published in between, which, when combined with your data, leads you to a different interpretation? A relatively simple way to discuss your findings is to draw parallels with studies of related proteins or drugs, or to similar studies in other organisms, tissue types or diseases. These are all things that are worth stating explicitly to make them clear to the reader.

The discussion is for putting the data into a wider context. One way you might want to consider doing this is by updating a model or diagram to capture how all the pieces of the puzzle come together. Make sure the diagram does help though, don't just put one in for the sake of it. One other thing to be careful of is that the diagram should not be too much of a stretch relative to your data. If you do include a diagram, don't forget to reference it in the text.

And finally; don't forget your citations! These core discussion paragraphs will need to be supported by *lots* of primary data references. Every token sentence within the body of each paragraph should be talking about your work in relation to others. If you find that don't need to cite many other papers then that it is a warning sign that you are either repeating your results or that you are taking too narrow a view of your findings!

Paragraph 5: Discuss limitations and caveats

No experimental system is perfect, and this restricts how strongly or definitively you can state your conclusions. You need to clearly define these limits and explain why you are prepared to accept them in your discussion. I recommend approaching this in one of two ways; either use one dedicated paragraph to cover limitations or combine the description of any limitations with the discussion of the key findings.

So that you don't sound too negative, aim for a balanced approach, one which emphasises the strengths of your study while simultaneously acknowledging the areas where you cannot be as confident. To so this, phrase your sentences so that they focus on what you *can* interpret. This balance comment also extends to how much space you devote to limitations. If your limitations sections extend for longer than your major findings, then you will leave the reader with the impression that your experiments weren't very well designed! There's not much chance of convincing an editor to publish your work if *you* aren't convinced the findings are strong enough to be believable.

What I like to do here is describe the different ways the data could be interpreted. Rather than present these alternative interpretations as a problem, I would instead detail how to differentiate between those alternative interpretations in the future and present arguments as to why you are willing to accept your limitations at this time. For example, you could reduce the negative impact of a limitation by saying something like; "To resolve this dilemma would require 100 extra human samples, which is unethical to request at this time."

Be careful whenever you describe limitation. If you could have addressed the issue relatively easily then a reviewer can, will, and really should, ask you to do the experiment rather than accept as is. You might as well just go ahead and do that experiment now.

A quick note on student assignment papers

A problem I have frequently encountered when grading student papers is that the descriptions of the limitations section are overly long, overly negative and fail to present solutions to the problems. One way to cut down how much you write is reduce the commentary on superficial things. Avoid the obvious comments about time limitations and the impact that has had on the number of biological repeats. Moreover, your markers will certainly know that the data might be more reliable if gathered by experienced researchers (I've seen this included as a limitation a lot more often than you would expect). Using more than one sentence to say any of these self-explanatory points won't add any *valuable* insight. If you do feel it is necessary to include something like this, then do it in a way that is short and focused, "sample size limitations preclude robust statistical inferences". Better still would be to indicate what sample size you would need to make future data reliable. If I am marking your work, I want you to show me that you have thought about the problem *and have a solution*.

Paragraph 6: Discuss wider implications

As you progress through your discussion, you should be steadily getting wider with the implications of your findings (i.e. the mirror image, to your introduction which goes from wide to narrow). Put your findings into their real-world context and demonstrate the "big picture" value.

The wider implications part of your discussion is the place where you can talk about the next big question(s). A specific agenda for future research based on the questions generated by the current findings is much more helpful to a reader than vague suggestions. A different approach to talk about next steps is to integrate these types of phrases into the "limitations" paragraph. For example, I might stress the value of making an animal model in the future to counter a current limitation of the absence of immune cells in my cell culture model.

Be positive about your findings but don't overstretch their importance. Not acknowledging any limitations will make your interpretation seem naïve.

As with limitations, don't go too far here. A long list of what needs to be done next could leave a reader thinking "what have they actually achieved?" Reviewers and readers appreciate how specific research recommendations will advance the field. For biological research this can often include the wider implications for clinical needs, for example you could describe how this work will open an avenue toward therapeutic development.

Paragraph 7: Conclusion

Round it off. Tie it up with a neat little bow. In positive language, describe your core finding and what it means in relation to the big picture. This **short** paragraph should be a slightly expanded version of the last line of your abstract and should connect to one or more of the motivations behind your research, the ones you established in the first paragraph of your introduction.

You might be tired and excited to finish by this point in your writing, but make sure your conclusion is as perfect as possible, it is the last chance to influence your readers' and reviewers' opinions. Indeed, some journals view the conclusion as being so important that it gets a separate section with a subsection header.

Final comments on Discussion

Or should that be "conclusion"? A discussion in a manuscript or project should be the length it needs to be. I've seen three paragraphs work well and equally 11 paragraphs that didn't feel too long, and those were both by the same author. Don't force it; use the style that works for the story that you are telling. If something needs to be discussed, then

discuss it. If things stand alone, are complete and obvious, then let them lie.

My biggest tip for discussions, as with other sections, is to set out a framework of topic sentences and then get a draft down without worrying too much about writing the perfect sentence. Once you have something in place it is easier to edit, edit, edit until the message is clear and compelling.

What to check when editing

Discussing single experiments on their own, in order.

Your discussion should be looking at the cumulative knowledge throughout. When you are editing, check that any time you mention a specific experiment you are doing so in a way that highlights its contribution to the combined story. Remove all references to primary data figures.

Too narrow.

I find that new writers often spend too much time focused only upon *their* findings, failing to connect those new data with the wider world. The only place you can be self-centred is in the synopsis. During the editing stage, make sure you have added enough connections between your work and the literature that everything is connected.

Too speculative.

A little speculation is good, but you can go too far. When you are editing, look at the balance of what you have written and try to avoid over-interpreting what you have found. Try to avoid including things just to show off your knowledge; every point should add value.

Too many unknowns.

If more than half of your discussion is saying "we don't know this" in a variety of different ways, then the overall feel to the reader will be that the study is incomplete. It isn't surprising to have unknowns, good research often raises more questions than answers, but do you really need to elaborate about them all? My advice in editing is to reduce the unknowns into a single paragraph and set yourself a rule that whenever you say "we don't know" you also include some statement of how you would address the gap in the knowledge.

New stuff.

Make sure that your introduction and discussion are connected. You shouldn't be bringing in completely new material into the discussion. You may need to edit the introduction by adding a sentence or two to the middle of the second or third introduction paragraphs.