Tips to Writing an Effective Paper

based on “Writing Science” by Joshua Schmiel

### **Overall**

* structure of your story
  + OCAR: Opening, Challenge, Action, Resolution
  + there are others, but this is most common, meant for specialist journals, so it’s the one I focus on for the remainder of this document
  + another good piece of advice is (from <http://dynamicecology.wordpress.com/2014/06/11/how-to-write-a-great-journal-article-act-like-a-fiction-author/>) is to know the one-sentence summary you want your reader to take away from your study. Always have this is mind before you write your paper, before you give a lab meeting presentation, etc.

### **Introduction**

* Overview of the three sections:
  + opening - what is the problem, who are the characters
  + background - what does the reader need to know to understand the context and why this question is interesting and important
  + challenge - state the hypotheses/goals for the paper
* The Opening
  + the Opening should narrow down to the challenge, stay narrow through the methods and results, and slowly expand into the discussion
  + *the goals:*
    - identify the problem that drives the research
    - introduce the characters
    - target an audience
  + suggestions:
    - make your first sentence strong
    - do not misdirect or switch focus
    - your use of vocabulary and specificity can be used to target a specific audience
    - background information should permeate throughout the introduction
    - an introduction should not be a literature review: focus on what is not known, not what we already know. Write about what is known only to create the boundaries of the problem
  + The Funnel: connecting O and C
    - narrows the focus from the general to the specific
    - *the goal:* argue that in order to tackle some larger problem, we need to tackle this smaller, more specific problem
    - define a knowledge gap: what don’t we know; surprise the reader (how didn’t we know that! why is no one studying this?!)
    - do not sell a solution before you’ve defined the specific problem
    - it’s not convincing to say, “we know little about X”; such an approach don’t focus on the problem or why finding a solution/answer is important. It’s also not concrete and generally false
    - sell the problem, then the solution, not the other way around

### **Challenge**

* This is the end of the Introduction, but it’s really important so it gets its own section
* *the goal:* describe the specific knowledge you hope to gain
  + offer a question
  + frame it into a hypothesis
  + describe specific research goals
* don’t state ‘our objectives are…” instead of “our question was…”: the former places emphasizes on the information you hope to collect, while the latter emphasizes the knowledge you want to gain
* focus on questions, not objectives
* after posing the question, lay out the research proposal: what are the specific questions and the information you will generate; what approach are you taking to answer the question?
* “to learn X, we did Y”: present the question and the approach to answering it

### **Materials/Methods**

* be specific
* pretty straightforward

### **Results**

* there are three types of material in the second half of a paper:
  + the data - the actual results
  + inference - clear, robust interpretations of the data that anyone would make
  + interpretation - your thoughts, hypotheses, and speculation about what the results mean for the larger problem you’re tackling
* just remember that it’s important to distinguish the results from their discussion; i.e., don’t mix the results of a statistical test (p < 0.05) with the interpretation of that test (fish associated a significantly greater time with the larger male)
* presenting data:
  + for each dataset your describe, start with a short opening that describes the pattern in the data and how to fits in with the larger story
  + make sure the distinguish *statistical differences* from *differences*; or *significance* from *effect size*. the two do not go hand in hand. Do not say, “there was no significant difference (p = 0.07)”; there was a difference, and you should report it, but it didn’t reach the 0.05 threshold
    - see fig. 8.3 in *Writing Science* for a good demonstration

### **Discussion**

* present thoughts and interpretations; answer the questions posed in the challenge; show the contribution of this work to the larger problem framed at the beginning of the opening
* you have a good bit of leeway in crafting a discussion
* the discussion should be a sort within itself

### **Resolution**

* forms the very end of the discussion
* *the goals:*
  + synopsize the key results
  + synthesize those results — how do they answer the questions that were posed at the beginning of the paper
  + tell us how this paper contributes to solving the larger problem
* show how our understanding has advanced as a result of this paper, offer new understanding that is gained from the paper, wrap it up
* Circle back to the starting point of the paper, but critically, that starting point has moved because the knowledge gained from this paper
* do not put anything new into the resolution
* it should be straightforward and walks through the OCAR steps backwards
* e.g.: what are your data, what do they suggest (your interpretation of them), how does this shed light on some larger issue
* should start fairly narrow (i.e. what you did) and then broaden
* do not say things like, “this study provides new insights into X” without being specific or telling it how it’s going to provide new insights into X
* do not undermine your conclusions or qualify unnecessarily

**After Writing Your Article, ask yourself the following:**

based on Kuyper 1991

Introduction

1. Read the statement of purpose at the end of the introduction. What was the objective of the study?

2. Consider the title. Does it precisely state the subject of the paper?

3. Read the statement of purpose in the abstract. Does it match that in the introduction?

4. Check the sequence of statements in the introduction. Does all information lead directly to the purpose of the study?

Methods

5. Review all methods in relation to the objective of the study. Are the methods valid for studying this problem?

6. Check the methods for essential information. Could the study be duplicated from the information given?

7. Review the methods for possible fatal flaws. Is the sample selection adequate? Is the experimental design appropriate?

8. Check the sequence of statements in the methods. Does all information belong in the methods? Can the methods be subdivided for greater clarity?

Results

9. Scrutinize the data, as presented in tables and illustrations. Does the title or legend accurately describe content? Are column headings and labels accurate? Are the data organized for ready comparison and interpretation?

10. Review the results as presented in the text while referring to data in the tables and illustrations. Does the text complement, and not simply repeat, data? Are there discrepancies in results between text and tables?

11. Check all calculations and presentation of data.

12. Review the results in the light of the stated objective. Does the study reveal what the researcher intended?

Discussion

13. Check the interpretation against the results. Does the discussion merely repeat the results? Does the interpretation arise logically from the data, or is too far-fetched? Have shortcomings of the research been addressed?

14. Compare the interpretation to related studies cited in the article. Is the interpretation at odds or in line with other researchers’ thinking?

15. Consider the published research on this topic. Have all key studies been considered?

16. Reflect on directions for future research. Has the author suggested further work?

Overview

17. Consider the journal for which the article is intended. Are the topic and format appropriate for that journal?

18. Reread the abstract. Does it accurately summarize the article?

19. Check the structure of the article (first headings and then paragraphing). Is all material organized under the appropriate heading? Are sections subdivided logically into subsections or paragraphs?

20. Reflect on the author’s thinking and writing style. Does the author present this research logically and clearly?

### **Other Writing Tips**

These are based on Steven Pinker’s book, “Sense of Style”.

The overarching idea: A writer, in conversation with a reader, directs the reader’s gaze to something in the world (pg 56).

* Avoid metadiscourse and signposting.
  + *Now I will show…, In the previous paragraph I explained X. Now I will talk about Y.*
  + Remember that writing should be like a conversation between the reader and writer. You would never use metadiscouse when having a conversation with someone.
  + Signposting just refers to tell the reader what you’re about to do.
  + Ways around signposting:
    - open with a question
    - treat the previous idea like something that the reader has observed, saw with her own eyes
    - use of ‘we’ and ‘lets’ to a sort of demonstration that the reader and writer are both engaged in the conversation
* Avoid profession narcissism.
  + Focus on the actual subject, not the state of the field
* Avoid hedging.
  + Be confidence in what you say or you undermine your writing.
  + bad words: apparently, I would argue, somewhat, sort of, in part, partially, presumably, to some extent, to a certain degree
  + Trust that the reader is intelligent enough to know that when you make an assertion, you’re not stating a universal truth or being completely accurate.
    - Example: Liz moves out of Seattle because it’s a rainy city. The reader knows the writer doesn’t mean ‘it rains 24-7-365’ so the writer doesn’t have to write that
* Avoid qualifiers.
  + examples: really, very, highly, extremely
  + Qualifiers transform adjectives that are typically interpreted categorically (e.g. *honest* means *totally* or *completely honest*) to a relative or quantitative scale, so thus weaken the adjectives
* Avoid cliches.
* Avoid abstract nouns.
  + examples: levels, strategy, model, prospect, issue
  + Pinker calls these metaconcepts because they’re concepts about concepts
  + this is really an example of S & W’s ‘use concrete language’
* **The Curse of Knowledge**
  + the difficulty of imagining what it is like for someone else not to know something you know
  + Much writing is bad because the writer assumes the reader knows as much as the writer does, or has though as long and hard about something as the writer has
  + Your readers know a lot less about your subject matter than you think they do
* Avoid abbreviations.
  + In general, if you’re defining the abbreviation in what work, you probably don’t need it
  + remember that people can only hold three-four ideas in their head at once
* Throw in a few extra words to explain technical terms
* Use ‘for example’ ‘such as’ and ‘as in’ when explaining something.
  + Giving a definition is not enough usually.
* Let the reader know your subject early.
  + Otherwise, there is no framework for assimilating the information the writer is providing.
  + Studies have shown this repeatedly.
* Don’t use different names to refer to the same subject.
  + You can use ‘great blue herron’, ‘heron’, and ‘bird’ to refer to the same thing, but don’t start using weird subjects just to avoid the monotony, like ‘flying animal’ or some shit like that

Andrew Hendry’s Advice (from <http://redpath-staff.mcgill.ca/hendry/writingtips.pdf>)

see (“writingtips.pdf” in you Grad School folder in your dropbox if link is broken)

**Writing Grants, with a focus on the DDIG**

The first paragraph should be its own little abstract. The writer should say, ‘Here’s this problem, this is why it’s important and important, this is how I’m going to go about answering it’ within three or four sentences.

Some notes on a meeting with Molly about writing DDIGs:

* DDIG research should be distinct from the rest of your PhD research. It should sold as, “Here’s my dissertation work, and if I got a DDIG, I’d have the resources to go the extra mile and do this really cool extension of my dissertation work that I wouldn't be able to do otherwise.”
* Broader impacts:
  + make it personal
  + should not be based on the P.I.’s broader impacts
  + tell the reader what you *will* do in the future, not just what you've done
  + be specific
* If your research topic is tricky, go slow, use pictures, and convince the readers that you really can answer your question.
* Be honest about what your data can and can’t tell you
* Use graphics to explain your hypotheses, timeline, and experimental procedures—make it easy for a reader to digest
* Set up your hypotheses clearly
* Also mention control groups
* Synthesize your PhD work with the proposed DDIG work — ‘my dissertation work inspired me to do this DDIG research’

Something to think about:

“In considering the appropriateness of any proposed experimental design, it is always needful to forecast all possible results of the experiment, and to have decided without ambiguity what interpretation shall be placed upon each one of them.” - R. A. Fisher, *The Design of Experiments*

**Politics and the English Language, George Orwell**

* There is a link between the way we think and the way we write. If we write poorly, it is probably being we are not thinking clearly. The use of mixed metaphors exemplifies this.
* One of Orwell’s main points is that writing should be *concrete*. He argues that words like *democracy* and *facism* (among others) are examples of words that have been stretched and bent so much that their meaning is ambiguous. What does it mean to be a defender of democracy if it’s unclear what democracy means?
* A second point that Orwell harps on, and one repeated by Pinker, is the use of vivid imagery to orient the reader to something concrete in the world.
* Avoid verb phrases (e.g. take effect, make itself felt, make contact with, be subjected to, give rise to) in favor of verbs.
* Ask yourself these questions of every sentence you write:
  1. What am I trying to say?
  2. What words will express it?
  3. What image or idiom will make it clearer?
  4. Is this image fresh enough to have an effect?
  5. Could I have put it more shortly?
  6. Have I said anything that is avidly ugly?
* Other tips:
  + Never use a metaphor, simile, or figure of speech that you’ve been in print
  + Never use a long word where a short word will do.
  + If you can cut out a word, do it.
  + Prefer the active to the passive voice.
  + Use simple words.

**Style: towards clarity and grace. Joseph Williams**

Writing sentences

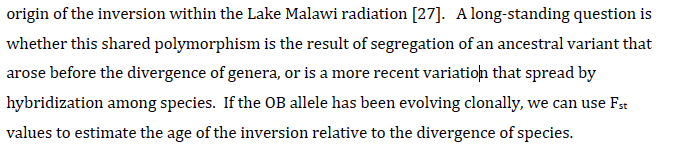
(1) The subjects of sentences should be the cast of characters, and (2) verbs (not nouns) that go along with those subjects name the actions. Don’t use a verb to simply state that an action exists—tell the reader what the subject is doing. p. 21

Using these two simple rules, in general, results in sentences that have better flow, are shorter, more concrete, etc.

**Some critiques of sentences:**

“Adjusted R-squared were, however, found maximal with hair methylation levels (adjusted R-squared - 0.620-0.785 depending on the coverage threshold considered). — Pedersen et al. 2014 Genome Research

“Understanding the genetic basis of speciation is a major goal of evolutionary biology. However, identifying the loci responsible for reproductive isolation using linkage mapping is a challenging task, and only a handful of genes have been directly implicated in either prezygotic isolation…” —doi: 10.1111/mec.12796

This is first sentence of a paper. It starts with a really boring, vanilla sentence that adds nothing to the paper. The second sentence goes right into linkage mapping…what the fuck? What is the connection between speciation and linkage mapping? They also start talking about reproductive isolation without reminding the reader that reproductive isolation is the basis of speciation.

The sentence that starts with “A long-standing question…” sets up two alternative hypotheses. The next sentence should really tell us how we can differentiate between these two alternatives. The potential to use parallel structure between the two sentences is also great. Unfortunately, the authors totally blow it. The second sentence requires further abstraction by the reader (“if OB is evolving clonally…that means…what?”), and doesn’t say *how* we can use FST to differentiate between the two hypotheses, just that we *can* use it.

“In a recently reported study, face and non-face distractor images were briefly flashed in the periphery while monkeys made eye movements to targets in order to receive fluid reward.”

Was it a recent study, or was the study simply reported (e.g. by the news) recently? The authors attempt to summarize an experimental design in one sentence, but leave a lot unanswered: they made eye movements to targets? what is a target? And worst of all: what the hell is a fluid reward? Why not just say juice?

“Both species were observed in a discrimination between two black geometric figures in a white background (filled triangle vs. empty circle).”

Observed in a discrimination? Why would you say something abstract (two black geometric figures in a white background—also, doesn’t you mean *on* a white background?) and then follow it by something concrete that actually makes sense?