

# A Note for Writing in the Sciences

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This is my study note for the *Writing in the Science* course, which is provided through Coursera.

## Prerequisite Knowledge

### 0.1 Article types

1. Research Papers: Experimental or theoretical studies on physical phenomena:
  - Physical Review A
  - Physical Review B
  - Physical Review D
2. Review Articles: Summaries of existing research on a physics topic.
  - Physical Review X
  - Reviews of Modern Physics
3. Letters/Short Communications: Brief reports on significant new findings.
  - Physical Review Letter
4. Methods Papers: Descriptions of new experimental techniques or tools.
  - Physical Review Applied
  - Journal of Applied Physics
5. Conference Papers: Short papers for conferences, focusing on recent results.
  - APS March Meeting and APS April Meeting
  - SPIE Conferences
6. Technical Reports: Details on new physics instruments or technology.
  - National Technical Reports Library
  - CERN Document Server
  - NASA Technical Reports Server
7. Commentaries and Perspective Articles: Opinions on current physics issues.
  - Nature Physics

- Science
- Physics Today
- Theses and Dissertations: In-depth studies for degree programs.
- Textbooks and Educational Materials: Books and materials for physics education.

# 1 Introduction, principles of effective writing

## 1.1 Introduction

- What makes good writing?
  - Good writing communicates an idea clearly and effectively;
  - Good writing is elegant and stylish
- Clearing writing just takes having something to say and clear thinking.
- Don't want you to even worry about elegance and stylish when you're writing your first draft, just worry about getting that idea across in a clear and logical, and efficient way.
- Elegant and stylish writing happens in revision, not on the first draft, even for professional writers. Just barrel through that first draft and then spend time revising.
- What makes a good writer?
  - Having something to say;
  - Logical thinking;
  - A few simple, learnable rules of style;
- Become a better writer
  - Read, pay attention, and imitate;
  - Write in a journey;
  - Let go of 'academic' writing habits (deprogramming step);
  - Talk about your research before trying to write about it;
  - Write to engage your reader: try not to bore them!
  - Stop waiting for 'inspiration';
  - Accept that writing is hard for everyone, even professional writers;
  - Revise. Nobody gets it perfect on the first try;
  - Learn how to cut ruthlessly, and never become too attached to your words;
  - Find a good editor;
  - Take risks.

## 1.2 Examples of what not to do

- Ask yourself
  - Is this sentence easy to understand?
  - Is this sentence enjoyable and interesting to read?
  - Is this sentence readable?
  - Is it written to inform or to obscure?
- The scientific literature should be enjoyable and interesting to read. The point of scientific writing is to inform.
- The verbs drive sentences whereas nouns slow them down.
- Themes of this course
  - Complex ideas do not require complex language;
  - Scientific writing should be easy and even enjoyable to read.

## 1.3 Overview, principles of effective writing

- Avoid the use of acronyms, other than those that are completely standard that most people will know.
- Do not put too much distance between the subject of the sentence and the main verb.
- Overview: Principles of effective writing
  - Cut unnecessary words and phrases; learn to part with your words;
  - Use the active voice (subject + verb + object);
  - Write with verbs: use strong verbs, avoid turning verbs into nouns, and don't bury the main verb;



## 1.4 Cut the clutter

The secret of good writing is to strip every sentence to its cleanest components. Every word that serves no function, every long word that could be a short word, every adverb that carries the same meaning that's already in the verb, every passive construction that leaves the reader unsure of who is doing what - these are thousand and one adulterants that weaken the strength of a sentence. And they usually occur in proportion to the education and rank.

William Zinsser. *On Writing Well*

- Be vigilant and ruthless
- After investing much effort to put words on a page, we often find it hard to part with them.
- Try the sentence without the extra words and see how it's better - conveys the same idea with more power.

### Avoid list

- Deadweight words and phrases
  - As it is well known
  - As it has been shown
  - It can be regarded that
  - It should be emphasized that
- Empty words and phrases
  - basic tenets of
  - methodologic
  - important
- Long words or phrases that could be short
- Unnecessary jargon and acronyms
- Repetitive words or phrases
  - studies / examples
  - illustrate / demonstrate
  - challenges / difficulties

- successful / solutions
- Adverbs
  - very, really, quite, basically, generally, etc.
- Some words and phrases are blobs. William Zinsser, *On Writing Well*.
- Long words and phrases that could be short
 

◦ a number of	→	many
◦ are of the same opinion	→	agree
◦ less frequently occurring	→	rare
◦ all three of the...	→	the three
◦ give rise to	→	cause
◦ due to the fact that	→	because
◦ Have an effect on	→	affect
◦ The result of	→	due to
◦ In many instances	→	often

I have only made this letter rather long because I have not had time to make it shorter.

Blaise Pascal. *Lettres Provinciales*, 16. Dec.14, 1656.

## 1.5 Cut the clutter, more tricks

### A few other small tricks

- Eliminate negatives
- Eliminate superfluous uses of ‘there are’ / ‘there is’
- Omit needless prepositions
- Use an exciting verb rather than a ‘to be’ verb.

## 1.6 Practicing cutting clutter

The best way to learn writing is through practice.

### Examples

- Before

Anti-inflammatory drugs may be protective against the occurrence of Alzheimer's Disease.

- After

Anti-inflammatory drugs protect against Alzheimer's Disease.

- Before

Clinical seizures have been estimated to occur in 0.5

- After

Clinical seizures occur in 0.5

- Before

Ultimately p53 guards not only against malignant transformation but also plays a role in developmental processes as diverse as aging, differentiation, and fertility.

- After

Besides preventing cancer, p53 also works in aging, differentiation, and fertility.

- Before

Injuries to the brain and spinal cord have long been known to be among the most devastating and expensive of all injuries to treat medically.

- After

Injuries to the brain and spinal cord are among the most devastating and expensive.

- Before

An IQ test measures an individual's abilities to perform functions that usually fall in the domains of verbal communication, reasoning, and performance on tasks that represent motor and spatial capabilities.

- After

An IQ test measures an individual's verbal, reasoning, or motor and spatial abilities.

- Before

As we can see from Figure 2, if the return kinetic energy is less than  $3.2 U_p$ , there will be two electron trajectories associated with this kinetic energy.

- After

Figure 2 shows that a return kinetic energy less than  $2.3 U_p$  yields two electron trajectories.

## **2 Writing with strong**

### **2.1 Use the active voice**

Use strong verbs, avoid turning verbs into nouns, and keep the subject and main verb close together at the beginning.

#### **Active voice**

- Subject → verb → object.

#### **Passive voice**

- A form of the verb ‘to be’ + the past participle of the main verb;
- The main verb must be transitive;
- The passive voice usually takes out the responsible party.

#### **To turn the passive voice back to the active voice**

- Who does what to whom? - The agent.

#### **Advantages of the active voice**

- Emphasizes author responsibility;
- Improves readability;
- Reduces ambiguity.

#### **Is it ever OK to use the passive voice?**

Yes! The passive voice exists in the English language for a reason. Just use it sparingly and purposefully. For example, passive voice may be appropriate in the methods section where what was done is more important than who did it.

## 2.2 Is it OK to use ‘We’ and ‘I’

**It’s okay to use personal pronouns.**

- the active voice is livelier and easier to read;
- Avoiding personal pronouns does not make your science more objective;
- Journals want this;
- By agreeing to be an author on the paper, you are taking responsibility for its content. Thus, you should also claim responsibility for assertions in the text by using personal pronouns.

**An example of an opening sentence in a paper**

We wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

*Nature*, 171, 737-738. April 25, 1953.

## 2.3 Active voice practice

Text of practice exercises for Module 2.3:

- Before

A recommendation was made by the DSMB committee that the study be halted.

- After

The DSMB committee recommended that the study be halted.

- Before

Major differences in the reaction times of the two study subjects were found.

- After

We observed major differences in the reaction times of the two study subjects.

- Or

The two study subjects differed in reaction times.

- Before

It was concluded by the editors that the data had been falsified by the authors.

- After

The editors concluded that the authors falsified their data.

- Before

The first visible-light snapshot of a planet circling another star has been taken by NASA's Hubble Space Telescope.

- After

NASA's Hubble Space Telescope has taken the first visible-light snapshot of a planet circling another star.

- Before

Therefore, the hypothesis that the overall kinetics of a double transtibial amputee athlete and an able-bodied sprinter at the same level of performance is not different was rejected.

- After

Therefore, we rejected the hypothesis that the overall kinetics of a double transtibial amputee athlete and an able-bodied sprinter at the same level of performance is comparable.

- If there is no agent, we can assume it's the authors of that article.

## 2.4 Write with verbs

### Three principles

- Use strong verbs
- Avoid turning verbs into nouns
- Do not bury the main verb

### Use strong verbs

- Verbs make sentences go;
- Pick the right verb, avoid the use of adverbs;
- Use ‘to be’ verbs purposefully and sparingly: they are overused and boring,

### Avoid turning verbs into nouns

- Examples
  - Obtain estimates of → estimate
  - Has seen an expansion in → has expanded
  - Provides a methodologic emphasis → emphasizes methodology
  - Take an assessment of → assess
  - Provide a review of → review
  - Offer confirmation of → confirm
  - Make a decision → decide
  - Shows a peak → peaks

### Do not bury the main verb

- Keep the subject and main verb: (Predicate) close together at the start of the sentence.
  - Readers are waiting for the verb.



## 2.5 Practice examples

- Before

The fear expressed by some teachers that students would not learn statistics well if they were permitted to use canned computer programs has not been realized in our experience. Careful monitoring of achievement levels before and after the introduction of computers in the teaching of our course revealed no appreciable change in students' performances.

- After

Many teachers feared that the use of canned computer programs would prevent students from learning statistics. We monitored student achievement levels before and after the introduction of computers in our course and found detriments in performance.

- Before

Review of each center's progress in recruitment is important to ensure that the cost involved in maintaining each center's participation is worthwhile.

- After

We should review each center's recruitment progress to make sure its continued participation is cost-effective.

- Before

It should be emphasized that these proportions generally are not the result of significant increases in moderate and severe injuries, but in many instances reflect mildly injured persons not being seen at a hospital.

- After

Shifting proportions in injury severity may reflect stricter hospital admission criteria rather than true increases in moderate and severe injuries.

- Before

Important studies to examine the descriptive epidemiology of autism, including the prevalence and changes in the characteristics of the population over time, have begun.

- After

Studies have begun to describe the epidemiology of autism, including recent changes in the disorder's prevalence and characteristics.

- Before

There are multiple other mechanisms that are important, but most of them are suspected to only have a small impact or are only important because of the impact on one of the three primary mechanisms.

- After

Multiple other mechanisms play only a small role or work by impacting one of the three primary mechanisms.

- Before

After rejecting paths with poor signal-to-noise ratios, we were left with 678 velocity measurements of waves with 7.5 seconds period and 891 measurements of 15 second waves.

- After

Rejecting path with poor signal-to-noise ratios left 678 velocity measurements of 7.5 second waves and 891 of 15 second waves.

- Before

It is suspected that the importance of temperature has more to do with impacting rates of other reactions than being a mechanism of disinfection itself since ponds are rarely hot enough for temperature alone to cause disinfection.

- After

Ponds are rarely hot enough for temperature alone to cause disinfection; thus, the effect of temperature is likely mediated through its impact on the rates of other reactions.

- Before

It was assumed that due to reduced work at joints of the lower limbs and less energy loss in the prosthetic leg, running with the dedicated prostheses allows for maximum sprinting at lower metabolic costs than in the healthy ankle joint complex.

- After

The prosthetic leg reduced work and energy loss compared with a healthy ankle joint, which may lead to lower metabolic costs during maximum sprinting.

## 2.6 A few grammar tips

**The word ‘data’ is plural.**

- These data show an unusual trend.

**Affect as a verb, denotes ‘to influence’.**

- The class affected her.

**Effect as a noun, denotes the form of this influence.**

- The class had an effect on her.

**Affect as a noun, denotes feeling or emotion shown by facial expression or body language.**

- The soldiers seen on television had been carefully chosen for blandness of effect.

**Effect as a verb, denotes to bring about or to cause.**

- to effect a change.

**That vs. which**

- That: the restrictive (defining) pronoun;
  - The vial that contained her RNA was lost.
- Which: the nonrestrictive (no-defining) pronoun.
  - The vial, which contained her RNA, was lost.

**Key question: Is your clause essential or non-essential?**

- That: The essential clause cannot be eliminated without changing the meaning of the sentence;
- Which: The non-essential clause can be eliminated without altering the basic meaning of the sentence (and must be set off by commas).

Care writers, watchful for small conveniences, go which-hunting, remove the defining whiches, and by doing so improve their work.

Strunk and White.

- Before

Stroke incidence data are obtained from sources, which use the ICD (International Code of Diseases classification system).

- After

Stroke incidence data are obtained from sources that use the ICD (International Code of Diseases classification system).

- From Physicist Richard Feynman:

When we say we are a pile of atoms, we do not mean we are merely a pile of atoms because a pile of atoms, which is not repeated from one to the other might well have the possibilities which you see before you in the mirror.

- After

When we say we are a pile of atoms, we do not mean we are merely a pile of atoms because a pile of atoms that is not repeated from one to the other might well have the possibilities that you see before you in the mirror.

### **Singular antecedents**

- Do not use ‘they’ or ‘their’ when the subject is singular.
- To avoid gender choice, turn to a plural.

## 3 Punctuation

### 3.1 Experiment with punctuation

Our friends the dash, colon, semicolon, and parenthesis... Use them to vary sentence structure.

#### Increasing power to separate

- Comma → Colon → Dash → Parentheses → Semicolon → Period

#### Increasing formality

- Dash → Parentheses → The Others (Comma, Colon, Semicolon, Period)

#### Semicolon

- The semicolon connects two independent clauses. A clause always contains a subject and predicate; an independent clause can stand alone as a complete sentence.
- Semicolons are also used to separate items in lists that contain internal punctuation.

#### Parenthesis (parenthetical expression)

- Use parentheses to insert an afterthought or explanation (a word, phrase, or sentence) into a passage that is grammatically complete without it;
- If you remove the material within the parentheses, the main point of the sentence should not change;
- Parentheses give the reader permission to skip over the material.

#### Colon

- Use a colon after an independent clause to introduce a list, quote, explanation, conclusion, or amplification.
- Use a colon to join two independent clauses if the second amplifies or extends the first.

#### The “rule of three’s” for lists and examples”

- It happened because people organized and voted for better prospects; because leaders enacted smart, forward looking policies; because people’s perspectives opened up, and with them, societies did too.

## Dash

A dash is a mark of separation stronger than a comma, less formal than a colon, and more relaxed than parentheses

Strunk and White.

Use a dash only when a more common mark of punctuation seems inadequate.

Strunk and White.

## 3.2 Practice, colon, and dash

- Before

Evidence-based medicine teaches clinicians the practical application of clinical epidemiology, as needed to address specific problems of specific patients. It guides clinicians on how to find the best evidence relevant to a specific problem, how to assess the quality of that evidence, and perhaps most difficult, how to decide if the evidence applies to a specific patient.

- After

Evidence-based medicine teaches clinicians the practical application of clinical epidemiology: how to find the best evidence relevant to a specific problem, how to assess the quality of that evidence, and how to decide if the evidence applies to a specific patient.

- Or

Evidence-based medicine teaches clinicians how to find the best evidence relevant to a specific problem, how to assess the quality of that evidence, and how to decide if the evidence applies to a specific patient.

- Before

Finally, the lessons of clinical epidemiology are not meant to be limited to academic physician-epidemiologists, who sometimes have more interest in analyzing data than caring for patients. Clinical epidemiology holds the promise of providing clinicians with the tools necessary to improve the outcomes of their patients.

- After

Finally, clinical epidemiology is not limited to academic physician - epidemiologists - who are sometimes more interested in analyzing data than caring for patients - but provides clinicians with the tools to improve their patients' outcomes.

### 3.3 Parallelism

Pairs of ideas joined by “and”, “or”, or “but” should be written in parallel form.

**A list of ideas should be written in parallel form**

- Unparallel

Locusts denuded fields in Utah, rural Iowa was washed away by torrents, and in Arizona, the cotton was shriveled by the placing heat.

- Parallel

Locusts denuded fields in Utah, torrents washed away rural Iowa, and blazing heat shriveled Arizona's cotton.

### 3.4 Paragraphs

#### Paragraph-level tips

- 1 paragraph = 1 idea
  - Let the reader appreciate short paragraphs and white space on the page;
  - Try to keep your paragraphs short and focused on a single idea.
- Give away the punch line early.
  - Present the main findings or conclusions at the beginning of a scientific paper.
- Paragraph flow is helped by:
  - A logical flow of ideas
  - parallel sentence structures
  - if necessary, transition words
- Your reader remembers the first sentence and the last sentence best. Make the last sentence memorable. Emphasis at the end.
- A logical flow of ideas:
  - Sequential in time: avoid the “Memento” approach in scientific writing;
  - General → specific: take-home message first;
  - Logical arguments: if “a” then “b”; “a” therefore “b”.