Chapter 18
Conclusions

What key skills are needed when writing the Conclusions?

One of my PhD students once remarked to me: *I find the conclusions quite difficult to write, even in my own language. If I wrote everything in the paper, what should I add at the end?* Her question sums up the dilemma that authors have with the Conclusions. It's not that the Conclusions section is difficult to write, it's just that authors don't know what to write. In fact, several journals do not even have a separate Conclusions sections, authors simply write a concluding paragraph in their Discussion.

Although the Conclusions may not be the last section that readers read, there is a strong probability that they will be the last thing that the referee reads. Consequently, they must be clear and concise, and leave the referee with a good impression. If your structure and English are poor here then this will have a negative impact on the referees and may affect their final decision as to whether to accept your paper or not.

The key skills are in knowing what referees and readers expect to find in Conclusions, not repeating exactly the same phrases and information from your Abstract and Introduction, and in providing a clear and high-impact take-home message for readers.

A. Wallwork, *English for Writing Research Papers*,
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Typical complaints of referees

The Conclusions are just a cut and paste from various other parts of the paper.

The authors have not concluded anything but just given a poor summary of what they have done. Their Conclusions read like someone who would rather be back in the lab, rather than someone who wants readers understand how their investigation may have added to the knowledge base in our field.

The conclusions should be also shortened by avoiding peripheral topics, they did not seem to be the final stone in their build up of logic. I also recommend that the authors should report very clearly why and how these findings may be of interest for future research and applications.

18.1 How should I structure the Conclusions?

The Conclusions section is not just a summary. Don't merely repeat what you said in the Abstract and Introduction. It is generally not more than one or two paragraphs long. A Conclusions section typically incorporates one or more of the following:

1. a very brief revisit of the most important findings pointing out how these advance your field from the present state of knowledge
2. a final judgment on the importance and significance those findings in term of their implications and impact, along with possible applications to other areas
3. an indication of the limitations of your study (though the Discussion may be a more appropriate place to do this)
4. suggestions for improvements (perhaps in relation to the limitations)
5. recommendations for future work (either for the author, and/or the community)
6. recommendations for policy changes

The order these items appear is likely to be the same as suggested above.

It differs from the Abstract and Introduction as it is for a more informed reader. In fact, you are making a summary for readers who hopefully have read the rest of the paper, and thus should already have a strong sense of your key concepts. Unlike the Abstract and Conclusions it:

- does not provide background details
- gives more emphasis to the findings (point 2)
- talks about limitations, which are not normally mentioned outside the Discussion and Conclusions (point 3)
- covers three additional aspects (points 4–6)

On his department's excellent website (see page 313 for a link), Dr Alan Chong of the Faculty of Applied Science and Engineering at the University of Toronto, makes the following comments about the difficulties of writing the Conclusions:

> Students often have difficulty writing the Conclusion of a paper because of concerns with redundancy and about introducing new ideas at the end of the paper. While both are valid concerns, summary and looking forward (or showing future directions for the work done in the paper) are actually functions of the conclusion. The problems then become (1) how to summarize without being completely redundant (2) how to look beyond the paper without jumping completely in a different direction.

The rest of this chapter is dedicated to solving Dr Chong's first problem. The second problem is not a language issue and simply involves making sure that you avoid developing any new directions in significant detail, and that these future avenues should be clearly linked to the work described in your paper.

18.2 How should I begin my Conclusions? How can I increase the impact of my Conclusions?

Here are some beginnings for the Conclusions section. They are typical but in fact make little impact.

S1. We have here described a linear model with an error specification that is considered appropriate for the estimation of … We have found significant evidence of …

S2. In this paper we have presented a statistical study of the nature of … We have shown that it is possible to reason about …

S3. In this paper it has been shown how X can be applied to a wide range of … A novel approach has been introduced to …

S4. In this work it has been attempted to analyze simple feedback loops with … It has been shown that for ...

S1 and S2 use a personal form, S3 and S4 use the passive. What all these examples have in common is that they are boring to read and have almost zero impact on either the referee or the reader. They also match the equally uninteresting first sentences often found in Abstracts (Sect. 12.8).

Just as professional copy editors advise against beginning a paper with *This paper describes*, they also suggest avoiding ending the paper in the same way (*This paper has described*). This is for three reasons:

- they waste a lot of words (5–7 words that tell the reader nothing)
- they delay the main topic
- they are not memorable for the reader and have no impact

It is not difficult to be more direct, as the following examples show.

	ORIGINAL VERSION (OV)	REVISED VERSION (RV)
1	In this study it is concluded that compression plays an important part in … It was found that …	Compression plays an important part in … In fact, it was found that …
2	This work has demonstrated that a number of compounds present in X are responsible for delaying the onset of …	A number of compounds present in X are responsible for delaying the onset of …
3	We have shown that the crystal structure of X reveals that …	The crystal structure of X reveals that …
4	It has been suggested in this paper that the localization of X in neurons is a good marker for neuronal viability.	The localization of X in neurons suggests that it is a good marker for neuronal viability.

The RVs have simply removed the initial 5–8 words of the OVs. This means that the main topic of the paper now appears in the first two to four words of the Conclusions. The result is a Conclusions section that is more concise and has more impact.

The RVs versions are considerably more direct and are found in many disciplines, particularly in medicine and biology related disciplines. If you are worried that they are too direct, then you can make them 'softer' by introducing hedgers (Sects. 9.2–9.6). So RV2 becomes *could be responsible*, and RV3 *seems to reveal* (RV4 already contains the verb *suggest*, which in itself is a good hedger).

In RV4 the passive form (*has been suggested*) has been replaced by an active form (*suggests*) while still maintaining an impersonal construction – this may be important if your journal does not allow you to use *we* (Sect. 7.1). In any case, using the passive form in the Conclusions is perfectly acceptable as it allows you to put your main topic at the beginning of the sentence.

> A simple method of extracting gold from plastic *has been described*.
>
> The gold found in waste materials *has been demonstrated* to produce more than 100 kg of gold per day from a typical recycling plant.

If the above two sentences had appeared in the Introduction, they might have been ambiguous. Given that they are in the passive there is no subject for the verb, so readers cannot be 100% sure if the author is referring to his/her own work or someone else's. However, in the Conclusions such ambiguity rarely arises because the reader is assumed to have read at least some other parts of the paper and thus knows that these are the authors' conclusions about their own work.

18.3 How can I differentiate my Conclusions from my Abstract?

In this section I am going to analyze an example from a writing skills exercise I set my PhD students. Below are an Abstract and Conclusions by Chiara Vallebona. She uses a model to predict how very heavy rain will erode soil in the near future. Note that the data presented below are completely hypothetical as no such study has actually been conducted.

Here is how Chiara begins her Abstract and Conclusions.

> ABSTRACT An increase in storm frequency and intensity is expected for the Mediterranean area. The aim of this study is to assess the risk of soil erosion in sub-basin croplands in Tuscany, Italy.
>
> CONCLUSIONS We assessed the risk of soil erosion in the Trasubbie (*Tuscany, Italy*) sub-basin croplands by using a scenario analysis.

The main topic (*the risk of soil erosion*) is the same in both sections, but the focus is different. In the first sentence of the Abstract, Chiara gives some background information. In the Conclusions, there is no background information. Instead in the first sentence of the Conclusions, Chiara summarizes the main activity of her research. In the Abstract, she mentions the location as a wide area (Tuscany, Italy), which she

thinks her readers will be familiar with. In the Conclusions she is more precise about this location (Trasubbie, a much smaller land area in Tuscany) – readers will have read the paper at this point so this precise location makes sense. Her Abstract and Conclusions then continue as follows.

> ABSTRACT We explored the potential response of soil erosion patterns to changes in temporal distribution and intensity of rainfall events, land-use, and soil conservation management practices by analyzing various scenarios. Most soil erosion is associated with a limited number of intensive-to-extreme rainfall events. Assessing the spatially-distributed soil loss due to intensive rainfall may help in predicting long-term soil erosion rate in order to implement efficient soil conservation management. An analysis on a sub-hourly basis was carried out using the SWAT model.
>
> CONCLUSIONS Various combinations for climate change (intensity and distribution of rainfall events), land use change, and conservation measures were evaluated using the SWAT model.

In the first sentence of Chiara's Abstract she gives more details about what she did during her research. In the second sentence she also provides more background information. In the third sentence she justifies the reason for her research. And in the fourth sentence she indicates what model she used to carry out this research. Her Conclusions summarize all these four points in one sentence. Her Abstract and Conclusions then end as follows.

> ABSTRACT Our analysis highlighted three specific management strategies that may help in preventing or reducing cropland erosion. We predict that these strategies could reduce erosion by up to 25% in the studied area over the next ten years.
>
> CONCLUSIONS The result was a range of possible erosion values for the next ten years – the worst possible scenario indicated a possible erosion rate increase of up to 25%. In the light of these dramatic findings, we believe that our analysis may contribute to implementing ad-hoc land management strategies to reduce, or even completely prevent, cropland erosion. We hope that our findings may influence policy planning. Future work will entail refining our model by exploiting data from satellite sensors (e.g. InSAR).

The differences in the way that her two sections end are that her Conclusions:

- use phrases to describe the results that have a much stronger impact (*dramatic findings*, *even completely prevent*)
- make recommendations for policy change – this helps give the conclusions more substance and authority
- indicate future work and how Chiara plans to conduct such work

So what are the main differences between the Abstract and the Conclusions? The two sections have completely different purposes. The Abstract is like an advertisement for your paper – it has to attract the reader's attention. On the other hand, the Conclusions section is designed to remind readers of the most salient points of your paper. However, the Conclusions also have to add value. This added value is typically contained in the recommendations, implications and areas for future research.

In any case, it is a good idea to revise the Abstract and Conclusions together, and even shift information from one to the other.

Inevitably there will be some overlap between the two sections, but this is both accepted practice and inevitable. An analysis of the Chiara's Abstract and Conclusions, highlights that:

- they are similar in length: Abstract (152 words) and Conclusions (125 words) – these relative lengths are fairly typical in research papers
- each contains at least 20% different vocabulary – there are 34 words in the Abstract that do not appear in the Conclusions, and 33 words in the Conclusions that do not appear in the Abstract
- words that are unique to the Conclusions include words that indicate findings, possibility and the future (*believe*, *could, findings, help, planning, policy, predict, refining, result will*) and specific words (*EU, InSAR, satellite, Trasubbie*), and emotive words (*completely, dramatic, worst*)

18.4 How can I differentiate my Conclusions from my Introduction and from the last paragraph of my Discussion?

The same comments made in Sect. 18.3 regarding the difference between the Abstract and the Conclusions, are also substantially the same as for the Introduction, so they are not worth repeating.

If your journal has a separate section for Conclusions, i.e. the conclusions are not included in the Discussion, then it may be best to shift any overall conclusions you may have made in your Discussion into your Conclusions. This means that the final paragraph of your Discussion may just be a conclusion regarding one specific point, rather than an overall summary of the whole paper. See Sects. 17.5 and 17.6 for more on this aspect.

18.5 I don't have any clear Conclusions, what can I do?

Sometimes it is impossible to leave the reader with clear conclusions regarding the contribution of your work – maybe your method turned out to be inappropriate and your results were not as brilliant as you were hoping for! In such cases simply say what you have learned about the problem and then suggest possible lines of future research. Such a final section is generally entitled Concluding Remarks.

If you don't have any clear conclusions, it is important not to present your findings in an exaggerated light or to say something uninteresting or irrelevant. Readers may

still be able to benefit from what you found (or equally important, did not find). In order to present inconclusive conclusions you may benefit from using hedging devices (Sects. 9.2–9.6).

Here are some examples of authors admitting that their work did not achieve all that they had hoped for. In some cases readers are immediately warned of this 'failure' through the use of the words highlighted in italics.

Unfortunately, we could not assess how much of the difference in outcome was due to ..

When results are compared across different components, the confidence intervals overlap, and we have no conclusive evidence of differences in ...

Although some progress has been made using our model, this incremental approach provides only a partial answer

Unfortunately this trial had too few subjects to achieve sufficient power and had a low …

It is also unclear what conclusion should be drawn …

Regrettably, we did not have the means to …

To make your Conclusions not sound too negative, you can add some hope for the future.

Although it is too early to draw statistically significant conclusions, two patterns seem to be emerging …

However, more definite conclusions will be possible when ...

Nevertheless, our study confirms recent anecdotal reports of …

Despite this, our work provides support for …

In any case, we believe that these preliminary results indicate that …

Again, the first words of the sentence alert the reader that you are now going to qualify the negative stuff you said before by offering some optimism. You could also use some conditional sentences to show what might have been possible if you had had different circumstances, or what might be possible in the future.

If we had managed to … then we might have been able to …

If we manage to … then we might be able to.

18.6 How can I end my Conclusions?

Once you have summarized your work and dealt with any limitations, there are three typical ways to end your Conclusions. You can use one or more of these ways.

The first is to show how your work could be applied in another area.

Our findings could be applied quite reliably in other engineering contexts without a significant degradation in performance.

These findings could be exploited in any situation where predictions of outcomes are needed.

Our results could be applied with caution to other devices that …

Note how the above phrases all make use of *could* as a hedging device (Sect. 9.6).

You might however like to say where they could not be applied for the moment.

However, it remains to be further clarified whether our findings could be applied to …

Further studies are needed to determine whether these findings could be applied to components other than those used for …

The second typical ending is to suggest future work. There is some general agreement that the use of *will* refers to your own planned work, and that *should* refers to work that you believe could be addressed by the general community. Thus the following represent the authors' plans:

One area of future work *will* be to represent these relationships explicitly …

Future work *will* mainly cover the development of additional features for the software, such as …

Future work *will* involve the application of the proposed algorithm to data from …

On the other hand, these examples show possible lines of research for anyone in this particular field:

Future work *should* give priority to (1) the formation of X; (2) the interaction of Y; and (3) the processes connected with Z.

Future work *should* benefit greatly by using data on …

The third way to end your Conclusions is to make a recommendation. The difficulty in making suggestions and recommendations is just in the grammatical construction. The examples below highlight a construction that may not exist in your language.

S1. We suggest that policy makers *should give* stakeholders a greater role in …

S2. We suggest that policy makers *give* stakeholders a greater role in …

S3. We suggest that the manager *giv*e stakeholders a greater role in …

S4. We recommend that stakeholders *should be given* a great role in …

S5. We recommend that stakeholders *be given* a greater role in …

The construction is thus:

to *recommend* (*suggest, propose*) + *that* + someone or something + *should* (optional) + infinitive (without *to*) + something

The only difference between S1 and S2, and between S4 and S5 is the use and non-use of *should* - the meaning is identical. S3 highlights that the form of the second verb does not change – in fact it is an infinitive form (or if you a language

expert, the present subjunctive). This means that in correct English no third person *–s* is required, so *we suggest that the manager gives* is incorrect (but still quite common). S4 and S5 use the passive infinitive (*be*) + past participle (*given*).

18.7 What tenses should I use?

Many tenses and constructions are used in the Conclusions – the future, conditionals, modal verbs etc. For details on how to use these forms see the companion volume English for Research: Usage, Style, and Grammar.

One distinction that many authors make is between what they did during the research (SIMPLE PAST) and what they did during the writing process of the manuscript (PRESENT PERFECT).

> We *have described* a method to extract gold from plastic. We *used* this method to extract 5 kg of gold from 50 kg of plastic. We *found* that the optimal conditions for this process were …

The first verb (*have described*) says what the authors have done in the paper, whereas the second and third verbs (*used, found*) say what they did in the laboratory (i.e. a finished action).

The following two sentences are incorrect because they use the PRESENT SIMPLE instead of the PRESENT PERFECT:

S1. *In this paper we *consider* the robust design of an extractor for removing gold from plastic.

S2. *In this study, it *is demonstrated* that by using an ad hoc extractor gold can be easily removed from plastic.

S1 and S2 would be correct in the Abstract or Introduction.

18.8 Summary: How can I assess the quality of my Conclusions?

To make a self-assessment of your Conclusions, you can ask yourself the following questions.

- Is what I have written really a Conclusions section? (If it is more than 200–250 words, then it probably isn't – it needs to be much shorter)
- If the conclusions are included in the Discussion, have I clearly signaled to the reader that I am about to discuss my conclusions (e.g. by writing *In conclusion …*)?
- Have I given a maximum of one line to comments related to descriptions of procedures, methodology, interviews etc.? (Generally such comments are not needed at all, unless the primary topic of your paper is the methodology itself)
- Have I avoided cut and pastes from earlier sections? Do my Conclusions differ appropriately from my Abstract, Introduction and final paragraph of my Discussion?
- Are my Conclusions interesting and relevant?
- Have I given my Conclusions as much impact as possible and have I avoided any redundant expressions?
- Have I avoided any unqualified statements and conclusions that are not completely supported?
- Is my work as complete as I say it is? (i.e. I am not trying to get priority over other authors by claiming inferences that cannot really be drawn at this stage)
- Have I introduced new avenues of potential study or explained the potential impact of my conclusions? Have I ensured that I have only briefly described these future avenues rather than getting lost in detail?
- Are the possible applications I have suggested really feasible? Are my recommendations appropriate?
- Have I used tenses correctly? PRESENT PERFECT (to describe what you have done during the writing process), PAST SIMPLE (what you did in the lab, in the field, in your surveys etc.)

In addition, you should look at the summary questions for the Discussion (Sect. 17.14), as these may also be helpful in deciding whether your Conclusions will have the necessary impact on your readers.