How to Write a Good Scientific Paper?

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Common Steps of Scientific Research Methods

1. Defining a Question (a phenomenon)
2. Literature Review
3. Formulating a Hypothesis
4. Testing the Hypothesis
5. Interpreting the Results
6. Communicating the Results
Presenting Your Research

Rule #1: Know what you’re talking about!

– Should be able to explain the gist of your research to a first year university student.

– Know the answers to: What? Why? How? So What?

– Believe in yourself!
Writing a Research Paper

- Remember the logical path; start the skeleton of the paper by answering the questions: *What? Why? How? So What?*

In typical sections of *Introduction, Method, Results, Discussion/Conclusion, Acknowledgment*
Writing a Research Paper

- **Introduction** (answering what? Why?)
  - background, motivation, research question, hypothesis

- **Method** (answering How?)
  - Research design, experiments, detailed info, methodological procedures

- **Results**
  - Connect to your research question(s), present the results with the same order of experiments in the Method’s section

- **Discussion and Conclusion** (answering so what?)
  - Make a connection to what ever you introduced in introduction, answer the research questions, discuss whether or not it was expected compared to previous research, limitation of the study
Introduction (answering what? Why?)

- Remember for whom you’re writing; not every reader is familiar with the exact research you’re doing.
- What is the specific problem or your research question?
- Why it is important to study this problem?
- What is the short-coming of all previous researches?
- What are you proposing to do (objectives)? Does it answer your research question? Don’t leave it to reader to figure out what your intended work is!
- What is new in your work? (have you done a thorough literature review?)
- Be positive and enthusiastic in your tone. Negative or defensive writing affects your mood and also the readers’ mood!
- Avoid jargon, redundancy, and lengthy general sentences.
- For every sentence that you write, ask what information that sentence is giving; if none, then delete it.
Writing a Research Paper

Method (answering How?)

- Give a fine experimental detail; enough detail such that somebody else with your background can repeat the work.
- Anything novel in your research design? Explain it clearly.
- Human or animals studies? Write about the Ethics approval.
- Using data of someone else? Give proper references and explain what the data is briefly.
- Is the research paper on introducing a new method? Then divide your method section into two sections of a) describing the developed algorithm/technique, and then b) validation or evaluation methods.
- Is the research work an observational/experimental research? Need statistical analysis, justification of population size and other parameters, etc.
- Some Common subsections: a) Data, b) Design, C) Validation
Results

– Present the results in the same order as described in Method section.
– Describe the results with the help of graphs, figures, tables.
– The caption of each table/figure must be in a way to understand the content independent of the text.
– Make it easy for the reader to find the results to the key questions by using proper sub-headings.
– Be honest!
Writing a Research Paper

- **Discussion/Conclusion** (answering so what?)
  - Relate the results to the research question posed in introduction; what can be read from your results? How do you interpret them?
  - Discuss the results in relation to the literature review mentioned in introduction; are your results congruent with previous findings? Are they leading to any new understanding?
  - Describe the impact and added value of your research.
  - Be honest; don’t read too much from your results!
  - Discuss the limitations of your study; how it can be improved.
Writing a Research Paper

Acknowledgment

Not part of the scientific sections but do acknowledge the financial support of the study and also people who have had a role in the study but are not a co-author.

Disclose any financial benefit/interest related to the study.
How to Write a Scientific Paper?

- In science, you are what you write.
- Style, Structure, Spirit
- Good writing cannot overcome bad science.
- Good science demands strong writing
10 Golden Rules for Effective Research Paper Writing

1. Follow the research methods in writing as well: **provide background info, propose research question(s), motivation** for your research, **the proposed method, results, validation, discussion** on how valid and congruent your results are with previous findings, and **conclusion**.

2. Be honest about your research; not too humble and not too arrogant!

3. Use definite, specific, concrete language

4. Use parallel construction for coordinate ideas

5. Emphasis position of a sentence is the end

6. Avoid sentences in loose succession; instead use expectation AB, BC, CD.....

7. Do not write long paragraphs; let the reader take a breath!

8. Make the connection between paragraphs like AB, BC, CD

9. In proposals, write as if reader is tired and may stop

10. Find a style that you like. Analyze it. Emulate it.
3. Use definite, specific, concrete language

Our model for the generation of swallowing sounds is composed of the series combination of two parts. The first part is an impulse train which plays the excitation role. The impulse train results from the superposition of the activities and movements of different muscles and bones ..... The second part of the model is a time-varying system which simulates the transfer function of the pharyngeal wall and tissue and skin beneath the microphone (Fig. 2).

Our proposed model for swallowing sounds generation is composed of a cascade of two systems. The first system represents the activities and movements of different muscles and bones ..... This system results in an impulse train, and excites the second system, which is a time-varying system simulating the transfer function of the pharyngeal wall’s structure, tissue and skin beneath the microphone (Fig. 2).
4. Use parallel construction for coordinate ideas

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There are two types of sleep apnea: Central and Obstructive sleep apnea. The most common type is obstructive sleep apnea, in which respiratory effort exists but there is no resulting respiratory airflow. The central sleep apnea is much less prevalent and is a dysfunction of central drive mechanisms, usually in the thalamus area of the brain. The central sleep apnea is distinguishable from obstructive sleep apnea by the fact that respiratory effort without airflow exists in the later one but not in the former one.

There are two types of sleep apnea: Central and Obstructive. Most common is obstructive sleep apnea, in which respiratory effort exists but there is no resulting respiratory airflow, and less common is central sleep apnea, in which respiratory effort does not exist due to dysfunction of central drive mechanisms, usually in the thalamus area of the brain.
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Since that time, humanity has advanced in many ways, but it has hardly advanced in fortitude.
There is a very long waiting list for patients (~3300 currently in Manitoba) to go through a full sleep study in Manitoba (current waiting time is 3.4 to 8.3 years) and elsewhere.

To obtain a full sleep study in Manitoba there is currently a long waiting list (3300 patients) and long waiting times (3.4 to 8.3 years).
Swallowing is among the most complicated acts of the human body. Even a slight delay or mismatch in the sequence of swallowing events allows food aspiration into the lung, and causes appreciable morbidity and mortality. Especially in the elderly and in patients with disabilities, stroke, head-neck or spinal cord injuries, swallowing disorders are quite common.

Swallowing mechanism is one of the most complicated mechanisms of the human body, in which a few different events occur within a few milliseconds. The timing and coordination of these swallowing events within a breath cycle is very crucial, as a slight delay or mismatch in the sequence of the events may cause aspiration (food entry into airway). Swallowing disorders in people with disabilities and patients with stroke, head-neck injuries or spinal cord injuries are quite common.
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To assess swallowing disorders, patients are generally observed with a special X-ray (videofluoroscopy) during feeding. Since our recent studies have shown promising diagnostic capabilities of swallowing sound analysis, we propose here to investigate other methods for swallowing assessment using acoustical analysis.
The “gold standard test” for swallowing assessment is the videofluorosopic swallow (VFS), which detects and localizes morphologic abnormalities and demonstrates the functional impairments that may result in aspiration. However, VFS has its own limitations, which are mainly related to radiation exposure that limits the number of swallows to be observed. In recent years cervical auscultation has been used by clinicians and researchers who investigate acoustical patterns and temporal relations, which exceeds auditory perception at both subjective levels via the stethoscope and objective levels via surface microphones or accelerometers with subsequent digital signal processing and pattern recognition techniques.

To better understand and diagnose dysphagia, in recent years cervical auscultation has been used by clinicians and researchers who investigate acoustical patterns and temporal relations. Such acoustical analysis exceeds auditory perception at both subjective levels via the stethoscope and objective levels via surface microphones or accelerometers with subsequent digital signal processing and pattern recognition techniques.
On the other hand, in a latter study it was found the learning force field learned by one arm generalizes to the other arm only from dominant to non-dominant arm and only in extrinsic coordinate system. **The generalization capability has not been studied in patients’ population with motor disorders.**

Each of the studies mentioned above employed perturbations with fixed and repeatable structures. However, the perturbations that people encounter in every day life do not always have a repeatable and consistent structure. For example, consider a worker whose job might be sorting packages of varying size and weight into bins, bags or slots.....
In general two processes contribute in any arm movement: Feedforward and feedback controls. Feedforward control is the generation of motor commands based a priori on the desired action and an internal model stored in the brain [1,2], whereas feedback control modifies these commands if necessary based on the errors detected during their execution.

To study these processes in HD, the research group at JHU [Smith et al., 2000] used the same 2-DOF manipulandum shown in Fig. 1, and studied the trajectories and velocity of the movements in 8 directions over 200 trials from several subjects with HD and also subjects with asymptomatic gene-carriers (AGCs). The results showed much more jerky movements for HD subjects compared to control group. However, all HD subjects reduced their movement jerk with practice, although not nearly to control levels. Further investigation of the initial and final stages of the movements showed that all HD patients had above-normal post-peak jerk. The amount of post-peak jerk correlated (r = -0.62) with estimated time to disease onset for AGCs. It was above normal in 4 of 5 close to onset (<7 years) subjects and in 3 out of 9 far-from-onset subjects (>7 years).

Moreover, AGCs, who were close to predicted disease onset, had significantly higher jerk in the third set than far-from-onset subjects, who in turn had significantly higher jerk than controls.

AGC patients had significantly higher jerk than controls. Moreover, AGCs, who were close to predicted disease onset, had significantly higher jerk in the third set than far-from-onset subjects.
9. In proposals, write as if reader is tired and may stop

**Specific aims**
whole grant on one page
The question
The rationale
The approach

**Hypothesis**
Start with the expected answer
Clear, mechanistic testable
Wonderful, not ordinary

**Background**
Not a review!
Define the playing field
Narrow the scope
Define the gap

**Preliminary Data**
Start where background leaves off
Experiments doable
By you
Hypothesis tenable

**Methods & Exp. Design**
Follow the data thread:
How acquired
How analyzed
How adduced to hypothesis
Anticipated results
Pitfalls
Alt. hyp

Clear writing reflects clear thinking. Don’t leave it to reviewer to sort things out. Reviewer will fight for only 1 grant in 10. Tell him/her why it should be yours. Biggest risk is playing it safe.
Kiss of death: descriptive, incremental, overambitious
Clear-eyed enthusiasm inappropriate in manuscript but desirable in grant
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The slides 11, 12 and 23 are from Dr. Jeff Fredberg’s slides, who has taught me how to write efficiently. Most of the examples, are from my grant proposals or papers as it went through revisions with his help.

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