

# How To Write A Scientific Paper



by Michael LaRocca

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### How To Write Any Paper

What is writing? I have some thoughts in my head. When you read what I've written down, you should understand those thoughts.

It sounds so simple when I say it like that. In practice, well, maybe it is and maybe it isn't. Let's find out.

Any textbook of English grammar will teach you the rules of writing clear correct English.

1. Choose the correct word
2. Prefer the simple word to the pompous one
3. Prefer the single word to the circumlocution
4. Prefer the short word to the long
5. Use the active rather than the passive voice

These rules apply regardless of whether you're writing about medicine, engineering, law, education, travel, dating, or even a good old-fashioned novel. Meanwhile, you've probably read a lot of published articles, journals, and entire textbooks that manage to violate all five of those rules.

I like the word "circumlocution," by the way. Locution is writing or speaking, from the same root word as locomotion. Circum means circular, from the same root as circumference. So *circumlocution* is not to say what you mean, but just to talk around it. That's a nice long word that I'll use because it's packed with info.

And now, back to some good writing.

In 1953, Watson and Crick wrote a letter to *Nature* magazine. It described the structure of DNA. Perhaps you've heard of DNA's double helix. They won a Nobel prize for that discovery. We'll talk about that letter some more later. It was less than 900 words.

I want to quote something that was published in 1977, just to show you how little things have changed. When you write your paper, you'll cite existing literature, right? I'm citing THORNE'S BETTER MEDICAL WRITING by S. Lock, Pitman Medical Publishing, © 1977.

Oh, and since this isn't being published in a peer-reviewed journal, expect me to use more and longer quotes "from the existing literature" than you're allowed to.

I'll be using a lot of my own words in this book, but I'm also going to lean on the experts because they make you more likely to believe me.

I think we all want to agree with THORNE'S BETTER MEDICAL WRITING. I'm just glad someone has, so to speak, given us permission. This isn't the only source that does. It's simply the one I've chosen.

“Scientific writers are rarely literate. If a colleague tells a scientist that his latest article is difficult to understand, the writer is more likely to assume that his colleague is unintelligent than that his article is unintelligible. Such writers believe that discussions about style, choice of words, length of sentences, active and passive voice, subjunctives, and the like, are for nonscientific second-rate minds with nothing original to say, and are irrelevant for serious scientific workers. Unfortunately, this argument can be supported by reference to published accounts of important work, many of which are badly written. No editor will reject firstclass research because it is in poor English, and few journals have enough staff to rewrite all the articles they publish.

“So why does style matter?”

“Simplicity and clarity are the features of good scientific writing. Nobody is asking you to write great literature, but the meaning must be readily understood. Good points to remember are that doctors not working in the subject should be able to understand the article, clear thought can be expressed clearly, and a man with something of value to say has no need to pad it out just to bore editors (who are likely to reject them) and bore their readers (who are unlikely to finish them).

“In other words, most writers are failing to communicate, which is the object of writing in the first place.”

Scientific writers are rarely literate? That's bold. It got your attention, didn't it?

Clear thought can be expressed clearly. The meaning must be readily understood. Communication is the object of writing.

Remember those.

## Planning

If I were sitting in the room talking to you, you'd fall asleep.

No, wait, let me start over.

If I were sitting in the room talking to you, and you didn't understand something I said, you could ask me for clarification.

With this book, you can't do that. You could send me an email, but if I even bothered to answer you'd end up waiting too long. So I have to be very clear in my writing.

That's the first reason we plan before we write.

What if you read something here that you don't agree with? I have to anticipate any and all possible disagreements, and address them adequately but not to excess, when I can't even talk to you. You might read these words two months later and half a world away.

Planning.

Writing requires fluency, clarity, accuracy, and an economy of words. In your favor, you can self-edit as many times as you want. You can spend weeks (months) on a paper.

But you do have to plan.

Let's do that now.

“What’s your paper about?” If I ask you that, and you can answer me in one or maybe three sentences, you’re on the right track. If not, you’ve got some more thinking to do.

But I’m probably skipping ahead. It’s possible to start writing your paper without really knowing what it’s about, and only finding out when you’re almost done.

In other words, it’s probable that the first sentence of your paper is the last one you write.

Also, the prospect of writing an entire paper can be daunting. Planning breaks your major project down into manageable steps.

So let’s start planning.

1. What’s your paper about? Can you tell me in a single sentence? Again, your search of the literature might refine this somewhat.
2. Is it worth writing? Have similar findings been reported? Is there a need for another report? If applicable, has your literature search turned up similar cases or reviews?
3. So what? How would your paper change concept or practice?
4. Who cares? Meaning, who would read your paper? Why?

The first step about the single sentence, incidentally, reminds me of something Einstein said. “If you can’t explain it to an eight-year-old, you don’t understand it.” I need to put that on a plaque.

The four steps above are my medical model, but you get the idea. Here’s a general prescription for any writing project.

1. Spend some time thinking before you start writing your rough draft.
2. Compile a list of your ideas while you are thinking.

3. Put the list in some order that makes sense to you (most to least important, sequential/chronological, etc.).
4. Write the rough draft.
5. Write a final draft that shows some changes from the initial draft.
6. Read your writing aloud, and you'll hear mistakes and find ways to correct them.

Finally, let me cite some experts here. We're going back to the medical field.

In 1997, Cambridge University Press published the second edition of *MEDICAL WRITING – A PRESCRIPTION FOR CLARITY* by Goodman and Edwards.

Don't you like a catchy title?

I'm just gonna quote them, at length, hence the British spelling.

Writing starts with planning. If you are writing a standard paper for a medical journal, then the outline for your plan will be the usual Introduction, Methods, Results, and Discussion. Methods is sometimes expanded to Patients and Methods, and Results may be Observations. Start by jotting down short answers to these questions:

1. What was I trying to do?
2. Why did I think it was worthwhile to do it?
3. How did I do it?
4. What did I show?
5. What do I need to stress?
6. What excuses do I need to make?
7. What is my message?
8. What would I like to do next?

Introductions usually start with the answer to 2: a *brief* review of important facts and references. Most introductions, when first submitted to journals, are too long; many of them stay that way. The last sentence or paragraph of the introduction should state the answer to 1.

Methods is the answer to 3. Make your notes in a logical order, describing things in sequence.

Your Results or Observations, question 4, must be stated as you measured or described them, not as you choose to interpret them. Use tables and figures if they will help readers; dense paragraphs of text interspersed with numbers make for difficult reading.

The Discussion is the most interesting part to write, but knowledgeable readers — and referees — will take far more notice of your methods and results.

Keep in mind that “What is the question?” is the single most important part of a clinical trial and, by extension, of any research. You should make sure that it remains uppermost in your readers’ minds as they digest the fruits of your labours.

### Watson and Crick show how it’s done

New topic, same source. Goodman and Edwards, MEDICAL WRITING – A PRESCRIPTION FOR CLARITY. They cite the Watson and Crick letter to *Nature*, the one that I told you earlier was under 900 words, as an example of clear scientific writing.

About Watson and Crick’s letter, they write “...many of the principles of clear writing are well illustrated by their opening paragraph.”

Look at that. Passive voice. I’d write, “Their opening paragraph illustrates many of the principles of clear writing.” I’ll edit anybody

Here’s the first paragraph from Watson and Crick:



*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.*

Goodman and Edwards then ask why it's a good example. Here's their reasoning, and I honestly don't remember how much is quoted and how much is paraphrased.

- It's direct. "We wish to suggest..." not *In this communication is made a suggestion....*
- It comes straight to the point. They could have started with a general statement about DNA: *Deoxyribose nucleic acid is a nucleotide that has been isolated from many species. We wish to suggest....* To write this would have reduced the impact.
- They make two simple statements in two short sentences. They could have linked the sentences: *We wish to suggest a structure for the salt of DNA that has novel features that are of considerable biological interest.* This version is more clumsy and also ambiguous: it is not clear now whether it is the suggested structure, or the salt of DNA itself, that has the novel features.
- They are not afraid of using the same word, *structure*, twice. Many writers would have started the second sentence with a pronoun, such as *It...*, or used a synonym, such as *This configuration...*; neither device would have been as effective as repeating *structure*.
- Every word is necessary: "We wish to suggest a structure for the salt..." not *We propose a possible structural hypothesis concerning the salt....* They even avoid *molecular structure*, there being no other type of structure to which they could be referring. And, while most writers would probably write *We would like to...* they use the elegant "We wish to..."

- Every word is the correct word, particularly *novel* (of new kind or nature, strange, hitherto unknown.) They write “features which are of considerable biological interest” not *features associated with considerable biological interest*.

One note from me, Michael, in late 2010. “Novel” is an excellent word. So excellent, in fact, that I see it in almost every paper I edit. And also in most papers that I don’t edit. I’ll guess Watson and Crick used it first, but now that I’ve mentioned it, look for it. You’ll see it everywhere except in a novel.

#### Published Writing That Sucks

“Thus, it would seem reasonable that shortening of 10 cm at skeletal maturity or predicted shortening of this amount when the child reaches adulthood would be sufficient to consider Syme amputation.”

That was published. What does it mean? Well, you have to stop and think about it, don’t you? Break it up into phrases. Shift some things around in your mind. Presumably your mind will reach a conclusion similar to:

“A Syme amputation should be considered for a shortening or predicted shortening of 10 cm at skeletal maturity.”

Meanwhile, I don’t think the reader should have to work that hard.

Here’s another.

“If the organism demonstrates to be a staph on the gram stain, one may consider drilling the femoral neck for prophylactic decompression as this may be secondary to a metaphyseal osteomyelitis.”

That's nice. Say it three times fast. Basically, it's a little *if...then* statement. Very useful to the medical profession. *If* you see this symptom, *then* you do that procedure. Why make that so hard to figure out?

"If the gram stain shows staphylococci, consider drilling the femoral neck to drain the metaphyseal abscess."

That's better.

Nathaniel Hawthorne never did any scientific writing that I know about, but do you know what he did write? "Easy reading is damn hard writing." I like that better than I do his novels and short stories. Here's something Hawthorne didn't write:

"It has been suggested that the utilization of surgical intervention be deferred until attenuation of the infectious symptomatology."

Freeze.

It has been suggested that...? I call those "weasel words." Delete them. Always. Later, I'll give you a list of words to always delete. "It is suggested that" is always on the list.

Also, teach your word processor how to replace "utilize" with "use."

"LaRocca recommends that surgery be delayed if the patient has an infection."

That's better. Or if you'd rather not dump the responsibility on your good buddy LaRocca because the patient died, try "Surgery should be delayed if the patient has an infection." That'll work.

George Orwell noted that good writing is like a window pane. Here's an author who needs a big ole shot of Windex:

"It is common for the need to voluntarily evacuate the pouch to occur on one occasion nightly; more frequent defecation interfering with the patient's sleep has not been encountered in our continent patients."

Thirty-three words. That's bad.

"Patients who are continent need only empty their stomach pouches once each night."

Thirteen words. That's good.

I refer to long-winded passive-voice writing that leaves readers wondering *What does that mean?* as speed bumps. You're cruising along at a nice steady pace, reading something, and BAM you've got to stop or slow down. Double back. Sort out the meaning that the author hid because of laziness, incompetence, or unclear thinking.

In writing, speed bumps are bad. Will the reader start reading again, or will he put down your article and go do something else?

*Does this author even care? Is he even trying?* Make an Acquisitions Editor wonder that enough times and you won't have a reader, because you won't get published at all.

It kinda nags at me that these were actually published, by the way. We've got a bad case of don't-care-it is to treat. Here's another symptom:

"The study confirmed the hypothesis that clinical instructors of undergraduate medical students would choose instructional techniques

limiting active student involvement in patient care activities when faced with problematical situations.”

When I gave this lecture to undergraduate medical students in Thailand, they should’ve all known what that sentence meant because they were experiencing it. But I didn’t always give them time to “translate” the bad English into good English before I blurted out the answer.

“Medical teachers of undergraduates tend not to let students look after difficult patients.”

Yeah, my examples in this book lean heavily toward medicine, because I lectured for so long at Chiang Mai University’s teaching hospital. But my examples and my message apply to all scientific writing.

Remember when I said you should read your writing aloud? One good reason for that is, if you do, you’ll automatically simplify the sentences as you go. That’s good.

For the other reason, I’m going to detour briefly into fiction.

“I’m coming,” he ejaculated.

There’s no way you could read that aloud without bursting into laughter. Then you’d delete it from your manuscript and make the world a better place.

Finally, let’s detour briefly to the US government. The Plain Writing Act of 2010 requires that government documents are written in “plain language” which is defined as “writing that is clear, concise, well-organized, and follows other best practices appropriate to the subject or field and intended audience.”

So what I'm teaching you here isn't just a good idea. It's the law.

From the Department of Health and Human Services: "The Dietary Guidelines for Americans recommends a half hour or more of moderate physical activity on most days, preferably every day. The activity can include brisk walking, calisthenics, home care, gardening, moderate sports exercise, and dancing."

That was changed to "Do at least 30 minutes of exercise, like brisk walking, most days of the week." A few examples were sacrificed, but the meaning is the same and it's certainly easier to understand.

"After notification of NMFS, this final rule requires all CA/OR DGN vessel operators to have attended one Skipper Education Workshop after all workshops have been convened by NMFS in September."

That's nice. I wonder what it means.

"Vessel operators must attend a skipper education workshop before commencing fishing."

Okay. Thanks.

Don't Do It!

<b>Avoid</b>	<b>Use</b>
A considerable amount of	Much (or) many
A decreased amount of	Less (or) fewer
A diagnosis consistent with	Diagnosed (or) diagnosis of
A majority of	Most
A number of	Many
A small number of	A few
Absolutely essential	Essential
Accounted for by the fact	Because
Adjacent to	Near

Adult human organism	Adult (or) person
After having been treated	After treatment
Along the lines of	Like
An adequate amount of	Enough
An example of this is the fact that	For example
An order of magnitude faster	10 times faster
Ancillary	Additional
Apprise	Inform
Are of the same opinion	Agree
As a consequence of	Because
As a matter of fact	In fact (or leave out)
As a result of	Because
As is the case	As happens
As of this date	Today
At a rapid rate	Rapidly
At an earlier date	Previously
At an early date	Soon
At no time	Never
At some future time	Later
At the conclusion of	After
At the present time	Now
At this point in time	Now
Attenuate	Weaken
Based on the fact that	Because
Because of the fact that	Because
By means of	By, with
Causal factor	Cause
Cognizant of	Aware of
Completely full	Full
Consensus of opinion	Consensus

Considerable amount of	Much
Contingent upon	Dependent on
Definitely proved	Proved
Despite the fact that	Although

Due to the fact that	Because
During the course of	During, while
During the period from...to	From...to
During the time that	While
Effectuate	Cause
Elucidate	Clarify, explain
Employ	Use
Enclosed herewith	Enclosed
End result	Result
Endeavor	Try
Entirely eliminate	Eliminate
Eventuate	Happen
Expire	Die
Fabricate	Make
Facilitate	Assist, support, help
Fatal outcome	Death
Few in number	Few
Fewer in number	Fewer
Finalize	End
First of all	First
Following	After
For the purpose of	For
For the reason that	Since
From the point of view of	For
Future plans	Plans
Give an account of	Describe
Give rise to	Cause
Has been engaged in a study of	Has studied
Has the capability of	Can
Have the appearance of	Look like
Having regard to	About
Impact (v.)	Affect
Implement	Start
Important essentials	Essentials
In a number of cases	Some



In a position to	Can, may
In a satisfactory manner	Satisfactorily
In a situation in which	When
In a very real sense	In a sense (or leave out)
In almost all instances	Nearly always (or) in most cases
In case	If

In close proximity to	Close, near
In connection with	About, concerning
In light of the fact that	Because
In many cases	Often
In my opinion it is not an unjustifiable assumption that	I think
In only a small number of cases	Rarely
In order to	To
In relation to	Toward, to
In respect to	About
In some cases	Sometimes
In spite of the fact that	Although
In terms of	About
In the absence of	Without
In the event that	If
In the not-too-distant future	Soon
In the possession of	Has, have
In this day and age	Today
In view of the fact that	Because, since
Inasmuch as	For, as
Incline to the view	Think
Initiate	Begin
Initiate	Begin, start
Is defined as	Is
Is desirous of	Wants
It has been reported by Smith	Smith reported
It has long been known that	(I haven't bothered to look up the reference)
It is apparent that	Apparently

It is believed that	I think
It is clear that	Clearly
It is clear that much additional work will be required before a complete understanding	(I don't understand it)
It is crucial that	Must
It is doubtful that	Possibly
It is evident that <i>a</i> produced <i>b</i>	<i>A</i> produced <i>b</i>
It is generally believed	Many think
It is my understanding that	I understand that
It is often the case that	Often
It is suggested that	I think (or) Smith thinks
It is worth pointing out in this context that	Note that
It may be that	I think
It may, however, be noted that	But
It was observed in the course of the experiments that	We observed
Join together	Join
Lacked the ability to	Couldn't

Large in size	Large
Larger in size	Larger
Let me make one thing perfectly clear	(A snow job is coming)
Majority of	Most
Make reference to	Refer to
Met with	Met
Militate against	Prohibit
Modifications	Changes
More often than not	Usually
New initiatives	Initiatives
No later than	By
Of great theoretical and practical importance	Useful
Of long standing	Old
Of the opinion that	Think that
On a daily basis	Daily
On account of	Because
On behalf of	For

On no occasion	Never
On the basis of	By
On the grounds that	Since, because
On the part of	By, among, for
On those occasions in which	When
Our attention has been called to the fact that	We belatedly discovered
Owing to the fact that	Since, because
Perform	Do
Place a major emphasis on	Stress
Pooled together	Pooled
Presented to or with	Had
Presents a picture similar to	Resembles
Previous to	Before
Prior to	Before
Quantify	Measure
Quite a large quantity of	Much
Quite unique	Unique
Rather interesting	Interesting
Red in color	Red
Referred to as	Called
Regardless of the fact that	Even though
Relative to	About
Resultant effect	Result
Root cause	Cause
Serious crisis	Crisis
Should it prove the case that	If
Small in size	Small
Smaller in size	Smaller
So as to	To
Subject matter	Subject
Subsequent to	After
Sufficient	Enough
Symptomatology	Symptoms
Take into consideration	Consider
Terminate	End

The great majority of	Most
The opinion is advanced that	I think
The predominant number of	Most
The question as to whether	Whether
The reason is because	Because
The vast majority of	Most
There is reason to believe	I think
They are the investigators who	They
This result would seem to indicate	This result indicates
Through the use of	By, with
To the fullest possible extent	Fully
Transpire	Happen
Ultimate	Last
Unanimity of opinion	Agreement
Until such time	Until
Utilization	Use
Utilize	Use
Utilized	Used
Utilizes	Uses
Very unique	Unique
Was noted to have	Had
Was of the opinion that	Believed
We have insufficient knowledge	We don't know
We wish to thank	We thank
What is the explanation of	Why
With a view to	To
With respect to	About
With the exception of	Except
With the possible exception of	Except
With the result that	So that
Within the realm of possibility	Possible

Spend a few minutes with your word processor's search features. If you've written anything on the left of the table, replace it with what's on the right. Bam! Your paper just got better.

For our next trick, here are some words and phrases you can just plain delete: actual, actually, exceptionally, in a very real sense, interestingly, it is of interest to note that, needless to say, quite, rather, really, the point here is that, truly, very.

Feel free to add your own words to these lists.

I also have a list of words I commonly misuse or overuse. Some authors, for example, confuse “then” with “than” when they write even though they really know better. I tend to type “that” far too often. If you’ve got some examples from your own writing, let your word processor hunt them down. After you finish writing and when you are self-editing, of course.

If you’ll do that, your editor will thank you. Instead of being distracted by such silliness, he can concentrate on improving what matters about your paper.

If the editor you send your paper to is in fact an Acquisitions Editor at a peer-reviewed journal, that’s even better. Most of the papers he’s reading won’t be so “ready to read” because many authors don’t do the simple steps I’ve just described. That just increased your chances of publication.

Speed bumps. Acquisitions Editors generally don’t start reading again. They’re swamped in other manuscripts.

### The Passive Voice

Which is better?

- The passive voice is a grammatical construct that you should not use.
- You should not use the passive voice.

We can see which one has the smaller word count and is easier to say without pausing for breath. It's also the one where the words strike you as being "in order." The doer (subject), what he's doing (verb), what he's doing it to (object).

But in fact, neither one is 100% correct. Writing should be *mostly* in the active voice, for ease of writing and ease of understanding. A paper written entirely in the passive voice would be difficult to read and remember, and it'd probably put a reader to sleep.

*Passive (weak):* An appendectomy was performed.

*Active (better):* We performed the appendectomy.

*Passive (weak):* The thigh is then abducted and the "clunk" of the femoral head reduction is felt.

*Active (better):* Abduct the thigh to feel for the "clunk" of the femoral head reduction.

HOWEVER, there are times when the passive voice is appropriate. I'll move away from my fiction-writing background and compromise with you a little bit on that.

So when is the passive voice appropriate and useful? When you need to emphasize the action or object of action rather than the doer. Like in these examples:

*The patient has been shot in the abdomen.*

In this case, who did the shooting is not relevant medical information. If you're the surgeon, all you care about is the wound.

*An 18-gauge needle is inserted through the skin wound and advanced through the renal parenchyma.*

The emphasis here is on method. These words are teaching somebody how to do a medical procedure, so all you care about is the procedure.

Well, honestly, I might write "Insert an 18-gauge needle through the skin wound and advance it through the renal parenchyma" because it's still emphasizing the method rather than the doer, but you get the idea.

### Article Format

1) **Title.** A good title catches the reader's attention and makes him want to read the article. It tells the reader what the article is about. I've also found that it's damn hard to write a good one, and that it's one of the last things I do.

Most effective titles are fewer than ten words. Think of it as a label. Leave out nonessential words and phrases such as "report on," "pilot study," "assessment of," and similar descriptors.

Phrased another way, think of Google keywords. If you wouldn't ask Google to find a word, try to leave that word out of your title.

*Excess words:* Report on the Destruction of Renal Calculi by Use of  
Ultrasound

*Better:* Ultrasonic Destruction of Kidney Stones

That's an example from SPEAKING & WRITING FOR THE PHYSICIAN by LT Staheli, Raven Press, 1986. "Report on the" and "by use of" are obviously wasted words. The second example looks more "active" to me even though, grammatically, it isn't.

The choice between “renal calculi” and “kidney stones” is perhaps a case of deciding which phrase a searcher might use. I can’t answer that without knowing more about your target reader.

*Excess words:* Prior Study to Access the Incidence of Coronary Artery Disease in a Group of High School Football Coaches

*Better:* Coronary Artery Disease in High School Football Coaches

“Prior study to access the incidence of.” Wow. Guess what? That was a published article, and I’d call it an important one. But what a long title. “In a group of” is also a mouthful of nothing.

In one of my lectures, we discussed an alternate title such as “Artery Disease in High School Football Coaches *in Thailand*.” If the country-specific nature of the data is a factor, my instincts say to mention that. But a few years after my lecture series, an engineering journal told one of my authors to *never* mention the location of a study.

Obviously, your target publication’s guidelines always override anything you read here or anywhere else.

2) **Introduction.** Start with a strong opening sentence to set the tone of your paper. Staheli gives us this example:

*Is the busy executive more likely to die prematurely from coronary artery disease?*

The title grabs the reader’s attention. The abstract gives him a better idea of what to expect. If he’s still reading, a good introduction will keep him interested and keep him reading. It’ll tell him why you wrote the paper. It’ll present the purpose and scope of the paper and provide any background information he needs. It can range from a few sentences to a page or two, depending on the nature and complexity of the study.



Write your introduction in the present tense, because you're giving established and accepted information.

3) **Materials and Methods.** This is where you explain how you conducted your study. Write it in the past tense.

Include source of data, method of organization, and system of analysis. Give the reader enough information to assess the validity of your study and repeat your method if he wants to. If your method is well established, this section can be relatively short. Otherwise more detail will be needed.

4) **Results.** Present your data or results in a straightforward, factual manner, without commentary or interpretation. This is the heart of your paper. Summarize your data in the most complete and efficient manner possible.

Write this section in the past tense. Tables and figures can be a big help in clarifying your data presentation.

5) **Discussion.** "So what? Why do your findings matter?" Answer that here. This is also where you speculate and theorize. Spark the reader's imagination. I think of this as the "fun" part of writing.

Write this in the present tense, because your findings are now established scientific knowledge. Ain't that cool?

6) **Summary and Conclusion.** The purpose of this section has evolved over the years, so check the policy of the journal you're submitting the paper to. You might just need to restate your main thesis and summarize your findings and conclusions, or perhaps make recommendations for further research or application of your findings.

7) **Abstract.** Most journals now include an abstract, and to a degree the abstract has replaced part of the summary and conclusion's old job. It provides an overview of your findings and should stimulate reader interest.

Abstracts are frequently reprinted in other journals or entered into computer literature retrieval systems, so they must be able to stand alone. In other words, this might be the only part of your paper some people read. Some websites let readers read the abstract free, and charge money for the rest of the paper.

Write the abstract last, after the rest of your paper is ready to send to a journal. Write it carefully, and revise it to get your word count as low as you can. An abstract should concisely state the purpose, methods, results and significance of the study. Use short sentences and active verbs for brevity, clarity, and impact.

Abstracts usually range from 100 to 200 words, but length varies with the journal. Check length requirements in the "Instructions to Authors" page and stay within the suggested word maximum.

Write your abstract in the past tense.

### Be Your Own Editor

As we near the end of this manuscript, I'm ready to acknowledge that not everybody reading or writing scientific papers is doing it in his or her native language. Anyone who writes in a second language impresses the heck out of me, too. I struggle in English. No, seriously. I've got a mathematical mind. Maybe you do too, since you're writing a scientific paper. To compensate, let's remember Mr. Spock. He uses English with the precision of a scientific instrument, and it's not his first language either.

*Be Your Own Editor* is the title of an essay from THORNE'S BETTER MEDICAL WRITING. It was the only one aimed specifically at non-native English writers. And yet, about 98% of the advice he gives applies to all writers

regardless of topic or language. I'm gonna quote the bits that gave me the strongest urge to just jump up and shout *Hell yeah!*

First, though, I'll briefly answer a question that was asked at every lecture. No, you should not write your paper in your native language. Write in English. Think in English. Adhering too closely to a document in another language will contort your thinking and your wording. Unless, of course, the only way you *can* write is to do it in your native language and then translate. I don't advise it, but if the other choice is not to write at all, well, go ahead, and good luck.

Here's what I swiped from the essay called *Be Your Own Editor*:

I now believe that much of what I do can be done by the author, either by himself or in collaboration with an interested colleague. If the colleague will ask the author to explain exactly in his own words what he means by each sentence, and even each word, the article will become steadily shorter and clearer as unnecessary words are crossed out and simple words and constructions replace complicated ones.

Articles that have had this time-consuming treatment, sometimes more than once, are much easier for an editor to accept and for a language supervisor to make sound English without changing the meaning.

I try to make it clear that my changes are only suggestions, not Holy Writ, and I make them in pencil so that they can be rubbed out if the author disagrees with them. At the same time I do not hesitate to comment on the length, the layout, or the logic. I am also convinced that articles by English and American authors would *invariably* benefit from scrutiny by colleagues. Not only articles but many expensive medical books are far too long and turgid to read because they get no such treatment from their authors or publishers.

I appreciate that many articles submitted in English have been written in another language and then translated. The “colleague treatment” can be applied to the draft in the original language and, if possible, to the English translation also.

The pencil. I love that. I still write with pen and paper, but I’m old. I bet you start on the computer. And regardless of how you start, you send your paper to an editor over the Internet or on a USB drive. He fires up Word with its bad-ass Tracking feature and marks the changes so that you can Accept/Reject/Ignore and ask him why. See, it ain’t Holy Writ.

(If you don’t know what Tracking is, download the free tutorial from <http://www.michaeledits.com> because Tracking is excellent.)

The colleague treatment. That sounds suspiciously similar to something I wrote earlier. Cool.

## Ways To Improve Your English

### Listening

- Follow TV and radio news in both your native language and in English. Understanding the ideas in your native language first will help you understand the English.
- Listen to songs in English.
- Watch films in English with English subtitles.
- Practice communicating with your friends in English.

### Speaking

- Learn the words to English songs and sing.
- Practice with English cassettes, CDs or internet sites.
- Read aloud (articles, stories, dialogues, film scripts).
- Watch English films and read the dialogue aloud from the subtitles.
- Talk to yourself in English.
- Talk to your friends in English.

- Make an “interest group” with friends/colleagues/classmates to speak in English while you do something you enjoy together (singing, eating, exercise, playing cards...).

### Reading

- Read about topics that interest you in English (e.g. sports, fashion, business...) in newspapers, library books or on the internet.
- Follow the news in both your native language and in English. Understanding the ideas in your native language first will help you understand the English.
- Read simple, modern short stories and novels in English.
- Read letters and emails from your friends in English.

### Writing

- Keep a diary in English. Just write freely about whatever you like. This helps you “think in English” more easily.
- Email or write notes to your friends in English.
- Write a song or a poem.
- Write the story of your life: past, present and future.
- Join an internet e-group and communicate with people who share your interests from all over the world.
- Chat in English on the internet with people from other countries.

Yeah, we’re wrapping this up with something for the non-native English speakers. Why not?

There’s nothing new on that list. But maybe you haven’t seen all those suggestions in one place before. I think this list is excellent. And do you know why that is? Because I didn’t write it. My lovely wife did.

Don’t do all that stuff, of course. Just pick one or two things from each skill set, something that interests you, and go for it. Every day.

“Michael,” I have been asked in many lectures and classrooms. “How can I improve my English?” As if I’ve got a secret formula or a magic pill or something.

You learn your second or third language the same way you did your first one. Surround yourself with it. That can be challenging if you're trying to learn Xhosa in Hanoi or whatever, but find a way. Practice every day.

Hey, that's how you learn to write better, too. Practice.

What I like to note, though, is that all writers are going to face many challenges. Non-native English authors are simply facing one more than the rest of us.

Write on.

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## Bibliography

- Bond JF. WAYS TO IMPROVE YOUR ENGLISH. [EnglishTeachingLive.com](http://EnglishTeachingLive.com).
- Goodman NW, Edwards MB. MEDICAL WRITING - A PRESCRIPTION FOR CLARITY. 2nd Edition. Cambridge University Press. © 1997.
- Huth EJ. HOW TO WRITE & PUBLISH PAPERS IN THE MEDICAL SCIENCES. 2nd Edition. Williams & Wilkins. © 1990.
- Lock S. THORNE'S BETTER MEDICAL WRITING. Pitman Medical Publishing. © 1977.
- Staheli LT. SPEAKING & WRITING FOR THE PHYSICIAN. Raven Press. © 1986.