Tips for writing a research paper

Sections of the report

Title. This should say as much as possible about the content of the paper, in as few words as possible.

Abstract. This is a brief (usually one paragraph) summary of the whole paper, including the problem, the method for solving it (when not obvious), the results, and the conclusions suggested or drawn. Do not write the abstract as a hasty afterthought. Look at it as a real exercise in cramming the most information in one paragraph. The reader should not have to read any of the rest of the paper in order to understand the abstract fully. Many readers will read only the abstract. Other readers will use it to decide what to look for in the paper, or to decide whether to read the whole thing. Remember Strunk & White's admonition, "Omit needless words."

Introduction. Tell the reader what the problem is, what question you will try to answer, and why it is important. It might be important for practical reasons or for theoretical (or methodological) reasons. Don't neglect either type of reason. Some people list questions as hypotheses, and give them names such as H1 and H2. If you do this, try to use more memorable names.

If the problem is a very basic one, you may state the problem first and then review what has already been found out about it. If the problem is one that grows out of past literature, review the history of how it arose. But do not forget to mention the basic issues behind the research tradition in question, the practical or theoretical concerns that inspired it.

It is sufficient to review the main papers that are directly relevant. Again, you should assume that your reader has not read them, but you need not go into detail. You should review only those points that are relevant to the arguments you will make. Do not say that "X found Y" or "demonstrated" if X's conclusions don't follow from X's results. You can use words like "X claimed to show that Y" or "suggested that" when you are not sure. If you see a flaw, you can add, "However ....". Try to avoid expressions like "Unfortunately, Smith and Jones neglected to examine [precisely what you are examining]." It might have been unfortunate for them or for the field, but it is fortunate for you, and everyone knows it.

The introduction should lead up to, and conclude with, a statement of how you intend to approach your question and why your approach is an improvement on past efforts (or why it is worth undertaking even if it isn't). This is essentially what is new about your approach, your particular contribution.

Method. This section gives the details of how you went about your project. It is usually divided into subsections such as subjects, materials, and procedure. These subheadings are standard ones, but they are not always appropriate, and other subheadings are
acceptable. The point of subheadings is that the reader may want to skip this section entirely and return to it later. The subheadings should make it easy to find relevant details. Excessive detail, such as verbatim copies of questionnaires, can go in an appendix.

**Results.** This is a summary of what you actually found. It is not a dump of your unanalyzed data, nor merely a report of whether your statistical tests were significant, but somewhere in between. It should contain whatever summary statistics will help readers see for themselves what happened, such as means and standard deviations of various conditions, and raw correlations, when these are relevant. It should also contain the results of statistical tests. Make sure to do and report just those tests that are relevant to the questions that inspired your project.

Graphs, charts, and tables are often useful in this section (and elsewhere, but less often). They should be labeled consecutively either as Figures or Tables, depending on whether a typesetter could be expected to set them, (yes for tables, no for figures), e.g., Figure 1, Figure 2, Table 1, etc. Each one should have a caption explaining clearly what it is, if possible without relying on anything in the text. The text should tell the reader when to look at the figures and tables ("As shown in Figure 1 ..."), and it should point out the important points, but it should not simply repeat in writing what they say.

**Discussion.** It is a good idea to begin the discussion with a summary of the results, for the benefit of the reader who wants to skip the results section (and to remind the reader who didn't skip it but got interrupted by a phone call and forgot it).

In the rest of this section, you return to your original question and tell the reader what your results have to say about it ("The results indicate that...") and what they do not have to say ("However, the results are inconclusive concerning..." or "do not speak to the question of"). In each case, tell why. Try to think of objections that someone might make to the conclusions that you draw (whether the objections are correct or not) and either answer them or qualify your conclusions to take them into account ("Of course, these conclusions assume that the subjects were telling the truth, which might not be the case"). You may also say why you think the objections are weak even if they are possible ("On the other hand, there was no reason for the subjects to lie"). Your task here is not to do a sales pitch for some idea but rather to help the reader understand exactly what can and cannot be concluded.

The discussion section may be combined with the results. The advantage of this is that it puts the results in the context of the issues that generate them. The disadvantage is that the flow of the discussion gets interrupted with a lot of statistics, etc.

The discussion section is also the place to say anything else you want to say that does not go anywhere else. You may reflect on the implications of your results, or your methods, or whatever, for other issues that were not the main point of the paper. You can talk about how your project should have been done, and why. Or you can make a more general argument, for which your results are only a part.
It is often a good idea to end the paper with a general statement of the main message. More generally, one type of well-constructed paper will reveal its main ideas to a reader who actually reads only the first and last paragraph and the first and last sentence of every intervening paragraph, and this principle applies especially to the discussion section by itself.

**References.** This is a list of the articles cited. Articles are mentioned in the text by author and date, e.g., Author1 and Author2 (2006), or Author1 et al. (2006), or (Author1 & Author2, 2006). References at the end are listed alphabetically by author, with initials following each author's last name. For journals, both the volume and the year are usually needed as well as the page numbers, because mistakes are common. For chapters in books, page numbers are needed.

**Footnotes.** Sometimes you want to say something that isn't quite necessary. This is the time to use a footnote. But sometimes it's hard to resist making rather extensive, but rather tangential remarks, e.g., about someone else's work. These go in footnotes, not the text. The really eager reader will read them. Others will not.

**General advice**

**The "reader".**

You may assume your readers are intelligent, but they read only your paper, not your mind. Therefore, when you use any terms that are not obvious, you must make sure to define them so as to remove any relevant ambiguity. The need to define terms is even more important when the readers come from many different disciplines. Please try to use memorable abbreviations, and define abbreviations when you first use them.

**Style.** The major rule of syntax is this: write so that a reader could parse your sentences -- that is, figure out what modifies what, what is the object of what, and so on -- without understanding what they mean. The syntax should help the reader figure out the meaning; the reader should not need the meaning to decipher the syntax. For example, put "only" just before what it modifies ("Smith suggested that only men are susceptible to this effect," not "Smith only suggested that men...") to avoid ambiguity of syntax, even if you think the meaning is clear from context. Of course, pay attention to correct usage as well. Make sure you know the rules for using commas; many people do not. (Strunk and White, "The elements of style," provide an excellent review of the roles, as well as many fine suggestions for elegance as well as clarity.)

Spellings: "i.e.," and "e.g.," with periods and commas.

The word "data" is the plural of "datum," and "media" is the plural of "medium." (I know this is old fashioned, but it will apply here.)

Please try to avoid "they" as third-person singular ("the subject read the instructions and then they answered the questions"). It is an old tradition, but it is now overdone. Use
plurals whenever possible ("the subjects ... and then they ..."), and otherwise try to use "he or she" or alternate gender.

Another overused word is "impact," especially as a verb. You can avoid this by paying attention to the difference between "effect" (n. "result", v. "to bring about") and "affect" (n. "emotion", v. "to cause").

Appendix on Good Scientific Writing

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I've been correcting graduate student papers and editing journal articles for more than twenty-five years. I see the same errors of writing over and over. Here are some to avoid:

**Vacant Lead Sentences.** The first sentences of each section, and the first sentences of each paragraph as well, are the most important sentences. They should state, in plain English, your main points. Then the details can follow.

Right:
Results. Cognitive therapy prevented relapse better than drug therapy. Drug therapy did better than no therapy at all. Analysis of covariance...

Wrong:
Results. We performed four analyses of covariance on our data, first transforming them to z scores. We then did paired comparisons using a Bonferroni correction...

**Qualifiers and Caveats.** Don't squander the opportunity to write forcefully by beginning with secondary points and caveats. They belong in the body of the paragraph or section, but not as openers.

**Distinguish between strong and weak statements.** Good scientific writing uses qualifiers and caveats sparingly. Qualifiers apply to marginal results, arguable statements, speculations, and potential artifacts. They do not apply to strong findings, well-confirmed statements, or bedrock theory. "Seem", "appear", "indicate", "may", "suggest" and the like are meaningful verbs. They are not to be used reflexively.

Right:
Because volume was barely significant, water-deprivation may lower hunger. Electric shock, however, increased hunger two-fold.

Wrong:
Our findings suggest that electric shock may increase hunger. It also appears that water-deprivation seems to lower hunger.

**Big words and long sentences.** Most readers are busy. Many readers are lazy. Many readers just scan. Help these readers by using short sentences and plain words. Whenever
a big word tempts you, look hard for a plain word. Whenever a long sentence tempts you, find a way to break it up. The big word and the long sentence must increase accuracy a lot to make up for impeding reading.

Wrong:
Thus, by assigning this group to the wait-list condition, treatment effects would not be artificially inflated by including the higher income group with a better prognosis in the initial treatment phase.

Right:
Richer people have less depression. So we biassed against our hypothesis by putting more of them in the wait-list control.

Overwriting. Omit words and ideas that the reader already knows. Overwriting slows the reader down and does not increase accuracy at all.

Wrong:
The wait list control group, when compared to the attention control group, the drug treatment group and the psychotherapy treatment group did worse than the attention control group, and much worse than the experimental drug treatment group and the psychotherapy treatment group.

Right:
Psychotherapy and drugs did better than attention alone and much better than no treatment.

The Royal "We" and the Passive Voice. Poor writers turn to the awkward passive voice to avoid saying "I did such and such". The first person, used sparingly, is fine. Write forcefully and use the active voice whenever you can.

Right:
I propose that animals can learn about noncontingency and, when they do, they become helpless.

Wrong:
It is suggested that animals can learn about noncontingency. When noncontingency is learned by an animal, helplessness results.

Citations in the middle. Don't break up sentences with citations. This small increase in accuracy slows the reader to a crawl. If you can manage it, group all your citations at the end of the paragraph.

Direction of statistical effects. Always state the direction along with its significance.

Wrong:
The interaction between drug and weight was highly significant (F(2,31)=14.56, p<.001).
Right:
Small doses of the drug put small rats to sleep right away, while big rats stayed awake even with very large doses (F weightXdose (2,31)=14.56, p<.001).