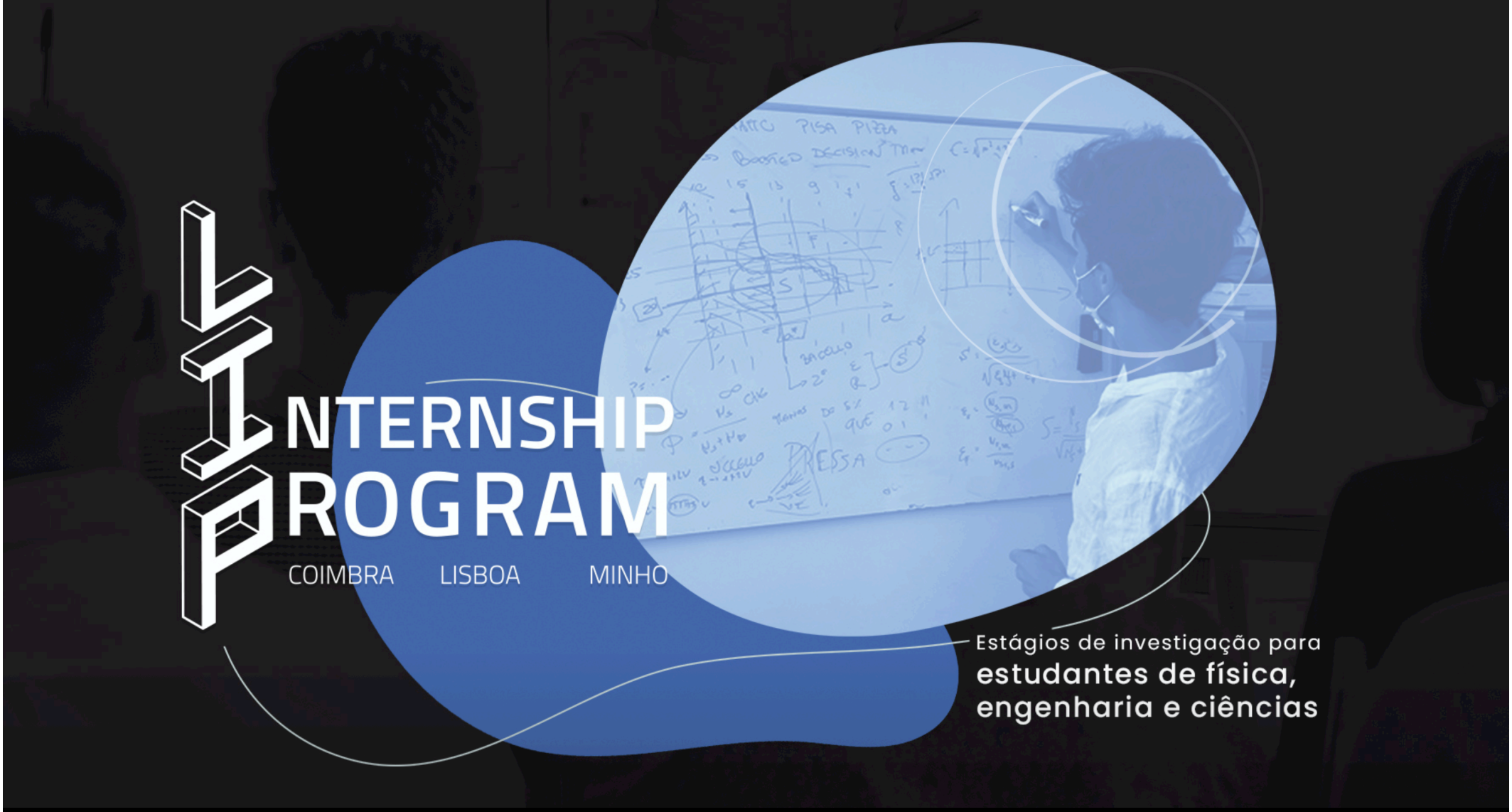


Science communication and writing

Pamela Teubig

Two branches of scientific writing

What we write

How we write

Scientific writing?

"A technical form of writing that **communicates scientific information** to other scientists in a document, book or presentation in written form."

- ☆ Academic Writing
- ☆ Science journalism
- ☆ Writing science books
- ☆ Science blogging
- ☆ Content marketing
- ☆ Science writing for social media
- ☆ Scientific scripting

Purpose of scientific writing

Present knowledge in a specific structure manner

- Show, demonstrate and explain **knowledge**
- Define research **question** with arguments
- Give **strength** to you findings, discuss other literature
- Convince and engage **readers**
- Or …. finish your **studies**

Publishing

Possible journals?

Scientific story board

Starting with a question

- ☆ Title
- ☆ Abstract
- ☆ Keywords
- ☆ Introduction
- ☆ Review of the literature
- ☆ Methodology
- ☆ Results
- ☆ Discussion
- ☆ Conclusion
- ☆ References

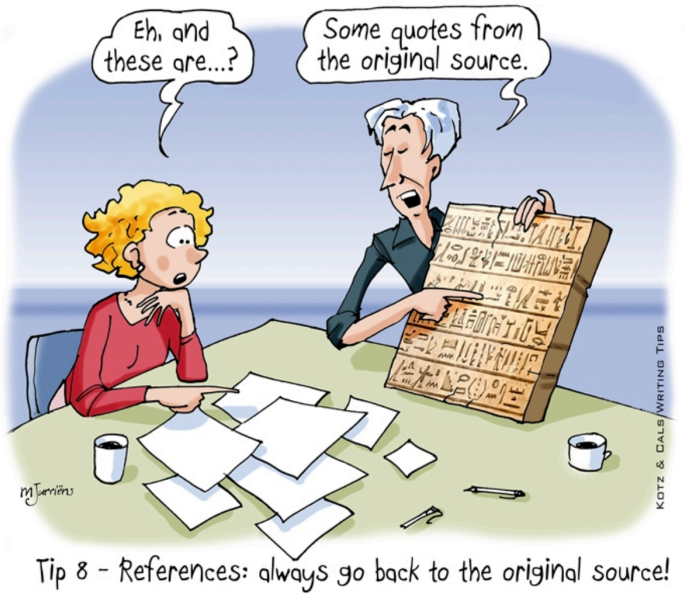
References

The references form the basis of YOUR research

- ☆ Abstract
- ☆ Keywords
- ☆ Introduction
- ☆ Review of the literature
- ☆ Methodology
- ☆ Results
- ☆ Discussion
- ☆ Conclusion
- ☆ **References**

What are **good** references?

How do we **cite** these?



Tip 8 - References: always go back to the original source!

We start by reading other people's work

CRAAP

DO YOU KNOW YOUR

C — Currency

Is the research up to date?

Have there been any new advancements since publication?

How frequently does research change in your field?

R — Relevance

Is the information fact or opinion?

Who is the intended audience?

Does the information add something to your topic?

A — Authority

What are the credentials of the author?

Is the author qualified to write on the topic?

How is this information published? Did it have to go through editing/peer review?

A — Accuracy

Is the information supported by evidence?

Can you verify any of the claims using outside information or personal knowledge?

Are there typographical errors?

P — Purpose

Who funded the study?

Why was this research conducted? To inform? To pursuade? To sell? To entertain?

Is the point of view impartial?

Robert S. Swanson Library & Learning Center
University of Wisconsin-Stout

HOW TO SPOT FAKE NEWS

CONSIDER THE SOURCE

Click away from the story to investigate the site, its mission and its contact info.

CHECK THE DATE

Reposting old news stories doesn't mean they're relevant to current events.

READ BEYOND

Headlines can be outrageous in an effort to get clicks. What's the whole story?

CHECK THE AUTHOR

Do a quick search on the author. Are they credible? Are they real?

CHECK YOUR BIASES

Consider if your own beliefs could affect your judgement.

SUPPORTING SOURCES?

Click on those links. Determine if the info given actually supports the story.

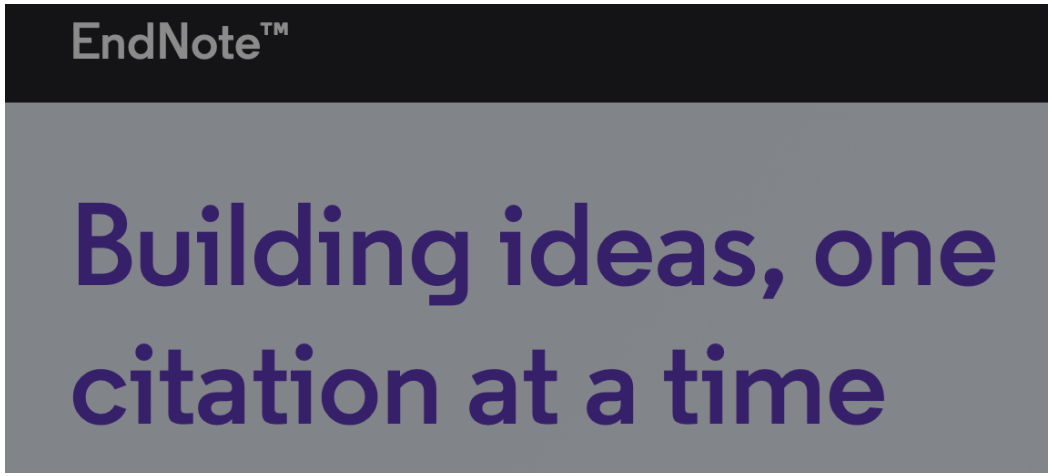
ASK THE EXPERTS

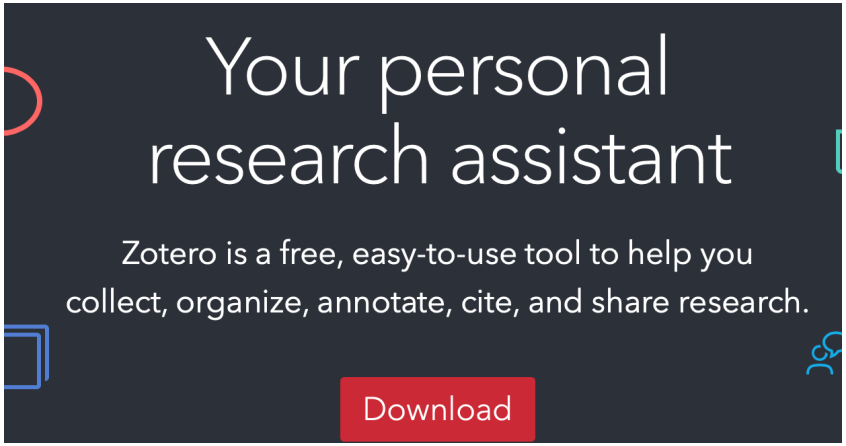
Ask a librarian, or consult a fact-checking site.

IS IT A JOKE?

If it is too outlandish, it might be satire. Research the site and author to be sure.

Install an Reference manager





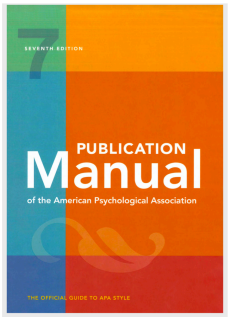
Citing a references

Quoting

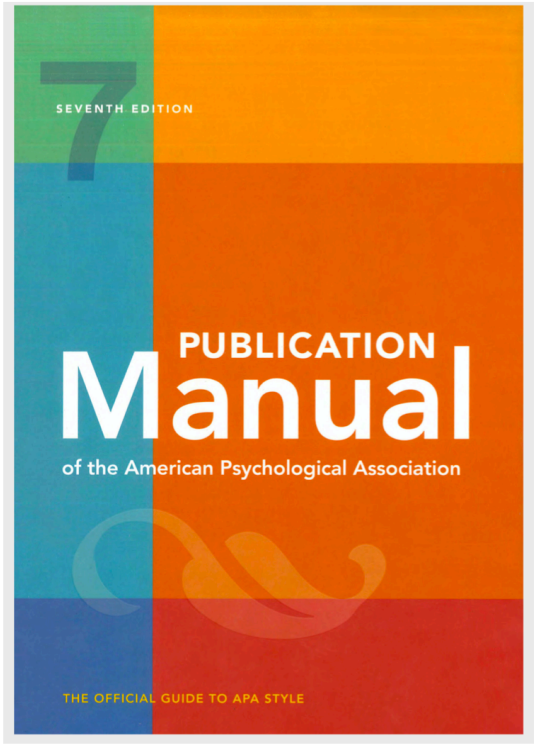
- “direct quote”, (Author, year)
- eg. “The term “impact factor” has gradually evolved to describe both journal and author impact.” Garfield, 2006, 90.
- As explained by Author (year) “…”.

Rewriting a text

- Impact factor nowadays describes both author and journal impact (Garfield, 2006, 90).
- Needs **PRACTISE**!!!



Citing a references



☆ **2 authors**

Author1 and author2 (year, page)

.... (Author1 & Author2, year, page)

☆ **3 or more authors**

Author1 **et al.** (year, page)

.... (Author1 **et al.**, year, page)

☆ **Citation of group of authors**

First quote
(National Institute of Statistics [NIS], 2022)

National Institute of Statistics (NIS, 2022)

Subsequent quote (NIS, 2022)

References

- **Author**: Who is responsible for this work?
- **Date**: When was this work published?
- **Title**: What is this work called?
- **Source**: Where can I retrieve this work?

- eg. American Psychological Association. (2020). *Publication* manual of *the American Psychological*. ISBN 978-1-4338-3215-4.

- DOI

- Webpage (last access date)

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Many different systems

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Scientific story board

… should have a defined structure

- Abstract
- Keywords
- **Introduction**
- Review of the literature
- Methodology
- Results
- Discussion
- Conclusion
- References

Introduce relevant topics,

why is your study novel?

17

Introduction

- Background
- Topic importance
- Existing knowledge
- Knowledge gap
- Rational
- Research question

Introduction

- Background -> New detector
- Topic importance -> Essential in the detection of reaction products
- Existing knowledge -> Other detectors
- Knowledge gap -> Algorithms for detection and id of high energetic gamma.
- Rational -> The use of specific developed algorithms….
- Research question -> Develop a novel algorithms

Scientific story board

… should have a defined structure

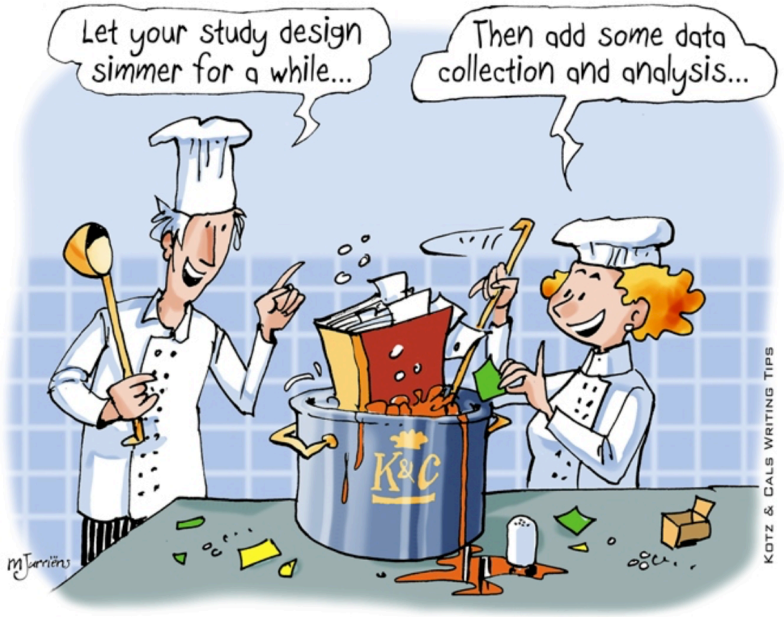
- ☆ Abstract
- ☆ Keywords
- ☆ Introduction
- ☆ **Review of the literature**
- ☆ Methodology
- ☆ Results
- ☆ Discussion
- ☆ Conclusion
- ☆ References

State of the Art

Scientific story board

The cookbook with all its ingredients

- Abstract
- Keywords
- Introduction
- Review of the literature
- **Methodology**
- Results
- Discussion
- Conclusion
- References



Introduces your study system

Explain how other people could replicate your study....

Scientific story board

… digested results provide meaningful information

- ☆ Abstract
- ☆ Keywords
- ☆ Introduction
- ☆ Review of the literature
- ☆ Methodology
- ☆ **Results**
- ☆ Discussion
- ☆ Conclusion
- ☆ References

Objective findings, focus on the result using statistics. Graphs and tables should be self-explanatory.

Scientific story board

… discuss YOUR results truthfully

- ☆ Abstract
- ☆ Keywords
- ☆ Introduction
- ☆ Review of the literature
- ☆ Methodology
- ☆ Results
- ☆ **Discussion**
- ☆ **Conclusion**
- ☆ References

Interpret your results, timing them back to the literature by answering possible knowledge gaps.

Limitations should clearly be stated.

Scientific story board

Sell your work!

- ☆ **Title**
- ☆ **Abstract**
- ☆ **Keywords**
- ☆ Introduction
- ☆ Review of the literature
- ☆ Methodology
- ☆ Results
- ☆ Discussion
- ☆ Conclusion
- ☆ References

Key results & search terms

Introduction

- Set the scene
- Introduction
- Research question
- Results

Contents lists available at ScienceDirect

Nuclear Instruments and Methods in Physics Research A

journal homepage: www.elsevier.com/locate/nima

Performance analysis for the CALIFA Barrel calorimeter of the R^3B experiment

ABSTRACT

The CALIFA calorimeter is an advanced detector for gamma rays and light charged particles, accordingly optimized for the demanding requirements of the physics programme proposed for the R^3B facility at FAIR. The multipurpose character of CALIFA is required to fulfil challenging demands in energy resolution (5–6% at 1 MeV for gamma rays) and efficiency. Charged particles, e.g. protons of energies up to 320 MeV in the Barrel section, should also be identified with an energy resolution better to 1%.

CALIFA is divided into two well-separated sections: a "Forward EndCap" and a cylindrical "Barrel" covering an angular range from 43.2° to 140.3°. The Barrel section, based on long CsI(Tl) pyramidal frustum crystals coupled to large area avalanche photodiodes (LAAPDs), attains the requested high efficiency for calorimetric purposes. The construction of the CALIFA Demonstrator, comprising 20% of the total detector, has already been initiated, and commissioning experiments are expected for 2014.

The assessment of the capabilities and expected performance of the detector elements is a crucial step in their design, along with the prototypes evaluation. For this purpose, the Barrel geometry has been carefully implemented in the simulation package R3BRoot, including easily variable thicknesses of crystal wrapping and carbon fibre supports. A complete characterization of the calorimeter response (including efficiency, resolution, evaluation of energy and reconstruction losses) under different working conditions, with several physics cases selected to probe the detector performance over a wide range of applications, has been undertaken. Prototypes of different sections of the CALIFA Barrel have been modeled and their responses have been evaluated and compared with the experimental results. The present paper summarizes the outcome of the simulation campaign for the entire Barrel section and for the corresponding prototypes tested at different European installations.

http://dx.doi.org/10.1016/j.nima.2014.09.018

Scientific story board

Abstract

- What areas caused you to **stumble**?
- Are there sentences you have to **re-read** to better understand them?
- What causes **confusion**?
- What places did you **loose interest**?
- Sentences that did **not feel right**?
- What are the sentences which are **easy to understand**?
- What sentences **helped** you to make predictions?
- What are the sentences which determine if this work makes it **helpful**?

Scientific story board

Starting with a question

- ☆ Title
- ☆ Abstract
- ☆ Keywords
- ☆ Introduction
- ☆ Review of the literature
- ☆ Methodology
- ☆ Results
- ☆ Discussion
- ☆ Conclusion
- ☆ References

How we write

To hit the target

English

- **Advantage** and **disadvantage** of English:
  - straight forward grammar,
  - irregularities

- **American** vs. **English** spelling (Oxford vs Cambridge)

"On Monday, the students protested against the removal of scientific writing from their curriculum." Nature

"Monday, the students protested the removal of scientific writing from their curriculum." Science

Formal English

- The English used in **scientific paper differs** from the one you will encounter in novels, newspaper, spoken, etc…
- Advise: **read the articles** and absorb the **type of language** they use.
- Also specific areas have their "**own language**" and **keywords**, which you want to use.

Formal Style: Quick tips

Example

Informal	Formal	Informal	Formal
Look into	Investigate	Lack	Deficiency
But	However	Put in	Insert
Whole	Complete	Chance	Opportunity
Anyway	Nevertheless	Use	Utilize
I think	In my opinion	Say no	Reject
Hurt	Damage	Show	Demonstrate
See	Observe	Seem	Determine
Need	Require	Throw away	Discard
Bad	Negative	Luck	Fortunate

Formal Style

- Scientific literature must be written in a **formal style** of writing.
- It is as if you are writing to an **unknown person**. You do not know the target.
  - I performed lab experiments to prove the results. But previous findings don't support our results.
  - Lab experiments were carried out to validate the results, however, are in contrast with previous findings.
  - **Passive voice** makes it easier to write formal English

Transition word

- Do not use to simple language

To make your sentences more complex, flowing and engaging, use transition words like: i**n addition, additionally, moreover, furthermore**, etc.

Times

- **Present tense** provided the **foundation** of scientific writing: suggest, is provided, is caused; eg. Figure 1, Presents the irradiation rate employed in the experiment.
- Be careful with **past tenses**: it denotes something which is **completed**;
  - Statistical analysis was carried out….
  - After 2010, the area had been revolutionised….

Precision

- Objective of scientific writing: **correct**, **factual** and **relevant knowledge**.

eg.

Hereditary breast cancer is caused by gene mutations and is inherited. The same set of genes also causes ovarian cancer. Ovarian cancer causes cancer in the female reproductive area.

Hereditary breast and ovarian cancer are used by gene mutations. BRCA1 and BRCA2 are common breast cancer-causing genes (Ref et al., 2022).

Building sentences

http://www.geo.umass.edu/faculty/wclement/Writing/gopen.pdf

1. Follow a grammatical **subject** as soon as possible with its **verb**.
2. Place in the **stress position** the "new information" you want the reader to emphasise.
3. Place the person or thing whose "story" a sentence is telling at the **beginning** of the sentence, in the topic position.
4. Place appropriate "**old information**" (material already stated in the discourse) in the **topic position for linkage** backward and contextualisation forward.
5. **Articulate** the action of every clause or sentence in its verb.
6. In general, provide **context** for your reader before asking that reader to consider anything new.
7. Ensure that the relative emphases of the substance coincide with the relative expectations for emphasis raised by the structure.

The thing about verbs

- As **precise** as possible!
  - e.g. accumulate, cite, cause, conclude, deduce, detect, explain, …

Write out all verb forms

There are no shorten forms of verbs in a scientific text:

- isn’t, can’t, don’t,
- It’s - has nothing to do with this and is allowed to be used

Punctuation . : ; ! ? “ ,

- The **point**: marks the end of a sentence. Good news - its the **easiest** to use
- The **semi-colon** **divides** two sentences into half, which belong together.
- The **colon** **introduce** a list e.g.
  - The parameters measured were: weight, height, blood sugar levels, ….
  - To divide a title, e.g. Research methodologies: scientific writing
- The **question mark** raises a question. Can be found in the results and the discussion part of a paper.

Punctuation . : ; ! ? “ ,

- The **exclamation mark** is used to show **surprise**. It is almost completely absent in a scientific paper.
- The **quotation mark** is used in a scientific paper to show that they are the words of another author.
- **Brackets** are used to mark a text which is not necessary for the meaning of the text, bit provides additional information.
  - “Anti-viral agents are available to combat several viruses **e. g.** HIV, influenza virus and herpes virus.”
  - “Anti-viral agents are available to combat several viruses (e. g. HIV, influenza virus and herpes virus).”
  - GSI (Gesellschaft fuer Schwerionen)

Finally: The comma

The comma is one of the more difficult once to use correctly. The use can be summed up in 4 rules:

1. Lists are separated with a comma
   - e.g. x, y and z (English -English), x, y, and z (American English)
2. Use commas like brackets (side sentences)
   - e.g. “Our latest results, **obtained using a recently developed technique**, also support our overall hypothesis.”
3. Comma after having linking words,
   - e.g. “**however**”, “**furthermore**”, “**additionally**” at the start of a sentence, or after a phrase that qualifies or introduces the main part of the sentence.
4. No comma “**that**" case,
   - e.g. “We showed that this hypothesis is false.”

Starting a sentence

- And
- But
- Because
- So

Considered poor style!

- In addition, additionally, further, furthermore, indeed, moreover
- However, in contrast, nevertheless, occasionally, of course on the contrary
- Use Instead for because (second part of a sentence)
- So can be replaced with accordingly, as a result, consequently, hence, in short, subsequently, therefore, thus or to this end.

Ending a sentence

- Too
- Also
- Though
- Yet

Considered poor style!

Avoid uncertainty

- A lot -> several, main, numerous, considerable, etc.
- Avoid adjectives like: amazing, incredible, etc.
- Absolute statements: Our results are 100 % proof.

a(n) vs. the

"During his voyages, Darwin noticed *variation* in animals. He became interested in a variation in the beaks of finches. Only a scientist with Darwin's background could have noticed the variation in these birds."

- General statement: absent
- A/an: singular, (e.g. There is a big mess on my table.)
- the: specific, (e.g. The results indicate that the majority of the students will pass research methodology this year.)
- Some words are universal concepts: hygiene
- Indicate possession

Example

Avoid uncertainty

Attribution	Endorsement	Conjunctions				Modality		Evaluation
Attributing or projecting claims to **outside authorities** in a specific or general way	Attributing claims with **more or less support** or certainty	Words that **link ideas**, helping to create a 'flow' in the writing. Many conjunctions can be used at the start of a sentence **and/or** to link two short sentences into one long one. See WriteSIte for examples, exceptions and exercises. (WriteSite web address at bottom of this page)				Words which express degrees of **certainty**, **frequency** or **obligation**		Words interpreted as **positive** or **negative** or which **intensify** meaning of other words
According to ____ _____argues (that) _____discusses _____states (that) _____shows (that) _____expresses _____proves (that) _____explains (that) ____suggests (that) ____ demonstrates ____ 's argument ____'s statement ____'s claim ____'s thesis ____'s position *In ____'s view* *As {argued} by ___* *There is (widespread) agreement that …* *There is (strong) evidence to {suggest}* *A number of researchers (____ 1995; ____ 2003)* *A study by__ {found} that …* *The researchers {suggest} that …* *____'s {claim} (that)*	**[neutral]** reports states notes describes explains illustrates argues shows finds outlines maintains persuades In the view of According to **[positive]** affirms agrees stresses asserts demonstrates emphasises makes clear **[negative]** claims assumes suggests proposes believes in his opinion overlooks	**Comparison** In the same way likewise just as both … and **Addition** In addition Additionally Furthermore Moreover Similarly and also as well besides not only but also besides	**Contrast** However In contrast On the other hand On the contrary Instead Nevertheless but yet still neither …nor even so **Replacement** Alternatively or or else **Concession** Although Even though Despite Whereas While NB: Concession words allow the writer to acknowledge opposing positions in less powerful ways e.g. *{Although} [there are some valid points raised by Smith], there are many significant problems …*	**Cause** because as so so that since Therefore Thus Hence As a result, Because of this For this reason in order for in order that consequently **Condition** unless if then in that case that being so	**Exemplifying** for example, for instance, to illustrate this such as **Restatement** in other words to sum up in summary in sum in brief that is to put it another way **Time & Place** First(ly), Second(ly), Finally, then after afterwards previously subsequently prior to up 'til now to the present at present first and foremost next	may could can might will would has to had to should * must * ought to need perhaps possibly probably certainly usually sometimes always * never * seldom rarely definitely absolutely by all means clearly of course surely obviously	occasionally generally regularly for the main part very just simply merely only even actually really in fact much barely slightly quite almost nearly scarcely hardly absolutely entirely completely totally * tends to seems appears	**[+ve]** important significant strong clear effective main major beneficial valuable relevant logical persuasive valid unbiased plausible useful succeeds in … **[-ve]** problematic limited unrealistic irrelevant minor unnecessary insignificant biased invalid questionable controversial fails to … neglects … dismisses … omits ...

- Words with an asterix (*) indicate high modality (ie. 'strong' words). In academic writing, it is often preferable to use medium modality words (e.g. "often" instead of "always"; "may" instead of "must").
- Tip: Only use words which you are comfortable with, otherwise your writing will sound 'forced' or 'unnatural'. Suggestion: highlight the words above you feel confident with now. As you read academic texts (e.g. journals), pay attention to the vocabulary you encounter.

References
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The Write Site http://writesite.elearn.usyd.edu.au (click on Module 3: Structure → Unit 5: Writing Cohesively → Section 6: Using Conjunctions)

Writing clear scientific English

Guidelines to improve your writing style:

- ☆ Make a plan
- ☆ Clean & legible layout
- ☆ Paragraphs
- ☆ Write **simple** sentences: one idea, direct & straight forwards
- ☆ Write **positive** sentences
- ☆ Write **active** sentences
- ☆ Omit **needless** words

Writing clear scientific English

Write positive sentences: **practise** (there is more than one right one!)

- ☆ The experiment did **not** work.
- ☆ **No** changes were observed in any of the variables tested.
- ☆ There is **not** a piece of evidence supporting this hypothesis.
- ☆ The variation was **never** more than 1%.
- ☆ **None** of the alternative explanations seemed likely.
- ☆ **No** less than eleven substances were presented in the mixture.

Writing clear scientific English

Write positive sentences: answer (there is more than one right one!)

- ☆ The experiment failed.
- ☆ All variables tested remained constant.
- ☆ The hypothesis lacks supporting evidence.
- ☆ The variation was always less than 1%.
- ☆ All alternative explanations seemed implausible.
- ☆ Everybody overlooked the *discrepancy* between the two sets of data.

Writing clear scientific English

Active sentences: Which one do you prefer?

- ☆ "The ability of the antibiotics to inhibit bacterial growth was examined by using standard *techniques*." (15 words)
- ☆ "We used standard techniques to examine the ability of antibiotics to inhibit bacterial growth." (14 words)
- ☆ "Standard techniques were used to examine the ability of antibiotics to inhibit bacterial growth." (14 words)

- ☆ "The improved versions are presented in section x." (8 words)
- ☆ "Section x presents the improved version." (6 words)

Writing clear scientific English

Omitting words: practice (there is more than one right one!)

- The fact that many young scientists need a significant amount of practice to improve their written communication skills is a case in point. It can be seen from the diagram in Figure 1 that those students who regularly handed in written work performed at a higher level than those who did not
- "It can be seen from the graph in figure x that ..."
- It can be seen from Figure 1 that there is a significant correlation between the rate of growth of the incidence of cardiac-related disease and illness and the increasing frequency of the possession and use of a television.

Writing clear scientific English

Omitting words: practice (there is more than one right one!)

- ~~The fact that~~ Many young scientists need ~~a significant amount of~~ practice to improve their written communication skills ~~is a case in point~~. ~~It can be seen from the diagram in~~ Figure 1 **shows** that ~~those~~ students who regularly handed in written work performed **better**. ~~at a higher level than those who did not~~ (newly added).
- "It can be seen from the graph in figure x that ..."
- Figure 1 shows that the incidences of heart diseases and television viewing correlate well.

ID Problems

Go through your text again, read it loud… is something missing

Ask yourself:

- Are all the paragraphs correct?
- Are all the sentences straightforward and simple?
- Do all the sentences make sense?
- Do all the sentences fit together?
- Are they linked with the *correct* words?
- Are there expressions that are repeated throughout the text?
- Are there needless words?

To believe the Spell checker or not

1. You must proof that two plus two equals four!
2. A prove that two plus two equals four is given on the first page.
3. Vaccines safe lives.
4. Spellcheckers chance the way we read our texts.
5. The theory of global warming remains to be proven.
6. Spellcheckers effect our ability to spell.
7. How do tortoises remain a life when hibernating?
8. Only a few scientists have received two Nobel Prices.
9. The affect of technology on the environment is substantial.
10. Tumour cells loose the normal controls of growth.
11. We judge how we live our lives form our own perspective.
12. The ability to write concisely and accurately is not heredity.

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Last comments

- Read through your work
- Give it to colleagues, group members for proof reading
- "And do as I say, not as I do!"

Tools

- **AI tools**: **chatGPT**, **OpenAI**, Yomu AI, Jenni AI, **Paperpal**
  - manage data, literature search, dev. Outlines, help with language issues
- **Avoid Plagiarism!**
  - Understand the source of your text
  - Supplement with info from other sources (no regurgitation)
  - Cite probably
  - **Review and edit carefully!**

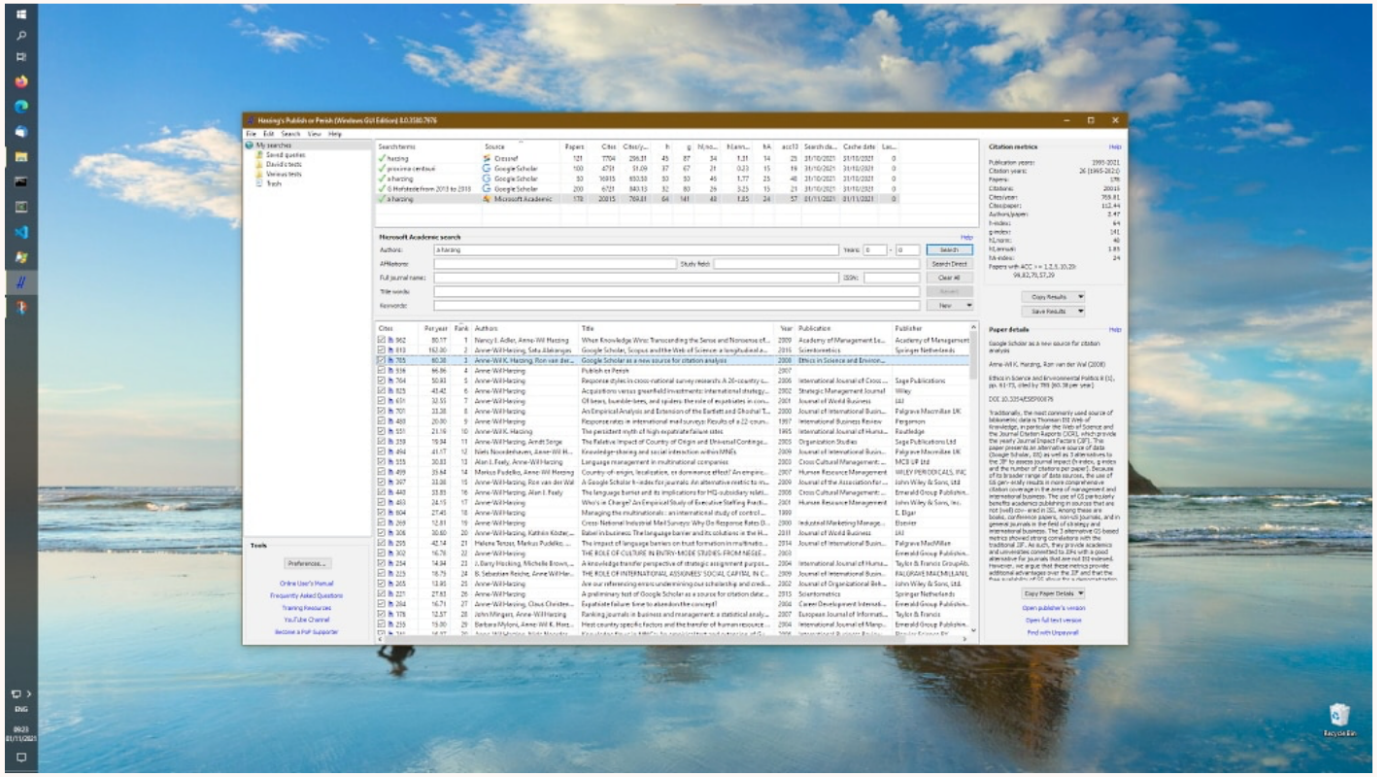
Huang J, Tan M. 2023;13(4):1148-1154. PMID: 37168339; PMCID: PMC10164801.

Applications

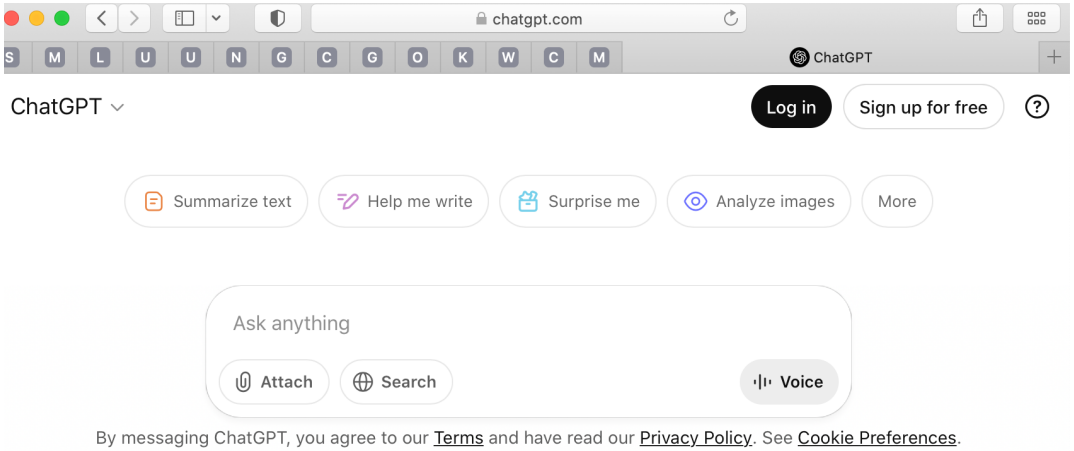
Publish or Perish

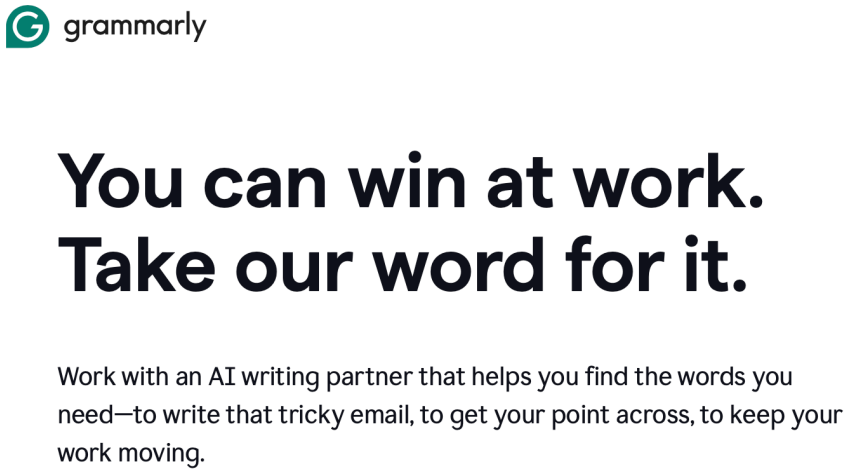
Explains the use of Publish or Perish and its metrics

Anne-Wil Harzing - Sat 6 Feb 2016 16:10 (updated Fri 25 Aug 2023 16:24)



The thing about AI...





The thing about AI…

scienceOS

grammarly

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Take our word for it.

Work with an AI writing partner that helps you find the words you need—to write that tricky email, to get your point across, to keep your work moving.

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CAREER FEATURE | 07 April 2025

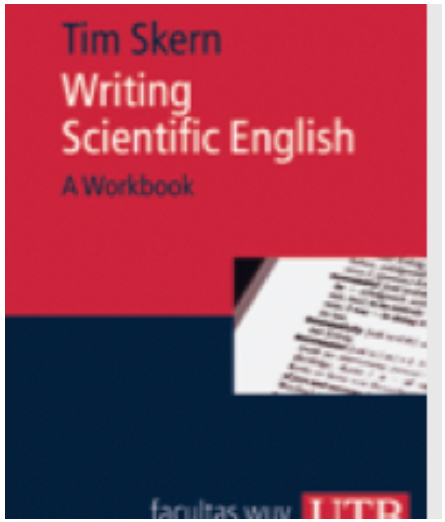
AI for research: the ultimate guide to choosing the right tool

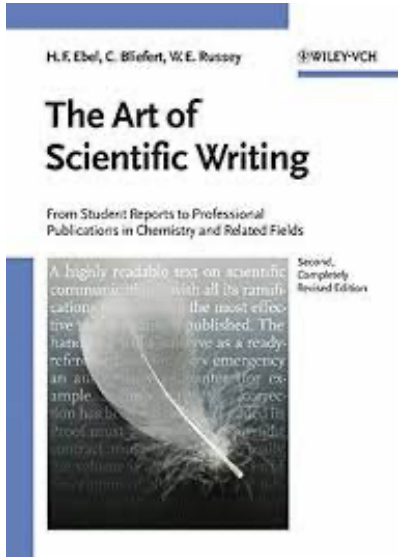
Curious about using artificial intelligence to boost your research? Here are the programs you shouldn't miss.

By Amanda Heidt

Summary

Sources





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Thank you!

Responding to reviewers (may) be frustrating!