A reminder:

DynoSoB - Group seminar
November 2020
How to write papers?

Two problems when preparing this talk:

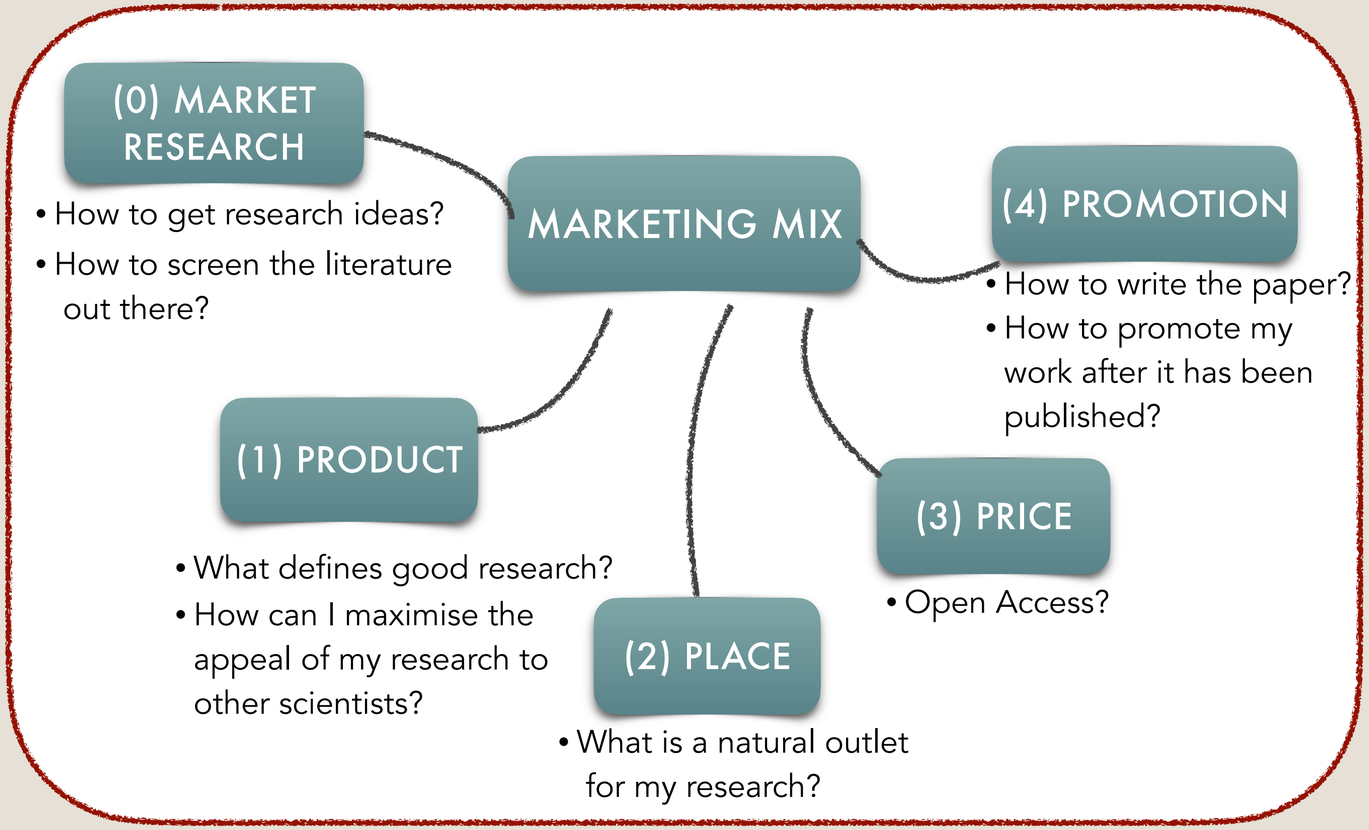
1. Writing a paper is not a mathematical theory. There is not a simple recipe how to do it (at least not one that works for everyone). Also, I wasn't formally trained in it.

2. It's not even clear what the topic should be:
   a. How does good text look like?
   b. What's the optimal process of writing?
   c. What's the optimal technique for designing research?

Two obvious disclaimers:

(1) To some extent the answer is subjective

(2) What do I know?



DynoSoB - Group seminar

Scientific Writing

Let’s have a discussion:

Question 1:

How does good text look like?

Answers:

(-) Not very long sentences
(-) consistent (words should keep their meaning, make clear if you use synonyms)
(-) good balance between abstract concept and example
(-) No typos, no grammar mistakes
(-) Reader should always know where they are and how things fit together
(-) Don’t jump across ideas
(-) Healthy amount of repetition

Let’s have a discussion:

Question 2:

Why is it hard to write good text?

Answers:
(-) We don’t plan before writing
(-) Hard to put yourself into reader’s shoe (curse of knowledge)
(-) Hard to write down abstract concept that is clear to self in simple sentences
(-) English is often not our native language

DynoSoB - Group seminar
Scientific Writing

My own take:

(Taken from the 2021 group retreat)

Key characteristics of a well-written article:

(Apart from the science that actually is to be reported)

1. **Clarity** … A reader finds it easy to grasp the meaning of a given text
   a. The sentences are easy to read (Topics: avoid complex nouns; optimal length of a sentence; passive voice)
   b. There are no ambiguities (Topics: "This"/"They")

   "Easy"

2. **Flow** … One thing naturally leads to the next (Structure)
   a. Micro-level: Within each paragraph, one sentence naturally leads to the next.
   b. Macro-level: Within the article, one paragraph naturally leads to the next ("Storytelling").

   Easy

   Hard

   (Results often don't have a linear structure)

3. **Engagement** … Keep the reader intellectually stimulated
   a. Stimulating science (before writing the article, make sure you have things to say)
   b. Connect your results to things the reader cares about (applications, previous work)
   c. Make sense of complicated relationships or equations
   d. For the main text, find right balance for how much (mathematical) detail you present (Topic: Writing from 'Most general to Special Case', or other way round)

   Requires Experience and/or Effort

Let’s have a discussion:

Question 3:

How important is good text, after all?

Answers:
(-) It’s somewhat sad if an actually good paper is not well written
(-) A waste if good results are packed into a badly written paper
(-) Journals should help authors more

Let’s look at examples:

Example 1:

Ohtsuki, Iwasa, Nowak (2009)

Human societies are organized around cooperative interactions. But why would natural selection equip selfish individuals with altruistic tendencies? This question has fascinated evolutionary biologists for decades. One answer is given in terms of direct reciprocity. There are repeated encounters between the same two individuals: I help you, and you help me. More recently, indirect reciprocity has emerged as a more general model: I help you, and somebody helps me. Indirect reciprocity is based on reputation. People monitor the social interactions within their group. Helping others establishes the reputation of being a helpful individual. Natural selection can favour strategies that help those who have helped others. The consequences for widespread cooperation are enormous. Direct reciprocity is like an economy based on the exchange of goods, whereas indirect reciprocity resembles the invention of money. The money that feeds the engines of indirect reciprocity is reputation. For direct reciprocity, my strategy depends on what you have done to me; for indirect reciprocity, my strategy also depends on what you have done to others. Direct and indirect reciprocity are mechanisms for the evolution of cooperation.

Let's look at examples:

Example 2:

Glynatsi (Blogpost)

It has been almost one and a half years since I started working on the prisoner's dilemma (this is not a complaint) and I still get amazed by the amount of information, insights and fun facts that I stumble upon;

- The origin of the game goes all the way back to 1950;
- Albert W. Tucker the man behind the `prisoner's' story was the doctoral advisor of the famous John Nash
- The prisoner's dilemma is not being used to model only human interactions but animals as well, such as vampire bats and sticklebacks.

When I started working on the game it was already decided that I was going to follow the work of the political scientist R. Axelrod. Axelrod, as far as I know, is the first person to run a computer tournament where machines were competing against each other in a prisoner's dilemma tournament. Axelrod's work has received more than 30,000 citations to date and many are familiar with his work and results. You might already know that, but during the tournaments that Axelord performed, the strategy that kept attracting attention was a strategy called Tit For Tat.

Tit for Tat is a much discussed strategy, submitted by Prof Anatol Rapoport in the first tournament. Tit for Tat is an example of reciprocal altruism; the strategy will always cooperate on the first round and then it will mimic the opponent's previous move. The success of Tit For Tat was soon known worldwide and several researchers focused their work on the strategy ever since. But success often comes with criticism. Axelrod's tournaments assumed that each player had perfect information of the opponent's actions. In a real life situation this is not always the case. Interactions often suffer from a measure of uncertainty. This measure of uncertainty is called noise. A probability that a strategy's action will flip.

Let’s look at examples:

Example 3:

Hauser et al (2019)

Here we introduce a general framework to study direct reciprocity among unequals. Our three complementary approaches—equilibrium calculations, evolutionary simulations and a behavioural experiment—suggest an unexpected benefit of inequality. We show that equal endowments can be detrimental to social welfare if subjects differ along multiple other dimensions, such as productivity or benefits from public goods. In those cases, some inequality can increase both the stability of cooperation and the efficiency of contributions.

Despite these potential benefits, inequality comes with caveats. First, maximizing cooperation requires a delicate balance between the different dimensions of heterogeneity. Finding the right amount of inequality can prove difficult when the players’ personal characteristics, such as their productivities, are known only imperfectly. The problem is aggravated by our finding that an excess of inequality is always detrimental.

Let's look at examples:

Example 4:

Pal (2020)

Agricultural intensification faces an uncertain future. From 1961 to 2013, production gains were mostly due to the steady growth in land productivity. Some studies suggest that certain major crops are approaching their yield ceilings in rich countries. There has been a deceleration in yield growth across the globe, primarily due to decreasing investment in agricultural research and reduced food production prices in both higher and lower-income countries. Slowing intensification may trigger agricultural land expansion if demand for food rises on account of growing populations and per capita income and if food production prices remain unchanged.

Mathematical models of sustainable food systems are becoming an increasing topic of research. Research on sustainable pathways for agricultural technologies tends to focus on the supply side of the problem. On the demand side, models often stipulate future demand trajectories that are independent of how the model variables evolve. For instance, sophisticated land system ensemble models used to project land use in Intergovernmental Panel on Climate Change (IPCC) reports use scenarios for homogenized dietary consumption patterns as inputs and, as such do not study the dynamics of system-induced drivers of human consumption behaviors. The importance of incentivizing sustainable, eco-conscious consumption has been noted. Dietary patterns can heavily influence trajectories of global land use and individuals include environmental factors while making dietary decisions, and therefore land-use dynamics and socially influenced dietary choices are coupled to one another through two-way feedback. However, there has been limited investigation into understanding how these shifts in dietary patterns evolve within populations due to social and economic factors, and in particular how they respond to changing land use.

The 7 commandments:

(Something I came up with when reading manuscript drafts from a very smart PhD student)

Rule 1

Write sentences that hit the right balance between being simple and engaging.

In the Intro and the Discussion, find a good mixture between short and long sentences. Remember there's no such thing as a sentence being too short. In particular, it can be nice to have a 5-word sentence once in a while.

Corollary 1.1: If the model or results section contains a sentence that needs two lines or more, consider revising.

Corollary 1.2: If the abstract, intro, or discussion contains two consecutive sentences with each having two lines or more, consider revising at least one of them.

Another rule of thumb is: The more important a statement, the clearer the respective sentence should be.

Corollary 1.3: The first and the last sentence of a paragraph should be as simple as possible (of course, they still need to serve their function. The first sentence needs to foreshadow what this paragraph will be about. The last sentence needs to summarize the conclusions to be drawn).

The 7 commandments:

Rule 2
Experts must find the abstract, the intro, and the discussion an easy read.

In the abstract, intro, and discussion, only use content that is easy to grasp (in the sense of: even if the reader is very tired or in the middle of a loud bus, he/she should have no problems following your argument).

Corollary 2.1: If an argument for some observation is necessarily technical, don't spell out the whole argument in the intro or the discussion. Just spell out the main idea and tell the reader that they can find the entire argument somewhere else.

The 7 commandments:

Rule 3
Break your work into simple steps and tell a story.

Try not to overwhelm your reader by mentioning too many things at once. Rather bring a temporal structure into your story. For example, avoid:

“To explore how X depends on the parameters, we have simultaneously varied Y from y1 to y2 and Z from z1 to z2.”

Rather say:

“To explore how X depends on parameters, we first studied the impact of Y. There we find [whatever].
However, these previous results assume that Z is fixed. To explore how changes in Z might modify these results we have run further simulations. The results are similar, but now...”

The 7 commandments:

Rule 4
Write your main text around your figures. Create your figures such that your main text can be written around them.

The logical flow of your main text should match the logical flow of each figure. Conversely, each figure should be necessary to illuminate or illustrate the text that you wrote.

Corollary 4.1. If the main text does not refer to a figure or a figure panel, either your main text is wrong or the design of your figure.

Corollary 4.2. If the main text mentions individual panels not in the same order as in the figure, either your main text is wrong or the design of the figure.

Corollary 4.3. If a figure contains several logically independent panels, write the main text such that you refer to the individual panels, instead of referring once to the entire figure.

The 7 commandments:

Rule 5

Polish your text time and time again. Especially the abstract, the intro, and the discussion.

Good text should be engaging and thought-provoking, but most importantly it should be clear. Suggested work-flow: After having written your thing, put it aside. Then read it again, the next morning. Whenever you realize that it took you some time to grasp the meaning of a sentence while reading it, rewrite the sentence (even if the initial confusion only lasted for a fraction of a second).

Corollary 5.1. If you realize that a sentence can be understood in several ways, rewrite it.

Corollary 5.2. If you realize there is some redundancy with previous text, or a missed opportunity to refer to previous text, rewrite.

Quite often, the first take at some manuscript yields a rather long text that can be substantially condensed with careful revisions.

The 7 commandments:

Rule 6
Give an adequate amount of information on related previous work.

A paper should stand on its own; a reader should not be required to know some previous work of yours or of someone else. As a consequence, you need to describe previous work and how it is relevant. At the same time, don't talk about irrelevant details.

Corollary 6.1. If some previous study is not crucial for your work, it is ok to mention it in passing, using only one sentence or less. But even in that case it needs to be clear why this previous work has been cited.

Corollary 6.2. If some previous work is crucial, it needs to be summarized in more detail, in more than one sentence. For this, the following general structure is often useful. (1) What was the main motivation of that previous study? (2) What were the specific assumptions made, or what was the experimental design? (3) Which results were shown? (4) How is the present work different from this previous study? **[Don't use judgmental language (unless you say something positive)]**

The 7 commandments:

Rule 7
Disentangle the task of finding an optimal structure from the task of finding optimal sentences.

First determine the optimal structure, then fill in the sentences.

Where to find more (and perhaps more professional) advice:

- Books
- Journal articles (PLoS Computational Biology: Ten simple rules for writing research papers)
- Twitter
- Etc.