



**INSTITUTE OF AERONAUTICAL ENGINEERING
(AUTONOMOUS)
Dundigal, Hyderabad- 500 043**



ENGLISH FOR RESEARCH PAPER WRITING
(Course Code : BCSB32)
Regulation: IARE-R18
M.Tech I Semester

Prepared By
M. Suguna Sri, Assistant Professor
Dr. K Shruthi, Associate Professor

UNIT I

PLANNING AND PREPARATION

Planning and preparation

To write a well-structured paper in good clear English you need to have a method. If you don't have a good method you may waste a lot of time having to re-plan and re-write entire sections of your paper

Reading this chapter should enable you to have clear preliminary ideas regarding:

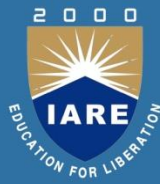
what journals are looking for (also in terms of English)

- standard phrases used in English in research
- how a typical paper is structured in your field
- what makes your research unique
- what referees' expectations may be

This chapter analyses the benefits for you of publishing your research and suggests various approaches for

- Choosing the right journal and understanding what the editor expects from a paper in terms of content, style, and structure
- Deciding the order in which to write the various sections (Introduction, Methods etc)
- Keeping the referees happy

Why should I publish? How do I Know whether my research is worth publishing?



You will be more motivated to write a good paper, if you have thought about exactly why you want to have your research published. One of your reasons will probably be because you believe you can make a contribution to a gap in the current knowledge base of your field. It helps if you can write down concisely what this contribution is, and then double check that your proposed contribution really is original

Which Journal should I choose?

An impact factor is a measure of how prestigious a journal is. The higher the impact factor, the more widely read the journal is, and the more likely other researchers will cite your paper. Tables of impact factors which rank all the peer-reviewed journals in the world are available on the Net, you can use Google Scholar to help you find them.

How can I know exactly what the editor is looking for?

The guidelines include: types of titles that are acceptable

- Structure of paper – for example, is the review of the literature near the beginning of the article or at the end? Are the Results included in the Discussion or in a separate section? Is there a Conclusions section?
- Layout (including how the Abstract should be presented – one long paragraph, or 5–6 short paragraphs)
- Structure of sections - some journals prescribe exactly how certain sections (most commonly the Discussion) are organized, and what subheadings should be included use of passive rather than personal style (*we, I*) how to make citations
- How to arrange the bibliography
- Use of key words
- American or British spelling

What preparation do I need to do?

Then you can fill in your table with brief notes for each of the papers you have analyzed. This analysis should help you to:

1. write your own literature review, because after this analysis you will be very familiar with the literature
2. Identify the differences in other researchers' approaches and results compared to your research
3. Note down the strengths and weaknesses (including possibly bias) in the work of others

How can I create a template?

Choose one paper that is close to your topic that is written by a native english speaker . Use this paper as a model into which you can paste your own research

Notice how your model paper is structured:

- how does the author begin?
- what points does s/he make in each section?
- how does s/he link paragraphs together?
- how does s/he connect the Results with the Discussion?
- how does s/he present the Conclusions?

In what order should I write the various sections?

A typical order

Abstract

Methods

Results

Discussion

Introduction

Conclusions

Abstract(final version)

Structuring a Sentence: Word Order

- Place the various elements in your sentence in the most logical order possible: don't force the reader to have to change their perspective
- Place the subject before the verb
- Don't delay the subject
- Keep the subject and verb close to each other
- Avoid inserting parenthetical information between the subject and the verb
- Don't separate the verb from its direct object
- Put the direct object before the indirect object
- Don't use a pronoun (it, they) before you introduce the noun that the pronoun refers to
- Locate negations near the beginning of the sentence
- Locate negations before the main verb, but after auxiliary and modal verbs
- State your aim before giving the reasons for it .

Structuring Paragraphs

- First paragraph of a new section – begin with a mini summary plus an indication of the structure
- First paragraph of a new section – go directly to the point
- Choose the most relevant subject to put it at the beginning of a sentence that opens a new paragraph
- Deciding where to put new and old information within a sentence
- Deciding where to put new and old information within a paragraph
- Try to be as concrete as possible as soon as possible
- Link each sentence by moving from general concepts to increasingly more specific concepts
- Present and explain ideas in the same (logical) sequence
- Use a consistent numbering system to list phases, states, parts etc.
- Break up long paragraphs

Breaking Up Long Sentences

- Analyse why and how long sentences are created
- Using short sentences will help your co-authors if they need to modify your text
- Using short sentence often entails repeating the key word, thus improving clarity
- Only use a series of short sentences to attract the reader's attention
- Combine two short sentences into one longer sentence if this will avoid redundancy
- When expressing your aims, consider dividing up a long sentence into shorter parts
- If possible replace and and as well as with a period (.)
- Be careful how you use link words
- Avoid which and relative clauses when these create long sentences
- Avoid the – ing form to link phrases together
- Limit the number of commas in the same sentence .

Breaking Up Long Sentences (contd....)

Write your first draft without thinking too much about the length of the sentences. Then

1. look for long sentences
2. read them aloud

If you have to inhale, you need to divide up the sentence. Here are some general rules:

- Do NOT write a long series of sentences of only 5–15 words.
- Occasionally use short sentences to attract attention (particularly in the Abstract and Discussion).
- Generally speaking, avoid sentences of more than 35 words.
- Clarity and readability are independent of sentence length.

Your main aim is to maintain readers' interest so that they continue reading.

If your sentence contains one or more of the following, you probably need to divide it up:

- which + which
- and + and + and
- also + in addition / furthermore

Being Concise and Removing Redundancy

- Write less and you will make fewer mistakes in English, and your key points will be clearer
- Cut individual redundant words
- Consider cutting abstract words
- Avoid generic + specific constructions
- Reduce the number of link words
- When connecting sentences, use the shortest form possible
- Choose the shortest expressions
- Cut redundant adjectives
- Cut pointless introductory phrases
- Prefer verbs to nouns
- Use one verb (e.g. analyze) instead of a verb+noun (e.g. make an analysis)
- Be concise when referring to figures and tables
- Use the infinitive when expressing an aim
- Be concise even if you are writing for an online journal

Avoiding Ambiguity and Vagueness

- Place words in an unambiguous order
- Beware of pronouns: possibly the greatest source of ambiguity
- Restrict the use of synonyms to non-key words
- Don't use technical / sector vocabulary that your readers may not be familiar with
- Be as precise as possible
- Choose the least generic word
- Use punctuation to show how words and concepts are related to each other
- Defining vs non-defining clauses: that vs which / who
- Clarifying which noun you are referring to: which, that and who
- -ing form vs that
- Avoiding ambiguity with the – ing form : use by and thus
- Referring backwards: the dangers of the former, the latter
- Distinguishing between both ... and, and either ... or
- Differentiating between from and by

Avoiding Ambiguity and Vagueness(contd....)

- False friends

False friends are words from two different languages that look very similar but have different meanings. The most common of these is actually , which in English means in reality , but its false friend in other languages means currently / at the moment .

Another false friend, which frequently appears in research, is to control which does not mean verify .

Here is the difference:

S1. A thermostat is used to control the temperature. [i.e. adjust, act on]

S2. We checked the patient's temperature with a thermometer. [i.e. verify without any intervention]

Avoiding Ambiguity and Vagueness(contd....)

- Be careful of typos

What impression would a referee have if he/she read the following?

S1. There are three solutions to asses .

S2. A solution of lead was added to the mixture.

Note: this addiction is likely to cause health problems.

S3. Acknowledgements: We would like to offer our tanks to the following people:

The author meant to write assess (asses = donkeys), addition (addiction = pathological dependence), and thanks (tanks = armored vehicles). No spell checking system currently available is likely to spot such mistakes.

UNIT II

ABSTRACT

Clarifying Who Did What

In various sections of your paper, you need to compare your methodology or results with what has already been established in the literature. You must make it 100% clear to the reader whose methodology or results you are talking about. If you don't, you will make it difficult for the referee to:

- identify your contribution
- decide how useful the contribution is
- make a decision as to whether this contribution is worth recommending for publication

For example, if you say *It was found that $X = 1$* , the referee needs to know whether you found that $X = 1$, or whether another author made this finding.

This chapter shows you how to make such distinctions.

Check your journal's style – first person or passive

Check your journal's 'guidelines to authors' to see whether you are permitted to use *we*. *If you can use 'we' then it is relatively easy for you to distinguish between your work and others.* Some journals, particularly those regarding Physics, tend to opt for an impersonal form in the belief that science is independent of the person writing about it. This entails adopting a lower profile and using the passive form.

How to form the passive and when to use it Active: *We performed two tests. Blake et al. carried out one replication.* Passive (*is / was / will be etc. + past participle*): *Two tests were performed (by us). One replication was carried out by Blake.* Use the active form when the passive might be ambiguous. Consider starting a new paragraph to distinguish between your work and the literature.

Make good use of references

ORIGINAL VERSION (OV)

Measurements (1) *were made* of the speed with which bilingual adults performed simultaneous translations of politicians' speeches because politicians tend to use formal language [Anderson and Wordsworth, 2008]. (2) *Similar tests* with Nobel prize winners' acceptance speeches gave similar values of speed. This finding strongly suggests that formal language represents an easier element for translation than informal language. The performance of teenagers (3) *in analogous situations* also confirms the above finding. Considering that informal language, in particular slang, (4) *intensifies* the stress levels of subjects undertaking simultaneous translation (5) *the lack of changes in stress levels* of the bilingual adults with respect to bilingual teenagers when simultaneously translating extracts from a teenage soap opera, would seem to indicate that experience plays an important role. Consequently, stress levels in bilingual subjects *tend* (6) to decrease with age.

REVISED VERSION (RV)

In a previous paper [Anderson and Wordsworth, 2008] we made measurements of the speed with which bilingual adults performed simultaneous translations of politicians' speeches. We chose politicians because it is well known that they tend to use formal language. In the same study [Anderson and Wordsworth, 2008] we conducted similar tests with Nobel prize winners' acceptance speeches, which gave similar values of speed. These two findings strongly suggest that formal language represents an easier element for translation than informal language. The performance of teenagers in analogous situations also confirms the above finding [Williams, 2009]. Williams found that informal language, in particular slang, intensifies the stress levels of subjects undertaking simultaneous translation.

Therefore the lack of changes that we found in our present research in the stress levels of bilingual adults with respect to bilingual teenagers when simultaneously translating extracts from a teenage soap opera, would seem to indicate that experience plays an important role. As a consequence of our latest findings, we conclude that stress levels in bilingual subjects tend to decrease with age.

Ensure that readers understand what you mean when you write *the authors*



Another problem arises when in consecutive sentences you describe your results in relation to the results of two or more authors. In S1, it is not clear who *these authors* refers to.

S1. *Our results agree with those on bilingual teenagers in Scandinavian countries by Magnusson et al. (2011), and those from the Middle East by Hussein et al. (2009), who used middle school and high school pupils; *these authors ruled out the existence of...*

These authors could refer to both Magnusson's group and Hussein's group, or just one or the other. If there is a possibility of ambiguity it is always best to specify the author again. In any case, S1 is very long and would be better written as S2.

S2. Our results agree with those obtained on bilingual children in Scandinavian countries by Magnusson et al. (2011). They also agree with studies in the Middle East by Hussein et al. (2009), who used middle school and high school pupils. Hussein et al. ruled out the existence of...

What to do if your paper is subject to a 'blind' review

Consequently, you should avoid giving any clues as to who you are. So if your name is John Doe, in your draft version you should not write a sentence

such as:

S1. In a previous paper (Doe et al, 2017) we demonstrated that ...

S1 would make it clear to the referees that you are John Doe and thus defeat the objective of a blind review. Instead you could write:

S2. Doe et al (2017) demonstrated that ...

However, when the paper has been accepted for publication, you should change all such sentences to the personal form (S1) so that you enable the reader to understand that when you write *Doe et al* you are in fact referring to your own work.

Highlighting Your Findings

1) Are you guilty of the faults identified by these two referees?

Given that the focus of this paper is on an ‘innovative methodology’, the author needs to make more effort to clarify what makes his / her approach special. I truly believe that the author is making a useful contribution but I reached that conclusion only by reading between the lines .

I have the strong feeling that the authors have overstated the achievements and the significance of their project, and thus may be guilty of bias. I recommend that they check all their data again to ensure that their conclusions are valid for all the results they obtained, rather than just a subset of them.

2) What ways can you think of to highlight your findings?

Your findings may be extremely valid and important. However, if the referees are not able to see or understand your findings because you have neither highlighted nor described them clearly enough, then your paper may not be published. Your contribution to the community may thus vanish into oblivion.

Show your paper to a non-expert and get him / her to underline your key findings



A great way of discovering how explicit you have been in presenting your key findings is to show a non-expert your paper. Ask them to underline where they think you have introduced / discussed your key findings. This task should be possible even for someone who knows very little about your topic. If they fail to underline your key findings, then you know that you need to highlight your key findings even more.

If you want to be more thorough, you could get the same person also to find places where you discuss the implications and limitations of your research – along with your findings these two are key elements that should stand out clearly for the reader

(contd....)

Avoid long blocks of text to ensure that referees (and readers) can find and understand the importance of your contribution

ONE LONG PARAGRAPH

This is one ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive. This is one ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive. This is one ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive. This is one ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive. Here are my findings you will be lucky if you can see them here buried in the midst of this ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive. And now I will continue with this ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive. So here we go again with this ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive. This is one ridiculously long paragraph containing all kinds of information about everything that you can possibly imagine and conceive.

THREE SHORTER PARAGRAPHS

This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.

Here are my findings, which you can now see quite clearly. Note how this paragraph is also quite short. In fact, it is shorter than the previous and following paragraphs.

This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph.
 This is now a much shorter paragraph..

(contd....)

Compare these two versions of the same text. This time read the texts.

READERS MAY OR MAY NOT NOTICE YOUR FINDINGS

The results showed that tourists in front of important monuments who take selfies using selfie sticks and those who drop litter have an equivalent negative empathy value suggesting that such people should be considered under the category of 'majorly selfish'. Additional observations support our view: i) subjects of the selfie group had a mean lag time of 30.3 seconds between arriving at the monument and the onset of the need to take a photograph of themselves. ii) The mean time of the litter group between arrival and dropping cans and food packages was aligned with the expected response from the selfie group to being given a warning by the monument guards. iii) The MEMEME ego ratio in the selfie group was compatible with a destructive form of graffiti writing, and not significantly different from that found in the can't-see-the-writing-on-the-wall group. iv) No significant differences in the recurrence rate of Kudnt Givadam Syndrome (KS) were observed between the groups.

READERS WILL NOTICE YOUR FINDINGS

The results showed that tourists in front of important monuments who take selfies using selfie sticks and those who drop litter have an equivalent negative empathy value, thus suggesting that such people should be considered under the category of 'majorly selfish'.

Four additional observations support our view.

Firstly, subjects in the selfie group had a mean lag time of 30.3 seconds between arriving at the monument and the onset of the need to take a photograph of themselves. Secondly, the mean time of the litter group between arrival and dropping cans and food packages was aligned with the expected response from the selfie group to being given a warning by the monument guards.

Thirdly, the MEMEME ego ratio in the selfie group was compatible with a destructive form of graffiti writing, and not significantly different from that found in the can't-see-the-writing-on-the-wall group.

Fourthly, no significant differences in the recurrence rate of Kudnt Givadam Syndrome (KGS) were observed between the groups.

Construct your sentences to help the reader's eye automatically fall on the key information

On what part of S1 does your eye fall?

S1. The goal of the service discovery is twofold: (i) allow devices to advertise the services they provide. and (ii) allow the clients to find the services they need.

Your eye probably falls on this part: *twofold: (i) allow*

This is because our eye falls on those parts of a sentence that are different from others:

- punctuation marks – particularly brackets, colons, exclamation marks and question marks given that these are less frequently used than commas
- white spaces, for example after a full stop (period) or between paragraphs
- numbers
- capital letters

Consider using bullets and headings

We tend to notice bullets (bulleted or numbered) more than blocks of text. So if your journal’s style guide allows, occasionally use bullets to summarize important points. You need to follow certain conventions when using bullets. The most important is that each bullet begins with the same grammatical part.

ORIGINAL VERSION (OV)	REVISED VERSION (RV)
<p>Equation 2 is the main result of our study. It can be used:</p>	<p>Equation 2 is the main result of our study. It can be used to:</p>
<ul style="list-style-type: none"> ▪ in numerical codes to evaluate the impact of the presence of anomalies in the various samples taken 	<ul style="list-style-type: none"> ▪ evaluate in numerical codes the impact of the presence of anomalies in the various samples taken
<ul style="list-style-type: none"> ▪ for simple estimates when designing experiments 	<ul style="list-style-type: none"> ▪ make simple estimates for designing experiments

(contd....)

In review papers and book chapters, use lots of headings. Use tables and figures to attract attention. When you have something really important to say, make your sentences shorter than normal.

ORIGINAL VERSION (OV)

The method developed in this work relies on a sample pre-treatment that allows a low final dilution, *guaranteeing, on the other hand*, a negligible shift of pH with regard to different specimens to be tested (± 0.15 units from 23 samples tested); *however, the slight shifts* of pH do not alter the response of the test, *as shown* by the overlapping of standard curves obtained by spiking buffers at different pH with IGF-1.

REVISED VERSION (RV)

Our method relies on a sample pre-treatment that only requires a minimal level of dilution. *In addition, it guarantees* a negligible shift in pH with regard to the different specimens to be tested (± 0.15 units from 23 samples tested). *Importantly*, the slight shifts in pH do not alter the response of the test. *This is revealed* by the overlapping of standard curves obtained by spiking buffers at different pH with IGF-1.

(contd....)

- Present your key findings in a very short sentence and list the implications
- Remove redundancy
- Think about the types of words that attract attention
- When discussing key findings avoid flat phrases
- Consider avoiding the use of phrases containing *note* and *noting*
- Be explicit about your findings, so that even a non expert can understand them
- Convince readers to believe your interpretation of your data
- Beware of overstating your project's achievements and significance

Hedging and Criticising

Why and when to hedge

Hedges are central to academic argument and are abundant in research articles. Because they withhold complete commitment to a proposition they imply that a claim is based on plausible reasoning rather than certain knowledge. This protects the writer against being proved wrong while recognizing alternative ideas on the subject. Professor Ken Hyland, Director, Centre for Applied English Studies and Chair of Applied Linguistics, University of Hong Kong

Hedging entails anticipating possible opposition by your referees and readers by not saying things too assertively or directly. A hedge was originally a fence or boundary delimiting an area of land – it was thus a form of protection from outsiders. Today, hedge has a metaphorical meaning – you protect yourself against some risk.

(contd....)

Some referees might interpret these as being arrogant because the authors leave no room for doubt. In S1 can they be sure that this is the *first attempt*? *Have they read* all the literature from all the world? In S2 they are only talking about their interpretation of their results that came from their sample – they cannot be sure that other researchers will not have a different interpretation or draw different conclusions from a different sample.

S3. Although many authors have investigated how PhD students write papers, *we believe / as far as we know / to the best of our knowledge this is the first attempt to systematically analyze* all the written output (papers, reports, grant proposals, CVs etc.) of such students.

S4. Our results *would seem to demonstrate that students from humanistic fields produce more* written work than students from the pure sciences and *this may be due to the fact that* humanists are generally more verbose than pure scientists. Obviously you don't need to 'hedge' every time you use the verbs *show, demonstrate, reveal etc.*

(contd....)

S5 would be better rewritten as one of the following:

S6. Our results would seem to indicate that dogs are more intelligent than the cats.

S7. A possible conclusion would be that dogs ...

S8. Our results may be a demonstration that dogs ...

S9. At least in terms of our sample, dogs appeared to be more intelligent ...

The examples in this subsection highlight that hedging often simply involves:

- adding a few words before making your claim: e.g. *we believe (S3), would seem to (S4, S6)*
- adding an adjective or adverb: e.g. *possible (S7), generally (S4)*
- replacing verbs that indicate 100% certainty, for example *prove, demonstrate is (and other forms of the verb to be) with may be (S4, S8).*

Highlighting and hedging

Highlighting and hedging are not contradictory skills, in fact they should be used hand in hand.

Highlighting means, for example:

- helping the reader to see your findings on the pages of your manuscript (e.g. not hiding key findings in the middle of a long paragraph)
- using shorter sentences when giving important information
- using more dynamic language when drawing attention to key findings than when talking about standard issues

You can do all the above and still hedge where appropriate.

S1. This is a very important finding.

S2. These results suggest that this is a very important finding.

Toning down verbs

Toning down adjectives and adverbs

Inserting adverbs to tone down strong claims

Toning down the level of probability

Saving your own face

Plagiarism and Paraphrasing

Plagiarism is not difficult to spot

Plagiarism is very easy to identify, particularly in papers written by non-native speakers. Plagiarism is particularly evident if you copy phrases from the Internet that contain examples of non-scientific English (e.g. that come from advertisements describing the technical features of a product) or that contain the second person pronoun 'you'. There are many different forms / registers of English (e.g. scientific, commercial, colloquial), and you should not mix them. The problem is that you may not be able to recognize which register a text is in.

I revise a lot of research papers from my PhD students. Sometimes I read a paragraph that contains a considerable number of mistakes in the English (grammar, vocabulary, spelling etc.) and then suddenly there is a sentence written in perfect English! If I then Google the sentence, I very frequently discover it comes from a published paper.

You can copy generic phrases

How to quote directly from other papers

(contd....)

How to quote from another paper by paraphrasing

Let us now compare the versions.

	WOOD'S ORIGINAL VERSION (S1)	PARAPHRASED VERSIONS (S2 AND S3)
(1)	owners	belongs
(2)	International scientific English	International scientific English
(3)	international scientists	everyone in science the whole scientific community
(4)	not Englishmen or Americans	not just ... native English speakers

(contd....)

Paraphrasing the work of a third author

Paraphrasing: a simple example

Albert Einstein has been quoted as saying: *The true sign of intelligence is not knowledge but imagination.* How could you paraphrase Einstein's quotation? [NB: 1935 in the examples below is just my guess as to the year when Einstein made his claim].

synonyms

verbs: Einstein proposed / suggested / stated / found / revealed that ... (1935).

nouns and verbs: A clear indicator of someone's power of intellect is not how much they know but how well their imagination functions (Einstein, 1935).

active to passive

It has been claimed / proposed / suggested / stated / found / revealed that ... (Einstein, 1935)

(contd....)

Note how the three key words – *intelligence, knowledge and imagination* – *have not* been paraphrased into words such as *smartness, knowhow or fantasy* . *None of these* three words are exact synonyms and they do not have the same semantic roots. It is important that key words remain as they are. However saying *power of intellect and how much they know* is approximately equivalent to saying intelligence and knowledge and is thus probably acceptable. The words that can be paraphrased are the more generic words such as *indicator for sign*.

Paraphrasing: how it can help you write correct English

Paraphrasing avoids:

- plagiarism (at least to some extent)
- repetition of phrases within your paper (e.g. not repeating sentences in the Conclusions that you already wrote in the Abstract)

But paraphrasing is also very useful when you are not sure that a sentence you have written is correct English. You can simply paraphrase the sentence using a form that you know is correct. A great rule for writing in English is: "Only write what you know is correct".

(contd....)

Plagiarism: A personal view

It is easy to become obsessed by plagiarism, particularly given that you can be 'discovered' by software.

But there is a danger that the anti-plagiarists become unnecessarily rigid.

In my view, plagiarism is unacceptable under three main circumstances:

- plagiarism of others: when you try to deceive editors and readers that some findings are yours when in reality they are someone else's and you have made no attribution to the original author
- quoting directly from another author (and referencing the quotation), but regarding a context that the original author did not intend. This is known as 'quoting out of context', i.e. where someone doesn't report fully what the 'author' meant but just uses a particular part of what was said in order to make a completely different point.
- self-plagiarism: when you try to publish essentially the same paper in more than one journal

Sections of a Paper

Titles

Titles:

1. An in-depth investigation into the overall possibilities of becoming an Olympic medal holder vs getting a well-paid position in academia
2. Inside the right-wing brain: the right hemisphere fails to fulfill abstract reasoning skills and focuses exclusively on self promotion rather than empathy
3. In-car cellular phone usage as a car accident determinant measurement
4. Measuring the sense of humour of various nations as revealed by feedback and comments left on Facebook
5. Observations on the correlation between post office queue length and a country's GDP
6. A novel approach to spam-content determination
7. Should anyone 'own' the world? Is mass emigration a crisis or an opportunity for global integration and understanding?

(contd....)

How can I generate a title? How long should it be?

Think about the following questions:

- Which of my findings will attract attention?
- What is new, different and interesting about my findings?
- What are the 3–5 key words that highlight what makes my research and my findings unique?

On the basis of your answers you should be able to formulate a title. If your paper is not about results but proposes a particularly methodology, then your title should encapsulate why your methodology is novel and useful.

Some research has shown that 'journals which publish papers with shorter titles receive more citations per paper'. However, not all researchers have reached the same conclusion, and the best advice is probably to go for a title of intermediate length.

Other research has found that, in some fields, the amount of humour in titles has increased over the years. One thing everyone agrees on is that the title should be clear and understandable, and be a true reflection of the content of the paper.

(contd....)

Should I use prepositions in my title?

	MEANING	POOR / INCORRECT ENGLISH	GOOD ENGLISH
by	how something is done	Fast computing machines equation of state calculations	Equation of state calculations <i>by</i> fast computing machines
for	for the purpose of	Depression measuring inventory	An inventory <i>for</i> measuring depression
from	the origin of	Antonio Gramsci prison notebooks selections	Selections <i>from</i> <u>the</u> prison notebooks of Antonio Gramsci
in	where something is located, what something regards	Vertical flux of ocean particles Classical theory of elasticity crack problems	Vertical flux of particles <i>in</i> <u>the</u> ocean Crack problems <i>in</i> <u>the</u> classical theory of elasticity
of	belonging to, regarding	Reality social construction Model dimension estimation Cancer causes: cancer avoidable risks quantitative estimates	The social construction <i>of</i> reality Estimating the dimension <i>of</i> a model <u>The</u> causes <i>of</i> cancer: quantitative estimates <i>of</i> avoidable risks <i>of</i> cancer

(contd....)

Are articles (*a / an, the*) necessary?

Although a title is not generally a complete sentence, it does have to be grammatically correct. This means that it must have articles where necessary, even though this will increase the length of the title.

S1. *Survey of importance of improving design of internal systems

S2. A survey of the importance of improving the design of internal systems

S1 is not correct English. A general rule of English is that a countable noun that is in the singular must be preceded by an article. In S1, *survey is a singular countable* noun, so it must be preceded by either *a* or *the* . In S2, *a* is the correct choice because we are not referring to a survey that the reader already knows about. An example of where *the* would be necessary is in S3, which is part of a literature review:

S3. Two surveys on x have been reported in the literature: *the survey conducted by Williams* is more comprehensive than *the survey carried out by Evans*, In S3, the author is referring to specific surveys, so *the* is obligatory.

(contd....)

Should I try to include some verbs?

ABSTRACT NOUNS

The *Specification* and the *Evaluation* of Educational Software in Primary Schools

Methods for the *Comparison* of Indian and British Governmental Systems in the 19th century

A Natural Language for Problem *Solution* in Cross Cultural Communication

Silicon Wafer Mechanical Strength *Measurement* for Surface Damage *Quantification*

VERBS

Specifying and *Evaluating* Educational Software in Primary Schools

Methods for *Comparing* Indian and British Governmental Systems in the 19th century

A Natural Language for *Solving* Problems in Cross Cultural Communication

Quantifying Surface Damage by *Measuring* the Mechanical Strength of Silicon Wafers

(contd....)

**Will adjectives such as *innovative and novel* attract attention?
Is it a good idea to make my title concise by having a string of nouns?**

ORIGINAL VERSION (OV)

REVISED VERSION (RV)

Educational software specification
definitions trends

Trends in defining the specifications for
educational software

Examining narrative cinema fiction and
fact boundaries

Examining the boundaries between fiction and
fact in narrative cinema

New archaeological research and
teaching technologies

New technologies for research and teaching in
archaeology

(contd....)

How can I make my title shorter?

LONG VERB	SHORT VERB	LONG NOUN	SHORT NOUN
achieve	gain	advantages	gains, benefits, pros
apportion	allot	examination, investigation	study
calculate, evaluate	assess, rate	improvement	advance
demonstrate, display, exhibit	show	modification	change
determine	fix	LONG ADJECTIVE	SHORT ADJECTIVE
facilitate	ease	accurate	exact
guarantee	ensure	fundamental	basic
prohibit	block	important	key, top
require	need	innovative	novel, new
support	aid	necessary	needed
utilize	use	primary	main

Abstracts

What is an abstract?

An Abstract is like a mini paper. It accurately summarizes all the sections of your paper. It will be judged in isolation from the accompanying paper. Abstracts are sometimes called Summaries. Abstracts are found before a full article in a journal, standalone in databases of abstracts, and in conference programs. An Abstract generally answers at least the first three of the following questions, and generally in the following order. You can use the answers to these questions to structure your Abstract.

- Why did I carry out this project? Why am I writing this paper?
- What did you do, and how?
- What were my results? What was new compared to previous research?
- What are the implications of my findings? What are my conclusions and/or recommendations?

How important is the Abstract?

Incredibly important.

Editors may decide whether or not to send your paper for review exclusively on the basis of your Abstract.

(contd....)

Where is the Abstract located?

A typical first page of a research paper for publication in an international journal contains the following headings, generally in this order:

1. Title
2. Abstract
3. Highlights
4. Key words

Not all journals require Highlights and Key Words.

What are 'highlights'?

Some journals require you to write between three and five bullet points reporting the core findings of your paper. The 'instructions to the author' will tell you how many bullets and how many characters per bullet.

The Highlights are generally located immediately below the Abstract and immediately above the Key Words.

(contd....)

How should I select my key words?

In most journals, directly below the Abstract there is a list of key words. These are for indexing purposes and will help your paper be identified more easily and thus cited more frequently. Ensure you check with your journal's 'instructions to authors' to see how many key words to include, and whether or not these can also be words that appear in the title of your paper.

Why should I download the instructions to the author? Isn't it enough to check how other authors for the same journal have structured their abstract?

You cannot tell from looking at a published abstract in your journal of choice exactly what the editors want and do not want. This information can only be obtained by downloading the journal's "instructions to authors".

What style should I use: personal or impersonal?

There are four possible styles for writing abstracts and papers:

style 1 I found that $x = y$.

style 2 We found that $x = y$.

style 3 It was found that $x = y$.

How can I assess the quality of my Abstract?

To make a self-assessment of your Abstract, you can ask yourself the following questions.

- Have I followed the journal's instructions to authors? Have I followed the right structure (i.e. structured, unstructured) and style (*we vs passive*)?
- Have I covered the relevant points from those below?
 - background / context
 - research problem / aim – the gap I plan to fill
 - methods
 - results
 - implications and/or conclusions
- Is everything mentioned in the Abstract also mentioned in the main text? Is the information consistent with what is presented in the paper?
- Whenever I have given my readers information, will it be 100% clear to them why they are being given this information? (You know why, but they don't.)
- Can I make my Abstract less redundant?

(contd....)

- Have I used tenses correctly? present simple (established knowledge), present perfect (past to present background information), past simple (my contribution)?
- Have I checked the spelling? Have I shown it to other people so that they can find any typos that I may have missed?
- Have I chosen my keywords carefully so that readers can locate my Abstract?
- Have I shown it to a colleague who is not familiar with the details of my research to see how much they can understand and can identify the value of the research?

Introduction

How should I structure the Introduction?

Can I use subheadings?

An Introduction generally answers the following questions. You can use the answers to these questions to structure your Introduction.

- What is the problem?
- Are there any existing solutions (i.e. in the literature)?
- Which solution is the best?
- What is its main limitation? (i.e. What gap am I hoping to fill?)
- What do I hope to achieve?
- Have I achieved what I set out to do?

If your Introduction is more than a couple of pages, subheadings will make it much more 'digestible' for the reader.

How does an Introduction differ from an Abstract?

There is some overlap between an Abstract and the Introduction. However, a frequent problem is that authors may cut and paste from their Abstract into their Introduction, which can be very repetitive for readers.

(contd....)

Below are the first two sentences from the Abstract and Introduction from a paper (or 'Letter' as it is called in the journal where this study appeared) entitled *Fragmentation of Rods by Cascading Cracks: Why Spaghetti Does Not Break in Half* by Basile Audoly and Sébastien Neukirch. These sentences highlight the distinct ways that an Abstract and Introduction should be written.

Abstract When thin brittle rods such as dry spaghetti pasta are bent beyond their limit curvature, they often break into more than two pieces, typically three or four. With the aim of understanding these multiple breakings, we study the dynamics of a bent rod that is suddenly released at one end.

Introduction The physical process of fragmentation is relevant to several areas of science and technology. Because different physical phenomena are at work during the fragmentation of a solid body, it has mainly been studied from a statistical viewpoint [1–5].

How long should the Introduction be?

FUNCTION	AUTHOR'S TEXT
1 definition of the topic plus background	An XYZ battery is a battery that... The electrodes in an XYZ telephone battery are made of a composite of gold and silver, coated with a layer of platinum. The gold and silver provide structural support, while the platinum provides resilience.
2 accepted state of the art plus problem to be resolved	The performance of the battery can be strongly affected by the number of times the battery is recharged and the duration of each individual recharge. The battery is subject to three possible failure modes. ...
3 authors' objectives	A research program has recently been started by the authors in collaboration with a major battery manufacturer, with the goal of developing new design models for XYZ batteries. Analytical techniques are needed that can predict ...
4 introduction to the literature	Computational techniques have been extensively applied to the study of the lifetime of XYZ batteries, in particular with regard to the number of times a battery is charged. However, little research to date has focused on the length of each individual recharge.

How should I structure the rest of the Introduction?

FUNCTION	AUTHOR'S TEXT
5 survey of pertinent literature	More recent research has occurred in the field of laptop and jPud batteries. Evans [15] studied the lifetime in 5G jPud batteries. Smith [16] and Jones [18] found that ... However their findings failed to account for ...
6 authors' contribution	To the best of our knowledge there are no results in the literature regarding how the length of each recharge impacts on the silver and gold in the electrodes.
7 aim of the present work	The aim of the present work is to construct a model to perform a comprehensive investigation of the effect of recharging on the electrodes, and to find a new proportion in the amount of metals used. The assumptions of Smith [16] and Jones [18] are used as a starting point ...
8 main results / conclusions	The results of the model are encouraging and show that ...
9 future implications	This new model will be able to ...
10 outline of structure	Section 2 introduces the concept of ...

How should I outline the structure of the rest of my paper?

ORIGINAL VERSION (OV)

The paper is structured as follows: in Section 2 a survey of the works related to X is provided. In Section 3 the method that we propose for the analysis of X is shown. In Section 4 the tool that automatizes this methodology is presented and in Section 5 its components are described. In Section 6 the experience in the application of the tool to industrial case studies is reported and discussed and finally, in Section 7, conclusions are provided and future works described.

REVISED VERSION (RV)

Section 2 surveys the works related to X. Section 3 outlines our method for analyzing X. In Section 4 the tool that automatizes this methodology is presented, and in Section 5 its components are described. Section 6 discusses some industrial case studies using the tool.

How can I assess the quality of my Introduction?

To make a self-assessment of your Introduction, you can ask yourself the following questions.

- Does my Introduction occupy too high a proportion of the entire paper and does it contain too many general statements that are already widely known?
- Are the rationale and objectives defined? Is it clear what problem I am addressing
- or trying to solve and why I chose my particular methodology?
- Is the background information all related to the objective of the paper?
- Is it clear what the reader can expect in the rest of the paper (i.e. main results and conclusions)?
- Does my Introduction act as a clear road map for understanding my paper?
- Is it sufficiently different from the Abstract, without any cut and pastes? (some overlap is fine)
- Have I mentioned only what my readers specifically need to know and what I will subsequently refer to in the Discussion?
- Have I been as concise as possible?

UNIT III

DISCUSSION AND CONCLUSIONS

Review of the Literature

How should I structure my Review of the Literature?

Do I need to cover all the literature? And what about the literature that goes against my hypothesis?

How should I begin my literature review? How can I structure it to show the progress through the years?

What is the clearest way to refer to other authors? Should I focus on the authors or their ideas?

How can I talk about the limitations of previous work and the novelty of my work in a constructive and diplomatic way?

What tenses should I use?

The present simple (S1) or present perfect (S2) are generally used to introduce the literature review.

S1. In the literature there *are several examples of new strategies to perform these tests, which all entail setting new parameters [Peters 2001, Grace 2014, Gatto 2018].*

S2. Many different approaches *have been proposed to solve this issue.*

(contd....)

How can I reduce the amount I write when reporting the literature?

ORIGINAL VERSION (OV)

- 1 Long sentences *are known to be* characteristic of poor readability [Ref].
- 2 *In the literature* the use of long sentences *has also been reported* in languages other than English [Ref].
- 3 The use of long sentences *has been ascertained* in various regions of Europe during the Roman period [Ref].
- 4 The concept of author-centeredness *has been suggested as playing* a role in the construction of long sentences [Ref].
- 5 *Several authors have proposed* that in scientific writing the occurrence of a high abundance of long sentences *is correlated* to ... [Ref].

REVISED VERSION (RV)

- Long sentences *are* a characteristic of poor readability [Ref].
- Long sentences *are* not exclusive to English [Ref].
- Long sentences *were used* during the Roman period in various regions of Europe [Ref].
- Author-centeredness *may play* a role in the construction of long sentences [Ref].
- In scientific writing the occurrence of a high abundance of long sentences *may be correlated* to ... [Ref].

Methods

How should I structure the Methods?

The Methods section should answer most of the following questions, obviously depending on your discipline:

- What / Who did I study? What hypotheses was I testing?
- Where did I carry out this study and what characteristics did this location have?
- How did I design my experiment / sampling and what assumptions did I make?
- What variable was I measuring and why?
- How did I handle / house / treat my materials / subjects? What kind of care /precautions were taken?
- What equipment did I use (plus modifications) and where did this equipment come from (vendor source)?
- What protocol did I use for collecting my data?
- How did I analyze the data? Statistical procedures? Mathematical equations? Software?
- What probability did I use to decide significance?

(contd....)

What style: should I use the active or passive? What tenses should I use?

How should I begin the Methods?

How you begin will very much depend on your discipline. To help you decide, take a look at the Methods section in papers from your chosen journal, and see how authors start this section.

Typical ways include:

- (a) Making a general statement about your method. The method described here is simple, rapid, sensitive and ...
- (b) Referring to another paper. The materials used for isolation and culture *are described elsewhere [20]. Materials were obtained in accordance with Burgess et al.'s method [55].*
- (c) Stating where you obtained your materials from. Bacterial strains ... *were isolated and kindly supplied by ...* Agarose for gel electrophoresis *was purchased from Brogdon plc(Altrincham, UK).*

My methods use a standard procedure. Do I need to describe the methods in detail?

(contd....)

How many actions / steps can I refer to in a single sentence?

ORIGINAL VERSION (OV)

A first postal invitation to participate in the survey was sent to 26 practices in South Yorkshire. A total of five practices indicated their willingness to participate. Multidisciplinary focus groups in four diverse practices were purposively identified. The identification entailed using a maximum variation approach. This approach was based on socio-economic population characteristics and ethnic diversity. These characteristics were taken with reference to census data.

REVISED VERSION (RV)

Following a first postal invitation to participate sent to 26 practices in South Yorkshire, five responded positively. Multidisciplinary focus groups in four diverse practices were purposively identified using a maximum variation approach, based on socio-economic population characteristics and ethnic diversity (by reference to census data).

(contd....)

What grammatical construction is used with *allow, enable and permit* ?

ORIGINAL VERSION (OV)

Limiting the Xs *allows* the complexity of Y *to be reduced* and *permits the user to control* the deduction process.

The analysis *allowed the characterization of pine resin* as the main organic constituents in the sample to be achieved.

This model *permits the analysis* of X.

The use of these substrates *enabled us to highlight* the presence of several nucleases.

REVISED VERSION (RV)

Limiting the Xs *reduces* the complexity of Y, and *facilitates control* of the deduction process.

The analysis *showed that pine resin* was the main organic constituent in the sample.

This model *can analyze* X.

With this model *we can analyze* X.

With this model, X can be determined

The use of these substrates:

highlighted the presence of ...

meant that we were able to highlight the presence of ...

offered a means *to highlight* the presence of ...

Results

How can I assess the quality of my Results section?

To make a self-assessment of your Results section, you can ask yourself the following questions.

- Have I expressed myself as clearly as possible, so that the contribution that my results give stands out for the referees and readers?
- Have I limited myself to only reporting the key result or trends that each figure and table conveys, rather than reiterating each value?
- Have I avoided drawing conclusions? (this is only true when the Results is an independent section)
- Have I chosen the best format to present my data (e.g. figure or table)?
Have I ensured that there is no redundancy between the various figures and tables?
- Have I ensured that my tables of results are comprehensive in the sense that they do not exclusively include points that prove my point?
- Have I mentioned only what my readers specifically need to know and what I will subsequently refer to in the Discussion?
- Have I used tenses correctly?

Active or passive? What kind of writing style should I use?

EXAMPLE

In 2018, *we confirmed* that complex sentences reduce readability [25].

In 2018, *Carter suggested* that complex sentences could also lead to high levels of stress for the reader [36].

In 2018, *it was suggested* that complex sentences could also lead to high levels of stress for the reader [Carter, 36].

In 2018, *it was suggested* that complex sentences could also lead to high levels of stress for the reader [25].

In 2018, *it was suggested* that complex sentences could also lead to high levels of stress for the reader.

COMMENTS

We clearly indicates that you are referring to your own work.

Carter, who is another author, is the subject of the verb. Thus it is clear to the reader that this is not your work.

The passive form means that the reader is not sure until the end of the sentence if it was you or another author. A long literature review or Discussion full of sentences like this is very heavy and annoying for the reader.

Readers cannot know who made the suggestion unless they go to Ref. 25 and see if it was you or someone else.

There is no reference. Readers cannot be sure if you made the suggestion or someone else.

(contd....)

How can I assess the quality of my Discussion?

When you have finished writing your Discussion, it is a good idea to make sure you can honestly answer 'yes' to all the questions below. This will enable your peers to make a critical assessment with regard to the strengths and weaknesses of (a) how you carried out your research (b) and how you analyzed your findings. The result will be that you will be seen as a credible researcher.

- Is my contribution to the knowledge gap clear? Have I underlined the significance of my findings? Have I related my findings and observations to other relevant studies?
- Have I explained what I believe to be new and important very clearly but without exaggerating? Have I ensured that I have not over-interpreted my results (i.e. attributed interpretations to them that cannot actually be supported)?
- Have I truly interpreted my results, rather than just reiterating them? Have I generated new theory rather than simply giving descriptions?
- Is there a good balance, rather than a one-sided version?

(contd....)

- Have I clearly distinguished fact from speculation? Will the reader easily be able to understand when I am merely suggesting a possible interpretation rather than providing conclusive evidence for something?
- Have I ensured that there is no bias in my research? (i.e. I have not hidden any of my data or any unexpected results, simply because they do not confirm what I was hoping to find)
- Have I included those works in the literature that do not corroborate my findings?
- Have I discussed my findings in the context of what I said in the Introduction? Have I exploited my Review of the Literature?
- Have I integrated my results with previous research (including my own) in order to explain what I observed or found?
- Have my criticisms of the literature been justified and constructive?
- Have I ensured that I have not introduced any new findings (i.e. findings not mentioned in the Results)?
- Are all the statements I have made in the text supported by the data contained in my figures and tables?

Conclusions

How can I differentiate my Conclusions from my Abstract?

ABSTRACT

With no hope of an afterlife, atheists may have difficulty rationalizing their purpose on earth. With the aim of understanding the coping mechanisms of non-believers, we interviewed 150 UK-born couples (125 mixed, 25 same sex; average age 46) who had happily cohabited for more than 15 years. Interviewees were asked ten simple questions regarding their attitudes to the meaning of life. Our results revealed that there are six key strategies in an atheist's pursuit of a happy and meaningful existence: (1) keep everything simple, (2) have fun, (3) cultivate a sense of community, (4) delight in the wonder of nature, (5) find time for creativity, (6) help other people through frequent acts of kindness. Atheists that implement a combination of these six strategies were found to be more equipped than other non-believers to deal with the death of close ones, health problems, financial difficulties, and bad luck.

CONCLUSIONS

We found that six strategies are key to atheists having a satisfying life: simplicity, fun, community, a love of nature, and the importance of creativity and of helping others. An additional but not unexpected finding, not considered in the original research aim, was that an unbridled respect for one's partner is fundamental for a long-lasting relationship. In the light of the vacuous and aimless nature of Western society, our findings suggest that the six strategies should be taught in schools as part of children's philosophy or religious education lessons. Comparisons with traditional religions revealed no substantial differences in approach, apart from a believer's blind faith in a benevolent omniscient overlord and the promise of an afterlife (or reincarnation). These commonalities indicate that traditional religions should attempt to be more sympathetic to atheists, and vice versa. Future work will investigate how the promise of an afterlife may undermine the fulfillment of one's true potential on earth.

(contd....)

How can I increase the impact of the first sentence of my Conclusions?

ORIGINAL VERSION (OV)

2. In this study it is concluded that compression plays an important part in ... It was found that ...
3. This work has demonstrated that a number of compounds present in X are responsible for delaying the onset of ...
4. We have shown that the crystal structure of X reveals that ...
5. It has been suggested in this paper that the localization of X in neurons is a good marker for neuronal viability.

REVISED VERSION (RV)

- Compression plays an important part in ...
In fact, it was found that ...
- A number of compounds present in X are responsible for delaying the onset of ...
- The crystal structure of X reveals that ...
- The localization of X in neurons suggests that it is a good marker for neuronal viability.

(contd....)

How can I assess the quality of my Conclusions?

To make a self-assessment of your Conclusions, you can ask yourself the following questions.

- Is what I have written really a Conclusions section? (If it is more than 200–250 words, then it probably isn't – it needs to be much shorter)
- If the conclusions are included in the Discussion, have I clearly signalled to the reader that I am about to discuss my conclusions (e.g. by writing *In conclusion ...*)?
- Have I given a maximum of one line to comments related to descriptions of procedures, methodology, interviews etc.? (Generally such comments are not needed at all, unless the primary topic of your paper is the methodology itself)
- Have I avoided cut and pastes from earlier sections? Do my Conclusions differ appropriately from my Abstract, Introduction and final paragraph of my Discussion? Are my Conclusions interesting and relevant?
- Have I given my Conclusions as much impact as possible and have I avoided any redundant expressions?

(contd....)

- Have I avoided any unqualified statements and conclusions that are not completely supported?
- Is my work as complete as I say it is? (i.e. I am not trying to get priority over other authors by claiming inferences that cannot really be drawn at this stage)
- Have I introduced new avenues of potential study or explained the potential impact of my conclusions? Have I ensured that I have only briefly described these future avenues rather than getting lost in detail?
- Are the possible applications I have suggested really feasible? Are my recommendations appropriate?
- Have I used tenses correctly? present perfect (to describe what you have done during the writing process), past simple (what you did in the lab, in the field, in your surveys etc.)
- In addition, you should look at the summary questions for the Discussion, as these may also be helpful in deciding whether your Conclusions will have the necessary impact on your readers.

The Final Check

- Respect the referee. Don't waste his or her time by submitting a poorly written manuscript
- Get a colleague to read through your paper or use a professional editing service
- Print a hard copy of your manuscript. Don't rely on reading it on screen
- Check for all types of mistakes in English: grammar, vocabulary and spelling
- Apply the same standards as if you had written your manuscript in your own mother tongue
- Cut as much as you can. Check your manuscript for readability and logic
- Be careful with problems caused by multiple authors, e.g. cut and pastes
- Ensure you have followed the journal's style guide, e.g. for citing the literature. Check for accuracy and consistency. Take editorial comments seriously
- As your last task before sending the manuscript to the journal, do a spell check. Don't rely 100% on automatic spell checkers. Spell checkers do not know the difference between *witch and which* , *asses and assets*

How to Prepare the Title

First impressions are strong impressions; a title ought therefore to be well studied, and to give, so far as its limits permit, a definite and concise indication of what is to come.

—T. Clifford Allbutt

Importance of the Title

In preparing a title for a paper, the author would do well to remember one salient fact: That title will be read by thousands of people. Perhaps few people, if any, will read the entire paper, but many people will read the title, either in the original journal or in one of the secondary (abstracting and indexing) publications. Therefore, all words in the title should be chosen with great care, and their association with one another must be carefully managed. Perhaps the most common error in defective titles, and certainly the most damaging in terms of comprehension, is faulty syntax(word order).

Length of the Title

Occasionally, titles are too short. A paper was submitted to the *Journal of Bacteriology* with the title "*Studies on Brucella.*" Obviously, such a title was not very helpful to the potential reader. Was the study taxonomic, genetic, biochemical, or medical? We would certainly want to know at least that much.

Much more often, titles are too long. Ironically, long titles are often less meaningful than short ones. A generation or so ago, when science was less specialized, titles tended to be long and nonspecific, such as "On the addition to the method of microscopic research by a new way of producing colour-contrast between an object and its background or between definite parts of the object itself" (J. Rheinberg, *J. R. Microsc. Soc.* 1896:373). *That certainly sounds like a poor title*; perhaps it would make a good abstract.

Without question, most excessively long titles contain "waste" words. Often, these waste words appear right at the start of the title, words such as "Studies on," "Investigations on," and "Observations on." An opening *A, An, or The is* also a "waste" word.

Need for Specific Titles

Let us analyze a sample title: "Action of Antibiotics on Bacteria." Is it a good title? In *form it is; it is short and carries no excess baggage* (waste words). Certainly, it would not be improved by changing it to "Preliminary Observations on the Effect of Certain Antibiotics on Various Species of Bacteria." However (and this brings me to my next point), most titles that are too short are too short because they include general rather than specific terms.

We can safely assume that the study introduced by the above title did *not test the effect of all antibiotics on all kinds* of bacteria. Therefore, the title is essentially meaningless. If only one or a few antibiotics were studied, they should be individually listed in the title. If only one or a few organisms were tested, they should be individually listed in the title. If the number of antibiotics or organisms was awkwardly large for listing in the title, perhaps a group name could have been substituted.

(contd....)

Examples of more acceptable titles are

"Action of Streptomycin on *Mycobacterium tuberculosis*"

"Action of Streptomycin, Neomycin, and Tetracycline on Gram-Positive Bacteria"

"Action of Polyene Antibiotics on Plant-Pathogenic Bacteria"

"Action of Various Antifungal Antibiotics on *Candida albicans* and *Aspergillus fumigatus*"

Although these titles are more acceptable than the sample, they are not especially good because they are still too general. If the "Action of" can be defined easily, the meaning might be clearer. For example, the first title above might be phrased "Inhibition of Growth of *Mycobacterium tuberculosis* by *Streptomycin*."

Long ago, Leeuwenhoek used the word "animalcules," a descriptive but not very specific word. In the 1930s, Howard Raistrick published an important series of papers under the title "Studies on Bacteria." A similar paper today would have a much more specific title. If the study featured an organism, the title would give the genus and species and possibly even the strain number.

Importance of Syntax

In titles, be especially careful of syntax. Most of the grammatical errors in titles are due to faulty word order. A paper was submitted to the *Journal of Bacteriology* with the title "Mechanism of Suppression of Nontransmissible Pneumonia in Mice Induced by Newcastle Disease Virus." Unless this author had somehow managed to demonstrate spontaneous generation, it must have been the pneumonia that was induced and not the mice. (The title should have read: "Mechanism of Suppression of Nontransmissible Pneumonia Induced in Mice by Newcastle Disease Virus.") If you no longer believe that babies result from a visit by the stork, I offer this title (*Bacteriol. Proc.*, p. 102, 1968): "Multiple Infections Among Newborns Resulting from Implantation with *Staphylococcus aureus* 502A." (Is this the "Staph of Life"?)

Another example I stumbled on one day (*Clin. Res.* 8:134, 1960): "Preliminary Canine and Clinical Evaluation of a New Antitumor Agent, Streptovitacin." When that dog gets through evaluating streptovitacin, I've got some work I'd like that dog to look over.

(contd....)

As a grammatical aside, I would encourage you to be careful when you use "using." The word "using" is, I believe, the most common dangling participle in scientific writing. Either there are some more smart dogs, or "using" is misused in this sentence from a recent manuscript: "Using a fiber optic bronchoscope, dogs were immunized with sheep red blood cells. "Dogs aren't the only smart animals. A manuscript was submitted to the *Journal of Bacteriology* under the title "Isolation of Antigens from Monkeys Using Complement-Fixation Techniques."

Even bacteria are smart. A manuscript was submitted to the *Journal of Clinical Microbiology* under the title "Characterization of Bacteria Causing Mastitis by Gas-Liquid Chromatography." Isn't it wonderful that bacteria can use GLC?

The Title as a Label

The title of a paper is a label. It is not a sentence. Because it is not a sentence, with the usual subject, verb, object arrangement, it is really simpler than a sentence (or, at least, usually shorter), but the order of the words becomes even more important.

Actually, a few journals do permit a title to be a sentence. Here is an example: "Oct-3 is a maternal factor required for the first mouse embryonic division" (*Cell* 64:1103, 1991). *I suppose this is only a matter of opinion, but I would* object to such a title on two grounds. First, the verb ("is") is a waste word, in that it can be readily deleted without affecting comprehension. Second, inclusion of the "is" results in a title that now seems to be a loud assertion.

Rosner (1990) gave the name "assertive sentence title" (AST) to this kind of title and presented a number of reasons why such titles should not be used. In particular, ASTs are "improper and imprudent" because "in some cases the AST boldly states a conclusion that is then stated more tentatively in the summary or elsewhere" and "ASTs trivialize a scientific report by reducing it to a one-liner."

(contd....)

The meaning and order of the words in the title are of importance to the potential reader who sees the title in the journal table of contents. But these considerations are equally important to *all potential users of the literature*, including those (probably a majority) who become aware of the paper via secondary sources. Thus, the title should be useful as a label accompanying the paper itself, and it also should be in a form suitable for the machine-indexing systems used by *Chemical Abstracts*, *Index Medicus*, and others. Most of the indexing and abstracting services are geared to "key word" systems, generating either KWIC (key word in context) or KWOC (key word out of context) entries.

Therefore, it is fundamentally important that the author provide the right "keys" to the paper when labeling it. That is, the terms in the title should be limited to those words that highlight the significant content of the paper in terms that are both understandable and retrievable. As an aid to readers, "running titles" or "running heads" are printed at the top of each page.

Abbreviations and Jargon

Titles should almost never contain abbreviations, chemical formulas, proprietary (rather than generic) names, jargon, and the like. In designing the title, the author should ask: "How would I look for this kind of information in an index? " If the paper concerns an effect of hydrochloric acid, should the title include the words "hydrochloric acid" or should it contain the much shorter and readily recognizable "HCl?" I think the answer is obvious. Most of us would look under "hy" in an index, not under "hc." Furthermore, if some authors used (and journal editors permitted) HCl and others used hydrochloric acid, the user of the bibliographic services might locate only part of the published literature, not noting that additional references are listed under another, abbreviated, entry. Actually, the larger secondary services have computer programs that are capable of bringing together entries such as deoxyribonucleic acid, DNA, and even ADN (*acide deoxyribonucleique*). *However, by far the best rule for authors (and editors) is to avoid abbreviations in titles. And the same rule should apply to proprietary names, jargon, and unusual or outdated terminology.*

Series Titles

Most editors I have talked to are opposed to main title-subtitle arrangements and to hanging titles. The main title subtitle (series) arrangement was quite common some years ago. (Example: "Studies on Bacteria. IV. Cell Wall of *Staphylococcus aureus*.") *Today, many editors believe that it is important, especially for the reader, that each published paper "should present the results of an independent, cohesive study; thus, numbered series titles are not allowed" ("Instructions to Authors," Journal of Bacteriology). Series papers, in the past, have had a tendency to relate to each other too closely, giving only bits and pieces with each contribution; thus, the reader was severely handicapped unless the whole series could be read consecutively.*

Furthermore, the series system is annoying to editors because of scheduling problems and delays. (What happens when no. IV is accepted but no. III is rejected or hung up in review?) Additional objections are that a series title almost always provides considerable redundancy.

(contd....)

The hanging title (same as a series title except that a colon substitutes for the roman numeral) is considerably better, avoiding some of the problems mentioned above, but certainly not the peculiar results from KWIC indexing.

Unfortunately, a leading scientific journal, *Science*, is a proponent of hanging titles, presumably on the grounds that it is important to get the most important words of the title up to the front. (Example: "The Structure of the Potassium Channel: Molecular Basis of K⁺ Conduction and Selectivity"—*Science* 280:69, 1998.) Occasionally, hanging titles may be an aid to the reader, but in my opinion they appear pedantic, often place the emphasis on a general term rather than a more significant term, necessitate punctuation, scramble indexes, and in general provide poor titles. Use of a straightforward title does not lessen the need for proper syntax, however, or for the proper form of each word in the title.

How to Prepare the Abstract

I have the strong impression that scientific communication is being seriously hindered by poor quality abstracts written in jargon-ridden mumbo-jumbo.

—Sheila M. McNab

Definition

An Abstract should be viewed as a mini version of the paper. The Abstract should provide a *brief summary of each of* the main sections of the paper: Introduction, Materials and Methods, Results, and Discussion. As Houghton (1975) put it, "An abstract can be defined as a summary of the information in a document."

"A well-prepared abstract enables readers to identify the basic content of a document quickly and accurately, to determine its relevance to their interests, and thus to decide whether they need to read the document in its entirety" (American National Standards Institute, 1979*b*). *The Abstract should not exceed 250 words and should be designed to define clearly what is dealt with in the paper. The Abstract should be typed as a single paragraph.*

(contd....)

The Abstract should

- (1) state the principal objectives and scope of the investigation,
- (2) describe the methods employed,
- (3) summarize the results, and
- (4) state the principal conclusions.

The importance of the conclusions is indicated by the fact that they are often given three times: once in the Abstract, again in the Introduction, and again (in more detail probably) in the Discussion. Most or all of the Abstract should be written in the past tense, because it refers to work done. The Abstract should never give any information or conclusion that is not stated in the paper. References to the literature must not be cited in the Abstract (except in rare instances, such as modification of a previously published method).

Types of Abstracts

The above rules apply to the abstracts that are used in primary journals and often without change in the secondary services (*Chemical Abstracts, etc.*). *This type of abstract is often referred to as an informative abstract, and it is designed to condense the paper.* It can and should briefly state the problem, the method used to study the problem, and the principal data and conclusions. Often, the abstract supplants the need for reading the full paper; without such abstracts, scientists would not be able to keep up in active areas of research. This is the type of abstract that is used as a "heading" in most journals today.

Another common type of abstract is the *indicative abstract (sometimes called a descriptive abstract)*. *This type of abstract is designed to indicate the subjects dealt with in a paper, making it easy for potential readers to decide whether to read the paper.* However, because of its descriptive rather than substantive nature, it can seldom serve as a substitute for the full paper. Thus, indicative abstracts should not be used as "heading" abstracts in research papers, but they may be used in other types of publications.

(contd....)

An effective discussion of the various uses and types of abstracts was provided by Mc Girr (1973), whose conclusions are well worth repeating: "When writing the abstract, remember that it will be published by itself, and should be self contained.

That is, it should contain no bibliographic, figure, or table references. . . . The language should be familiar to the potential reader. Omit obscure abbreviations and acronyms. Write the paper before you write the abstract, if at all possible."

Unless a long term is used several times within an Abstract, do not abbreviate the term. Wait and introduce the appropriate abbreviation at first use in the text (probably in the Introduction).

Economy of Words

Occasionally, a scientist omits something important from the Abstract. By far the most common fault, however, is the inclusion of extraneous detail. I once heard of a scientist who had some terribly involved theory about the relation of matter to energy. He then wrote a terribly involved paper. However, the scientist, knowing the limitations of editors, realized that the Abstract of his paper would have to be short and simple if the paper were to be judged acceptable. So, he spent hours and hours honing his Abstract. He eliminated word after word until, finally, all of the verbiage had been removed. What he was left with was the shortest Abstract ever written: " $E = mc^2$."

Today, most scientific journals print a heading Abstract with each paper. It generally is printed (and should be typed) as a single paragraph. Because the Abstract precedes the paper itself, and because the editors and reviewers like a bit of orientation, the Abstract is almost universally the first part of the manuscript read during the review process.

(contd....)

However, if by definition the Abstract is simply a very short version of the whole paper, it is only logical that the reviewer will often reach a preliminary conclusion, and that conclusion is likely to be the correct one. Usually, a good Abstract is followed by a good paper; a poor Abstract is a harbinger of woes to come. Because a heading Abstract is required by most journals and because a meeting Abstract is a requirement for participation in a great many national and international meetings (participation sometimes being determined on the basis of submitted abstracts), scientists should master the fundamentals of Abstract preparation.

When writing the Abstract, examine every word carefully. If you can tell your story in 100 words, do not use 200. Economically and scientifically, it doesn't make sense to waste words. The total communication system can afford only so much verbal abuse.

(contd....)

The story goes like this: One night a symphony orchestra was scheduled to play the famous Beethoven's Ninth Symphony. Before the performance, the bass viol players happened to be chatting among themselves, and one of the bass players reminded the others that there is a long rest for the bass players toward the conclusion of Beethoven's Ninth. One bassist said, "Tonight, instead of sitting on the stage looking dumb all that time, why don't we sneak off the stage, go out the back door, go to the bar across the street, and belt down a few?" They all agreed. That night, when "rest" time came, they indeed snuck off the stage, went to the bar, and knocked back about four double scotches each. One bass player said, "Well, it's about time we headed back for the finale." Whereupon another bassist said, "Not to worry. After we decided to do this, I went up to the conductor's stand and, at the place in the conductor's score where our rest ends, I tied a bunch of string around his score. It will take him a few minutes to untie those knots. Let's have another." And they did.

How to Write the Introduction

A bad beginning makes a bad ending.

—Euripides

Suggested Rules

Now that we have the preliminaries out of the way, we come to the paper itself. I should mention that some experienced writers prepare their title and Abstract after the paper is written, even though by placement these elements come first. You should, however, have in mind (if not on paper) a provisional title and an outline of the paper that you propose to write. You should also consider the level of the audience you are writing for, so that you will have a basis for determining which terms and procedures need definition or description and which do not. If you do not have a clear purpose in mind, you might go writing off in six directions at once. It is a wise policy to begin writing the paper while the work is still in progress. This makes the writing easier because everything is fresh in your mind. Furthermore, the writing process itself is likely to point to inconsistencies in the results or perhaps to suggest interesting sidelines that might be followed.

(contd....)

The first section of the text proper should, of course, be the Introduction. The purpose of the Introduction should be to supply sufficient background information to allow the reader to understand and evaluate the results of the present study without needing to refer to previous publications on the topic. The Introduction should also provide the rationale for the present study. Above all, you should state briefly and clearly your purpose in writing the paper. Choose references carefully to provide the most important background information. Much of the Introduction should be written in the present tense, because you will be referring primarily to your problem and the established knowledge relating to it at the start of your work.

Suggested rules for a good Introduction are as follows:

- (1) The Introduction should present first, with all possible clarity, the nature and scope of the problem investigated.
- (2) It should review the pertinent literature to orient the reader.
- (3) It should state the method of the investigation. If deemed necessary, the reasons for the choice of a particular method should be stated.

Reasons for the Rules

The first three rules for a good Introduction need little expansion, being reasonably well accepted by most scientist writers, even beginning ones. It is important to keep in mind, however, that the purpose of the Introduction is to introduce (the paper). Thus, the first rule (definition of the problem) is the cardinal one. And, obviously, if the problem is not stated in a reasonable, understandable way, readers will have no interest in your solution. Even if the reader labors through your paper, which is unlikely if you haven't presented the problem in a meaningful way, he or she will be unimpressed with the brilliance of your solution. In a sense, a scientific paper is like other types of journalism. In the Introduction you should have a "hook" to gain the reader's attention. Why did you choose *that subject, and why is it important?* .The second and third rules relate to the first. The literature review and choice of method should be presented in such a way that the reader will understand what the problem was and how you attempted to resolve it. These three rules then lead naturally to the fourth, the statement of principal results and conclusions, which should be the capstone of the Introduction.

Citations and Abbreviations

If you have previously published a preliminary note or abstract of the work, you should mention this (with the citation) in the Introduction. If closely related papers have been or are about to be published elsewhere, you should say so in the Introduction, customarily at or toward the end. Such references help to keep the literature neat and tidy for those who must search it.

In addition to the above rules, keep in mind that your paper may well be read by people outside your narrow specialty. Therefore, the Introduction is the proper place to define any specialized terms or abbreviations that you intend to use. Let me put this in context by citing a sentence from a letter of complaint I once received. The complaint was in reference to an ad which had appeared in the *Journal of Virology during my tenure as Managing Editor*. The ad announced an opening for a virologist at the National Institutes of Health (NIH), and concluded with the statement "An equal opportunity employer, M & F." The letter suggested that "the designation 'M & F' may mean that the NIH is muscular and fit, musical and flatulent, hermaphroditic"

UNIT IV

WRITING SKILLS

How to Write the Methods Section

The greatest invention of the nineteenth century was the invention of the method of invention.

—A. N. Whitehead

Purpose of the Section

In the first section of the paper, the Introduction, you stated (or should have) the methodology employed in the study. If necessary, you also defended the reasons for your choice of a particular method over competing methods. Now, in Materials and Methods, you must give the full details. Most of this section should be written in the past tense.

The main purpose of the Materials and Methods section is to describe (and if necessary defend) the experimental design and then provide enough detail so that a competent worker can repeat the experiments. Many (probably most) readers of your paper will skip this section, because they already know (from the Introduction) the general methods you used and they probably have no interest in the experimental detail.

(contd....)

However, careful writing of this section is critically important because the cornerstone of the scientific method *requires that your results, to be of scientific merit*, must be reproducible; and, for the results to be adjudged reproducible, you must provide the basis for repetition of the experiments by others.

That experiments are unlikely to be reproduced is beside the point; the potential for reproducing the same or similar results *must exist, or your paper does not represent good science*. When your paper is subjected to peer review, a good reviewer will read the Materials and Methods carefully. If there is serious doubt that your experiments could be repeated, the reviewer will recommend rejection of your manuscript no matter how awe-inspiring your results.

Methods

For methods, the usual order of presentation is chronological. Obviously, however, related methods should be described together, and straight chronological order cannot always be followed. For example, even if a particular assay was not done until late in the research, the assay method should be described along with the other assay methods, not by itself in a later part of Materials and Methods.

Headings

The Materials and Methods section usually has sub headings. When possible, construct subheadings that "match" those to be used in Results. The writing of both sections will be easier if you strive for internal consistency, and the reader will be able to grasp quickly the relationship of a particular methodology to the related Results.

Measurements and Analysis

Be precise. Methods are similar to cookbook recipes. If a reaction mixture was heated, give the temperature. Questions such as "how" and "how much" should be precisely answered by the author and not left for the reviewer or the reader to puzzle over.

(contd....)

Ordinary statistical methods should be used without comment; advanced or unusual methods may require a literature citation. And, again, be careful of your syntax. A recent manuscript described what could be called a disappearing method. The author stated, "The radioactivity in the tRNA region was determined by the trichloro acetic acid-soluble method of Britten et al." And then there is the painful method: "After standing in boiling water for an hour, examine the flask."

Need for References

In describing the methods of the investigations, you should give sufficient details so that a competent worker could repeat the experiments. If your method is new (unpublished), you must provide *all of the needed detail*. *However, if a* method has been previously published in a standard journal, only the literature reference should be given. But I recommend more complete description of the method if the only previous publication was in, let us say, the *South Tasmanian Journal of Nervous Diseases of the Gnat*. If several alternative methods are commonly employed, it is useful to identify your method briefly as well as to cite the reference.

(contd....)

Tabular Material

When large numbers of microbial strains or mutants are used in a study, prepare strain tables identifying the source and properties of mutants, bacteriophages, plasmids, etc. The properties of a number of chemical compounds can also be presented in tabular form, often to the benefit of both the author and the reader. A method, strain, etc. used in only one of several experiments reported in the paper should be described in the Results section or, if brief enough, may be included in a table footnote or a figure legend.

Correct Form and Grammar

Do not make the common error of mixing some of the Results in this section. *There is only one rule for a properly written Materials and Methods section:* Enough information must be given so that the experiments could be reproduced by a competent colleague. A good test, by the way (and a good way to avoid rejection of your manuscript), is to give a copy of your finished manuscript to a colleague and ask if he or she can follow the methodology.

(contd....)

Mistakes in grammar and punctuation are not always serious; the meaning of general concepts, as expressed in the Introduction and Discussion, can often survive a bit of linguistic mayhem. In Materials and Methods, however, exact and specific items are being dealt with and precise use of English is a must. Even a missing comma can cause havoc, as in this sentence: "Employing a straight platinum wire rabbit, sheep and human blood agar plates were inoculated . . ." That sentence was in trouble right from the start, because the first word is a dangling participle. Comprehension didn't totally go out the window, however, until the author neglected to put a comma after "wire."

Because the Materials and Methods section usually gives short, discrete bits of information, the writing sometimes becomes telescopic; details essential to the meaning may then be omitted. The most common error is to state the action without stating the agent of the action.

How to Write the Results

Results! Why, man, I have gotten a lot of results. I know several thousand things that won't work.

—Thomas A. Edison

Content of the Results

So now we come to the core of the paper, the data. This part of the paper is called the Results section. Contrary to popular belief, you shouldn't start the Results section by describing methods that you inadvertently omitted from the Materials and Methods section. There are usually two ingredients of the Results section. First, you should give some kind of overall description of the experiments, providing the "big picture," without, however, repeating the experimental details previously provided in Materials and Methods. Second, you should present the data. Your results should be presented in the past tense.

Of course, it isn't quite that easy. How do you present the data? A simple transfer of data from laboratory notebook to manuscript will hardly do. Most importantly, in the manuscript you should present representative data rather than endlessly repetitive data.

(contd....)

The fact that you could perform the same experiment 100 times without significant divergence in results might be of considerable interest to your major professor, but editors, not to mention readers, prefer a little bit of predigestion. Aaronson (1977) said it another way: "The compulsion to include everything, leaving nothing out, does not prove that one has unlimited information; it proves that one lacks discrimination." Exactly the same concept, and it is an important one, was stated almost a century earlier by John Wesley Powell, a geologist who served as President of the American Association for the Advancement of Science in 1888. In Powell's words: "The fool collects facts; the wise man selects them."

How to Handle Numbers

If one or only a few determinations are to be presented, they should be treated descriptively in the text. Repetitive determinations should be given in tables or graphs. Any determinations, repetitive or otherwise, should be meaningful. Suppose that, in a particular group of experiments, a number of variables were tested (one at a time, of course).

(contd....)

If statistics are used to describe the results, they should be meaningful statistics. Erwin Neter, the late Editor-in-Chief of *Infection and Immunity*, used to tell a classic story to emphasize this point. He referred to a paper *that reputedly* read: "331/3% of the mice used in this experiment were cured by the test drug; 331/3% of the test population were unaffected by the drug and remained in a moribund condition; the third mouse got away."

Strive for Clarity

The results should be short and sweet, without verbiage. Mitchell (1968) quoted Einstein as having said, "If you are out to describe the truth, leave elegance to the tailor." Although the Results section of a paper is the most important part, it is often the shortest, particularly if it is preceded by a well-written Materials and Methods section and followed by a well-written Discussion. The Results need to be clearly and simply stated because it is the Results that constitute the new knowledge that you are contributing to the world.

(contd....)

Avoid Redundancy

Do not be guilty of redundancy in the Results. The most common fault is the repetition in words of what is already apparent to the reader from examination of the figures and tables. Even worse is the actual presentation, in the text, of all or many of the data shown in the tables or figures. This grave sin is committed so frequently that I comment on it at length, with examples, in the chapters on how to prepare the tables and illustrations.

Some writers go too far in avoiding verbiage, however. Such writers often violate the rule of antecedents, the most common violation being the use of the ubiquitous "it." Here is an item from a medical manuscript: "The left leg became numb at times and she walked it off. . . . On her second day, the knee was better, and on the third day it had completely disappeared."

How to Write the Discussion

It is the fault of our rhetoric that we cannot strongly state one fact without seeming to belie some other.

—Ralph Waldo Emerson

Discussion and Verbiage

The Discussion is harder to define than the other sections. Thus, it is usually the hardest section to write. And, whether you know it or not, *many papers are rejected by journal editors because of a faulty Discussion, even though the data of the paper might be both valid and interesting.* Even more likely, the true meaning of the data may be completely obscured by the interpretation presented in the Discussion, again resulting in rejection.

Many, if not most, Discussion sections are too long and verbose. As Doug Savile said, "Occasionally, I recognize what I call the squid technique: the author is doubtful about his facts or his reasoning and retreats behind a protective cloud of ink" (*Tableau, September 1972*).

(contd....)

Components of the Discussion

What are the essential features of a good Discussion? I believe the main components will be provided if the following injunctions are heeded:

1. Try to present the principles, relationships, and generalizations shown by the Results. And bear in mind, in a good Discussion, you *discuss*—you *do not recapitulate*— the Results.
2. Point out any exceptions or any lack of correlation and define unsettled points. Never take the high-risk alternative of trying to cover up or fudge data that do not quite fit.
3. Show how your results and interpretations agree (or contrast) with previously published work.
4. Don't be shy; discuss the theoretical implications of your work, as well as any possible practical applications.
5. State your conclusions as clearly as possible.
6. Summarize your evidence for *each conclusion*. Or, as the wise old scientist will tell you, "Never assume anything except a 4% mortgage."

(contd....)

Factual Relationships

In simple terms, the primary purpose of the Discussion is to show the relationships among observed facts. To emphasize this point, I always tell the old story about the biologist who trained a flea. After training the flea for many months, the biologist was able to get a response to certain commands. The most gratifying of the experiments was the one in which the professor would shout the command "Jump," and the flea would leap into the air each time the command was given.

The professor was about to submit this remarkable feat to posterity via a scientific journal, but he—in the manner of the true scientist—decided to take his experiments one step further. He sought to determine the location of the receptor organ involved. In one experiment, he removed the legs of the flea, one at a time. The flea obligingly continued to jump upon command, but as each successive leg was removed, its jumps became less spectacular. Finally, with the removal of its last leg, the flea remained motionless. Time after time the command failed to get the usual response.

(contd....)

Claude Bishop, the dean of Canadian editors, tells a similar story. A science teacher set up a simple experiment to show her class the danger of alcohol. She set up two glasses, one containing water, the other containing gin. Into each she dropped a worm. The worm in the water swam merrily around. The worm in the gin quickly died. "What does this experiment prove?" she asked. Little Johnny from the back row piped up: "It proves that if you drink gin you won't have worms."

Significance of the Paper

Too often, the *significance of the results is not discussed or not discussed adequately. If the reader of a paper finds* himself or herself asking "So what?" after reading the Discussion, the chances are that the author became so engrossed with the trees (the data) that he or she didn't really notice how much sunshine had appeared in the forest. The Discussion should end with a short summary or conclusion regarding the significance of the work. I like the way Anderson and Thistle (1947) said it: "Finally, good writing, like good music, has a fitting climax."

(contd....)

Defining Scientific Truth

In showing the relationships among observed facts, you do not need to reach cosmic conclusions. Seldom will you be able to illuminate the whole truth; more often, the best you can do is shine a spotlight on one area of the truth. Your one area of truth can be illuminated by your data; if you extrapolate to a bigger picture than that shown by your data, you may appear foolish to the point that even your data-supported conclusions are cast into doubt.

One of the more meaningful thoughts in poetry was expressed by Sir Richard Burton in *The Kasidah*:

All Faith is false, all Faith is true:

Truth is the shattered mirror strown

In myriad bits; while each believes

His little bit the whole to own.

So exhibit your little piece of the mirror, or shine a spotlight on one area of the truth. The "whole truth" is a subject best left to the ignoramuses, who loudly proclaim its discovery every day.

UNIT V

QUALITY AND TIME MAINTENANCE

Useful Phrases

How to use the Useful Phrases

Words and phrases between slashes (/) indicate various ways the sentence could be composed. The ways suggested are not exhaustive. A slash does not always indicate synonymous expressions, but simply words and phrases that are likely to be used in a similar context. You are advised to consult a bilingual dictionary to help you to differentiate the differences between the words and phrases given.

In some cases words and phrases have an identical meaning. For example, when used with reference to figures and tables, there is little, if any difference in meaning between verbs such as *shows*, *reports* and *highlights*. However, some words apparently seem to be synonyms, but may have specific or subtle differences in your field. For example, the following groups generally have distinct meanings:

- argue, assert, claim, state
- assume, hypothesize, suggest
- find, discover
- demonstrate, prove, test

(contd....)

If you have checked that a word or phrase really has the same meaning, I suggest you choose the shortest option. For example choose:

Since $x = y$...

Although $x = y$...

Rather than

Given the fact that $x = y$...

Despite the fact that $x = y$...

Notwithstanding the fact that $x = y$...

Of course, if you need to use the same type of phrase on several occasions, then you can use the longer constructions too.

- Establishing why your topic (X) is important
- Outlining the past-present history of the study of X (no direct references to the literature)
- Outlining the possible future of X
- Indicating the gap in knowledge and possible limitations
- Stating the aim of your paper and its contribution
- Explaining the key terminology in your field

(contd....)

- Giving general panorama of past-to-present literature
- Reviewing past literature
- Reviewing subsequent and more recent literature
- Reporting what specific authors of have said
- Mentioning positive aspects of others' work
- Highlighting limitations of previous studies - authors not mentioned by name
- Highlighting limitations of previous studies - authors mentioned by name
- Using the opinions of others to justify your criticism of someone's work
- Describing the apparatus and materials used and their source
- Reporting software used
- Reporting customizations performed
- Formulating equations, theories and theorems
- Explaining why you chose your specific method, model, equipment, sample etc.
- Explaining the preparation of samples, solutions etc.
- Outlining selection procedure for samples, surveys etc.

(contd....)

Ensure your paper is as good as it could possibly be the first time you submit it

On the excellent pages on the website of the University of Canberra, Professor Ken Lertzman makes the following comment:

It takes much longer to read poor writing than good writing. It is a waste of an advisor's or editor's time to read material that is not yet ready to be presented - and it is disrespectful to expect them to do so.

Researchers tend to leave the manuscript writing process to the very last minute. This often results in a poorly written paper. Unfortunately, poor English and lack of clarity are one of the most frequent causes of a paper being initially rejected. You will waste several months if you have to resubmit your paper, and in the meantime someone else might publish a paper on the exact same topic. Ideally, you should get a colleague to read through your manuscript to check for points 20.7–20.19 below.

THANK YOU