Writing Research Articles

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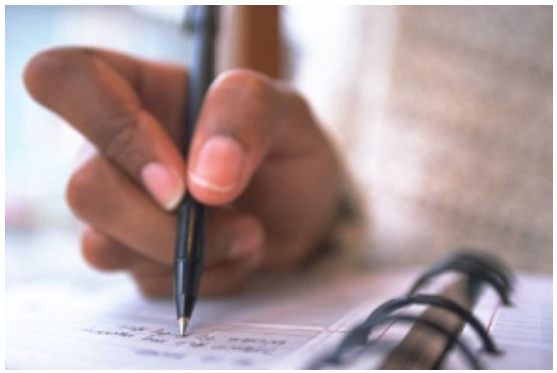
Overview

- Why do we bother to write?
- Composition of a research article
- The process of writing
- Concluding remarks



Why do we need to write?

"If I have seen further, it is by standing on the shoulders of Giants." (Newton)

- To complete the cycle of investigation
- To contribute to the growing body of knowledge about the world.
- To receiving constructive criticism of your work.
- To communicate to the public what scientists do

Why do we need to write? Career Prospect

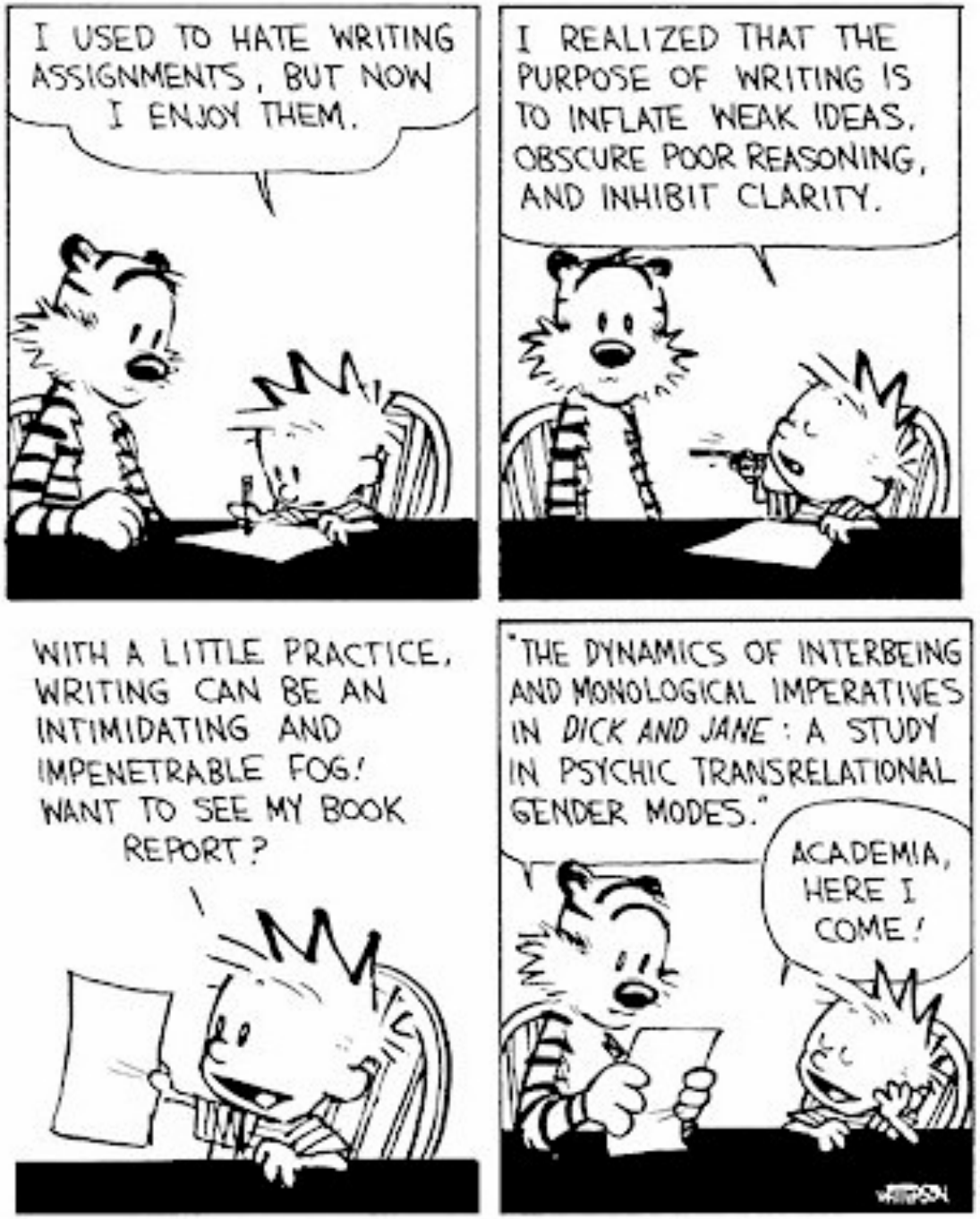
- To gain recognition for your work: Having your work published can prove to future employers and supervisors that you are dedicated and competent.
- It helps secure funding for future projects
- It is an integral part of career advancement!

Why do we need to write well?

- Having a good idea is not enough: ***"If a tree falls in a forest and no one is around to hear it, does it make a sound?"***
- Many papers are badly written
- Good writing is a skill that you can and should learn
- It is a skill that is worth learning:
  - You will get more credit (in the long run, more funding and more papers accepted)
  - You will have better ideas
  - Your ideas will have more impact

"Journal of Obscure Research"

Some papers just belong in the "Journal of Obscure research"
(actually, there is a journal called "Journal of Irreproducible Results"
http://www.jir.com/ ☺)



Papers communicate ideas

- Your goal is to infect the mind of your reader with your idea, like a virus
- Papers are very durable
- The greatest ideas are (literally) worthless if you keep them to yourself

What makes a good research paper?

- Know your audience.
- Like any good writing, a research paper has to tell a story.
- Start with the general and/or the familiar, and work your way to the specifics.
- Make sure your paragraphs are well organized. Have a topic sentence and supporting materials.
- Watch your transitions between paragraphs and sections. Are you telling a cohesive story?

Narrative flow of a good research paper

- Here is a problem
- It's an interesting problem
- It's an unsolved problem
- Here is my idea
- Here is now I implemented / evaluated it (details)
- My idea works (data)
- Here's how my idea compares to other people's approaches

or

I wish I knew how to solve that!

I see how that works. Ingenious!

Structure of a paper

- Title (1000 readers)
- Abstract (4 sentences, 100 readers)
- Introduction (1 page, 100 readers)
- The problem (1 page, 10 readers)
- My idea (2 pages, 10 readers)
- The details (5 pages, 3 readers)
- Related work (1-2 pages, 10 readers)
- Conclusions and further work (0.5 pages, 30 readers)

Title page

1. Title
2. Authors (the order is important)
3. Affiliations and addresses
4. Keywords
5. Abstract

Abstract

- The abstract is a brief, standalone summary of your research (often used by conference PC to assign reviewers, by a reader to decide whether to read it, etc.).
- Some people write it at the very end.
- Ideally four sentences, in any case, not more than 2,000 characters!
- Typically includes the following (each 1-2 lines of text):
  - [Why] Introduction: Background and Significance (What is the problem and why it is interesting?)
  - [What] Your idea / approach
  - [How] Methods and Materials: How did you do it and what your solution achieves?
  - Results: What have you been able to demonstrate? If possible, quantify your claims.
  - Discussion and Conclusions: Why did your approach work so well?
- No abbreviations or acronyms, except for really obvious ones (FIFO, USB, GUI, etc.)
- No citations

Introduction

- Describe the problem and your contributions.
- Provide a rationale for the study.
- State the nature and scope of the problem
- Include background/history and references important to understanding the study
- Make the reader crave to read more.
- Typically one page

There is generally no “correct” or “best” approach!

Try to develop your own style.

Introduction: The need for a good story

- Start with an exposition of the problem.
- List approaches to solving the problem (this is really a very brief review of the relevant literature).
- Give it a generous credit! You are "standing on the shoulders of giants," this work would not be possible without them.
- Point out that they *did not* look at the aspect that you are looking at, they *did not* manage to solve the problem to the end, or the existing solutions have other problems
- Make it obvious that what you are doing is the next logical thing to do.

The body of the paper

- Consider using a “recursive” structure:
  - The first paragraph of every section should set the spirit of the section (by positioning, summarizing or reviewing what will follow)
  - The first sentence of every paragraph should set the spirit of the paragraph (by saying the most important thing)

Conveying the idea is important!

- Explain it as if you were speaking to someone using a whiteboard
- Better yet: write as if you were writing to your grandmother ☺
- "A picture is worth a thousand words" – use graphs and figures whenever possible and appropriate
- Conveying the intuition is your primary and not secondary goal
- Once your reader has the intuition, he/she can follow the details. It is much harder for the reader to develop intuition from the formal details.
- Even if he skips the details, the reader will still take away something valuable

Results

- Results section should describe what you have shown graphically in tables and figures
- Make sure you refer to all tables and figures here
- Results are not conclusions! They are the unbiased outcome of your research that other scientists should be able to use if they want.
- Report all details (the platform, processor, operating system, language, compiler, optimizations, etc.)
- Pay attention to validity of your results.
- Do not claim more than you did!

Discussion / Limitations

- Critical part in case where results are not immediately obvious or expected
- Interpretation of Results
- Comparisons to similar studies
  - Are results consistent with, different from, or an improvement on another study?
  - Address questions or possible discrepancies that others may raise about your research.
- Good place to discuss possibly limits of your study
- If results are inconclusive, discuss that too.

Conclusion / Future Work

- Re-state what you did and list your main results
- Many readers will simply skip to conclusions after reading abstract / introduction!
- Do not claim more than you did!!!
- Do not generalize from one study or result!
- Do not claim that because it worked well on a few test cases that it will work well on all test cases, all platforms and for all inputs!
- Mention avenues for possible future research

Related work

Giving credit to others does not diminish the credit you get from your paper

- Be generous to the competition. "In his inspiring paper [Foo98] Foogle shows.... We develop his foundation in the following ways..."
- Acknowledge weaknesses in your approach

Related work

Failing to give credit to others can kill your paper

If you imply that an idea is yours, and the referee knows it is not, then either

- **You don't know that it's an old idea (bad)**
- **You do know, but are pretending it's yours (very bad)**

Acknowledgments

- Acknowledge all funding sources (this is why they are giving you the money ☺).
- Warmly acknowledge people who have helped you, especially if the help consisted of major intellectual assistance to you.
- Acknowledge reviewers (even if they are anonymous).

Citations

- Cite ideas or information from other sources
- Numbered style
  - In the body of the text [1]
  - With complete citation in the references section

    [1] J. Doe, “The Greatest Paper Ever Written,” *Journal of Great Research,* 5(12):155-167, 2001.
- If possible, use the name/year style,
  - e.g., (Doe 2001)
- Do not just copy citations! Read the original papers!

Bibliography

- **With some exceptions, bibliography (references) is assembled at the end of the paper**
- **Different sources (conferences, books, journals) have different rules**
  - Kleinberg, J. M. (1999) Authoritative sources in a hyperlinked environment. Journal of the ACM 46 (5), 604-632.
  - Kleinberg, J. M.: Authoritative sources in a hyperlinked environment. Journal of the ACM 46, 5 (1999) 604-632
- **EndNote/BibTeX will help you to follow the rules consistently**
- **You have to ensure that all components of a references are collected!**
  - **Author, title, journal (conference), volume, issue, pages, location, publisher, date, URL (if online source)**

Final check

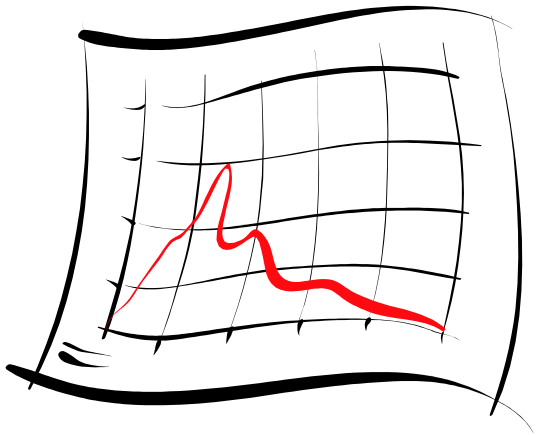
Check your paper for the following:

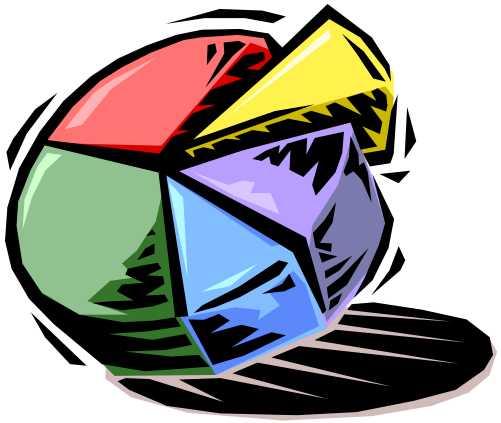
1. Format requirements (format, number of pages, font, spacing, etc.)
2. Do not narrow the margins, reduce line spacing, or use 8pt font,
3. Faulty overall structure
4. Weak introduction
5. Weak conclusion (the paper just stops)
6. Excessive wordiness
7. Grammar
8. Quality of English (have it proofread!)

Lots and lots of rewrites, scrutinize for flow, grammar, usage, and spelling.

Visual structure of your paper

- Give strong visual structure to your paper using
  - sections and sub-sections
  - bullets
  - italics
  - laid-out code
- Find out how to draw pictures, and use them





"A picture is worth a thousand words"

Which of these two are better: A table or a graph?

Test case	ATT	TI	EOP	None
encrypt	11.62	0.96	0.53	0.53
php2cpp	6.66	1.24	0.77	0.77
fft	25.84	3.32	2.37	2.33
graphdraw	54.22	7.55	5.43	5.40
ep matrix	175.56	35.04	29.42	29.29
vkey	133.22	19.01	15.53	15.53

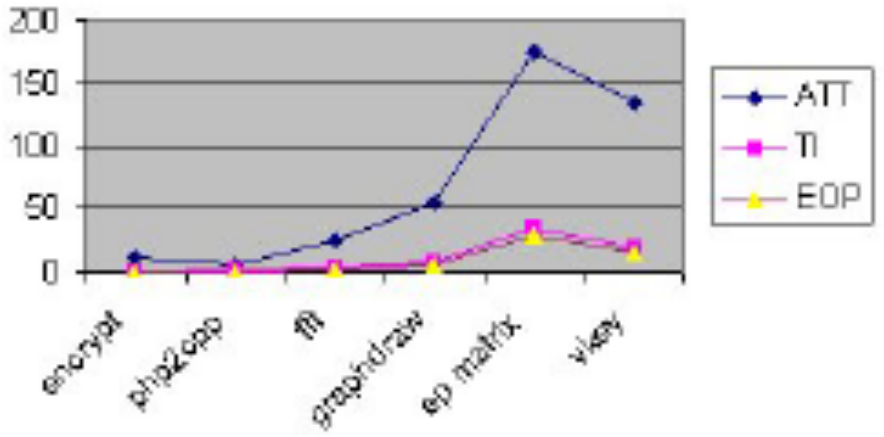


Figure 8. *Efficiency results.*

Do not use passive voice!

The passive voice is "respectable" but it DEADENS your paper. Avoid it at all costs.

NO	YES
It can be seen that...	We can see that...
34 tests were run	We ran 34 tests
These properties were thought desirable	We wanted to retain these properties
It might be thought that this would be a type error	You might think this would be a type error

"We" = you and the reader

"We" = the authors

"You" = the reader

Use simple, direct language

NO	YES
The object under study was displaced horizontally	The ball moved sideways
On an annual basis	Yearly
Endeavour to ascertain	Find out
It could be considered that the speed of storage reclamation left something to be desired	The garbage collector was really slow

The process of writing

- Start AEAP (As Early As Possible ☺).
  - Papers written the night before the deadline get typically rejected.
  - Papers are like wine and cheese: they need time to mature.
- Collaborate – this will increase your productivity.

The process of writing: Getting help

Get your paper read by as many friendly reviewers as possible

- Experts are good.
- Non-experts are also very good.
- Each reader can only read your paper for the first time once, so use them wisely.
- Ask for high-level structural comments (generally, “I got lost here” or “this seems wrong” are more important than corrections of spelling errors).

The process of writing: Getting help

- When you think you are done, send the draft to the competition and ask them for feedback. Something like "could you help me ensure that I describe your work fairly?" will get their attention.
- Often they will respond with helpful critique (they are interested in the area). Of course, they will also make sure that you acknowledge their work fairly (or more than fairly ☺).
- They may end up being reviewers of your paper anyway, so getting their comments or criticism early is a good idea.

Listening to your reviewers

Treat every review like gold dust

Be (truly) grateful for criticism as well as praise

This is really, really, really hard

But it's
really, really, really, really, really, really, really, really, really, really
important

Listening to your reviewers

- Read every criticism as a positive suggestion.
- Even if you disagree with the remarks, view them as a prompt to explain your ideas more clearly.
- Do not even think of responding “You are stupid. How could one understand it this way? I meant X.”. Fix the paper so that X is apparent even to the most cognitively challenged reader.
- Thank the reviewers warmly. They have donated their time to your cause.

Typical “deadly” faults

- Not reviewing prior work
- Not comparing with the “competition”
- Not explaining the scope, novelty, and importance of the work
- Too few technical details – no “meat”
- Too many technical details instead of clear idea
- Carelessness: unfounded assumptions, arbitrary and unmotivated choices
- Too weak or too strong claims (“I propose an algorithm” vs. “I propose an algorithm that solves everything” vs. “I propose an algorithms that improves the state of the art algorithm by 35%”)

Concluding remarks

- Write clearly, use simple language, use the first person ("I" or "we" if multiple authors)
- Label and explain graphs and tables properly – if they were worth to place in the paper, they deserve some guidance in the text.
- Do not mix conclusions with the results.
- Proofread, spell check, and polish your paper.
- Ask your colleagues and mentors to read your paper, consider their advice!
- Choose a strategy that works for you best (top-down, bottom-up, or mixed).