English Solutions for Engineering and Sciences Research Writing:

A guide for English learners to publish in international journals

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English Writing Lab
교수학습개발센터 Hanyang University Center for Teaching and Learning

These materials were designed for engineering and sciences graduate students writing for publication in English at Hanyang University in Seoul, Korea. However, most of the material is useful for writing in other fields and for new authors from any language background. This edition is a work in progress. Some formatting problems remain.

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Common format and punctuation errors
http://www.hanyangowl.org/course/view.php?id=26

How to modify the settings of MS Word editing functions
http://www.hanyangowl.org/media/computerassisted/2007mswordediting.pdf

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Suggestions or corrections are welcome: adamturner7@gmail.com

Preface: How to use this book

Who is this book for?

This book was written primarily for Korean engineering and sciences master's and Ph.D. students at Hanyang University in Seoul, Korea writing their first SCI journal article or conference paper as the primary author. It is also intended to help those students who want to write their science thesis or dissertation in English. However, even non-native speaking faculty may benefit from some of the advanced grammar and writing style advice. Although designed for engineering and sciences, most of the content of the book is useful for writing in other fields. Students in social sciences using quantitative methods in particular will also find it useful. This book was not designed for writing in fields such as law, literature, and other humanities. However, much of the writing advice still applies. Authors in biomedical writing should combine this one with a specialized text at http://www.hanyangowl.org/media/biomedical/handbookbiomedicalwriting.pdf

Who wrote this book?

It is a project of the Hanyang University Center for Teaching and Learning English Writing Lab and was written by its current director, Adam Turner. The English Writing Lab offers a free consulting service to help Hanyang authors publish their research in English, provides specialized workshops based on original research on writing for publication, and creates specialized online and print materials to support Hanyang researchers writing across a variety of fields. See www.hanyangowl.org.

Why was this book written?

This book grew out of my own difficulty in finding a textbook suitable for Hanyang graduate engineering students. Although there are many books on scientific writing skills, they are mainly designed for native speakers and usually give only very general advice on writing. Many lack specific information on the structure and grammar of scientific writing needed by Korean researchers. Other books designed for non-native speakers tend to be too basic and not give enough detailed information on paragraph and article structure that is science and engineering specific. In short, the book was written because I couldn't find one similar to it.

A second important purpose is to support Hanyang faculty in their efforts to help their graduate students learn to write in English for publication. In talking to faculty, it was found that a lot of time is being taken up helping with or correcting students' basic writing problems when revising first drafts of articles written by graduate students. It is hoped that the quality of student first drafts can be improved if students refer to this guide.

The book is also part of our wider strategy to integrate Writing Lab face to face writing consulting, workshops, print self-study materials, and online interactive materials into an integrated system to help support Hanyang graduate students, faculty, and researchers to publish internationally in English. Details on the CTL English Writing Lab consulting service can be found at the end of this preface.

How is this book different from other books?

1. It is research-based

The book uses insights from research in the fields of Applied Linguistics and English for Specific Purposes and the emerging field of English for Research Purposes. These research areas analyze the type of language spoken and written in professional fields like engineering and medicine. Rather than just giving general English writing advice using instructor intuition, this book uses research insights from specialized writing journals to improve the material.

2. It is based on computer analysis of authentic texts

All the best practices and examples are directly taken from computer analysis of real published articles. In looking at authentic text, it was found that some general advice on writing like “avoiding the passive” or never using “we” does not apply to fields like engineering. In addition, by only looking at real published papers, some significant differences between fields even within the same discipline such as engineering were found in terms of article structure and writing style.

Unlike many other writing books published in Korea, it is not just a collection of example sentences but combines best practices and frameworks for different sections of the paper, such as the introduction or abstract, with advanced grammar tips on the specific sentence structures that are needed for each section of the paper. For example, the grammar to politely but critically evaluate problems with previous research in the introduction is explained. This book takes a general approach inspired by Swales and Feak (1994) that combines higher level genre analysis with grammar support needed for functions in each section of the research article.

3. It is based on a needs analysis of Korean students

Language background and education experience are important factors that influence student needs. This book is specifically designed to meet the needs of Korean graduate students and faculty writing in English.

How is this one different from the first edition?

The chapters on computer-assisted writing and common format punctuation errors were expanded and revised but removed from this book and made into separate files available at www.hanyangowl.org.

The first edition was based on engineering writing. However, during my research I found that there were significant differences between fields of engineering, for example, between computer, chemical, and civil engineering. Indeed papers in some fields like computer hardware engineering and applied physics were found to have more in common with each other than with other fields like civil engineering. Therefore, a more general approach to science and engineering writing was taken in this book. Future revisions will focus on single fields or research approaches rather than disciplines like engineering or medicine. The fields of English for Specific, Academic, or Research Purposes are probably overusing the category of “discipline” for genre and corpus studies and course and materials design.

How to use this book

This book is designed as a self-study guide to help students improve their manuscript before showing their paper to their advisors or seeking help at a Writing Center. Research studies and my own experience teaching graduate engineering students has shown that graduate students are more like busy adult learners than undergraduate students. Self-study materials, study groups in a lab, or feedback from advisors are the ways graduate students seem to learn rather than only through traditional writing classes. The CTL Writing Lab at Hanyang was also designed to help students exactly when they need it most: when they are actually writing their articles for publication.

A copy of the first book was given to each professor in engineering and natural science departments at Hanyang University for students to consult the book in the lab while they are writing. Professors could also assign students who are writing their first draft of a co-authored article, thesis or dissertation in English to read chapters of the book. In addition, the book chapters are also being used by study groups organized in a lab and led by a senior student. There are also writing checklists for each section of the article that students can check while editing their papers.

Limitations

I recognize that good writing materials and Writing Lab help are only a part of the solution. It is only the experience of a professor in the field advising a graduate student that can produce the best co-authored paper. However, the purpose of our materials is only to help raise the quality of the basic structure and level of English of the manuscript from students writing as the primary author, so faculty can concentrate more on what they do best: share their knowledge of their field.

Future plans

We invite faculty and graduate students from all departments to give feedback on this book and suggestions for materials on English research writing. For example, we have identified the difficulty of replying to reviewers' comments and the need for more sentence level grammar advice as possible topics. Please email adamturner7@gmail.com with suggestions. To find out more about our writing consulting services for Hanyang students and faculty please see the writing lab homepage at http://www.hanyangowl.org and view the description of the service following this preface.

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English Writing Lab

교수학습개발센터 Hanyang University Center for Teaching and Learning

Free individual help to publish your journal article in English

The Center for Teaching and Learning (교수학습개발센터) English Writing Lab at Hanyang University in Seoul, Korea, provides faculty, researchers, and graduate students with free individual native-speaker help to improve English journal articles for clear meaning, organization, logic, and best research writing practices. The purpose of our service is to help Hanyang first authors to revise SCI, SCI-e, SSCI, or A&HCI journal articles, or documents that directly support publication, such as responding to "reviewer's comments," before the article is sent for proofreading (see Step 3) or (re)submission to a journal. Feedback is first given by email, and then authors can meet face to face with our consultant to ask questions and get additional help to revise the paper as necessary.

The service does not correct all grammar errors, but we do give feedback on important grammar or sentence structure errors that may interfere with clear communication. We not only make suggestions, but explain why changes should be made so that you can become a more skillful writer. Good English revision can mean the difference between a paper being accepted or rejected.

How to apply for the consultation service

STEP 1 First please view this checklist of common errors in research writing
http://www.hanyangowl.org/media/researcharticle/combinedchecklist.pdf
and specialized research writing and grammar materials at http://www.hanyangowl.org/

STEP 2

a) Email hanyangwritingcenter@gmail.com Please include your name, position (professor or graduate student), department and/or lab, phone number, email address, and type of paper (SCI, SCI-e, SSCI, or A&HCI). Please also indicate the deadline you need for feedback.

b) Attach your paper as an MS Word file. Please delete any large color graphic figures so your paper is less than 2MB. If you are using LaTeX, please export the text to an MS Word file but also provide the PDF for our reference as well. We use the editing functions of MS Word and can ignore the LaTeX commands.

c) Also attach an already published sample article PDF file from the exact target journal you want to publish in. If you are resubmitting your article after revision, include the reviewer's comments, particularly if there are comments related to problems with the English or the clarity of the writing.

STEP 3 You will receive email feedback from Adam Turner with suggestions for revision using the editing functions of MS Word. After the email feedback, you may revise the paper and send it again, or meet for a face to face consultation in person to ask questions and get additional help. Please call 02-2220-1612 for an appointment.

In addition to our Writing Lab consultation, you can also receive free grammar proofreading for SCI, SCI-e, SSCI, and A&HCI articles with a Hanyang first author. Please view this *Hangul* file download from the research department for more information http://www.hanyang.ac.kr/data/101279/40_0.hwp

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Chapter 1: **Writing Formal Email**

1.1 Introducing yourself

The ability to write email to foreign researchers and companies using a style and tone that is appropriate is an essential professional skill. In this chapter we will cover the basic format for formal email used for professional communication as well as the basic grammar for polite requests in English.

1.1.1. Introducing yourself at a conference or in email

Imagine that you meet a well-known professor in your research area at a conference. It is a great opportunity to ask a question, but first you must introduce yourself. Also, when writing an email to a foreign professor, writing an application, or writing to a foreign company, it is common to introduce yourself in the beginning of your email using the same structure.

EXAMPLES

Hello, my name is Ji-Sung Park. I am a master's student in the Department of Chemical Engineering at Hanyang University in Seoul, Korea. I am currently researching hybrid materials.

Hello, my name is Yuna Kim. I am a Ph.D. student in the Department of Electronics Engineering at Hanyang University in Seoul, Korea. I am currently researching video compression, audio compression, and computer graphics.

Any of these structures are correct for talking about your student status. However, master's candidate is not as common, but not wrong.

I am a	master's student.
	master's candidate.
	doctoral student.
	doctoral candidate.
	Ph.D. student.
	PhD candidate.

1.1.2 Writing a bio statement for a conference or journal

Some journals and conferences will require you to submit a bio, which is a paragraph about your background and research interests of about 75-100 words. It is written in the third person, meaning that you do not use “I” to describe yourself. Bios seem to be more common in electronic engineering journals than in chemical engineering journals. It may depend on your field. There are many possible formats. Below is a real example from a Hanyang author in an IEEE journal.

EXAMPLE

Chul-Ho Choi (M’99) received the B.S. degree in control and instrumentation engineering from Hanyang University in 1998 and the M.S. degree in EECI from Hanyang University. He is currently pursuing the Ph. D. degree at the same university. In 1998, the 3rd TI DSP contest prize was awarded to him. He has been engaged in research and development of control system for flat panel displays and has designed LCD controller for UXGA. His research interests include image processing, VLSI design, 3D display, and flat panel displays.

Source: C.-H. Choi et al.: IEEE Transactions on Consumer Electronics, Vol. 50, No. 3, AUGUST 2004 p. 909 ©2004

A bio can include

- where you got your previous degrees and what year you graduated.
- which lab you are part of.
- any prizes or awards you have received such as outstanding student conference paper.
- any professional associations you are a member of such as IEEE.
- any poster or conference papers you have presented and at which conference (usually only for graduate student conferences.)
- any other papers you have published (not as common).
- your research interests.

1.1.3 Common mistakes when writing formal email

When you are introducing yourself, don’t just mention that you are a graduate student. Say what kind of student you are, master’s or doctoral.

Major is used only for undergraduate students. Major is a type of student; it is not a field of study. If you introduce yourself at a conference and say, “My major is mechanical engineering,” then people might think that you are an undergraduate student who is helping to move tables and give directions at the conference, not a presenter!

“Course” refers to a program of study or a class, but not a person. Don’t use it to introduce yourself.

EXAMPLES
X: I am a doctor’s course student
Correct: I am a doctoral student

For doctoral degrees, use either periods after both “h” and “D” or no periods at all, not just one period. It is an abbreviation of Doctor of Philosophy from the Latin, *Philosophiae Doctor*, or D.Phil., so the “h” is not a full word. Traditionally in Europe, all those who gained the highest degree in a field except for theology, medicine, or law were awarded a Doctor of Philosophy. The modern trend is to write it without periods.

EXAMPLES
X: She is a Ph.D student.
Correct: She is a PhD candidate.
Correct: She is a Ph.D. student.

Don't use an abbreviation for the word "university" in normal writing unless you are filling out an application form or you lack space to write in a document like a brochure.

EXAMPLES
X: I graduated from Hanyang Univ.
X: I graduated from Hanyang U.
Correct: I study at Hanyang University.
Correct: I am studying at Hanyang University in Seoul, Korea.

Do not use "about" or "part" to describe your research.

EXAMPLES
X: I am currently researching about fuel cells.
X: My research part is nanoparticles.
CORRECT: I am currently researching fuel cells.
CORRECT: My research field is nanoparticles.
CORRECT: My area of research is hydrogen storage materials.

There is an official difference between Ph.D. student and Ph.D. candidate. A Ph.D. candidate is considered to have finished taking courses, and is currently researching or writing a dissertation whereas a Ph.D. student is still taking classes. Although many people are not aware of this difference, it might be a good idea to follow this usage for formal job, scholarship, or post-doc applications.

You receive a degree in a subject or from a university, but not a department or a division.

EXAMPLES
X: He has a M.S. in the Department of Materials Science and Engineering.
X: He has a M.S. in the Division of Materials Science and Engineering.
CORRECT: He has a M.S. in Materials Science and Engineering from Hanyang University.
CORRECT: He is a master's student in the Division of Materials Science and Engineering at Hanyang University.

1.1.4 Undergraduate student introductions

These examples are appropriate for introducing undergraduate students.

EXAMPLES

CORRECT: My name is Ki-Hyun Seol, and I am a senior in the Department of Civil Engineering at Hanyang University in Seoul, Korea.
CORRECT: I am studying civil engineering at Hanyang University.
CORRECT: My major is civil engineering. I go to Hanyang University.

1.2 Format for writing the date

There are a surprising number of differences in how the date is written in Korea, America, Europe, and in the international standard used in many scientific documents. Not knowing these differences can cause confusion. You may need to know this difference for organizing business meetings by email, proposals, orders, contracts, business letters, or applications.

1) Korea

2009.12.10

Month Day

2) The United States

December 10, 2009

To avoid possible confusion, the month is often spelled in Western languages.

Put a comma here. The formats 25th , 2nd or 3rd are more traditional, but are becoming less common in modern business writing.

3) Europe, Australia, New Zealand, and Canada

10 December 2009

No commas required here

4) ISO 8601 International Standard http://www.iso.org/iso/en/prods-services/popstds/datesandtime.html

2008-12-10

Year-Month-Day

When writing the date on a business letter or document, spell the month and there will be no confusion. As you can see, confusion can result between British and American English. The date 06/01/09 would be 6 January, 2009 in Europe, but June 1st in the US. Slash marks "/" or a "-" hyphen (not a period) are used when writing a numerical date in English. The official style in Canada is the same as Europe, but some Canadians use the American format. The next time you are looking in Hyundai or Lotte Department Store in Seoul, look at the expiry date on items in the foreign food section such as cheese, and see if you can understand the dates on the packages. It might not be as easy clear as you think. It is hard to believe that there is no clear standard even for medicine labels!

Note also that abbreviations of the names of long months can be either three letters "Sep" in scientific writing or four letters "Sept."

1.3 Names and titles

Names and titles are difficult because there are so many cultural differences. This section tries to explain some of these differences. The first step is to understand the difference between first and last names in English. I sometimes see incorrect references in papers resulting from confusion between first and last name.

1.3.1 Titles and greetings

I sometimes receive email or telephone calls that start like this:

"Hello, this is Kim."

What is the problem here? Family name only without any title such as Mr. is not usually used to refer directly to everyday people. In English, however, it is used in newspapers and current events, sports, the military, and some traditional private schools when teachers are calling students, but it should not be used in normal speech or email. In countries like Korea and China where many family names are the same it is especially a problem.

A) If you are emailing a foreign professor whose name is John Jones, the format is as follows:

EXAMPLE
Correct: Dear Professor Jones:
X: Dear Jones

B) There are actually very few titles in English. They are professor, Dr., Mr., Ms., Mrs., and many military and some political titles. Use only one title with a family name, however, and not both Dr. and Prof. together.

EXAMPLE
X: Prof. Dr. Dong-guk Lee
Correct: Professor Jones
Correct: Dr. Jones

C) In Korean, it makes sense to say, "안녕하십니까? 김 센터장" in an office. However, addressing someone as "Director Kim" in English sounds strange. We would just say "Mr. Kim." In short, the only titles you will probably ever need to use in English are Mr. Ms. Mrs. Dr. or professor. Teacher, director, and manager are not titles in English to be used to refer to a another person, to speak directly to a person, or to address a greeting in an email. One exception here is that the word "Teacher" is used by children to refer to their teacher in elementary school. The word "Miss" is also sometimes used with first name "Miss Mary" by children referring to their elementary school teacher.

EXAMPLES
X: Dear Turner
X: Dear Adam Teacher
X: Dear Manager Turner
X: Dear Director Turner
CORRECT: Dear Mr. Turner
CORRECT: Dear Professor Turner
CORRECT: Dear Adam, (but see 1.4.)

D) The abbreviation Prof. is usually only used with the full name, not with family name only, but this is not a serious mistake. The abbreviation Dr. is used with family name only, except for very formal introductions such as introducing a guest speaker. The full name and title format is mostly used for registration, government applications, and other documents that are kept by alphabetical order. Writing the word "Doctor" is only used for medical doctors, M.D.

If you are sending an email to a faculty member then use title and family name only except for the most formal situations.

EXAMPLE
Dear Professor Jones:

It is generally true that North American culture is more casual than Korean culture. I usually call other foreign English teachers or professors by their first names only, but I always use the title "Professor" when speaking or writing to Korean professors. Be careful not to exaggerate how casual Western culture is, however. I called all of my professors "Professor [+ family name]" when I was a university student in Canada. However, especially in small American colleges or between graduate students and professors, first names may sometimes be used.

E) If the title is used with the family name then it is capitalized. If you are talking about a job in general with no specific reference to a person it is not.

EXAMPLE
Many professors applied for government funding, but only Professor Kang from Hanyang University was awarded the research grant.

Writing to female office staff is more complex. Ms. is most commonly used for women today as the equivalent to Mr., because it does not show if a woman is married or not. Only use Mrs. or Miss if a woman asks you to do so.

Dear	Ms. Smith	single
Dear	Mrs. Smith	married
Dear	Ms. Smith	married or single

F) If you are emailing female office staff at a foreign company or university and you know their name, I suggest using "Ms.", unless you know that they have a Ph.D.

EXAMPLE
Dear Ms. Knight:

Here is a review of the different combinations of name and title that are acceptable.

Title	Family Name
Dr.	Park
Dr.	John Jones
Professor	Oh
Prof.	John Jones

Title	Family Name
Mr.	Turner
Ms.	Lee
Mrs.	Kim
Miss	Smith

TIP

There is no period after titles like Mr Mrs Dr or Ms in British English.

1.3.2 Korean names

Korean names are very interesting and complex in English. Imagine a foreigner who did not know anything about Korean names and they saw the name of this woman from Korea. How would they understand the name?

Ha Ha Na	Three words?
Ha Ha Na	Miss Ha, first name Hana?
Ha Ha Na	Miss Na, first name Haha?
Na Ha Ha	Miss Haha, first name Na?

A space in English means a word. Therefore, if you put a space between the two syllables (sounds) of your first name then logically in English it is two words. Although a Korean name may be made up of two Chinese characters, it is not really two separate words as a name. This is why most people use a hyphen.

To prevent confusion in English, I recommend using a hyphen or one word for Korean names.

EXAMPLES

CORRECT: Ji-sung Park
CORRECT: Jisung Park
ACCEPTABLE: Ji-Sung Park
NOT RECOMMENDED: Ji Sung Park

In Western culture hyphenated first names also exist, often of French origin and for women, for example, Anne-Marie Latour.

Note that some Korean authors are using hyphens for initials in references, for example, “C.-H. Choi et al.” Although this is not standard, it may be a reasonable solution to the problem of distinguishing Korean names when there are so many similar first and family names in Korea. Other Journals in Korea are using the full Korean first name or the first initials of the author’s first name in author-date format in-text references, (Jisung Park, 2007), which is unnecessary because the year will indicate the correct author. Putting a comma between the last and first name can also be seen in Asia.

EXAMPLE

Director

Park, Ji-Sung

But this is not standard English and is not recommended either. It does not really help a foreign reader understand which name is the family name as it breaks the order for English Names. My name is "Turner Adam" when written in Korean in Korean government documents: 터너아담.

1.3.3 Middle names

As well as first and family names, most western people have middle names. Jonathan is my middle name. My full name then is "Adam Jonathan Turner." However, middle names are usually only used in reference abbreviations such as A.J. Turner, in passports, or in government documents. The second letters G and m indicate middle names in this reference.

EXAMPLE

Raleigh, G.**G**.; Cioffi, J.**M**.
Communications, IEEE Transactions on
Volume 46, Issue 3, Mar 1998 Page(s): 357 – 366

Note that Western middle names are not the same as the second part of Korean first names, as the "ho" in Chan-ho Park. In Korean names, the second letter is not really a middle name, but since so many Koreans have similar family names, the second part of the first name is often used like a middle name in references like this one. I think the hyphen format J.-G.. Kim makes more sense for Korean names.

EXAMPLE

[1] J. G. Choi, S.W. Lee, and S. D. Kim, "Spatio-temporal video segmentation using a joint similarity measure," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 7, pp. 279–285, 1997.

I hope that English journals will also include Chinese Characters for East Asian names in the future.

1.4. Understanding the format of an email

Correct punctuation is important because it can show the relationship between the speakers. It is meaningful. When I email other English professors for the first time, I often start like this:

Dear Professor Taylor:

After we exchange email and I know a bit more about the person, such as that they are a similar age and status, I might change to

Dear Professor Taylor,

Finally, as we get to know each other or after we have met in person, I might change my greeting to

Dear Robert,

If we become friends then I might change to

Hi Rob.

If you use the wrong level of politeness, it is not just a punctuation mistake; it could be interpreted as a lack of respect for the recipient of your email.

There are also other interesting differences in the ways that different languages organize information. David Shaffer, an English professor who has spent decades in Korea, explains that information in Korean is usually given from larger to smaller units. In English, it is often the opposite. Korean addresses start with the city; English starts with the apartment or house. Notice that Korean also starts with the group (family) and then the individual, but English is the opposite. Keeping this in mind, here is a properly formatted example of a signature line of an email. All professors and graduate students in engineering should have an email signature line for the address they use to communicate for professional purposes.

Dong-gun Chang, Ph.D.
Associate Professor

Department of Civil Engineering
Hanyang University

17 Haengdang-dong, Sungdong-gu
Seoul, Korea, 133-791

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Fax: +82-2-2293-8877
dgchang@hanyang.ac.kr

http://www.apvlab.com

1.4.1 Common email problems

"Dear" is the correct formal greeting for all types of email and letters. It is not only for personal email as some of my students believe.

You should always try to find the name of the person you are sending applications to, but if you can't then you should use either of these two examples:

Dear Sir or Madam:

To Whom It May Concern:

The use of "Hi" should only be used for personal emails, or if you know the recipient of the email well. The use of "Hello," is generally acceptable for the first line of an email.

Handphone is Asian English. Mobile is European or Australian English, and cell phone or cell is American English. The abbreviations H.P. or C.P. are not common in English in signature lines or business cards and should be avoided in English.

With the exception of some personal names, only capitalize the first word of any word containing a hyphen:

EXAMPLES
CORRECT: E-mail
CORRECT: Email
X: E-Mail

The correct format for university names can be quite complex. "University of" is used to describe a university that belongs to a specific city or province. Other university names have the same format as Hanyang with the name first. State universities in the US don't always

follow this rule, however. Pennsylvania State University is not the same as the University of Pennsylvania.

It is a good idea to maintain consistent format, color, style, and spelling for university documents to establish the identity of a university. This is seen as important by many American universities http://www.cmu.edu/styleguide/. I have seen all of the different spellings below on Hanyang webpages, email signature lines, business cards, signs, and vehicles. The abbreviation HYU is also not standard because Hanyang is only one word, but it is a reasonable choice because there are so many Korean university names that start with H.

EXAMPLES
X: HanYang University
X: Han-yang University
X: Han-Yang University
X: University of Hanyang
X: Hanyang Univ. (unless there is some reason for the abbreviation like a lack of space in a table or a long list)
CORRECT: Hanyang University
CORRECT: HYU

1.4.2 Signature lines

Use a colon (:) to introduce information. There is no space before a colon, but one space after it. A period can also be used for telephone numbers.

EXAMPLES
X: Tel)+82-02-2261-4915
CORRECT: Tel: +82-02-2261-4915
CORRECT: Tel. +82-02-2261-4915

Capitalize the official name of your department or lab if you include the name of the specific university, but do not capitalize it if you are just talking about the subject in general.

EXAMPLES
X: He is a student in the department of mechanical engineering at Hanyang University.
CORRECT: He is a professor in the Department of Mechanical Engineering at Hanyang University in Seoul, Korea
CORRECT: He is studying mechanical engineering.

1.5. Formal email style

Always organize your formal emails into logical paragraphs. Do not write emails line by line. Most formal emails contain a three or four paragraph structure that includes the following:

1. An introduction that introduces yourself or reminds the person who you are
2. An explanation of the request or problem
3. A request for action or information
4. A closing sentence.

1.5.1 Email ID name

You might want to write your name in both English and Korean *Hangul* or other Asian languages for your email ID if you email foreign professors, companies, or for applications abroad. Some recipients of your email might not have Korean (*Hangul*) or other fonts loaded on their computer unless they work with Koreans. If they don't, your name in the email containing your resume or CV attachment may look like this! "±³º¸¹®°í". I have actually received email

that looks like this from students whose languages are not as common internationally. Note also that the standard Korean default fonts Batang and Gulim are not used for English text when writing international documents in English.

1.5.2 Emoticons

Don't use emoticons or unnecessary punctuation when mailing foreign professors, universities, companies, journals, or graduate students. In most cases, common usages in East Asia such as Okay ^^ HI!! Bye~~ just look childish for graduate students. Female students in particular should make sure they avoid sending cute avatars in signature lines for very important email. A student of mine realized that she had a cute angel avatar for her hanmail.net signature line only after sending an email for an important post-doctoral scientific research application!

For example, subject lines such as "Re: here you are, sir~^^" or a closing "ok bye~~" are not appropriate for formal email. Tilde~~ is not used in formal email except for scientific equations. You may, of course, use these forms in personal email between friends. I would also not advise you to include personal www.cyworld.co.kr or other personal homepages or blogs in your formal email signature line unless you use them to discuss research or issues related to your field.

1.5.3 Have a clear subject line

Make sure the person can find as well as recognize your email easily in their inbox. Unrecognized email addresses might be deleted if there is no clear subject line.

1.5.4 Use your professional email address, not your personal one

If you have a university account, try to use your real name, not a nickname for your ID if possible. Don't use an account like toughguy@ihanyang.ac.kr for formal email or job applications. It is a good idea to have one email for your professional purposes and another one for your school or job related mail. You can add some numbers if you have a common family name as I have done, adamturner7@gmail.com.

1.5.5 Do not rely on spell check

There are many common errors that spell check programs cannot find. It is better to proofread very important documents on paper before sending them.

EXAMPLES
It's -> its form -> from there -> their

It is a good idea to write the first draft of an important email in a word processing program to allow you to check the grammar and spelling. You can then copy and paste the text into your email program.

1.6. Politeness in English email

Writing with an appropriate level of politeness is very difficult in a foreign language. Here are some guidelines for email.

1) Don't be too demanding

Imagine that you are asking a foreign professor, English instructor, or colleague to help you with your paper.

EXAMPLES
X: Can you edit my paper? I need it on Friday
(too demanding, could be used between a boss and an employee).
X: I expect your answer soon.
CORRECT: Would it be possible for you to edit my paper by Friday? The deadline is next Tuesday
(acceptable, background reason and polite form used).

2) Avoid use of "you" when disagreeing

Using "you" makes it feel more personal. If you disagree with a reviewer's comment on your apper you might change to passive sentence structure to make it more polite.

EXAMPLES
X: The comments were very helpful and we have changed the text as recommended. However, we disagree with one of your comments.
CORRECT: The comments were very helpful and we have changed the text as recommended except for page two paragraph six, which was not changed because …

3) Be specific

Think of your audience. Give them the complete information to solve the problem, answer your question, or complete the task. Give them exact page references of articles, product numbers, or shipping orders that they might need to do a job or fix a problem without looking up the information.

EXAMPLE
X: It would be very helpful if you could send me some image data that is mentioned on your website.

The recipient might ask: Which website? What data? What section or page? Which article? These are all types of questions that the reader of your email should not have to ask.

4) Use "-ing forms" for politeness

The past continuous verb tense (was +ing verb) is often used in polite expressions.

EXAMPLES
X: Can you check my paper?
CORRECT: I was if you could review my article.

There seem to be some cultural differences in closings in email. Don't demand or ask for a positive result, whether it is for a job or a journal article. Also, don't say that you are waiting for an answer, but instead give a specific reason why they should contact you by a specific time.

EXAMPLES
X: Please send E-mail to me, I hope with good news.
X: I look forward to your positive reply.
X: I am waiting for your answer soon.
X: I expect that I get help from you.

CORRECT: Thank you for considering my application.
CORRECT: I would really appreciate any advice you could give me.
CORRECT: I look forward to your reply.

CORRECT: If you have any questions or require further information, please do not hesitate to contact me at …

1.6.1 The grammar of politeness

In Korean, the grammar of politeness is very complex and difficult to use correctly. You must change verbs and even nouns. However, in Korean, at least the rules for politeness are more clear and systematic. On the other hand, in English the rules are not as well defined, but you may use the following guidelines when considering the level of politeness necessary. When writing formal email to a person you do not know well, use politeness levels 3 or 4 below.

There are four basic steps to increased levels of politeness:

1) Change from imperative to question form
Edit this paper -> Can you edit this paper?

2) Change from question form to modal question form (could, would)
Could you edit this paper please?

3) Add politeness phrase to modal question form
I would really appreciate it if you could review this article this week.

4) Add background, a reason, an excuse, or an explanation to your request.

Your paper entitled, "_____" has been essential for my work on _____. Would it be possible for you to explain the method for _____ on page 23 of your article? How does your proposed algorithm…?

Internet Links

It is fairly common practice in East Asia for some professors to ask students to write the first draft of their own reference letters themselves in English before the professors edit and sign the final draft. Here is a useful link for students and faculty who must write letters of recommendation for those who want to work or study particularly in North America. Note that there are some important cultural differences in what is considered appropriate in a letter of reference. In some Asian countries such as Japan, there is a tendency to write in a style that is too modest for a reference to an American graduate school or company, for example. Here is useful general advice on writing reference letters in English.

http://isites.harvard.edu/fs/html/icb.topic58474/Verba-recs.html

1.7. Formal email format handout

Use this format for business purposes, writing to professors, or for applications.

[Greeting or salutation]

Dear Professor Taylor:

[Or]

Use a colon for formal emails. No space before a colon: one space after it. “Dear” does not have a period or comma after it.

Dear Mr. Turner

Always capitalize the first letter of family names. These days punctuation is getting simplified, especially in the business world. If it is routine email and not a formal letter on paper then no colon is acceptable. In British English, there is no period after Mr or other titles when writing business email.

[Body of email]

……
……
……
……

[Closing]

Sincerely,

[Or]

Yours truly,

“Sincerely”, and other closings are followed by a comma. For email, the name should be typed after skipping one line. If it is a business letter on paper then you should skip four lines because your handwritten signature should be between "Sincerely" and your name. Many documents, like a cover or reference letter, must be signed on paper unless there is a special online application.

(Signature line)

Notice that the second word “truly” is not capitalized.

Dong-gun Chang

No punctuation at the end of a line. The format “Chang, Dong-gun” is sometimes used for names in Korea and some other Asian countries, but it is not standard in English except for forms in alphabetical order.

Ph.D. candidate
Department of Civil Engineering
Hanyang University

There should be a full signature line at the end of professional email.

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Seoul, Korea, 133-791

Tel: +82-2-2290-0708

Fax: +82-2-2293-8877

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http://www.apvlab.com

No space before a colon: one space after it. Don’t forget to include full international contact numbers when writing applications or working with foreign researchers or companies. Note that for reasons of privacy most people do not include cell phone numbers, only office numbers. The entire mailing address is not always included.

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Computer-assisted Writing Chapter 2 from the previous edition
"**English Solutions for Engineering Research Writing**"
http://ctl.hanyang.ac.kr:8001/writing/engineeringresearchwritingebook.pdf

is now a separate file at ://hanyangowl.org/course/view.php?id=3

Chapter 2: **Sentence Structure**

In order to improve your writing style and understand some of the advanced writing principles in this book, you may need a review of sentence structure grammar. This review takes a different approach by only describing how grammar is related to writing and the meaning of sentences. It is not the kind of grammar that you may see on a TOEIC test, for example. Having a deeper understanding of English sentence structure will also help you to avoid many grammar and punctuation mistakes.

2.1. Sentences in English

Writing is not simply about making grammatically correct sentences. Grammar is not just a set of rules; it is a tool to help you communicate your meaning accurately.

Consider the following simple sentences. Both are grammatically correct. However, where we put the information changes the meaning of the sentence. Ordering the information changes whether the sandwich was eaten before or after the person went home.

EXAMPLE

A) I went home and ate a sandwich.
B) I ate a sandwich and went home.

Many students in Korea like to have a late night snack (분식) after studying—ramen is also popular with students in North America. Consider the following sentences about what kind of food someone likes to eat at night. Both are grammatically correct, but where we put “AND” as well as the comma changes the meaning of the sentence. In the first sentence we like four items, but in the second sentence we only like three choices. It is the combination of ramen and kimchi together that is so delicious in the second sentence, rather than the choice of either one.

EXAMPLE
What do you like to eat for a late night snack?

C) I like kimbap, mandu, ramen, or kimchi.
D) I like kimbap, mandu, or ramen and kimchi.

Grammar is not simply a set of rules for making correct sentences, but a tool to express meaning. Unfortunately, many Korean students have done grammar exercises without being taught that how they combine clauses and where they put information in the sentences can actually change the intended meaning.

2.2. What is a sentence?

A sentence is a complete thought containing a subject and a verb between the capital letter (Y) and a final period (.), question mark (?), or exclamation mark (!).

TIP

If you see any basic grammar terms like noun or phrase that you have forgotten since high school, have a look at this page: **http://www.chompchomp.com/terms.htm** and the glossary of grammar terms in the appendix.

Understanding these basic grammar terms is essential for you to be able to follow this guide to improving your writing. Knowing these terms will also help you to study for TOEFL, TOEIC, IELTS, GMAT, or GRE tests in the future.

There are four basic types of sentences:

1. Declarative (common) statements: I am going to the lab.
2. Questions: Are you hungry?
3. Orders (imperative): Finish the experiment today.
4. Interjections: Oh, no! (Someone forgot to go to the bank).

In this writing guide, we will only be concerned about statements (declarative) or common sentences. The other types of sentences are rarely used in science writing.

TIP

Don't use imperative forms in the methods section of your paper. It makes it seem like a cooking recipe. Generally, use the passive.

EXAMPLE
X: Add the compound to the mix.
O: The compound was added to the mix.

The exception is when explaining equations or giving instructions in computer programming such as pseudo code.

One essential tool to improving your writing style is understanding clauses (절). Clauses are the basic building blocks of sentences. Unfortunately, many Korean high school textbooks only explain simple sentences. Understand clauses and you will be able to improve your writing style, find mistakes more easily, and write more clearly.

2.3. What is a clause (절)?

A clause is a group of words that contains (at least) a subject and a verb.
A clause = a subject (주어) + a verb (동사)

EXAMPLE

Although the method improved accuracy, it caused a significant increase in computation time.
(subject) (verb) (subject) (verb)

2.4. What is the difference between a main clause (주절) and a subordinate clause (종속절)?

There are two types of clause: main clause (also called an independent clause; 주절) and subordinate clause (also called a dependent clause; 종속절).

2.4.1. Main (Independent) clause

A main clause contains a subject and a verb that has a tense that expresses a complete thought. It can make sense as a sentence by itself as the underlined clause shows below.

A main clause is formed with **subject + verb.**

EXAMPLE
Although the method improved accuracy, it caused a significant increase in computation time.

2.4.2. Subordinate (Dependent) clauses

A subordinate clause begins with a **subordinator** such as *when*, *although*, *if*, *that*, or *who*. A dependent clause does not express a complete thought and does not make sense as a complete sentence by itself. It supports the main idea in the main clause.

A subordinate clause is formed with **subordinator + subject + verb.**

subordinate clause			main clause	
subordinator	**subject**	**verb**	**subject**	**verb**
Although	the method	improved accuracy,	it	caused a significant increase in computation time.

If you were talking about research and another member of your lab said, “Although the method improved accuracy” and then stopped speaking, you wouldn’t know how to answer them. You would be waiting for the main point. The sentence does not make sense by itself, so it is not really a sentence but only a subordinate clause. We call this kind of sentence structure mistake in English a “fragment.” This is because it needs more information to be a proper sentence and make sense. The most common fragment problem in writing is using “Because” only with one subordinate clause.

EXAMPLE
X: The proposed method was rejected. Because it was not cost-effective.
O: The proposed method was rejected because it was not cost-effective.

If you were talking about your research and a classmate said, “There was a significant increase in computation time,” you might respond by saying, “That is too bad. Try another method.” The sentence makes sense by itself, so it is a main clause. It could also be used as a complete sentence.

TIP

How can I remember the difference?
Sub means “*under*” like in the word *Subway*. Just as a general gives orders to his subordinate soldiers, a subordinate clause supports the main clause. In some grammar books, the subordinate clause is also called the *dependent* clause because it *depends* on the main clause to have meaning.

What is the difference between a clause and a sentence?
A main clause makes sense as a complete sentence. A subordinate clause lacks some information to make it a complete sentence. We could compare it to a train (sentence), which can pull one or more cars (clauses). It doesn’t matter how many; it is still a train.
More detailed reading on types of clauses
http://grammar.ccc.commnet.edu/grammar/clauses.htm

We learned earlier that there are four basic types of sentences. However, the type of sentence that is commonly used in research writing is the declarative sentence, which makes a statement. There are four kinds of declarative sentences in English. Along with understanding clauses in English, understanding these four types of declarative sentences is essential in improving your writing.

2.5. Four types of informational sentence structures in English

Here are the basic types of informational sentences in English that are used in academic writing. These structure charts should help you to paraphrase references in your own words. Also, they may help to fix most sentence structure errors as follows:

1. Count the number of clauses (subject + verb) in the sentence

2. Determine whether each clause(s) is a main or a subordinate clause.

A main clause makes sense as a complete sentence, while a subordinate clause does not. The words: “Because it was raining”, although they have a subject and verb like other sentences, do not make sense as a complete sentence because information is missing from the main clause, such as “I decided to stay home and watch a movie.” A phrase is just a group of words that does not have a subject AND verb; for example, “in the morning”, “at 10 am”, “To improve writing skills” etc.

3. Look at the tables below to determine how the clauses should be joined.

2.5.1. Simple sentence (단문)

A simple sentence has **one independent clause**.

EXAMPLE
I like pizza.

2.2.2. Compound sentence (중문)

A compound sentence has **two main (independent) clauses** joined by a
A) coordinator
B) conjunctive adverb or a
C) semicolon.

EXAMPLES

A) Coordinator

main clause	, coordinator	main clause
I really like bulgogi	, but , for , and , nor , but , or , yet , so	she prefers pizza.

B) Conjunctive adverb

main clause	; conjunctive adverb,	main clause
Writing well is a difficult skill to develop	; however, ---------- ; accordingly, ; consequently, ; for example, ; furthermore, ; hence, ; however, ; in addition, ; in contrast, ; in fact, ; indeed, ; instead, ; moreover, ; nevertheless, ; otherwise, ; therefore, ; thus,	it is important for professional success.

C) Semicolon

main clause	;	main clause

Developing writing skills is a challenge	;	It takes a lot of time and effort.

This structure is used when there is a close logical relationship between the clauses.

2.2.3. Complex sentence (복문)

A complex sentence has **one independent and one (or more) dependent clauses**. There are three kinds of subordinate clauses:

A) adverb clause
B) adjective clause and
C) noun clause

In an adverb clause, the subordinate clause can be either in the beginning or end of the sentence. Words like while, when, if, because, since, whereas, as, etc. introduce subordinate adverb clauses.
The punctuation depends on the placing of the dependent clause(s).

EXAMPLES

A) Adverb clause

subordinate clause (adverb clause)	,	main clause
Because using multimedia is more interesting to students	,	they may be more motivated to learn.

main clause	No comma	subordinate clause (adverb clause)
They may be more motivated to learn		because using multimedia is more interesting to students.

B) Adjective (relative) clause

main clause	subordinate clause (adjective clause)
Communicative teaching is done using group work,	which helps students to have more time to use the new language in conversation.

C) Noun clause

main clause	dependent clause (noun clause)
The teachers do not agree	that the teaching method is effective.

2.2.4. Compound-complex sentence (혼합문)

A compound-complex sentence is a combination structure that has two main clauses and one (or more) subordinate clauses.

EXAMPLE

subordinate clause,	main clause/adjective clause	, coordinator	main clause
Because effective writing and communication skills are difficult to develop,	companies value employees who have these skills	, so	they are more likely to achieve promotion.

Links

You can take this quiz to make sure you understand what a (main) independent clause is.
http://grammar.ccc.commnet.edu/grammar/quizzes/indep_clause_quiz.htm
If you need to review clauses, you can consult this site.
http://grammar.ccc.commnet.edu/grammar/clauses.htm

2.3. What is a phrase (구)?

It is also important that you understand phrases. A phrase is simply a group of words without a subject and verb but functioning as a grammatical unit in a sentence.

1) Verb phrase (동사구)
A verb phrase acts as the verb.

EXAMPLE
Most of the conference participants <u>will be arriving early in the morning.</u>

2) Prepositional phrase (전치사구)
A prepositional phrase can be an adjective modifier giving more information about the noun itself or an adverbial modifier giving more information about the time, place or circumstances.

EXAMPLE
Most <u>of the conference participants</u> will be arriving early in the morning.
(adjective modifier)

Most of the conference participants will be arriving early <u>in the morning.</u>
(adverbial modifier)

3) Noun phrase (명사구)

EXAMPLE
<u>Most of the conference participants</u> will be arriving early in the morning.

4) Gerund phrase (동명사구)
A gerund phrase can function as a subject or as a direct object.

EXAMPLES
<u>Seeing</u> is believing.
(subject)

She tried <u>bungee jumping.</u>

(direct object)

5) Participial phrase (분사구)
A participial phrase can modify a subject or a direct object.

EXAMPLE
Trusting her instincts, Jin-ah tried a new approach to the experiment.
(subject modifier)

I am reading an article discussing human synthetic muscle.
(direct object modifier)

6) Infinitive phrase (부정사구)
An infinitive phrase can function as a direct object (noun); as a subject (noun); as an adjective; or as an adverb.

EXAMPLE
This research group wants to improve fuel efficiency.
(direct object)

To improve the accuracy of the results may be very difficult.
(subject)

The government's plan to increase spending on research is vital for the economy.
(adjective)

They arranged the agenda to concentrate on the problems in the organization.
(adverb)

2.3.1 What is the difference between a clause and a phrase?

A clause has a subject and an active verb whereas a phrase does not have a subject and a verb. A phrase is a groups of words that is a unit of grammar, but never a complete thought.

EXAMPLE
Although the new manufacturing process creates less pollution, it is more expensive to operate.
(subject) (verb)
(CLAUSE)

She is going to start a master's in chemical engineering in the spring.
(prepositional phrase) (prepositional phrase)
(PHRASES)

2.3.2 The connection between grammar and writing

You may have done English grammar exercises in high school joining sentences and rearranging sentence structures. However, it may not have been clear to you why these skills were important. However, where you arrange the information and the type of clause you use actually affects the meaning of the sentence in English. There are four important effects of this.

1. Clauses are like Lego building blocks that can be moved around to construct different types of sentences. The type and place of the clause you put the information in affects the meaning of a sentence. In English, the main point of the sentence is usually in the main clause at the end of a sentence.
2. If you know how to rearrange the clause structure of your sentences, you can write more effectively. English paragraphs are arranged in terms of old and new information (explained in 3.12.1.). This links one sentence to the next and makes writing flow naturally. When your writing breaks this hidden rule of English information structures, it can look awkward and unnatural.
3. The most common sentence grammar mistakes are caused by not understanding clauses. Errors in sentence structure are considered a serious mistake and will hurt you not just in writing your research, but in applications to graduate school, job applications, and in TOEFL or GRE tests.
4. Many common punctuation mistakes can be eliminated by better understanding sentence structure.

These relationships between grammar and meaning will be explained in the next section.

Links

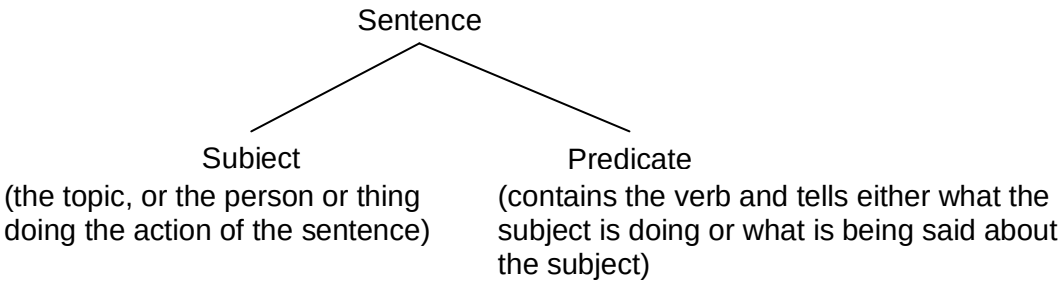
If you need to review phrases consult these sites will help.

http://www.mhhe.com/mayfieldpub/tsw/phrases.htm
http://grammar.ccc.commnet.edu/grammar/phrases.htm

2.4. The core idea of a sentence

Do you find that your sentences are too long when you write in English, especially if you translate from Korean? Locating the core idea will help you to revise. Part of the explanation in this section is based on Professor Kolln's method of explaining sentence structure in her book "Rhetorical Grammar" (2003).

No matter how long a sentence is and how many phrases and clauses it has, almost every English sentence has really only one main simple idea. Think of English sentences as having two basic parts:



Notice we already have a difference between Korean and English. In Korean, there is a distinction between the subject marker (-이/가) and the topic marker (-은/는). Even if Korean verbs were in the same position as verbs in English and not at the end of the sentence, Korean and English sentence structure would still be very different.

Remember that there are four kinds of statement sentences in English: simple, compound, complex, and compound-complex. However, no matter how complex the sentence structure

is, there should really be only one clear main idea in your sentence. All phrases, subordinate clauses, and other modifiers are really just extra information. If you find that your sentence is too long, then stop and find the main idea. The main idea is usually going to be a main clause with a subject and verb. Here is an example of a difficult sentence that contains a core idea.

EXAMPLE
In contrast, **data** addressing specific backbone hydrogen bonding contributions to the thermodynamics and kinetics of protein folding **are scarce** because ordinary mutagenesis does not alter the backbone.
Source: Deechongkit et al.: J. AM. CHEM. SOC. 2004. Vol. 126 No.51 p.16762 ©2004

Despite the complexity of this sentence, the core idea is simple. **Data are scarce.** All the rest of the information in the sentence is extra supporting information that gives more detail.

Here is another example.

EXAMPLE
There are backbone amide replacements that can be incorporated into polypeptides using solid phase peptide synthesis approaches that perturb hydrogen bonding.
Source: Deechongkit et al.: J. AM. CHEM. SOC. 2004. Vol. 126 No.51 p.16762 ©2004

The main idea is simple: **There are backbone amide replacements.** To prove that all the other pieces of the sentence are optional, we can see that we can re-engineer the sentence piece by piece by adding the clauses and phrases. Each example below could be a grammatical sentence by itself.

- **There are backbone amide replacements.**
- There are backbone amide replacements **that can be incorporated into polypeptides.**
- There are backbone amide replacements that can be incorporated into polypeptides **using solid phase peptide synthesis approaches.**
- There are backbone amide replacements that can be incorporated into polypeptides using solid phase peptide synthesis approaches **that perturb hydrogen bonding.**

Therefore, when writing English sentences, no matter how complex the subject matter is, there should only be one core idea. If your sentence is too long, stop and find the core idea. If you are reading a long sentence and can't understand it, stop and find the core idea. If you are having trouble explaining something complex, then you can start by writing short core sentences containing the key points step by step and then joining them together later. I often use this technique when helping students at the Writing Lab to re-engineering their sentences.

The next step in improving writing style is thinking about the logic of how sentences are joined.

Link

Review of sentence structures
http://www.ucalgary.ca/UofC/eduweb/grammar/course/speech/1_3b.htm

2.5. Sentence logic

Note: You must understand the difference between a phrase, a clause, and a sentence to understand this explanation. Review 3.1.2. if necessary.

We have already reviewed the fact that almost all English sentences, no matter how complex, basically have one main idea. The next important principle is that clauses must be joined logically. The most common problem is overusing “and” to join clauses. The word “and” should only be used to join clauses that have the logic of “addition.” As we saw in the beginning of our discussion of sentences, how we organize information is meaningful, not just empty grammar.

Let’s take a look at this sentence.

EXAMPLE
The method improves accuracy and requires a longer time to compute.

This sentence seems strange. This is because the two parts are joined with “and” but the relationship between them does not show the logic of addition. One clause is positive, but the other is negative. Therefore, the connecting logic should be contrast, not addition. How clauses are joined together in sentences, and how sentences are joined together in paragraphs should have a clear logical structure.

The essential logic of sentence structure is formed around the following meanings:

To illustrate this point, let’s look at some simple sentence examples. The three sentences below all make grammatical sense, so which one is correct? Clearly it depends on the context and purpose of the sentence. Again we see that the choice of logical connection is important. These oversimplified examples lack context, but the main point here is grammatical.

EXAMPLES
1. I went home, so I watched the game on TV.
2. I went home, and I watched the game on TV.
3. I went home, but I watched the game on TV.

Here is some context to make sense of the simplified sentences above.

EXAMPLES
1. I was able to finish my work before the soccer game on TV started. I arrived home just before the start of the game, so I was able to watch it.
2. The tickets for the game were sold out, so I went home and watched it on TV.
3. A lot of people were watching the game on campus, but I had a lot of work to do so I went home to work. But when I arrived home to get to work, I watched the game on TV instead of doing some of my work.

By adding context to these sentences, we see that the choice of AND, BUT, or SO clearly depends on the logic between the clauses. It is also affected by the context of the sentence within the paragraph. In this sense, sentences may be grammatically correct, but without the context, they may still not be the best choice for a particular paragraph. Once again we can clearly see the difference between just grammar and writing. Even many advanced writers fail to show the logic between the clauses or sentences correctly, especially by overusing “and.” I am often disappointed in Korea by those who think proofreading for grammar is just a matter of being correct or incorrect. Without communication with the author I cannot always correct writing to the best of my ability.

In the next section, the choices involved in joining clauses in a sentence will be explained.

2.6. Connecting clauses

There are two different ways that we can join clauses into sentences:

1. Coordination and
2. Subordination

Coordination is used for two clauses that co-operate or that are grammatically equal. Subordination is used when one clause gives additional information about the main clause or depends on the main clause for its meaning. The clauses are not equal grammatically. Therefore, follow these general principles.

1) If you have two equal ideas, join them using coordination.
2) If you have two unequal ideas, join them with subordination.

First, we will review the structures used to join clauses.

2.7. Coordination structures

A **compound sentence** has two independent clauses joined by a

2.7.1 Coordinator

Main clause	**, Coordinator**	Main clause
...	, and , but , for , nor , or , so , yet	**...**

EXAMPLE
The conventional method is unreliable, and the maintenance costs are too high.

2.7.2 Semicolon

Main clause	**;**	Main clause

The material is very susceptible to contamination**;** it requires pure hydrogen and oxygen.

2.7.3 Conjunctive adverb

Main clause	**; Conjunctive adverb,**	Main clause

...	; accordingly, ; consequently, ; for example, ; furthermore, ; hence, ; however, ; in addition, ; in contrast, ; in fact, ; indeed, ; instead, ; moreover, ; nevertheless, ; on the other hand, ; otherwise, ; then, ; therefore, ; thus,	...

EXAMPLE
The high temperature makes reliability a problem; however, it has a number of advantages.

2.7.4 Understanding coordination

Coordination links equal ideas

Therefore, do not use "So," in the beginning of a sentence in research writing. The purpose of a coordinator is to join two main clauses. The word "So," at the beginning of a sentence may be used in casual writing and dialogue, but not in engineering writing.

Although you may find some examples of sentences beginning with "and" in the beginning of a sentence, it is quite rare in research writing, and should only be used for emphasis. Generally avoid using "But" at the beginning of a sentence in engineering writing. It is a more casual expression. Use "However," instead.

Another important point that helps to make the logic of a sentence clearer is putting a comma after a coordinator that joins two main clauses. In the following examples, there is a grammatical difference between the two uses of "and" in this sentence. See how the comma clarifies the structure of the sentence.

X: The president will give out new grants for innovative research proposals <u>and</u> the Ministry of Science <u>and</u> Technology will select the recipients of the grants early next year.

CORRECT: The president will give out new grants for innovative research proposals, <u>and</u> the Ministry of Science <u>and</u> Technology will select the recipients of the grants early next year.

In sentences that are short people tend to omit the comma, however. In addition, if the subject of both sentences is the same we tend not to repeat the subject and we don't need the comma.

EXAMPLE

I had a cup of coffee and read the newspaper.

TIP

> Each sentence should have one main idea. Using AND as a coordinator twice may make a sentence too long and the relationship between the ideas may start to become unclear. Don't use AND twice in a sentence to join main clauses.

2.7.5 Choosing between a coordinator, colon, semi-colon, or a conjunctive adverb

1) Coordinator vs. correlative conjunction

A coordinator (and, but, so,) establishes a basic relationship between two clauses. The correlative conjunctions (not only X but also Y, both X and Y) put an equal emphasis on both clauses in the sentence and can be an exception to the general rule that there is only one main idea in a sentence. When you want to emphasize both parts of a positive contrast use "not only X but also Y." For example, compare the difference between these two sentences.

EXAMPLE
E) The proposed method is faster and more accurate than the conventional method.
F) The proposed method is not only faster, but also more accurate than the conventional method.

The first sentence is the "normal" sense of addition. However, if you want to emphasize the results or make an important conclusion then the second structure is more powerful and is a better choice. In the following engineering example, it is clear that the author wants to emphasize both points.

EXAMPLE
This almost perfect growth of each individual pore is a consequence <u>not only</u> of the lithographic pattern <u>but also</u> of the orientation of the silicon single crystal.
Source: Römer et al.: J. AM. CHEM. SOC. 9 Vol. 126, No. 49, 2004 p.16268 ©2004

2) Coordinator vs. semi-colon or conjunctive adverb

The fewer words between clauses, the stronger the connection. If you want to make a stronger connection between two clauses, then choose the semi-colon.

EXAMPLE
1. The experiment was a disaster, so we had to start again.
2. The experiment was a disaster; therefore, we had to start again.
3. The experiment was a disaster; we had to start again.

All of these sentences are possible. Sentence three with the semi-colon makes the strongest connection. It reads more quickly and has a sense of urgency showing a closer connection.

3) Semi-colon; vs. colon:

A colon can also join two main clauses if the information after the colon is a definition or an explanation. A colon, not a semi-colon, also introduces a list.

EXAMPLE
MODIFIED X: They can be divided into three main approaches; frequency, spatial, and temporal.
O: They can be divided into three main approaches: frequency, spatial, and temporal.
Source: Cen and Cosman: IEEE Transactions on multimedia, Vol. 5, No. 1 p. 1 © IEEE 2003

Basically, a colon signals that the information that follows will further explain or define. If the emphasis is on definition, then use a colon. If the emphasis is on connecting two equal ideas, use a semi-colon. You could argue that either a colon or a semi-colon could be possible here.

EXAMPLE
1. The method was not effective; it cost twice as much as existing ones.
2. The method was not effective: it cost twice as much as existing ones.

A semi-colon joins two clauses closely while the colon signals a definition or a list. Here is an authentic example of using a colon to define exactly how a design was modular.

EXAMPLE
Our design is modular: generating the different tiles sets in Figure 1A-D only required replacing strands no. 2 and 4 with versions bearing the desired sticky ends.
Source: Rothemund et al.: J. AM. CHEM. SOC. 9 Vol. 126, No. 50 p.16346 ©2004

Note that this use of a colon to define is not so common and is an advanced writing point.

4) Punctuating a list with a colon.

In a list, some writers put a comma after the second item in a list, but others don't. Either is correct, but I recommend that you include the second comma to prevent any confusion. If we don't follow this rule, a few sentences can be confusing to read. Compare these two sentences:

EXAMPLE

X: The new cell phone design has three areas of improvement: cost, color and design and clarity and reception.

CORRECT: The new cell phone design has three areas of improvement: cost, color and design, and clarity and reception.
comma

The sentence is intended to show that the new cell phone design has <u>three</u> areas of improvement: 1. cost, 2. color and design, and 3. clarity and reception. This is clear in the second example but not in the first.

5) Lists of choices

In negative lists or choices, "or" is used rather than "and."

EXAMPLE
- Do you want coffee, tea, or coke to drink?
- Do you want coffee, tea, and coke to drink?

The second sentence would mean that either the person was very thirsty or that they wanted a strange cocktail of three different drinks to wake up and write their engineering article!

6) Sentence structure punctuation errors in coordination

Understanding coordination will also help you avoid one of the most common sentence structure mistakes. Have a look at the following sentence:

EXAMPLE
X: We need to design a new system, it must be three times faster than the current one.

This kind of sentence structure mistake is called a "comma splice." It is a common sentence structure mistake.

This sentence has two main clauses: 1) We need to design a new system, and 2) it must be three times faster than the one we have now. Therefore, we cannot join the clauses with a comma because it is not one of the options we saw for coordination. A similar error is called a "run-on" sentence.

EXAMPLE
X: We need to design a new system it must be three times faster than the current one.

The solution is to use one of the three ways to join a compound sentence, subordination, or to break it up into two sentences by putting a period between the clauses.

X: We need to design a new system it must be three times faster than the current one.
X: We need to design a new system, it must be three times faster than the current one.

Coordination solutions

CORRECT: We need to design a new system, but it must be three times faster than the current one.
CORRECT: We need to design a new system; it must be three times faster than the current one.
CORRECT: We need to design a new system; however, it must be three times faster than the current one.

Subordination solutions

CORRECT: We need to design a new system that must be three times faster than the current one.

Separate sentences

CORRECT: We need to design a new system. It must be three times faster than the current one.

2.8. Subordination structures

The second way we can join ideas is through subordination. This is done when one idea (clause) is subordinate or depends on the other idea (clause) in the sentence to have meaning. Unlike coordination, the ideas are not equal grammatically or in importance.

Imagine that a friend came up to you and said, “Because the soccer game is on.” It would be very difficult for you to reply because the clause does not make sense without more information. In fact, when writing, it is a serious grammar mistake. We call this a “fragment” because it is only a piece of a sentence.

However, if he said, “I want to go home now because the soccer game is on,” it would make sense because it is a complex sentence.

2.8.1 Adverb clauses

Adverb clauses give information about when, where, why, and how something happens.

Main clause	**Subordinator**	Subordinate clause
…	after although as because before if since unless until when whenever whereas while	…

OR

Subordinator	Subordinate clause, (comma)	Main clause
After Although As Because Before If Since Unless Until When Whenever Whereas While	…,	…

If a complex sentence begins with a subordinator, it must have a period at the end of the clause. If the subordinate clause is at the end of the sentence, it does not need a comma. Both arrangements of the clauses are possible.

EXAMPLE

- Because the material could not withstand the intense heat, we had to look for an alternative.
- We had to look for an alternative because the material could not withstand the intense heat.

↑ no comma

How then do you choose where to place the adverb clause in the sentence? In English, the focus of the sentence is at the end. Therefore, if your focus is on the alternative, the first example would be better. If your focus is on the heat, then the second example would be better. We cannot mix subordination and coordination unless we have a compound-complex sentence, however.

EXAMPLE
X: Although the method is effective, **so** it requires a great deal of computation time.
O: Although the method is effective, it requires a great deal of computation time.

There are two other types of subordinate clauses.

2.8.2 Relative clause

A relative clause is a type of subordinate clause that gives more information about a noun or pronoun. There are two types: restrictive and non-restrictive.

A non-restrictive (also called non-identifying) relative clause just gives additional information about the subject. A comma is used to indicate that the clause is additional information.

EXAMPLE
Based on our simulation results, the estimation error of the model when the subject wears eyeglasses is 8.17%, which is larger than the error obtained from the offline FME algorithm.
Source: Kuo *et al.*: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 p. 22 ©2003

If the non-restrictive relative clause is deleted, then the sentence will still make sense. The additional information is not essential to the meaning of the sentence. In fact, any information surrounded by commas can be left out and a sentence should still make sense as this modified sentence by Kuo et al. shows.

EXAMPLE [MODIFIED]
[…] The estimation error of the model when the subject wears eyeglasses is 8.17% […]
Source: Kuo *et al.*: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 p. 22 ©2003

In the next example, "that" is used to identify exactly which type of mean squared error (MSE) is being indicated. In the second sentence, the information in the relative clause is essential to the meaning of the sentence and cannot be left out. Deleting the additional information in bold would prevent proper identification of "maximum" MSE.

EXAMPLE
The MSE will then be what results from each [missing macroblock] MB being concealed by its best EC method among the set. We call this the "omniscient minimum" MSE, and it could also be obtained by transmitting a few bits explicitly for each MB to tell the decoder which [error concealment] EC method to use for that MB. What we consider the "maximum" MSE is the MSE that results from using a single fixed and best method from Table II.
Source: Cen and Cosman: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 p.4 ©2003

In American English, “that” is used in a relative clause to show that the clause is essential to the meaning of the sentence. Note however that this distinction is not as strong in British English, definition writing, and in normal conversation. You may find examples of published papers that do not use commas with “which.”

TIP

> If you are having difficulty reading a sentence, delete all the words surrounded by commas and the sentence should still be grammatically correct. This may also help you find the core idea.

2.8.3 Noun clause

A noun clause is a dependant clause that functions as a noun. It can have the role of subject, object, or subject complement.
Source:
http://www.english.uiuc.edu/cws/wworkshop/writer_resources/grammar_handbook/complements.htm

EXAMPLE
The department requires that all students must attend orientation.

2.9. Review of connecting clauses

Here is a table that combines the methods of connecting clauses with the logic of the sentence. When editing your writing, think about how you are connecting the sentences. It is not just an empty grammar exercise, but a way to communicate more accurately.

Meaning	Coordinators	Subordinators	
Addition	and		
Comparison	both A and B not only A but also B neither A nor B	as just as	
Contrast	but yet	although even though though	whereas while
Possibility	or	if unless	
Time		after as as soon as before while	since until when whenever
Place		where wherever	everywhere anywhere
Cause	for	because as	since
Effect	so		

2.10. Sentences in paragraphs

Before discussing paragraph structure in detail, this section will discuss the relationship between sentences in the same paragraph.

To understand the next section you need to know

- the four basic types of normal sentences.
- the difference between a clause and a sentence.
- the difference between a main and an subordinate clause.
- the difference between a phrase and a clause.
- three ways to combine compound sentences.

If you are not familiar with these terms then please review the introduction to sentences Section 3.1.1. before reading this section.

Many students think that longer sentences always show a more sophisticated writing style. However, one key to effective writing is having a variety of sentence types and sentence lengths. This is especially important in the introduction and discussion sections of your paper because you are developing your ideas. In the methods section, you may have a lot of short sentences because you are often describing a process.

Paragraphs where all of the sentences are a similar size can be difficult to read. Even if all the sentences are medium sized, about 12-24 words, then it still might not read easily if the sentences lack variety.

2.10.1 Sentence length

Generally, when writing engineering papers, the average sentence length of a paragraph should be around 24 words. If your average number of words per sentence is above 25, your writing style might be hard to read. If you have an average of less than 17, your writing style probably needs longer more complex sentences: sentences with a main and a dependant clause joined by a subordinator such as “although, whenever, or because.” However, it also depends on the kind of writing you are doing. If you are writing a user manual, then an average of about 17 is probably standard. If you are writing a business report or a proposal for a general audience, then an average of around 20 words is probably fine. Research writing, especially in the social sciences and humanities, tends to have a longer average number of words per sentence than writing for a general audience. If you are writing for a company newsletter or a user manual then the average sentence length should be shorter than for a research article. Unless it is a long list, consider revising any sentence over about 35 words, which is generally considered too long.

TIP

> TOOLS (도구) → Word Count (단어 개수) in the MS WORD menu will count the number of words for any highlighted text or entire document. Remember not to count the references and figures at the end of a paper when doing a word count.

When writing flows well, one of the most important reasons is that it has a variety of sentence lengths and types of sentence. One way you can check this is to use a little known function of MS WORD. See Skill 2.4.3 Use Readability Statistics (문장 난이도 표시) to analyze your writing style.

2.11. Variety of sentence types and lengths

1) Sentence type

TASK
Analyze a long paragraph of your writing. Color or use the highlighter function to color each different type of sentence in your paragraph: Simple, Yellow; Compound, blue; Complex, Green; Compound-complex, pink. You can do this on paper or on the computer

Then analyze a paragraph from the introduction or discussion section of a published journal article and then compare a paragraph of your own writing with it. A well-written paragraph should be a colorful mix, but not too much pink! However, these are general guidelines. You may find some paragraphs in published papers that are not necessarily easy to read. You may also find that methods or experimental sections are more likely to have shorter simple sentences and a smaller average sentence size. Remember that you can copy and paste from most PDF files. How to do this is explained in Chapter 2.

2) Sentence length

TASK
Use the "WORD COUNT" function in MS WORD to count the average number of words in each sentence of a paragraph. Highlight a sentence and then use the word count function. It will then only count that sentence. Then take a color pencil or highlighter or write in your WORD DOCUMENT and analyze a single paragraph of your writing by looking at the length by counting the number of words: short (under 15), medium (15-24), or long (25+ words). Write down the number at the end of the sentence. Is there variety? What is the average length?

TASK
Do the same exercise on a paragraph from a published article that seems to read very well. See what the difference is.

Here is an example from an engineering article that has an average of 22 words. Your writing should have a variety of sentence structures: simple, compound, complex, and compound-complex like the following example.

EXAMPLE
When video signals are compressed and transmitted over unreliable channels, some strategy for error control or concealment must be employed.(20 words complex) Possible strategies include forward error correction added at the encoder, post-processing methods employed by the decoder, and interactive requests for repeated data, involving both encoder and decoder.(27 words simple) In this paper, we are concerned with post-processing methods [that are] employed by the decoder.(13 words complex) We consider the single-layer case where coding modes, motion vectors, quantized DCT coefficients, and other information about macroblocks are all sent with the same priority.(25 words complex) When errors strike the bitstream, we assume the decoder loses all information about that slice up to the next resynchronization point.(21 words complex) In the absence of block interleaving, a horizontal swath of macroblocks is missing, and the decoder's post-processing methods must conceal this from the viewer.(24 words compound) Source: Cen and Cosman: IEEE Transactions on multimedia, Vol. 5, No. 1, p. 1 © IEEE 2003

Notice that the type of sentence structure and the word length are not necessarily related. A simple sentence can be longer than a complex sentence because it contains a list or a number of prepositional phrases, for example. Here is a simple example to show this point.

EXAMPLE
Complex sentence: I bought a new CD player when I was shopping yesterday.
Simple sentence: On Saturday, I bought my favorite singer's latest CD at the music store in COEX mall.

3) Variety in active and passive sentence structure

Short active sentences can be more powerful. They should be used to make important conclusions and for emphasis. On the other hand, use the passive for routine procedures and facts.

2.12. Connecting sentences in paragraphs

Before discussing paragraph structure, this section will explain some principles of writing sentences and their relationship to paragraph organization. In order to understand this section, you must be familiar with

- the four basic types of normal sentences.
- the difference between a clause and a sentence.
- the difference between a main and an subordinate clause.
- the difference between a phrase and a clause.
- three ways to combine compound sentences.

If you are not familiar with these terms then please review the introduction to sentences, Section 3.1.1. before reading this section.

This section deals with connecting ideas between sentences. Remember that an idea is expressed through a sentence that has at least one main clause. We also learned that no matter how long or complex a sentence is, almost all English sentences have only one main idea. Determining if a sentence is grammatically correct is only the first step. Determining if a sentence has the right structure depends not only on the meaning the author wants to communicate, but also on the sentences before and after it in the rest of the paragraph.

As we have seen:

If the information in the two clauses in a sentence is equal then coordination is the right choice. If one clause depends on the other clause for meaning then use subordination.

However, our choices may also be affected by the sentences in the rest of the paragraph.

2.12.1 English information in sentences is generally organized in a Given to New information pattern

Information that is new is usually put at the end of the sentence. When it is no longer new, it is moved into the subject position at the beginning of the next sentence, and new information about it is added to the end of that sentence. In this example, I saw the Major League

Baseball pitcher Chan-ho Park on campus. He is a Hanyang alumni. Let's look at how the information is linked together in this paragraph example.

EXAMPLE
A few years ago I had an unusual lunchtime at Hanyang. I was walking on campus, when I saw Chan-ho Park. He was visiting campus to give money for scholarships for new students. The money was donated to help support student athletes.

In the first sentence, Hanyang is the new information. Being at Hanyang becomes old information and changes to the beginning of the sentence in the form of "on campus." Then the new information is introduced: Chan-ho Park. In the next sentence, Chan-ho is no longer news, so the word "He" is used and moved to the beginning of the sentence where more information is added about him giving money at the end of that sentence. Finally, the money is no longer the new topic, so it is moved to the beginning of the next sentence where the new information about how it will help student athletes appears at the end of the last sentence. We would expect the paragraph to continue talking about how the money will be used to support athletes.

This linking of Given to New information helps create the organization and flow of information in English paragraphs that explain, discuss, or analyze information. This type of organization is common in introduction and discussion sections. Other sections like the methods section that describe a process may not follow this rule as closely, however. Most, but not all, paragraphs are structured this way as it is a basic characteristic of good English writing. When the topic changes, a new transition signal such as "Next" or "Second" is usually introduced, and then the pattern may start again. The first sentence of a paragraph introducing a new topic may also not follow this pattern.

Not following this rule may make your writing difficult to read, even if the sentences are grammatically correct. Note that some types of paragraphs such as those that give instructions may not follow this pattern. There are also other types of patterns explained in **4.3.2**

TASK
Choose a complex sentence. Move a clause from the beginning to the end of the sentence. Change the information from the main clause to the dependent clause. Does the meaning of the sentence feel different to you? Does it still make sense in the paragraph? Can you understand why the writer chose to organize the information in that way?

As we can see, fully understanding clauses and how to place them is really the key to more advanced writing.

2.13. Connecting ideas among sentences in a paragraph

2.13.1 Repeat the key nouns or use synonyms to show that you are referring to the same topic in your paragraph

Another strategy to make your writing flow is shown in the paragraph below. The word "technology" is repeated to make sure the reader can follow the development and organization of the paragraph. Repeated key nouns help the reader to follow the development of your paragraph.

EXAMPLE

In this paper, we describe two technologies for making a wireless multimedia communication system energy-efficient while ensuring QoS. The first technology is an energy-efficient protocol,
Multimode Adaptive Power Saving (MAPS).
Source: Lan and Twefik: IEEE Transactions on Multimedia, Vol. 5, No. 2, June 2003 p.268 © IEEE 2003

2.13.2 Repeat key words rather than risk unclear pronouns

Now imagine we take the sentences above and use the pronoun "it" instead of the repeated keyword.

EXAMPLE [MODIFIED]
In this paper, we describe two technologies for making a wireless multimedia communication system energy-efficient while ensuring QoS. [It] is an energy-efficient protocol, Multimode Adaptive Power Saving (MAPS).

In this example, it is not clear what "it" refers to. Is it describing one of the technologies or is it trying to explain Quality of Service (QoS)? This modified sentence is hard to read without the repeated key word to guide the reader. In engineering and formal writing words like "it" and "they" are not used as often as in normal writing. The most important thing is to be clear, even if some sentences are a little repetitive.

2.13.3 Use short forms of terms to link to previous words

Another strategy is to use keywords that are part of the longer descriptions of the terms being used.

EXAMPLE
The information data rate is another factor that affects transmission power. In general, a higher data rate yields higher transmission power. On the other hand, the data rate is associated with the compression ratio of multimedia coders. An efficient multimedia coder can remove most of the redundancy that exists in the raw input data, thus a high compression ratio is achieved. In general, the compression efficiency directly relates to computational power consumption.
Source: Lan and Twefik: IEEE Transactions on Multimedia, Vol. 5, No. 2, June 2003 p.268 © IEEE 2003
In the second sentence, information data rate is shortened to just data rate, but it is clear that the same concept is continuing in the sentence. In the third and fourth sentence, multimedia coder is repeated. Finally, high compression ratio is summarized as compression efficiency in the last sentence.

This may seem a bit repetitive, but it is not for research writing. The sentences flow naturally and it is easy to understand. It could even be improved if we changed the position of data rate and transmission power in the first sentence to follow the Given to New information pattern we have mentioned.

2.13.4 Use words that summarize key words of previous sentences

1) Another strategy is to use words that summarize a key word or even a whole clause or previous sentence. As we saw earlier, using only pronouns like "it" or words like "this" alone can make it unclear what the sentence is referring to. Instead, we can use a summary noun (Swales, 2004). Using THIS + noun is a clear and effective way to make your writing more readable. It is used to continue a topic from a previous sentence. Using only "this," "it," "these," or "they" alone can make it unclear. Instead, connect words like "this" and "these"

with the key noun (idea) of the previous sentence. Here are some examples of common summary nouns from engineering papers: This shift, This capability, This method, These two approaches, These techniques, This material, This theory, Such problems, etc.

EXAMPLE
The second technology is a simple multirate transmission scheme. This scheme optimally combines the elements of source and channel coding and multirate modulation to form a multirate source-channel-modulation communication system.

Source: Lan and Twefik: IEEE Transactions on Multimedia, Vol. 5, No. 2, June 2003. p.268. © IEEE 2003

TASK
Read the introduction of a paper. Scan for any summary nouns and underline them. Then delete or cross out the noun and see how much more difficult it is to read. Is it clear without the summary noun what words like "this" are referring to?

2) Summary nouns can also be used to summarize previous sentences or clauses.

EXAMPLE
Berkeley's Infopad project [10] also implements a power-aware idea in its design. In Infopad, designers shift most computations for multimedia processing to a base station, provided the transmission bandwidth is large enough and the distance between a base station and mobiles is short. However, those restrictions do not fit into current wireless systems.
Source: Lan and Twefik: IEEE Transactions on Multimedia, Vol. 5, No. 2, June 2003 p.269. © IEEE 2003

In this example, there are two restrictions: provided the transmission bandwidth is large enough and the distance between a base station and mobiles is short. The words those restrictions summarizes the bandwidth and distance restrictions. The authors also put those restrictions in the beginning of the sentence to emphasize that it is summarizing old information from the previous sentence. However, as mentioned, in this case the word "these" is usually used rather than "those."

In addition to repeating the key noun, writing is clearer when the reader is guided along using words that show the relationship between clauses, sentences, paragraphs, and even whole sections of a paper. These transition signals act as signs to help the reader navigate through the text by indicating the relationship between ideas, or when a subject or topic changes. In fact, this paragraph itself is a transition to help me introduce the next section.

2.14. Transition signals between sentences

One of the clearest indications that writing is much more than correct grammar is the use of transitions or connections between clauses, sentences, paragraphs, or even sections of a document. One method we have already introduced is to use conjunctive adverbs such as "'… ;however, …"

EXAMPLE
The proposed method is more accurate than the conventional approach; however, it takes too long to be practical for real-time applications.

We also have an option of using a transition that logically links one sentence to the next sentence.

EXAMPLE

The proposed method is more accurate than the conventional approach. However, it takes too long to be practical for real-time applications.

The conjunctive adverb joins two clauses that are part of the same sentence. The adverbial transition “However,” joins two separate sentences. Therefore, sentences with conjunctive adverbs have more emphasis and are used to show a closer connection between the two clauses. Transition words like “However,” are used between regular sentences: the connection is not as strong.

Note the difference in punctuation between a conjunctive adverb and an adverb in one clause.

EXAMPLES

- The proposed method is more accurate than the conventional approach; however, it takes too long to be practical for real-time applications.
- The proposed method is more accurate than the conventional approach. It takes too long, <u>however</u>, to be practical for real-time applications.

In the second sentence, “<u>however</u>” only has commas around it because “It takes too long, however, to be practical for real-time applications” has only one subject and one verb: it is only one clause. A semi-colon and a comma around a conjunctive adverb are only used to connect two clauses in the same sentence.

Also, notice that the adverbial transition can be placed in the beginning, middle, or end of a sentence.

EXAMPLES

1) However, it takes too long to be practical for real-time applications.
2) It takes too long, however, to be practical for real-time applications.
3) It takes too long to be practical for real-time applications, however.

In the first position, the link between the two sentences is emphasized. In the second, the emphasis is on “too long,” and in the third sentence, the emphasis is on “real-time applications.” In short, the comma causes us to pause at the word before it. The first position is the most common while the middle position is more formal and more characteristic of writing than speech. The end position is less common (Kollin, 2003).

More information on the role of transitions in the paragraph can be found in Section 4.7. The next section will explain paragraph structure.

Chapter 3: **Paragraph Structure**

A sentence in English is the basic unit of grammar and thought. However, the paragraph is the basic unit to organize that thinking. If a student asks me if a sentence is correct, I usually ask them for the context of where that sentence came from. In short, without paragraphs, there is only grammar, not really writing. A sentence can be perfectly correct grammatically, but may not be the right sentence for that particular paragraph. The sentences before and after a sentence can affect the meaning of the sentence and how a reader understands that sentence.

In research and professional writing, we don't communicate in sentences, but in paragraphs. Even email should not be written sentence by sentence with no paragraph organization. When you write a formal email, for example, you should organize your sentences into paragraphs. There are four essential concepts that should be understood about paragraphs.

- Generally have one clear main idea per paragraph in the form of a topic sentence.
- Understand the structure of the paragraph.
- Understand the method of development of the paragraph.
- Show how the ideas are related to other ideas, sentences, or sections of your work.

To be well-structured paragraphs must be clearly organized around one main idea that is explained and supported. Paragraphs that explain, analyze, or persuade usually have the following structure.

3.1. Basic paragraph structure

Structure	Notes

Transition sentence (optional)	The paragraph may open with a transition from a previous paragraph. Transition sentences or clauses may also occur between the controlling ideas that elaborate the topic sentence in the paragraph.
Background information (optional)	Before the main point of the paragraph is given, there may be some background information on the topic that provides some context for the reader before the topic sentence is introduced.
Topic sentence (recommended)	The topic sentence gives the main point of the paragraph that must be explained, defined, proven, or analyzed. It is almost always at the beginning of the paragraph. The topic sentence may also give the controlling ideas that structure the paragraph, such as a main idea being divided into two points. Not all types of paragraphs, such as conclusion paragraphs or transition paragraphs, may have a clear topic sentence. However, it is suggested.
Elaboration of the topic sentence (optional)	The topic sentence may be a very general statement. The elaboration sentence gives more specific details of the structure of the paragraph that follows (Reid, 2000 p. 24).The elaboration may also give the controlling ideas that structure the paragraph.
Supporting sentences (required)	This is the standard type of sentence that develops the topic sentence. All of the sentences in the paragraph should support the topic sentence. If a new topic is introduced, a transition or a new paragraph should also be introduced.
Conclusion (optional)	A sentence that summarizes the key points of the paragraph. Suggested if the paragraph is long or difficult, or if many ideas have been introduced. For example, a conclusion sentence is often found at the end of a paragraph that reviews previous research.

The following is a paragraph from an engineering article about coal that has been divided for the purpose of analysis.

EXAMPLE

Paragraph	Analysis

Coal, the most abundant, widely distributed, and economical fossil fuel, is a solid with high carbon content but low hydrogen content (usually less than 6%).	**Background** information
As a solid, coal is not easily used as a transportation fuel.	Transition to the topic of **transportation fuel**
However, transportation fuels and other chemicals may be derived from coal through *liquefaction.	**Topic sentence**: Main idea of the paragraph, liquefaction.
The two methods to convert solid coal into liquid fuel are direct liquefaction and indirect liquefaction.	**Elaboration of the topic sentence**; Contains the two controlling ideas of the paragraph.
Direct liquefaction, the most efficient route currently available, with catalyst and a hydrogen donor solvent at very high temperature and pressure, can convert coal into artificial petroleum. In indirect liquefaction, coal is completely gasified with steam. The gasification products are mixed with H2 and CO with the removal of sulfur-containing species. Over a catalyst at relatively low pressure and temperature, the mixture reacts to produce the final synthesis liquid fuel.	**Supporting sentences**; Each of the two controlling ideas is explained, direct and indirent liquefaction. The rest of the paragraph is structured around these two controlling ideas.
By adjusting the composition of catalyst, hydrogen/carbon ratio, temperature, pressure, etc., one can obtain a variety of different products, such as paraffins, olefinic hydrocarbons or alcohols [4].	**Conclusion**

Source: Z. Wu et al. Fuel 84 (2005) p.1790 ©2005

Note: *liquefaction means to make something liquid.

3.2. The topic sentence

What is a good topic sentence? It introduces a proposition that must be argued, explained, or analyzed. When we read a topic sentence we are introduced to the main idea of a paragraph. However, the topic sentence is more likely to occur in paragraphs that argue, explain, or analyze a point. Each paragraph, no matter how long, should only have one main point contained in the topic sentence. However, this main point may contain controlling ideas that explain the main topic in further detail. When you start to discuss a new topic, it is time to change the paragraph.

"Topic sentences appear most frequently as the first sentence in a paragraph. This position helps readers become oriented immediately to the paragraph's topic and facilitates communication (e.g., an estimated 95% of paragraphs in professional/technical writing begin with their topic sentences)."

Source: http://web.mit.edu/writing/Writing_Process/topicsentence.html

What are the possible functions of a topic sentence?

A topic sentence may

- Introduce a proposition to be proven or explained.
- Show the structure of the paragraph by indicating the items to be discussed.

One way to tell if a sentence is a topic sentence is to see if the rest of the paragraph answers the implied question of the topic sentence.

EXAMPLE

"However, transportation fuels and other chemicals may be derived from coal through liquefaction." **Implied question →How are they derived from liquefaction?** The rest of the paragraph answers this question of how liquefaction occurs.

Not all paragraphs may be structured like this, however. Some paragraphs may be transitions to a new section of a paper. Some paragraphs may be conclusions and others may introduce a list. Some engineering papers even have conclusions that are just a numbered list of key points.

1) Elaboration of the topic sentence

Sometimes the topic sentence is too general or doesn't have clear controlling ideas. Therefore, we need to provide an additional sentence that gives more detail in order to show the structure of the paragraph (Reid, 2000, p.24).

EXAMPLE

[Topic sentence→] However, transportation fuels and other chemicals may be derived from coal through liquefaction. **[Elaboration→]** The two methods to convert solid coal into liquid fuel are direct liquefaction and indirect liquefaction.

Here we have the topic of this paragraph: deriving coal through liquefaction. However, the author probably thought that this topic sentence needed to be more exact to fit in one paragraph. The topic sentence was limited to the two controlling ideas of direct and indirect liquefaction.

2) Controlling idea(s)

The controlling idea indicates what the paragraph will say more exactly about the topic. It may be found in the topic sentence itself or in the elaboration of the topic sentence in the next sentence. It limits or controls the topic to a specific aspect of the topic sentence in that paragraph.

EXAMPLE

[**Topic→**] The two methods to convert solid coal into liquid fuel are [**Controlling idea→**] direct liquefaction and [**Controlling idea→**] indirect liquefaction.

In our example, the paragraph is about converting solid coal into liquid fuel. To make this topic suitable for one paragraph, it has to be limited in some way. This is done by limiting the paragraph to talking about direct and indirect liquefaction, which are the controlling ideas. Everything in the rest of the paragraph is controlled by these two ideas that help to structure the rest of the paragraph. Without such a structure, a paragraph can be unorganized.

3.3. Paragraph methods of development

When we look at a paragraph closely we should be able to see a clear structure. There are basically four types of paragraph methods of development in English that are often found in engineering papers. These structures only refer to how the sentences in the paragraph are organized. They do not describe the content or logical relationships.

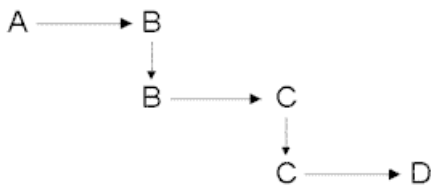
- **Linked chain**: Explanation or analysis. More common in methods and results
- **Repeated topic**: Description, classification and often with narration. More common in introduction and discussion sections
- **Division**: Common in introduction sections.
- **Hybrid**: Combination of any of the above.

Adapted in part from: http://exchanges.state.gov/forum/vols/vol33/no4/p22.htm

Paragraphs within different sections of the paper tend to follow one type of this paragraph organization. Division paragraphs are more likely to be in an introduction as different methods are classified. Paragraphs that are not clearly structured are hard to read.

3.3.1 Linked chain

In the linked chain paragraph, a Given to New information pattern (see 3.12.1) organizes the sentences in the paragraph. To be able to move the information around in clauses correctly, it is important to master the different types of sentence structures presented in Chapter 3. Knowledge of sentence structures allows the writer to move information around between the beginning and end of the sentence by manipulating the placement of phrases, main, and subordinate clauses.



Source: http://exchanges.state.gov/forum/vols/vol33/no4/p22.htm from Dane (1974).

In this example, we can see how the pieces of information indicated by the letters are moved to create the linked chain of information structure.

EXAMPLE

Linked chain paragraph	Analysis
A PLATFORM manipulator A is a closed-loop mechanism in which a moving platform is connected to the base by at least two serial kinematic chains B (legs). Applications of this type B of manipulator can be found in pilot-training simulators and in high-precision surgical tools because of C their high load-carrying capacity and accurate positioning. Recently, researchers have tried to utilize these features C to develop multiaxis machine tools [1] and precision assembly tools [2] based on D platform-manipulator architectures. However, the design, trajectory planning, and application development of parallel manipulators D are quite challenging E. The closed-loop nature of the mechanism E limits the motion of the platform and creates complex kinematic singularities F in its workspace. To overcome these drawbacks F, we employ the modular design concept in the development of platform manipulators G [3]. A *modular* platform manipulator G consists of a set of independently designed standard modules, such as actuators, passive joints, rigid links (connectors), mobile platforms, and end-effectors that can be rapidly	Two serial kinematic chains B is the new information about platform manipulators A. In the next sentence this type B with serial kinematic chains is no longer new information, so it is moved to the beginning of the next sentence. The new information, their high load-carrying capacity and accurate positioning C, is then added. This information, which is summarized as these features using the summary noun strategy we saw before, is moved to the subject position because it is no longer new. The new information, the tools based on D platform-manipulator architectures, is added. However, new information about the manipulators, that they are challenging, E is added. How they are challenging is summarized by these drawbacks F in the beginning of the sentence. The new information about the modularity is then introduced G, which then becomes the subject of the next sentence, where information

assembled into various layouts with different kinematic and dynamic characteristics. Source: Angeles et al.: IEEE/ASME Transactions on Mechatronics, Vol. 8, No. 4 p.469 © IEEE 2003	about the modularity is given.

Let's compare the following two paragraphs. If we change the order of the information, the Given to New pattern is broken and the paragraph becomes hard to read. It seems like new topics are suddenly being introduced. Despite this, there is nothing grammatically wrong with the text. This is another example of how writing is more than just making correct sentences.

Here is the original example.

EXAMPLE

The closed-loop nature of the mechanism E limits the motion of the platform and creates complex kinematic singularities F in its workspace. To overcome these drawbacks F, we employ the modular design concept in the development of platform manipulators G [3]. A *modular* platform manipulator G consists of a set of independently designed standard modules, such as actuators, passive joints, rigid links (connectors), mobile platforms, and end-effectors that can be rapidly assembled into various layouts with different kinematic and dynamic characteristics.

Here is an example above that I have changed to break the information pattern. It becomes much harder to follow as a result.

EXAMPLE [MODIFIED FROM THE ORIGINAL]

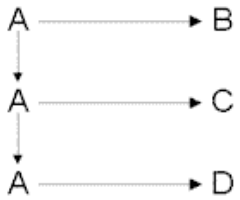
The motion of the platform in its workspace is limited, and complex kinematic singularities are created F due to the closed-loop nature of the mechanism E. We employ the modular design concept G in the development of platform manipulators to overcome these drawbacks F [3]. A *modular* platform manipulator G consists of a set of independently designed standard modules, such as actuators, passive joints, rigid links (connectors), mobile platforms, and end-effectors that can be rapidly assembled into various layouts with different kinematic and dynamic characteristics.

Notice especially that research writing sometimes looks repetitive. For example,"… platform manipulators G [3]. A *modular* platform manipulator G …" but this helps to create connections and flow between sentences. It also helps to avoid unclear sentences. Text can be made less repetitive by following the tips in Section 13.

Linear chain development is the standard method of development for English paragraphs.

3.3.2 Repeated subject

The second structure is the repeated subject structure. This is a very effective paragraph structure for emphasis, but it is not as common as the other three structures mentioned.



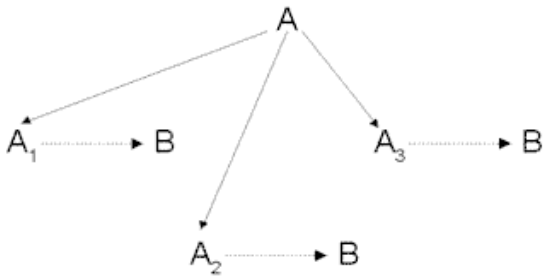
Source: http://exchanges.state.gov/forum/vols/vol33/no4/p22.htm from Dane (1974).

EXAMPLE

Repeated subject	Analysis
Although embedded text/captions provide important information about the image, it is not an easy problem to reliably detect and localize text/captions embedded in images. In a single frame, the size of characters can change from very small to very big. The font of text can be different. Text present in the same image can have multiple colors. Text can occur in a very cluttered background. For video sequences, the text can be either still or moving in an arbitrary direction. The same text may vary its size from frame to frame, due to some special effects. The background can also be moving/changing, independent of the text. Source: Zhong et al.: IEEE Transactions on pattern analysis and machine intelligence, Vol. 22, No. 4, p. 385 © IEEE 2000	The paragraph begins with a transition from the previous paragraph which introduces the idea of the problem of finding text in images. The topic of the sentence, text, is used as the repeated subject throughout the paragraph, which creates emphasis by repeating the same structure. When the topic changes slightly in the last sentence, the transition word “also” is used to help the reader understand that the repeated subject pattern is finishing.

3.3.3 Division

The final method of development is one that we have seen before. It divides a paragraph into parts and describes each part one by one. It is often used in classification as well as comparison and contrast paragraphs in introduction sections.



Source: http://exchanges.state.gov/forum/vols/vol33/no4/p22.htm from Dane (1974).

Here the main topic of the paragraph is about coal liquefaction (making something liquid), but it is divided into two controlling ideas: direct and indirect liquefaction.

EXAMPLE

Division	Analysis
Coal, the most abundant, widely distributed, and economical fossil fuel, is a solid with high carbon content but low hydrogen content (usually less than 6%). As a solid, coal is not easily used as a transportation fuel. However, transportation fuels and other chemicals may be derived from coal through liquefaction. The **two methods** to convert solid coal into liquid fuel are direct liquefaction and indirect liquefaction. **Direct liquefaction**, the most efficient route currently available, with catalyst and a hydrogen donor solvent at very high temperature and pressure, can convert coal into artificial petroleum. In **indirect liquefaction**, coal …. Source: Z. Wu et al. Fuel 84 (2005) 1790–1797 p.1790 ©2005	The paragraph is divided into two parts. The first part describes **direct liquefaction**, and the second describes **indirect liquefaction.**

TIP

In division paragraphs, don't forget the second part. I sometimes find student papers that start discussing one part, such as one type of method, but then forget to include the other part. Another common mistake is to forget to use transitions like ONE, the OTHER, FIRST or SECOND, and/or to repeat the key word so the reader can very clearly locate when the first part of a division ends and when the second part begins. Sometimes I read student papers that say that there are two methods, the first one, and then I can't find the second one because it is buried in a long paragraph with no transitions or connecting keywords. It is acceptable, however, for the second part of the

3.3.4 Hybrid

In addition to paragraphs with one structure, you may also find hybrid paragraphs. In this example, it starts as a linked chain organization, but then changes to a repeated subject.

EXAMPLE

Hybrid paragraph structure	Analysis
[LINEAR CHAIN] DIGITAL video A now plays an important role B in entertainment, education, and other multimedia applications. With hundreds of thousands of hours of archival videos, there is an urgent demand B for tools that will allow efficient browsing and retrieving of video data C [1], [20], [21]. In response to such needs C, various video content analysis techniques using one or a combination of image, audio, and textual information present in video have been proposed to parse, index, and abstract massive amounts of data D [1], [3], [15],[20]. Among these information sources D, caption text E present in the video frames plays an important role in understanding the content of a raw video sequence. [**REPEATED SUBJECT**] For example, captions E in news broadcasts and documentaries usually annotate information F on where, when, and who of the reported events. More importantly, a sequence of frames with caption text E is often used to represent highlights G in documentaries. Also, captions E are widely used to depict H titles, producers, actors, credits, and sometimes, the context of a story. Furthermore, text and symbols that are presented at specific locations in a video image can be used to identify the TV station and program associated with the video. In summary, captions in video frames provide highly condensed information about the contents of the video and can be used for video skimming, browsing, and retrieval in large video databases. Source: Zhong et al.: IEEE Transactions on pattern analysis and machine intelligence, Vol. 22, No. 4, p.385 © IEEE 2000	This starts with a linked chain structure, but changes to a repeated subject structure once the idea of "caption text" is introduced. Notice also that the transition word, "Furthermore," clearly indicates the end of the repeated structure pattern. The transition "in summary" announces that the paragraph is ending Also, notice that it is an eight sentence paragraph, which is fully developed. Many paragraphs from student papers are too short.

There are many possible combinations of hybrid paragraphs. A division paragraph, for example, may change to a linked chain format as each part is explained.

In this section, we have seen the basic paragraph structure of English writing. In addition, to understanding English sentence structure, a clear understanding of what the reader expects

when you are writing a paragraph will help you to write more effectively. In the next section, we will see some of the functions of paragraphs and how they can be developed further.

3.4. Paragraph structure analysis

A writing researcher named Frances Christensen developed a useful method to analyze paragraph structure. Just like sentences, paragraphs are developed by coordination, equal parts of the paragraph, or subordination, one sentence giving more information about the previous sentence. In English, there is also a general preference for general to specific order of information. If we combine these concepts, we can see the structure of a paragraph more easily by looking at the "level of generality." Sentences in paragraphs tend to be organized from most general to more specific sentences in a paragraph.

To identify the Level of Generality for each sentence in a paragraph, we can assign a value ranging from 0–4 or more as follows.

3.4.1 Level of Generality paragraph analysis

Level	Explanation
0	A sentence that summarizes a previous paragraph, provides background as a way to introduce a new topic, provides a transition to the new paragraph or controlling idea, or concludes the paragraph.
1	The most general sentence containing the main idea in the topic sentence of the paragraph. The main idea may have two or three parts or controlling ideas, however. For example, "There are two types of X: Y and Z. These controlling ideas are often the repeated key words of the rest of the paragraph.
2	A more specific sentence that elaborates an idea in #1
3	An even more specific sentence that elaborates an idea in #2
4	An even more specific sentence that adds information to # 3, # 4, as necessary.

Source: Adapted from http://www.uwc.ucf.edu/Writing%20Resources/Handouts/checking_para_coherence.htm

Here is an example analysis with the value at the end of the sentence. Words are underlined to show how they are linked back to the previous sentence.

EXAMPLE

Coal, the most abundant, widely distributed, and economical fossil fuel, is a solid with high carbon content but low hydrogen content (usually less than 6%) 0. As a solid, coal is not easily used as a transportation fuel 0. However, transportation fuels and other chemicals may be derived from coal through liquefaction 0. The two methods to convert solid coal into liquid fuel are **direct liquefaction** and **indirect liquefaction** 1. **Direct liquefaction**, the most efficient route currently available, with catalyst and a hydrogen donor solvent at very high temperature and pressure, can convert coal into artificial petroleum 2. In **indirect liquefaction**, coal is completely gasified with steam 2. The gasification products are mixed with H_2 and CO with the removal of sulfur-containing species 3. Over a catalyst at relatively low pressure and temperature, the mixture reacts to produce the final synthesis liquid fuel 4. By adjusting the composition of catalyst, hydrogen/carbon ratio, temperature, pressure, etc., one can obtain a variety of different products, such as paraffins, olefinic hydrocarbons or alcohols [4] 0.

The paragraph structure above looks like this.

0) Background

0) Background

0) Transition

1) Topic sentence containing two controlling ideas: direct liquefication and indirect liquefaction

2) Direct liquefication

(No supporting sentences)

2) Indirect liquefication

(Both are marked #2 to show they are of equal coordinate value.)

3) more specific information on the process of indirect liquefaction

4) more specific information on # 3

0) Conclusion

From our analysis, it is clear that there is one main idea here: How to produce liquid from coal through **liquefaction**. This main idea is divided into two parts. The first part 2) above is direct liquefication, which is not developed because there are no supporting sentences of level 3 or 4, and the other part 2) indirect liquefication, which is explained with supporting examples. Finally, there is a conclusion. There are two parts labeled 2) because they are coordinate: they are at the same level of generality, two controlling ideas of the topic sentence. In the conclusion, the keywords catalyst, hydrogen/carbon ratio, temperature, and pressure are repeated, so we know that they refer to the two methods of liquefication.

The Level of Generality test is an excellent way to analyze your own writing. It can indicate paragraphs that are not well-structured, or it can help you to analyze examples of good writing. If your paragraphs lack enough level 3 or 4 sentences, your controlling ideas may not be fully supported with information or examples. However, this method is more effective for sentences in the introduction and discussion sections of research writing. Methods sections may have process paragraphs that explain how to do something in a series of steps, which may all be equal. Abstracts also do not follow this structure.

3.5. Paragraph length

There is no set length for a paragraph. Paragraphs that introduce a new section or that introduce an equation may only be one or two sentences. However, most well developed paragraphs in journal articles are at least four sentences in length. Generally speaking, in a two column engineering journal article, most columns will have at least part of three paragraphs in each column. Note that many graduate students write paragraphs that are too short.

3.6. Transition signals

Transition signals clearly show the connections between sentences, ideas, paragraphs, and even whole sections of an article or dissertation. This concept includes some of the writing tips that we have already mentioned but also introduces other structures.

In the following paragraph, we see that the relationship between each sentence in the paragraph is clear. In the second sentence "urgent demand" is referred to and connected in the next sentence by the transition "such needs." The phrase "Among these information sources" makes it clear that this sentence is giving information about only one of the types mentioned in the previous sentence. Other types of transitions such as "for example," "more importantly," and "furthermore," give a clue to the reader of how to understand the sentence. We can see that "more importantly" helps us to understand the key point the writer is trying to make, but "furthermore" is used to give an additional point.

EXAMPLE

DIGITAL video now plays an important role in entertainment, education, and other multimedia applications. With hundreds of thousands of hours of archival videos, there is an urgent demand for tools that will allow efficient browsing and retrieving of video data [1], [20], [21]. In response to such needs , various video content analysis techniques using one or a combination of image, audio, and textual information present in video have been proposed to parse, index, and abstract massive amounts of data [1], [3], [15], [20]. Among these information sources, caption text present in the video frames plays an important role in understanding the content of a raw video sequence. For example, captions in news broadcasts and documentaries usually annotate information on where, when, and who of the reported events. More importantly, a sequence of frames with caption text is often used to represent highlights in documentaries. Also, captions are widely used to depict titles, producers, actors, credits, and sometimes, the context of a story. Furthermore, text and

symbols that are presented at specific locations in a video image can be used to identify the TV station and program associated with the video. In summary, captions in video frames provide highly condensed information about the contents of the video and can be used for video skimming, browsing, and retrieval in large video databases.

Source: Zhong et al.: IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 22, No. 4, p. 385 © IEEE 2000

Read this paragraph again after all of the transition signals have been taken out.

EXAMPLE [TRANSITIONS REMOVED]

DIGITAL video now plays an important role in entertainment, education, and other multimedia applications. There is an urgent demand for tools that will allow efficient browsing and retrieving of video data [1], [20], [21]. Various video content analysis techniques using one or a combination of image, audio, and textual information present in video have been proposed to parse, index, and abstract massive amounts of data [1], [3], [15],[20]. Caption text present in the video frames plays an important role in understanding the content of a raw video sequence. Captions in news broadcasts and documentaries usually annotate information on where, when, and who of the reported events. A sequence of frames with caption text is often used to represent highlights in documentaries. Captions are widely used to depict titles, producers, actors, credits, and sometimes, the context of a story. Text and symbols that are presented at specific locations in a video image can be used to identify the TV station and program associated with the video. Captions in video frames provide highly condensed information about the contents of the video and can be used for video skimming, browsing, and retrieval in large video databases.

The text itself is understandable, but it seems to read like a list of equal parts. It is possible, for example, to miss the fact that the use of captions to represent highlights in documentaries is very important, or that the last sentence is a conclusion. One of the most common writing problems for Korean scientists writing in English is a lack of transitions. This lack of transitions is often what makes a reviewer state that a paragraph is “unclear” or “hard to follow.”

3.6.1 Transitions help show the structure of paragraphs

Earlier we learned about the structure of paragraphs. Most paragraphs that explain or analyze have a topic sentence, which may indicate that the paragraph has more than one controlling idea or level 2 sentence using the level of generality concept introduced in **4.4.** Generally speaking, whenever you introduce a level 2 idea, it is a good idea to use a transition signal. Words like “first” or “second” are often used as transitions to introduce parts of a paragraph. Words like “furthermore” or “also” are often used to indicate that a new point is being made. In short, if you have finished discussing an idea either start a new paragraph or introduce a transition.

3.6.2 Transitions help show the structure of entire documents

Transition signals can also tell the reader what you are going to talk about next or remind them of what you have already mentioned. You can think of these phrases as commenting on the writing itself. Examples include: In Section 4 we will discuss the importance of X, X will be examined in Chapter 5, as previously stated and discussed above. These types of comments are especially important in long pieces of writing such as a thesis, dissertation or textbook.

3.6.3 Types of transitions

Transition signals can be words, phrases, or even whole sentences or paragraphs between sections of a paper.

Korean students are familiar with transitions like “However,” “therefore,” “first,” and “in conclusion.” However, to write sophisticated research papers effectively, you should be able to make transitions at the phrase, clause, and sentence level as well.

3.6.3.1 Transition word

This is a word which shows how two sentences or paragraphs are linked. The examples below indicate that additional information is being added.

EXAMPLE

Also, captions are widely used to depict titles, producers, actors, credits, and sometimes, the context of a story. Furthermore, text and symbols that are presented at specific locations in a video image can be used to identify the TV station and program associated with the video.

3.6.3.2 Transition phrase

This is a phrase (a group of two or more words in sequence) that shows how two sentences or paragraphs are linked. It explains how the following sentence gives more information about the needs for efficient browsing and retrieving of the previous one. For further information on the definition of phrase see Section 3.1.5.

EXAMPLE

With hundreds of thousands of hours of archival videos, there is an urgent demand for tools that will allow efficient browsing and retrieving of video data [1], [20], [21]. In response to such needs, various video content analysis techniques…

3.6.3.3 Transition clause

This is a clause (a group of words containing a subject and a verb) that shows how two sentences or paragraphs are linked. It summarizes the previous sentence or paragraph. Here the clause reviews the value of the information in the previous sentence before adding a point about the problems involved.

EXAMPLE

In summary, captions in video frames provide highly condensed information about the contents of the video and can be used for video skimming, browsing, and retrieval in large video databases.Although embedded text/captions provide important information about the image, it is not an easy problem to reliably detect and localize text/captions embedded in images.

3.6.3.4 Transition sentence

When the logical relationship between the paragraphs is more complicated, writers use a sentence to indicate how they are linked. The sentence example summarizes all previous research methods before introducing the proposed method in the paper.

EXAMPLE

This texture-based method was applied to a variety of still images with an acceptable performance. All the above text detection methods were applied on uncompressed images, even though they are designed for digital images and video. None of the previously published algorithms utilized features present in the compressed domain to locate the text directly in compressed images.

In longer documents, transition sentences or even whole paragraphs can describe other sections of the paper. This is especially true in thesis and dissertation writing.

EXAMPLE

The rest of the paper is organized as follows: We describe the details of the proposed method in Section 2, which includes texture feature extraction from MPEG compressed

domain and the refinement of the text candidate blocks. The experimental results and performance evaluation are presented in Section 3. Section 4 summarizes the paper and presents future work.

Source of all the transition examples: Zhong et al.:IEEE Transactions on pattern analysis and machine intelligence, Vol. 22, No. 4, p. 385. © IEEE 2000

Transition signals are related to the function of the paragraph. The use of a particular transition signal is related to the logic of the connection between the sentences or paragraphs. The following chart summarizes the key choices when comparing or contrasting, adding information, or indicating cause and effect.

3.6.4 Chart of transition signals

Meaning/ Function	**Sentence connectors**	**Clause connectors**		**Others (adjectives, verbs, and prepositions)**
		Coordinators	Subordinators	
To introduce a similar additional idea	also furthermore in addition moreover too	and nor		another an additional
To compare things	also likewise similarly too	and both X and Y neither X nor Y	as just as	as … as like/alike just like similar to be alike be similar

Meaning/ Function	Sentence connectors	Clause connectors		Others (adjectives, verbs, and prepositions)
		Coordinators	Subordinators	
To introduce an opposite idea, and to contrast things	however in contrast instead in/by comparison nevertheless on the other hand on the contrary	but yet	although even though though whereas while	despite in spite of compared to/with be different (from) be unlike differ (from)
To introduce an example	for example for instance			such as like an example of
To emphasize	in fact, indeed,	not only X but also Y		
To explain and restate	that is			
To introduce an alternative	otherwise	or	if unless	

Meaning/ Function	Sentence connectors	Clause connectors		Others (adjectives, verbs, and prepositions)
		Coordinators	Subordinators	
To signal time	first, second, third. then, next, now, last, finally, after that, since then,		after as as soon as before since until when while	the first the second the next before afterwards
To indicate order of importance	most importantly, significantly primarily			a more important the most important the primary
To introduce a cause or reason		for	because since as	result from be the result of due to because of the consequence of
To introduce an effect or result	accordingly as a result as a consequence consequently hence thus therefore			the effect of have an effect on the reason for as a result of as a consequence of

Meaning/ Function	Sentence connectors	Clause connectors		Others (adjectives, verbs, and prepositions)
		Coordinators	Subordinators	
To conclude	in brief in conclusion in short in summary	so		It is clear that X We can see that X The evidence suggests that X These examples show that X

Source: Adapted from Oshima and Hogue (2006) 4th Ed. *Writing academic English.* Pearson: NY

TIP

These websites have more useful information on how to use transitions.

http://www.io.com/~hcexres/textbook/structov.html

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Chapter 4: **Before You Begin Writing**

There are some fundamental skills you need to master and some essential questions to answer before you start writing your journal article, conference paper, thesis, or dissertation. This chapter presents a list of skills specifically for graduate students.

4.1. Connect reading and writing skills

Well-written engineering papers not only describe the content, but follow a certain structure and answer important questions in the reader's mind. The following link is only one page long, but it may help you evaluate how you are reading papers. It may also help you to think about how your paper should be written. The page has some advice on how to read research papers from an American professor to his students. Good critical reading is not as easy as it may seem. http://www-cse.ucsd.edu/users/wgg/CSE210/howtoread.html

TIP

> If you read an engineering paper sentence by sentence from the abstract all the way to the conclusion, you don't read like most professional researchers.

Because not all readers read all of the contents of a journal article, you should repeat the key points of your paper in the abstract, introduction, and discussion/conclusion section.

4.2. Consider using a literature review matrix

When you are researching a topic, it is difficult to remember what you have read and the similarities and differences between these papers. In order to organize your research, a literature review matrix may be helpful. Simply make an MS EXCEL file with the key points of any paper in your field, such as the author names and title of the article, the date of the paper, the specific aspect of the research problem examined, the type of materials used, the experimental methods used, the research methods used. The exact categories can be customized to each field of research. Then, fill in the grid with summaries of the papers you have read. This matrix format, especially with the addition of color coding, will help you see the

overall picture of your research field and will allow you to see similarities, differences, and patterns in research. This tool is even more useful for theses and dissertations, or other longer more complex multi-paper research projects or proposals done by a whole lab. Each member of a research team could add to this matrix after they have read a paper. The quality or usefulness of an article could also be indicated by using a point or star system. A matrix may also be useful background for a proposal or research grant application for a non-specialist audience.

Download this file to see examples from the fields of health sciences and environmental protection and modify the method according to your own needs.

http://www.tceq.state.tx.us/assets/public/implementation/air/terp/ntrd/prog_rpts/Tables_Complete.pdf

Also, search "Literature Review Matrix" in quotation marks in an internet search to find further examples. This technique does not seen to be that common in engineering, but it seems to be very useful across many fields.

4.3. Use a worksheet to help you organize your thinking

Much engineering writing is organized in a framework that we might call a problem-solution structure. To help you organize your writing, it is a good idea to make notes on a worksheet or to design one for your own lab to help you understand your own paper or the structure of other papers more clearly. An example of a worksheet is shown on the following page. Answering these questions may help you to organize your thinking about your paper more effectively before you start writing.

4.3.1 Worksheet for analyzing engineering papers

❑ What is the problem that needs to be solved in this paper?

❑ What have other researchers done to try to solve this problem?

❑ Why haven't they solved it? Or why is their solution not good enough?

❑ What is the solution in this paper or what new information have you found? How is it different from previous solutions?

❑ How exactly and under what conditions is your solution better than other proposed methods?

❑ Even if your solution was not totally successful, what exact knowledge has it contributed to the field, and what are the implications of this research for your field?

❑ What other knowledge is lacking concerning this research problem and should be studied in future research?

Once you have collected your ideas, there are many important characteristics of the engineering research article that you should always keep in mind while writing for international publication in English.

4.4. Understanding characteristics of research writing in your field

4.4.1. Understand that the purpose of the introduction is not simply to introduce your paper

Some introductions written by students are too short. This is perhaps because it is not always understood fundamentally that the introduction is not just about your own paper but its relationship to the field as a whole. The real purpose of an introduction is to persuade the reader of the importance of your paper, and to explain exactly how your paper is making an important contribution to your field as a member of a community of scholars. Clearly indicating the relationship between your paper and the problems in your field is one key to more effective introduction writing.

4.4.2. Have a clear idea of how your paper is different from other papers

It is a good idea to make it clear to tell the reader (and journal reviewers!) exactly how your paper is different/superior to previous papers; otherwise there is no reason to publish it! Engineering papers are like superheroes: they should be better, stronger, or faster than any others. We might also add smaller (nanotechnology, semi-conductor chips), or cheaper (fuel cells, materials). Also, emphasize exactly what the new contribution is in your paper's abstract, introduction and conclusion.

Journal readers expect and journal editors want new ideas, theories, methods and applications. In this sense, they are not that different from newspapers or magazines. They need to attract readers. Make it clear what you are offering in your paper and why people need to read it. Failure to explain the significance of the paper is a common reason for reviewers to reject a paper.

4.4.3. Understand the importance of critical analysis of previous work when writing for international journals

Some researchers believe that there are some important cultural and disciplinary differences in writing style that should be considered when evaluating previous research (Swales & Feak, 2000).

Know your audience. If sending a paper to an America-based journal, consider writing more critically of previous research. If writing for some East Asian journals in English, the same writing style might seem somewhat aggressive. However, if you simply summarize the previous research without showing why it is not sufficient and why your research is needed, it is not a good introduction for international publication. See Chapter 6 for more detail on how to criticize previous work politely.

4.4.4. Be careful not to overestimate the background knowledge of some readers

Research has shown that writers tend to overestimate the background knowledge of their readers, who could be master's students just learning the field, for example. In many fields like materials science, chemical, and biomedical engineering, there is a lot of multidisciplinary work, so those reading the papers may not even be from the same field. If you read papers from famous universities, you might find that the introduction is more likely to be longer and the background is more fully explained, rather than shorter and more complex.

Once you understand these important characteristics, there are a number of things you might consider before starting to write the paper.

4.4.5. Use the advanced search functions of Adobe Acrobat like a database of sample sentences

Using the instructions in Chapter 2, put at least 100 PDF files from journal articles in your field on a CD or on your hard drive in a single folder. This will allow you to use previous papers like a database of writing structures you can use.

4.4.6. Choose the journal first or after you have completed a first draft

Not surprisingly, a general journal requires a more general introduction and more background information. A specialist journal might allow you to use more terms or procedures without defining them. Some very famous journals like *Science* or *Nature* are written for a more general audience, so articles in these journals have more background information than highly specialized journals. They don't even have a traditional abstract, but ask the author to give an overview of the field. In short, the type of journal you choose will affect how you write your abstract, introduction, and conclusion, and perhaps even your method or results sections.

4.4.7. Find and follow the author guidelines for the journal or conference

Always read the author guidelines from the journal to which you are sending a paper. The author guidelines may contain very specific information such as the word limits for abstracts, number of keywords allowed, British or American English preferences, preparation of figures, and reference format as well as tools and templates to be used. Some journals like *Nature* have a totally different format and do not even have traditional abstracts for letters: http://www.nature.com/nature/authors/gta/Letter_bold_para.doc

Make sure that you follow the author guidelines or your paper may be rejected. See http://www.ieee.org/portal/pages/pubs/transactions/information.html for an example of detailed author guidelines and tools.

Here are a few more tips that may help you prepare to write your paper.

4.4.8. Consider starting with the methods section

The most terrifying thing about writing your first paper is getting started. The methods section is the easiest section of the paper to write, and it will build your confidence as well as help you to get started. Many researchers start with the methods section when writing a paper or briefly outline the entire structure of the paper before starting to write. In fact, most experienced authors do not start by writing the introduction section.

4.4.9. Make sure that you are using references properly

Since the introduction can be so difficult to write, some students tend to copy and paste sentences together from the introductions of different papers with the reference for their introduction. Other students use what is called "patchwriting" or only changing a few words from another author's paper but keeping the same sentence structure. Even if a reference is given (such as [1]), it is not acceptable to copy and paste the entire sentence or even much of a sentence from another paper into your introduction. When you use sentences from another paper, you must rewrite the original in your own words. If you have any doubts, read the next section on using references for a useful discussion on what sources should be documented and why. Professors should make sure that the graduate students with whom they are co-authoring papers understand how to use references from other papers. Faculty should be concerned that

some graduate students lack knowledge of correct referencing and that these students may be writing with their professor's name on the paper as advising co-author or dissertation advisor.

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Chapter 5: **Using references in sciences and engineering**

5.1. What are references?

When you use information from another paper, you have to give the source of the information and the text. Failing to give the source of a sentence is called plagiarism (copying) and is a very serious problem that could end your career as a researcher! Even if you give a reference such as [1] for a sentence, you still cannot simply copy and paste or translate the sentences of other papers into your work. References, also called citations, are also important because the number of times a paper is cited by other papers is a good indication of the importance of the paper and how much impact it has on a field. http://scientific.thomson.com/products/sci/
How often the articles in each journal are cited is also one way that journals are ranked. The frequency of citation is called the "impact factor." Therefore, publication in a high impact factor journal is valued more than lower impact journals. Because this concept is so important to your career as a researcher, you might want to learn more about it. In fact, how these statistics are used is actually quite controversial.
http://scientific.thomson.com/free/essays/journalcitationreports/impactfactor/

This section answers common questions about references.
Information on the formats in this section is adapted from
http://www.engineering.utoronto.ca/about/programs/communication/Online_Handbook/Accurate_Documentation.htm

5.2. The "intext" reference is in the body of the paper

In engineering, there are three styles of intext references commonly used.

1) Author-Date

This style is based on the *Chicago Manual of Style* and may be used in civil, chemical, industrial, or mechanical engineering.

EXAMPLE
Berge et al. (1976), Theus and Chou (1983), Ruud et al. (1990, 1993) examined stress corrosion cracking and measured the residual stresses for the integrity of S/G tubes.
Source: Shin et al.: Simulation of stress corrosion crack growth in steam generator tubes Nuclear Engineering and Design 214 (2002) p. 91 ©2002

2) IEEE style

This uses a number [1], and may be found in electrical or computer engineering.

EXAMPLE
One of the most popular models used in information retrieval is the vector model [1], [10], [11].
Source: Lu et al.: IEEE Transactions on Multimedia, Vol. 5, No. 3 p. 340. © IEEE 2003

3) Superscripted [1]

This style is often found in chemical engineering and applied physics.

EXAMPLE
Nucleic acids provide a unique material for constructing molecular devices.[1] They support a diversity of structural[2-4] and functional[5-7] motifs governed by predictable properties of the double helix, such as base pairing and stacking, A- and B-form geometries, and energetics.
Source: Rothemund et al.: J. AM. CHEM. SOC. 2004, 126, 16344-16352 p.16344 ©2004

5.3. The reference list is found at the end of the article

There are also a number of formats depending on the field and the journal.

1) They can be organized alphabetically by family name.

EXAMPLE
Bamford, W.H., Foster, J.P., 1995. Crack growth and microstructural characterization of alloy 600 head penetration materials, EPRI TR-105958.
Chung, H.S., Kim, K.T., Kim, H.D., Lee, H.J., Nam, M.W., 1998. A study on the integrity assessment of defected S/G tube, KEPRI Report.

2) Or they may be organized in a numbered list of varying formats

EXAMPLE
[1] K. Hatanaka, Y. Shirasaki, N. Fujiwara, M. Watanabe. T. Furukawa and S. Kawabe, "A Digital FM Signal Processing System for VCRs," *IEEE Trans. Consumer Electronics*, vol. 4, pp. 405-411, Aug. 1995.
[2] B. Song and I. S. Lee, "A digital FM Demodulator for FM, TV and Wireless," *IEEE Trans. Circuits and Systems: Analog and Digital Signal Processing*, vol. 42, pp. 821-825, Dec. 1995.

EXAMPLE
(1) (a) Quail, P. H. *Nat. Re*V. *Mol. Cell Biol.* 2002, *3*, 85. (b) Hughes, J.; Lamparter, T. *Plant Physiol.* 1999, *121*, 1059. (c) Fankhauser, C. *J. Biol.Chem.* 2001, *276*, 11453.
(2) Ru¨odiger, W.; Thu¨ommler, F.; Cmiel, E.; Schneider, S. *Proc. Natl. Acad. Sci. U.S.A.* 1983, *80*, 6244.

EXAMPLE
[1]L. Neel, Ann. Geophys. C.N.R.S. 5, 99 1949.
[2]S. Shirkman and E. P. Wohlfarth, Phys. Rev. Lett. 85, 467 1981.
[3]J. L. Dormann *et al.*, Phys. Rev. B 53, 14291 1996.
[4]J. L. Tholence, Solid State Commun. 35, 113 1980.
[5]J. L. Dormann, D. Fiorani, and E. Tronc, Adv. Chem. Phys. 98, 283 1997.

The type of reference system indicates whether the AUTHOR and DATE alphabetically, or the NUMBER only is used to find the source in the list of references at the end of the paper. However, since there is such variation, always download and read the author guidelines before writing your journal article or conference paper. Follow the reference style used in the particular journal where you are sending your paper to be published. Differences in format between journals can be found even within the same field of engineering. If you make basic format mistakes and do not follow the journal format, the editors may just reject your manuscript. They may also doubt your ability as a scholar and how carefully you check your work. Author guidelines may include templates for your article or detailed instructions for figures and graphics. Here is an example of author guidelines.
http://www.ieee.org/portal/cms_docs/pubs/transactions/auinfo03.pdf

TIP

> Since the exact format may differ in different journals, it is a good idea to choose which journal you are sending your paper to before you do the references. This will save you time by not having to reformat your paper.

Many software programs can be used to automatically format and store all your references and/or research notes. Ph.D. students and faculty should consider using research software programs to increase productivity. Most are not free, but the university may have a site license for *Endnote* software. Here are some of the more popular online services or software.

http://www.endnote.com/
http://refworks.com/
http://www.refman.com/

Here are some additional online tools for reference software.

A free online shared reference system from the journal *Nature* http://www.connotea.org/
http://www.library.utoronto.ca/gerstein/subjectguides/personalbib.html

Research visualization	http://www.endnote.com/pubtools/refviz.asp
Korean research software distributor	http://www.philscience.com/
Scientific proofreading tool	http://www.sciproof.com/

5.4. Why are references required?

A good introduction with a literature review in a thesis or “related works” section of an article is not simply a summary of previous research, but should show that you have made a contribution to a problem or missing area of research in your field. As well as showing where you got the ideas from, references also allow you to show the difference between your work and previous research. Therefore, you make reference to other research when presenting the importance of your own paper. Citations to other similar research also helps the reader to understand the context of your paper. Citation also help to determine the importance and influence of an article by showing the number of references.

TIP

> A problem for some graduate students is a lack of references to previous research in the introductions section. Browse the already published articles in the journal you want to publish in and get an idea of the average number of references. Then compare it to the number of references in your paper. If there is a very significant difference in the number of references in your article and many previously published articles, it may indicate a problem. It is only a rough guide, but it is a helpful comparison.

2) Location of references in the paper

It may be obvious that references occur in the introduction and discussion sections of papers, but they may also occur in the methods or results sections as well. For example, if you are using a method that is not commonly known in your field, you may add a reference from another field that has used a similar method successfully. In fact, you can add references to almost any section of the paper except the abstract, where full references are never given except rarely for some conference proposals. In short, do not put references in an abstract unless a journal or conference specifically asks for them.

TIP

You may mention a particular method, research instrument, theory, or author, but you should not give a numbered reference or author-date reference in the abstract itself.

Here is an example of the first line of an abstract. There is no reference. If this sentence were in an introduction, we would normally see references for the methods, theories, specific papers, or procedures, but not in the abstract.

EXAMPLE
The perturbation method is used to construct the general solution of a centrally symmetric quasistatic problem of elasticity under the assumption that all thermomechanical characteristics of a body are functions of temperature.
Source: Popovych and Sulym. *Materials Science, Vol. 40, No. 3, 2004* p. 365 ©2004

There are basically three ways to use sources from other papers:

1. Direct quotation
2. Summary or
3. Paraphrase

5.5. Direct quotation

Direct quotation is used when you want to use the exact words from a source, term, or an example. Basically, anything between the "quotation marks" should not be changed from the original at all. In this example, the author uses quotation marks to indicate the exact sentences used in searches.

EXAMPLE
All of the above discussed models, [6], [7], [22], [27], share the following drawbacks. 1) They do not represent time-varying visual features other than direction, for example, a simple query as the following is not supported "*find a shot that has an object whose color changes from red to blue*", 2) they do not support rich sets of VST relationships between objects, for example, a simple query as the following is not supported "*find a shot that has two objects, where O1 is smaller, darker, and faster than O2*," and 3) their query tools do not allow users to specify the appearance and disappearance of an object trajectory in reference to trajectories of other objects, for example, a simple query as the following is not supported "*find a shot that has two objects, where O1 appeared in the shot before, and disappeared after,* O2".
Source: Aghbari et al.: IEEE Transactions On Multimedia, VOL. 5, NO. 4, December 2003 p.517 © IEEE 2003

In this example from civil engineering, it is important for the author to show the exact words from the design code, so a direct quotation is used.

EXAMPLE
All connections are assumed to be fully rigid, in agreement with the design code philosophies. In Ref. [4,Chapter 5.2.2.2] (models for global analysis), paragraph 6 states the following: "In general, the connections in bridges should be designed as rigid except for pinned connections or connections of cables which may be considered as nominally pinned, to improve their fatigue life". In Chapter 5.2.3.5 (truss bridges), paragraph 2 contains this note: "For the fatigue verification secondary moments shall be taken into account."
Source: K. Kiss, L. Dunai / Computers and Structures 78 (2000) p.333

However, unlike the social sciences, direct quotation is rarely used in engineering writing. Instead, summary and paraphrase are standard. Direct quotation is used more commonly in business writing in reports, recommendations, or proposals, however. For more information on how to use direct quotation see
http://www.engineering.utoronto.ca/English/page-1-2076-1.html#3

Notice that double quotation marks are used in American English, but single quotation marks are used in British English. For further explanation, see Section 10.10.

5.6. Summary

Summary occurs when you only want to refer to the main idea of a paper or a group of papers that share some characteristics. For example, in this article related to coal fuel, the author is summarizing the changes over the years contained in a number of different articles up to the present [2-6].

EXAMPLE
The code has been modified over a number of years to model the flow and combustion processes in bagasse fired boilers [2–4]. Details of a more recent version of the FURNACE code are described elsewhere [5,6].
Source: Dixon et al.: Fuel 84 (2005) p. 1304 ©2005

When making a summary, you cannot just copy and paste a sentence from other papers but must write your own sentence in your own words containing the main idea of the previous article or articles. Summary is common in engineering writing.

5.7. Paraphrase

Paraphrase involves taking a sentence from a part of a paper and rewriting it in your own words. Paraphrasing properly is very difficult, but common in engineering writing. It will be explained in detail in the next section.

Steps to proper paraphrasing:

1. Read and fully understand the sentence you want to use.
2. Identify the key terms in your field that must be used and the words that need to be rewritten.
3. Modify the sentence structure and change the vocabulary words as necessary.
4. Include the reference to the original.

Even if a reference is given (such as [1]), it is not acceptable to copy and paste the entire sentence or even much of a sentence from another paper into your introduction. When you use references from another paper, you must rewrite the original in your own words.

5.7.1 Technical terms in paraphrasing

In order to paraphrase correctly, it is essential to know the difference between the technical terms in your field and the particular general vocabulary words that the author has chosen. In addition, you must be able to distinguish between fixed phrases common in your field, and phrases unique to individual authors based on their own choice of general words.

These are three important points to remember when you are paraphrasing.

1) Do not change technical terms when paraphrasing

Words like “end-to-end delay” in voice communications should not be changed because this term has a specific technical meaning in this field known to everyone. Changing this term would only confuse the reader with an unfamiliar word. Here is the definition of “end-to-end delay.” http://www.iec.org/online/tutorials/voice_qual/topic05.html

To find the use of technical terms in your field you can use the Google Internet and Acrobat search techniques introduced in Chapter 2 to see how specific words are used in your field.

2) Be able to recognize fixed expressions in your field

One guideline for a computer program that checks sentences for copying is whether six words in a string are the same. See
http://www.nature.com/nature/journal/v435/n7040/full/435258a.html

However, I think it is more important to recognize the difference between fixed expressions in your field, and the unique words chosen by the author that can be changed by using other words with a similar meaning. The following are examples of fixed expressions common in engineering that do not have to be rewritten. You can find more useful patterns by using the advanced Adobe search techniques introduced in Chapter 2. Learning these common fixed expressions will help you to write in a style that is appropriate in your field.

EXAMPLES

- …., as shown in Figure 1.
- Previous work has mainly focused on improving the tradeoff between …
- In this paper, we propose a new/novel …
- This paper is organized as follows. Section II describes the …
- As illustrated in Fig. 2, we denote the …

3) Change the structure of the sentence without changing the meaning of the original author's words

When paraphrasing, we have to keep the original meaning of the sentence. Therefore, be careful not to mix your own ideas together with the paraphrased words in a single sentence. Even if you give the reference at the end, it may be unclear which ideas are being referenced.

5.7.2 Examples of incorrect paraphrase

Imagine that you are writing your introduction on voice communication over IP networks.

You start off the introduction of your own paper with a general statement that introduces the reader to the research problem that will be introduced.

Eliminating excessive end-to-end delay is an essential step in ensuring quality-of-service (QoS) in real-time voice communication over IP networks (VoIP).

In your reading you found an important point from Liang et al. on why voice communication must not be interrupted, which you would like to use in your article. You also like the way the authors have emphasized the "interactivity of human conversation" and want to include it in your paper.

The unreliable and stateless nature of today's Internet protocol (IP) results in a best-effort service, i.e., packets may be delivered with arbitrary delay or may even be lost. This quality-of-service (QoS) limitation is a major challenge for real-time voice communication over IP networks (VoIP). <u>Since excessive end-to-end delay impairs the interactivity of human conversation, active error control techniques such as retransmission cannot be applied.</u> Therefore, any packet loss directly degrades the quality of the reconstructed speech. Furthermore, delay variation (also known as jitter) obstructs the proper reconstruction of the voice packets in their original sequential and periodic pattern.
Source: Liang et al.: IEEE Transactions on Multimedia, Vol. 5, No. 4, December 2003 p.532 © IEEE 2003

Simply copying and pasting this sentence without a reference would be totally unacceptable, but this is not usually a problem with students. However, proper paraphrase is often a problem, and it can get quite complex. The following paraphrase is **<u>not</u>** acceptable because we have just copied and pasted the sentence, even though we have included a reference [1] to indicate that we got this example from Liang et al.

ORIGINAL EXAMPLE
Since excessive end-to-end delay impairs the interactivity of human conversation, active error control techniques such as retransmission cannot be applied.
Source: Liang et al.: IEEE Transactions on Multimedia, Vol. 5, No. 4, December 2003 p.532 © IEEE 2003
Remember that the first sentence is your own sentence and not the paraphrased one.

➔ Incorrect paraphrase 1
Eliminating excessive end-to-end delay is an essential step in ensuring quality-of-service (QoS) in real-time voice communication over IP networks (VoIP). Since excessive end-to-end delay impairs the interactivity of human conversation, active error control techniques such as retransmission cannot be applied [1]. Therefore, …

We need to rewrite the sentence in our own words. In order to do that, we need to understand the meaning. Basically the sentence means that, unlike other types of data that are sent in packets, voice data cannot be interrupted or resent because it needs to arrive in the proper order and time for people to be able to interact in real-time when talking.

ORIGINAL EXAMPLE
Since excessive end-to-end delay impairs the interactivity of human conversation, active error control techniques such as retransmission cannot be applied.
Source: Liang et al.: IEEE Transactions on Multimedia, Vol. 5, No. 4, December 2003 p.532 © IEEE 2003

➔ Incorrect paraphrase 2
Eliminating excessive end-to-end delay is an essential step in ensuring quality-of-service (QoS) in real-time voice communication over IP networks (VoIP). **Because** excessive end-to-end delay impairs the interactivity of human conversation, active error control techniques such as retransmission cannot be **used** [1]. Therefore, …

The paraphrase above is still not correct because we have only substituted a few key words and have not modified the structure of the sentence. As a result, we have taken too many of the author's choices of words. There are too many strings of text that are the same, such as "impairs the interactivity of human conversation," and, therefore, we are stealing the author's words. The author's words themselves and not just the ideas cannot be copied. Words and not just ideas are intellectual property, just like company slogans.

ORIGINAL EXAMPLE
Since excessive end-to-end delay impairs the interactivity of human conversation, active error control techniques such as retransmission cannot be applied.
Source: Liang et al.: IEEE Transactions on Multimedia, Vol. 5, No. 4, December 2003 p.532 © IEEE 2003

➔ Incorrect paraphrase 3
Excessive end-to-end delay is an essential step in ensuring quality-of-service (QoS) in real-time voice communication over IP networks (VoIP). **Because** excessive end-to-end delay **interrupts** the interaction necessary for human **speech**, **retransmission or other** active error control techniques cannot be **used** [1]. Therefore, …

In this example we have changed some words and included the reference, but it is still not acceptable because the structure is entirely the same as the original. This is a writing strategy often called "patchwriting" among English teachers. It can be useful for learning to write, but it is not acceptable for school assignments or for international SCI publication.

5.7.3 Acceptable paraphrase

Here is our original sentence that has been improperly paraphrased so far.

Eliminating excessive end-to-end delay is an essential step in ensuring quality-of-service (QoS) in real-time voice communication over IP networks (VoIP). Since excessive end-to-end delay impairs the interactivity of human conversation, active error control techniques such as retransmission cannot be applied **[1].** Therefore, …

Here is an acceptable paraphrase of that sentence.

Eliminating excessive end-to-end delay is an essential step in ensuring quality-of-service (QoS) in real-time voice communication over IP networks (VoIP). However, retransmission or other error control techniques are not feasible for real-time voice data because excessive end-to-end delay interrupts the real-time interaction necessary for human speech [1]. Therefore, …

Then, at the end of our paper in the references section, we would give the complete citation information, along with the other papers we have referenced. This example is in IEEE format. The exact format would be different in different fields and journals.

[1] Yi J. Liang, N. Färber, and B. Girod, "Adaptive playout scheduling and loss concealment for voice communication over IP networks," *IEEE Trans. Multimedia*, vol. 5, pp. 532-542, December 2003

Why is this an acceptable paraphrase?

1. The meaning of the original sentence has not been changed.
2. The original words of the author have been rewritten, but the key technical terms have been kept.
3. The sentence structure has been changed.
4. Reference to the original is included at the end of the paraphrase.

Links
A discussion of how to paraphrase correctly and what is considered plagiarism (copying)
http://www.engineering.utoronto.ca/English/page-1-2076-1.html

For a useful discussion on what and why sources should be documented, read
http://www.engineering.utoronto.ca/English/page-1-2053-1.html

An excellent article from the journal *Nature* on the common and complex problem of plagiarism (copying) in scientific journals.
http://www.nature.com/nature/journal/v435/n7040/full/435258a.html

5.8. BEST PRACTICES for using references

Using references properly is very complex. Here is a guide to best practices. The key words that illustrate the best practices are underlined.

BEST PRACTICES 5.8.1	Summarize the important points of previous research

Good introductions don't just list previous research, but explain how the results of what was found are related to the author's paper. In the following example, the previous study is not only listed, but the important conclusions are also described.

EXAMPLE
Colucci and Viskanta [21] studied experimentally the effects of nozzle geometry on the local heat transfer coefficients of confined impinging jets. Low nozzle-to-plate gaps were considered in the Reynolds number range of 10,000–50,000. The results were compared with similar experiments for unconfined jets. <u>An important conclusion was that the local heat transfer coefficients for con- fined jets are more sensitive to Reynolds number and nozzle-to-plate gaps than those for unconfined jets.</u>

Source: D.R.S. Guerra et al.: International Journal of Heat and Mass Transfer 48 (2005) p. 2831 ©2005

BEST PRACTICES 5.8.2	Balance references to general trends in research with

	explanations of specific papers

In some papers there is just a long list of previous studies without a clear indication of why these studies are important or relevant to the author's work. However, in the following example, a general overview of research on heat transfer rate is given. Specific papers on fin design are then mentioned. The author concludes the paragraph by indicating that the previous research has not been adequate. There is a good balance of types of references from a summary of general trends to analysis of specific papers here.

EXAMPLE
To make the heat exchanger more compact and practical, many investigators [11–13] showed that a higher heat transfer rate may be achieved by applying a prescribed thickness of insulation to a smaller fin at high operating temperatures. As for the optimization of fins, Haley and Westwater [5] proposed a turnip-shape fin with minimum volume for boiling heat transfer. Later, Cash et al. [14] modified the complex shape fin by using a two-cone assembly attached to a small cylindrical neck. Due to the impermanence of the insulation material and the difficulty in manufacture of these fins, lots of efforts were still needed in the improvement of the fin designs.
Source: S.-P. Liaw et al. International Journal of Heat and Mass Transfer 48 (2005) p.2494 ©2005

In addition to clearly indicating the weaknesses of previous approaches or methods, you can also critically evaluate the research done in individual papers. In this example, there is a direct reference to the problems with a single paper. However, it is best not too criticize too aggressively. See section 6.3.5. for more polite ways to evaluate previous research.

EXAMPLE
You and Chang [15] experimentally obtained the porous flow characteristics for air flow through uniformly distributed square pin-fins. They did not provide systematic results for the permeability or inertial coefficient of fin arrays.
Source: Jeng and Tzeng. International Journal of Heat and Mass Transfer 48 (2005) p.3141 ©2005

BEST PRACTICES 5.8.3	Understanding reporting verbs

Be aware of the type of verbs used to present research. The verb shows the opinion of the writer about the research; it is not just a random choice. Verbs like the following: suggests / considered/ presented / obtained / investigated/ examined / provided / evaluated / proposed / all have slightly different meanings.

Notice the word choice and variety in the verbs chosen below to indicate the status of the research.

EXAMPLE

Other methods are using POCS [37], or bayesian approaches [36]. Kokaram suggests a detection method in [26] and a spatial interpolation method in [27] for missing data. In [14], a local analysis of spatio–temporal anisotropic gray-level continuity for film blotch removal is proposed, and in [30] a method for blotch and scratch detection in image sequences is developed.

Source: Jung et al.: IEEE Transactions on Multimedia, Vol. 5, No. 3, September 2003 p.146 © IEEE 2003

For example, "proposed" means that a method has been published, but it has not been widely accepted in the field yet; the method is still under consideration.

Words like "investigated" imply that research was done to solve a specific problem. If you study how verbs are used to introduce research in your field, you will have a more sophisticated writing style. Types of reporting verbs chosen may also differ by field, however.

BEST PRACTICES 5.8.4 Position references carefully

1) Whenever possible, put references next to what they refer to in the sentence.

EXAMPLE
"Other methods are using POCS [37], or bayesian approaches [36]. Kokaram suggests a detection method in [26] and a spatial interpolation method in [27] for missing data. In [14], a local analysis of spatio–temporal anisotropic gray-level continuity for film blotch removal is proposed, and in [30] a method for blotch and scratch detection in image sequences is developed."
Source: Jung *et al.*: IEEE Transactions on Multimedia, Vol. 5, No. 3, September 2003 p.147 © IEEE 2003

In the example above, it is clear exactly what each reference is referring to. Now imagine that the paragraph only had the references at the end of the sentence.

EXAMPLE [MODIFIED]
Other methods are using POCS or bayesian approaches [37], [36]. Kokaram suggests a detection method and a spatial interpolation method for missing data. [26], [27]. A local analysis of spatio–temporal anisotropic gray-level continuity for film blotch removal is proposed, and a method for blotch and scratch detection in image sequences is developed [14], [30].

In this revision, it is not clear whether references [26] and [27] refer to both the detection method and the spatial interpolation method, or whether each reference refers to one of these methods, respectively. We can guess but we cannot be certain. When giving references, you should make it as easy as possible for the reader to find the information they need for further study without guessing.

This sentence is from a published paper, and although it is not a serious mistake, there is a lot of ambiguity here.

EXAMPLE
Accordingly, there have been many PAR reduction schemes proposed, including clipping, coding, tone reservation, tone injection, partial transmit sequence, selected mapping, compounding approaches and various combinations of the above; see [1], [2], [3], [4], [5], [6], [7] and references therein.
Source: Baxley and Zhou. IEEE Transactions on Consumer Electronics, Vol. 50, No. 3, AUGUST. p.792 © IEEE 2004

It is really not clear which references refer to "selected mapping," for example. In order to find the combinations of schemes, the reader would have to consult most of the references to find the papers that are relevant, but they shouldn't have to.

2) If you have a number of points joined by AND in a sentence, it can be unclear what is being referred to if you put the references at the end of the sentence away from the words they refer to.

EXAMPLE
Future 4G wireless systems, based on the combination of multi-carrier (OFDM) and spread spectrum (CDMA) technologies, popularly known as OFDM-CDMA (or MC-CDMA), applied to a wide-area environment, can achieve very large average user throughputs by using adaptive modulation and coding (AMC), instead of fixed modulation methods, and power control [2,3].
Source: Chatterjee and Fernando. IEEE Transactions on Consumer Electronics, Vol. 50, No. 4, NOVEMBER. p.1066 © IEEE 2004

It is hard to decide whether references [2] and [3] refer to the use of adaptive modulation and coding (AMC) in future designs or if they refer to the old models of "fixed modulation methods" and "power control." Or do the references refer to "fixed modulation methods" [2] and "power control" [3] respectively? Or could [2] refer to MC-CDMA and [3] refer to fixed modulation

methods and power control? In short, the reader should not have difficulty understanding what the references refer to.

3) It is also a good idea to make sure that your references refer not only to general background research in the field, but also include papers containing research on the exact same or most similar research problem you are writing about.

If you claim that the conventional approach is not adequate then the reader should be able to easily find examples of this approach in order to evaluate your paper. This seems obvious, but many papers fail to give an adequate amount of background information to help their reader evaluate the paper in the context of the research in the field.

5.9. Common errors using references

5.9.1 Be careful of the "borrowed literature review."

Don't put a long series of sentences each with a reference for a whole paragraph. It makes it look like you just copied and pasted the sentences and "borrowed" the literature review. References should be mixed with your own sentences of analysis and classification. Even if another paper has already written out a literature review or related works, resist the temptation to use too many of the same references. As well as being more ethical, depending on the research of previous authors may cause you to have references that are not up to date, and by writing your own literature review, you will better understand the relationship between your paper and the rest of the field.

5.9.2 Avoid Self-Plagiarism

You can even cheat from yourself! If you reuse sections of one of your own papers that you or your professor co-authored, you must acknowledge the original source. You cannot reuse most of the text of an introduction section from your previous paper on the same topic, and you must acknowledge if you reuse figures and tables from previous papers in published conference proceedings. Here are the actual IEEE guidelines from electronic engineering:

"C. When an author reuses text, charts, photographs, or other graphics from his/her own previously published material, the author shall

1. Clearly indicate all reused material and provide a full reference to the original publication of the material and
2. If the previously published or submitted material is used as a basis for a new submission, clearly indicate how the new submission differs from the previously published work(s)."

Source:
http://a957.g.akamai.net/f/957/3680/1h/www.ieee.org/organizations/pubs/pab/opsmanual.pd

There is also a danger of reusing too much of the introduction from a professor's or a senior's already published paper from the same lab, especially when working on the same research problem.

5.9.3 A method for professors to check improper paraphrase

I suggest that professors or senior students ask their co-authors to put all the PDF files in their reference list onto a CD with their article or dissertation. Then, when a professor wants to check if proper paraphrase is being done, they can use the Adobe advanced search techniques from Chapter 2.0 of this guide to compare suspicious sentences with the original papers.

Here are some useful tips for the format of references.

5.9.4 Using et al.

The words “et al.” are used to save space by not having to mention the name of every author in the text. The word “et” simply means AND in Latin so it is not an abbreviation and does not require a period. The word “al.” is an abbreviation of “*alia*” meaning “and others”, so it requires a period. Impress your friends with this knowledge! Because this term is now common, et al. does not require italics, although you will see the italics in many published papers. Follow the same style used in other published papers from the same journal to which you are sending your paper.

TIP

If there are many authors, you can use the family name of the first author followed by “et al.” in the body of the text. However, do not to use “et al.” in the list of references at the end of the paper. Only use it to save space in the body of the text. No matter how small, everyone likes to have credit for their contribution to a paper by having their name listed. Would you like to be called “et al.”? Some styles recommend only using “et al.” in the list of references if there are more than five names.

5.9.5 Using names in references correctly

Western names are in the opposite order of Korean names: Adam Jonathan Turner. Turner is my family name. Make sure that the references in the text only use the family name.

I sometimes see Korean students incorrectly use both names or incorrectly use the given name rather than the family name for western names in references. In the references at the end of the paper, family name plus initials is used (Turner, A.J.) The second initial in a western name is called the middle name. For example, my full name is Adam Jonathan Turner. I almost never use my middle name in everyday English, except for some government documents. Koreans do not have middle names, but a first name often written with initials, for example, D.J. Kim. In references in the text, I would be referred to as Turner. In the reference list at the end of the paper, initials of the first and middle name are often used. For Korean names, it is advisable to treat the first name as two initials, Lee C.H., for Lee Chun-Soo, for example. Interestingly, when I write my name in *Hangul* for Korean government documents, it should be written in the Korean order: 터너아담 Turner Adam.

Links

Using LaTeX with tips on storing references
http://www.eng.cam.ac.uk/help/tpl/textprocessing/reports.html

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Chapter 6: **Effective Introduction Sections**

This Chapter has four sections:

1. **A worksheet for analyzing introduction sections**
2. **A framework for the structure of introduction sections**
3. **A grammar guide for problems in each section of the introduction**
4. **A checklist of common errors**

6.1. Introduction: Worksheet for Analyzing Journal Articles

While reading other papers or thinking about your own article, keep these questions in your mind as you read and write. One of the most common problems students have in writing introduction sections is not clearly explaining the relationship between previous research and the research that is being presented in their own article.

- What is the research problem or area of knowledge that is missing in this field?
- What background does the reader need to know to understand this research problem?
- What have other researchers done to try to solve this problem?
- Why haven't they solved the problem? Or why are their solutions not good enough?
- How is your paper a solution to the problems that other papers could not solve or knowledge that is missing in your field?
- How exactly and under what conditions is your solution better or different than other solutions?
- Even if your solution was not totally successful, what exact knowledge has it contributed to the field and this research problem?
- What other knowledge is lacking concerning this research problem and should be studied in future research?

6.2. **Framework for the structure of introduction sections**

This framework for paper introductions can be used for the analysis of published papers as well as writing your own paper. In the framework below, note that "AND/OR" indicates a choice between two steps or a combination of both of them, "OPTIONAL" indicates a choice while "AND" alone indicates a requirement. We can understand introduction sections as having three essential steps.

STEP 1. SITUATION: Explain the background and importance of the topic

A) General background information on the topic. May include some very general references to the field.
B) Explain the general research purpose/problem/issue in this field and its importance
C) **Optional**: Define the key terms and/or explain the key concepts necessary to understand the paper.

Note: The background information serves to indirectly argue that the topic is important as well as help the reader understand the background for the research in your paper.

STEP 2. PROBLEM CYCLE: Review and show problems with previous research, methods, or theories in the field

D) Summarize, classify and compare the different methods, techniques, issues, or theories in this research area.
E) Critically evaluate previous theories/methods/issues including mentioning individual author's articles directly related to the problem of your paper by explaining their strengths and weaknesses.
F) **AND/OR** Indicate a "gap" or data that is lacking in this field to better understand this research problem.

Note: In some papers there may be more than one problem or issue in the research, so they may be a cycle of a summary, analysis, and often criticism which is repeated for more than one issue before the main purpose of the paper is introduced. D+E+F may be mixed together rather than clear separate parts.

STEP 3. SOLUTION: Introduce your paper as a solution to these problems or missing areas of research

Explain how your paper is going to help solve the research problem or fill the "gap" in research in your field that you introduced in STEP 2.

G) Introduce your own paper and how it is going to solve the problem or fill the gap introduced in STEP 2, and give more information about the methodology or arguments used in the paper and how it is different from other papers.
H) **Optional:** Summarize your main results (only in some fields such as some Chemical Engineering papers).
I) **Optional**: indicate the organization of each section of your paper (Common in fields such as computer engineering but not all fields).

Note: The letters in these steps are often not perfectly in this exact order. Also, some papers may have a separate section called "Related works" or "Literature Review" especially in the social sciences, where a longer explanation of the background may be found. This template only applies to introduction sections. Also, some of these steps may be quite short, even a couple of sentences or only one paragraph. Some steps will be mixed together in the same paragraph. (Framework adapted in part from John M. Swales (2004) *Research Genres*).

To demonstrate this framework, an analysis of an introduction section from a published paper is shown below.

6.2.1 Example analysis of an introduction section

STEP 1. SITUATION: Explain the background and importance of the topic	The letter from the framework above is placed at the end of each sentence.
This paper proposes a method for searching quickly through a long audio or video signal (termed a *stored signal*) (C) to detect and locate a known reference audio or video signal (termed a *query signal*). (B) Audio and video data from radio, television, databases, or on the Internet has been a source of recent research interest. (A)	(A) Give background information on the topic. (C) Define key terms. (B) Explain the general research purpose
Among the many studies that have targeted audio or video information search, most have dealt with so-called content-based retrieval by means of indexing and classifying audio or video information. For example, in image or video retrieval tasks, a major issue has been constructing efficient indexes [1]–[4]. Similarly, in audio retrieval tasks, most works have been based on high level information such as audio content classification (e.g., indexes for speech segments and nonspeech segments), recognized speeches, or transcribed musical pieces [5]–[9]. (D)	(D) Summarize previous research: Content-based retrieval vs. similarity-based search.
In contrast, this study concerns a similarity-based search, which is the search of and retrieval from unlabeled audio or video archives based solely on a signal similarity measure. (C) [Figure deleted] Though the range of applications for similarity-based search may seem narrow compared to content-based retrieval based on high level information, this is actually not the case: applications, such as detection and statistical analysis of broadcasted music or commercials, or copyright management on the Internet, are possible. Just as high-speed text search algorithms have come into widespread use, quick search algorithms for audio or video signals may too become basic technologies of handling multimedia information. (A)	(C) Define key terms (A) Give general background information
STEP 2. PROBLEM CYCLE: Review and show problems with previous research, methods, or theories in the field	
A conventional approach for the similarity-based search of audio or video data (hereafter time-series data) is the signal detection technique based on correlations of data itself or on feature vectors extracted from the data [10]. However, with this technique, searching may become impractical in terms of computing time in the case of long-running (e.g., several-days' worth of) stored signals or many reference signals. (E) Search speed might be improved through a rougher matching, but that would inevitably reduce search accuracy and reliability.	(E) Critically evaluate previous methods
STEP 3. SOLUTION: Introduce your paper as a solution to these problems or missing areas of research	

The algorithm proposed in this paper (G) offers significantly faster search with sufficient accuracy. (H) The key to the acceleration is an effective pruning algorithm introduced in the feature matching stage using feature histograms. (G)	(H) Summarize your main results (G) Introduce and give more information about the methodology [G and H mixed together]
Through the pruning, the actual number of matching calculations is reduced by 200 to 500 times compared with exhaustive search while mathematically guaranteeing the same search result. (H)	(H) Summarize your main results.
The rest of this paper is organized as follows. Section II describes the basic algorithm, and discusses some extension to efficient AND/OR search and feature distortion absorption. Section III evaluates the proposed algorithms under realistic circumstances. Finally, Section IV gives conclusions. (I) Source: Kashino et al.: IEEE Transactions on Multimedia, Vol. 5, No. 3, September 2003 p. 349 © IEEE 2003	(I) Indicate the organization of each section of your paper.

Examples of Effective Introduction Sections

Recent work on research writing has revealed that the key to writing better introductions is to understand that a good introduction does not simply introduce your paper.

A good introduction persuades your reader how you have contributed to the research in your field—how your research has solved a problem, found missing knowledge, come up with a better method, or invented a new method, algorithm, theory or idea in your field (Swales, *Research Genres*, 2004). This understanding of research writing introductions helps us understand how to structure the introduction more effectively. In short, you need to clearly show that your paper is worth reading because it contributes something new.

Examples of the characteristics of good introduction sections from A to L in the chart above are given in the next section. A grammar guide to these characteristics follows this section.

STEP 1. SITUATION: Explain the background and importance of the topic

Note that the background information really only serves to indirectly argue that the topic is important. In the following example of the first sentence of the introduction, it is clear that the reason the paper was written was to meet the demand for better picture quality. We expect the background to become more specific in later sentences.

A) Give general background information on the topic (may include very general background references)

EXAMPLE
"**Currently**, MPEG-2 video [1] is the most common standard for video coding, due mainly to the growth and expansion of digital TV broadcasting all over the world, and it is also popular for storage devices such as DVD. However, there has been a **strong demand in recent years for better picture quality of MPEG-2**."

Source: N. Hara et al., "Flicker Reduction in MPEG-2 Video by Post-Processing," *IEEE Transactions on Consumer Electronics*, vol. 51(1), p. 210 © Feb. 2005. IEEE

Note however that in this example the introduction has not been too wide. We can see what the general topic of the paper is going to be about. An introduction that starts something like "The environment is a big problem these days" is clearly starting too broadly. In short, the reader should be able to guess what your general topic is going to be about from the first sentence of the introduction.

See GRAMMAR SKILL 1: Verb tenses in introduction sections

B) Explain the general research problem/issue in this field and its importance

In the following first sentence of the introduction example, the reason for writing the paper, trying to overcome engine failure from high-cycle fatigue, is so important that it is a life or death issue.

"One of the principal challenges currently associated with the safety and readiness of military aircraft fleets is the susceptibility **of turbine engine components to failure from high-cycle fatigue** (HCF), i.e., the rapid propagation of fatigue cracks under high frequency vibratory loading [1,2]. **Such failures are extremely costly, leading to severe engine damage, loss of aircraft, and even loss of human life."**

Source: Campbell and Ritchie, *Engineering Fracture Mechanics*, vol. 67, pp. 209-227 © 2000 *Engineering Fracture Mechanics*

See GRAMMAR SKILL 7: Using references correctly

C) OPTIONAL: Define the key terms and/or explain the key concepts necessary to understand the paper.

Research has shown that most writers overestimate the background knowledge of their readers. There are a number of reasons to give more background information in the introduction. Readers can be other graduate students who are not necessarily experts in the field. Other readers may be doing interdisciplinary research, especially in fields such as chemical, materials science or biomedical engineering. Papers submitted to more general journals may require you to explain and define the concepts more than if you were writing for a highly specialized journal in your field. In thesis and dissertation writing, graduate students need to prove to their professors that they fully understand the history and background of their research area.

The example below clearly defines and then classifies the two components and five kinds of subunits of different enzymes referred to in a chemistry article.

EXAMPLE

1. "FOF1-ATP synthase is a multisubunit enzyme that catalyzes ATP synthesis in oxidative phosphorylation and photophosphorylation using the electrochemical potential of a proton gradient.1-4 **This enzyme consists of two components, FO and F1. The simplest F1 (F1-ATPase) comprises five kinds of subunits** with a stoichiometry of …"

Hiromasa Yagi, et al., "Conformational Change of H+-ATPase *â* Monomer Revealed on Segmental Isotope Labeling NMR Spectroscopy," *J. AM. CHEM. SOC.*, vol.126, pp. 16632-16638 © Nov. 2004. J. AM. CHEM. SOC

See GRAMMAR SKILL 2: Formal definition structure

STEP 2. PROBLEM CYCLE: Review and show problems with previous research, methods, or theories

Note: Summarizing and critical evaluation may be mixed together in the same paragraph. It is not good research writing simply to list all previous papers in the research area without classification or critical analysis. This is the most difficult part of writing a review of the literature. It is not just a summary of previous papers.

D) OPTIONAL: Summarize, classify and compare the different methods, techniques, issues, or theories in this research area.

In sciences and engineering classification of methods or materials is often part of a good introduction. In social sciences, different theoretical approaches should be explained. A good introduction should give the background information so that the reader can understand the problem you are investigating in your field. For

example, if you are coming up with a combined method or a new method of doing something then the reader needs to know the similarities and differences of previous methods/theories to determine why and how your method/theory is effective. This introduction paragraph indicates that there are three main approaches in this field and that there are also hybrids of these three approaches.

1. "Many post-processing error concealment methods **have been proposed** (see, e.g., [1], [2], [4], [5], [7]–[10], [12]–[15]). **They can be divided into three main approaches:** frequency, spatial, and temporal. There are also **hybrids of these three main groups**, and the methods can be made adaptive."

Source: Song Cen and Pamela C. Cosman, "Decision Tress for Error Concealment in Video Decoding," IEEE Trans. Multimedia, vol. 5(1), © 2003 IEEE

EXAMPLE
One approach to solving this problem is to define separate distance functions for color, shape, and texture and, subsequently, combine them to derive the overall result. An alternate approach, proposed in [11], [25], is to use the dominant wavelets coefficients for an image as its signature—since wavelets capture shape, texture, and location information in a single unified framework, their use eliminates the need for separate indices.
Source: Natsev et al.: IEEE Transactions on Knowledge and Data Engineering, Vol. 16, No. 3, p. 301 © IEEE 2004

The paragraph above not only discusses the main approach and an alternative approach, but it also analyzes the characteristics of the alternative approach by indicating that it "eliminates the need for separate indices."

See GRAMMAR SKILLS 3 + 4: Using colons and examples

E) Critically evaluate previous theories/methods/issues including mentioning individual author's articles directly related to the problem of your paper by explaining their strengths and weaknesses.

A more complete and detailed review of the literature may also be in a separate section called "Theoretical background", "Literature Review" or "Related works." For an example, see Lu, et al. "Joint Semantics and Feature Based Image Retrieval," IEEE Transactions on Multimedia, vol. 5(3), Sep. 2003.

According to research (Swales & Feak, 2003), one of the biggest cultural tendencies between especially American English and non-native speaking writers is the extent to which previous research is directly analyzed and criticized. An effective introduction in English is not just a summary of previous research but a critical analysis. This may even include direct criticism of the results of individual articles.

The following passage shows the patterns of previous research "all of the above mentioned classification techniques are based on color edge detection" and then clearly explains why previous methods are not adequate. The paragraph then concludes with a clear statement of what is needed in the field, "Therefore, an automatic way for threshold value selection is required." This last sentence provides an opportunity for the authors to introduce their paper as a solution to the problem presented in the field.

1. "A similar but more elaborated approach is given by **Stander [5]** for detecting moving shadows. **However**, the method is based on a complex geometry model restricted to the detection of cast shadows. **Furthermore, all of the above mentioned classification techniques are based on color edge detection, which is, in general, dependent on the appropriate setting of threshold values to determine the edge maps.** This threshold is found, in general, by trial-and-error. **For general video segmentation and content recognition, manual settings of thresholds should be avoided. Therefore, an automatic way for threshold value selection is required."**

Source: Theo Cevers et al. "Classifying Color Edges in Video Into Shadow-Geometry, Highlight, or Material Transitions," IEEE Transactions on Multimedia, vol. 5(2), © IEEE 2003

In the following example, criticism of individual papers [9] and [4], "These methods have their own drawbacks" is direct and explained. Notice that the author identifies problems with individual papers and not just general trends and theories in the field.

2. Several methods have been proposed to overcome these problems. In [25] the dominant colors in the histogram are used, and a multiresolution color clustering is suggested in [23] to reduce the computational complexity in distance calculation. Singular value decomposition (SVD) [9] and Hilbert curve fitting [4] are used to reduce the dimensionality of the feature vectors. **However, these methods have their own**

drawbacks. In [9] SVD is performed on the quadratic matrix of correlations between the color histogram bins. The resulting eigenvectors are not related to the feature data, **and may result in significant errors** when lower-dimensional transformed feature vectors are used to approximate the original feature vectors. The results of Hilbert curve fitting depend on the data distributions. Points that are close to each other in the original feature space might be far apart on the Hilbert curve. The distances in the original space **might not be preserved well** in the curve approximation.

IEEE Transactions On Image Processing, VOL. 10, NO. 1, JANUARY 2001 Yining Deng, Member, IEEE, B. S. Manjunath, Member, IEEE, Charles Kenney, Michael S. Moore, Student Member, IEEE, and Hyundoo Shin IEEE p. 140

See GRAMMAR SKILL 5: Criticizing Previous Research

F) AND/OR Indicate a "gap" or data that is lacking in this field to better understand this research problem.

Note: American Academic English, in comparison to other research languages, has been said to point more explicitly to "gaps" or "weaknesses" in the previous research (See English in Today's Research World: A Writing Guide, Swales & Feak, 2003).

Here a chemical property is still not clear in this field.

EXAMPLE
The absolute configuration of incarvilline (3),7 the core compound of these alkaloids 1-3, has been assigned as shown based on Mosher's method and X-ray analysis of incarvilline methiodide. However, the absolute stereochemistry of incarvillateine (1) and incarvine C (2) **has still not been established**, …
126, 16553-16558 9 16553 © 2004, J. AM. CHEM. SOC.

Finally, in this chemistry paper, a process is not fully understood.

Although nanotubes are a fundamental form encountered in tilebased DNA self-assembly, the factors governing tube structure **remain poorly understood.**
Rothemund et al.,126, p. 16344, 16344-16352 © 2004 J. AM. CHEM. SOC

SEE GRAMMAR SKILL 6: Negative openings

STEP 3. SOLUTION: Introduce your paper as a solution to these problems or missing areas of research

In this third section the purpose of the paper and its structure is introduced.

G) Introduce your paper and how it is going to help solve the research problem or fill the "gap" in research in your field that you introduced in STEP 2.

In short, the review of previous research should directly connect to the purpose of the paper as it does in this example.

2. In an hybrid coder, such as H.264/AVC, **the loss of a <u>frame</u>** can significantly affect the quality of subsequent pictures due to the temporal prediction. **Therefore, it is necessary to introduce some feature to detect the loss of a <u>frame</u>**, to readjust the reference picture buffer for preventing memory access violations and, possibly, to recover the lost image. **In this paper we propose an algorithm based on the optical flow assumptions to conceal the loss of a whole <u>frame</u>.** The method can be executed in real time by an H.264/AVC decoder.

IEEE Transactions on Consumer Electronics, p. 227 Vol. 51, No. 1, Copyright IEEE FEBRUARY 2005

Pierpaolo Baccichet, Daniele Bagni, Antonio Chimienti, Luca Pezzoni and Fabrizio S. Rovati

This paper identifies incomplete understanding of a problem because previous research has only focused on rewards for participating in company knowledge management programs rather than understanding the social relationships that influence the use of technology. The authors then focus on the part that is neglected in the research in order to more fully understand the problem.

3. Malhotra and Galletta [13], [24] argued that previous Knowledge management (KM) literature focused on commitment by compliance (to gain extrinsic reward), which makes our **understanding** of social influence and knowledge-sharing behavior **incomplete**. **Thus, this paper investigates several psychological variables** that have been recently introduced into the KM literature, which enables us to **more fully understand** the important factors and dynamic relationships involved in knowledge sharing in the Technology Mediated Learning environment. IEEE Transactions on Professional Communication, VOL. 50, NO. 3 p. 232 © IEEE SEPTEMBER 2007

Another effective strategy is to combine two approaches that are not new but have never been used together before. The following example clearly shows the connection between previous research and the purpose of the paper. It shows how previous research has not dealt with the two major research problems in the field simultaneously. This clearly indicates how this paper is different from other papers on the same topic. It also puts emphasis on how the proposed approach in the paper is new by combining approaches in a new way.

"Very few approaches have been proposed to tackle **both problems** simultaneously. **Consequently**, we propose in this paper a **new** decoding method, adapted to DCT-based compression algorithms, that will deal simultaneously with compression and transmission artifacts, and dropouts."
Joël Jung and Marc Antonini, "Optimal Decoder for Blocl-Trasform Based Video Coders," *IEEE Transactions on Multimedia*, vol. 5(2), pp. 145-160, ©Jun. 2003. IEEE

G) give more information about the methodology or arguments used in the paper and how it is different from other papers.

This introduction section example is interesting because it directly says how the authors think they have overcome the limitations of previous research and have contributed a new framework to the knowledge of the field (the real purpose of an introduction section).

"To address the limitations of the current relevance feedback systems, we put forward a framework that performs relevance feedback on both the images' semantic contents represented by keywords and the low-level feature vectors such as color, texture, and shape. Additionally, we have implemented the image retrieval system *iFind* to demonstrate the effectiveness of our approach**. In our opinion, the primary contribution of this paper is that it proposes a framework** in which semantic and low-level feature based relevance feedback can be seamlessly integrated. Moreover, we propose a ranking measure that integrates both semantic- and feature-based similarities for our framework. We also examine possible techniques for automatic and semi-automatic image annotation."

Lu et al. "Joint Semantics and Feature Based Image Retrieval," IEEE Transactions on Multimedia, vol. 5(3), © Sep. 2003, IEEE

I) Optional: Summarize your main results (only in some fields such as some Chemical Engineering papers).

Some Journals give the general results of the paper at the end of the introduction section, but this is not standard in all engineering fields and Journals. Look carefully to see if this is common in your field. In most fields detailed results are not given until the Results/Discussion section.
"This paper addresses design issues such as flexure design and bistable mechanisms and discusses the detailed actuator modeling and optimization. **Simulations [7] and experimental results suggest that practical binary devices with large number of DOF can be achieved with current technology."**

Source: Moustapha Hafez et al., "Optimized Binary Modular Reconfigurable Robotic Devices," IEEE/ASME Transactions on Mechatronics, vol. 8(1) ©March 2003, IEEE/ASME

J) Optional: indicate the organization of each section of your paper (Common in fields such as computer engineering but not all fields).

Some fields such as computer and civil engineering often give an outline of the paper at the end of the introduction. However, this is not true in all fields. Check other example journal articles in your field.

"The paper is organized as follows. In Section II, we present our new EC methods, as well as other ones available to our decision tree. In Section III, we discuss the classification tree design and our experiments. Results and conclusions are described in Section IV."

Source: Song Cen and Pamela C. Cosman, " Decision Tress for Error Concealment in Video Decoding," *IEEE Trans. Multimedia*, vol. 5(1)© March 2003, *IEE*

6.3. Grammar Guide for Introduction Sections

Grammar for STEP 1. SITUATION

GRAMMAR SKILL 1. Choose the appropriate verb tense when reviewing the research in the introduction

A) **Present/ Present passive tense:** A process, fact or knowledge that is generally accepted in the field, may or may not be used with references.
B) **Present perfect tense:** (has/have +ed) a summary or generalization about research in the field up to the present or general trends in society. No specific time or date. In citations many studies are usually summarized.
C) **Present continuous/passive tense.** An ongoing situation that is currently developing. More emphasis on the present time than present perfect tense. (… is being developed etc.)
D) **Past tense:** Results of individual experimental papers. Finished events in the past or with a specific time.

Introduction

A

D

In contrast to image-based query systems, region-based systems do not treat each image as an atomic and indivisible entity, but rather work at the subimage level by extracting, indexing, and comparing image regions and corresponding features. Region information can be used not only to locate relevant images, but it has also been used for classification purposes and retrieval based on query concepts [12].

B

Smith [22] considered image query systems that integrate spatial and feature information, both at the image and region level. His system allows the user to specify the spatial location of regions, both in absolute terms, as well as relative to each other. Each image is decomposed into regions by reverse-mapping region features from a finite library of patterns to the image. The library is obtained offline and is static, which raises questions about the robustness of this region extraction method. Also, image similarity is computed based on the relative position of matching regions, which makes it sensitive to object shifting.

A

Source: Natsev et al. WALRUS: "A Similarity Retrieval Algorithm for Image Databases" *IEEE Transacti On Knowledge And Data Engineering*, Vol. 16, No. 3, March 2004

A. Present passive tense: This is a description of the process used and not the results of an experiment.

Understanding present perfect tense

The present perfect verb tense is used to give background information that is not at one specific time in the past. It is formed as follows:

PRESENT PERFECT: HAS / HAVE + past participle +ED for regular verbs but many irregular verbs

Note: The Korean language does not have a present perfect verb tense.

Use the Present Perfect when….

6.3.1. You want to give information or facts that give the background understanding for your field.

"In recent years, technology **has reached** a level where vast amounts of digital information are available at a low price. During the same time, the performance-versus-price ratio of digital storage media **has steadily increased**."

Source: HANJALIC *et al.*: "automated high-level movie segmentation "IEEE transactions on circuits and systems for video technology," VOL. 9, NO. 4, p.581 © JUNE 1999 IEEE

6.3.2. You want to give background information about past research methods in your field.

"The strain energy density factor (SEDF) approach **has been used** to analyze fatigue crack growth behavior of welded joints [10–12]."
Source: D.H. Choi, H.Y. Choi / Theoretical and Applied Fracture Mechanics. 44 .17–27 © 2005 Theoretical and Applied Fracture Mechanics

6.3.3. You want to write a sentence to give a general overview of the current research situation in the field.

"However at initial stage of fatigue life a corner crack occurs in lugs, which is the three-dimensional crack of a finite body, therefore the studies mentioned above **have been extremely limited**."
Source: J.-H. Kim et al. *Theoretical and Applied Fracture Mechanics* 40.p. 136, 135–144 © 2003 Theoretical and Applied Fracture Mechanics

6.3.4. You want to summarize the main trends of a number of articles in your field but do not want to refer to a specific article.

"Many researchers **have addressed** semantic modeling of content in multimedia databases. Researchers **have also reported** on concrete video retrieval applications by high-level semantics in specific contexts such as movies, news, and commercials.[2,3]"

Source: Assfalg et al. "Annotation of Sports Videos" *IEEE MultiMedia* © April–June 2002 *IEEE*

More information on the difference between the past and present perfect tense

This page compares how to use the two verb tenses: Present Perfect Tense vs Past Tense:
http://web2.uvcs.uvic.ca/elc/studyzone/410/grammar/ppvpast.htm

This page give clear information on when and how we use the present perfect

http://www.englishpage.com/verbpage/presentperfect.html

Continuous Tenses +ING forms

Continuous or ING forms of verbs are also used in the first paragraphs to describe a current situation that is still developing. The +ing form means that an action has not yet finished. These verb tenses are often used to describe ongoing research, but present perfect is used more to discuss background information while continuous ING forms put emphasis on the current situation that is ongoing.

1. “Performance of traditional approaches to edge-based image segmentation **is being improved** by utilizing advanced segmentation criteria that reflect higher level of knowledge about the segmented object.”
Source: BREJL AND SONKA. “Object Localization and Border Detection Criteria Design” *IEEE Transactions on Medical Imaging*, VOL. 19, NO. 10, p. 973 © IEEE OCTOBER 2000

2. “In a home entertainment environment and computing system, the proposed number of loudspeakers **has been increasing** with the demand for better sound effects.”
Source: Yang et al. “Development of Virtual Sound Imaging System using Triple Elevated Speakers” *IEEE Transactions on Consumer Electronics*, Vol. 50, No. 3, © IEEE AUGUST 2004

Another common way to describe the current research situation is to use the keywords “Increasingly” or “Increasing.”

“IMAGE RETRIEVAL has recently drawn the attention of many researchers in the computer science community. With the **increasing** availability of digital imaging devices, the number of digital images is growing at a considerable rate.”
Source: LU *et al.*: joint semantics and feature based image retrieval
IEEE Transactions On Multimedia, VOL. 5, NO. 3, p. 340 © September 2003 *IEEE*
“Stainless steels are widely used in the chemical processes and power generation industries. However, **increasingly** they are also being considered for structural applications, for example, in facading and transportation industries.”

Source: P. J. Singh et al. *Engineering Failure Analysis* 10 ,p. 26, 25–36 © 2003 Engineering Failure Analysis

GRAMMAR SKILL 2: Formal definition structure

Thing to be defined	=	Group it belongs to	+	Unique characteristics that make it different from every other item in the same group

Formal definitions are structured according to the following grammar:

Item **Thing to be defined**	=	**Class** **Group it belongs to**	**+** **relative pronoun like “which”**	**Uniqueness** **Unique characteristics that makes it different from every other one in the same group**
Nanotechnology http://www.webopedia.com/TERM/N/nanotechnology.html	is	a field of science	whose	goal is to control individual atoms and molecules to create computer chips and other devices **that** are thousands of times smaller than current technologies permit.
Term	**=**	**General Class Word**	**+**	**Specific characteristics**
A cellphone An astronomer A laboratory	is	a mobile device a scientist a place	**that** **who** **where**	is used for voice communication. studies the universe. experiments are performed.
Term		**Class**		**Characteristics**

Energy	is	ability	+	to do work (INFINITIVE PHRASE)
Kinetic energy	is	energy	+	of motion (PREPOSIONAL PHRASE)
Term	**=**	**Specific characteristics**	**+**	**General class word**
Mercury Asbestos	is	a liquid a fire-resistant		metal. mineral.

Adapted from: Zimmerman (1989) *English for Science*. Prentice Hall: New Jersey

Other common structures for definitions: IS DEFINED AS, and REFERS TO

"The solvation energy (*E*solv) of a structure **is defined as** the (optimized gas-phaseenergy) - (optimized solution-phase energy)." J. AM. CHEM. SOC. 9 VOL. 126, NO. 51, 2004 16923

"The Kirkendall effect normally refers to comparative diffusive migrations among different atomic species in metals and/or alloys under thermally activated conditions.1 Because of the difference in atomic diffusivities, for example, zinc diffuses into the copper faster than the copper diffuses into the brass in a brass-copper interface." J. AM. CHEM. SOC. 2004, 126, pg. 16744

Some common vocabulary mistakes when writing definitions:

a) ____ is a kind of _____ is not used in formal writing for definitons. Use "a type of."

b) "A means B" is not the correct form for definitions. It is used for translation between languages such as English to Korean.

c) Do not use "is called" when writing definitions. It is only used to introduce a new term or to introduce the name of a new vocabulary word but not to describe it.

For more information on definition structures: http://hanyangwriting.tripod.com/definition.html

GRAMMAR SKILL 3: Structures for giving examples

Structures	Selected examples
▪ For example, ▪ ; for example, ▪ For instance, ▪ As an illustration, ▪ As an example, ▪ e.g. (for example) ▪ i.e. (that is) ▪ an example of X ▪ such as X	For simplicity, we assume here that S is sufficiently smooth that structures <u>such as</u> a Riemannian metric can be defined on it. Source: Scholkopf et al.: IEEE Transactions on Neural Networks, Vol. 10, No. 5, September 1999 p.1003 ©1999 Fiber channel disks [7] available in the commodity market <u>are an example of</u> network attached disk, without the built-in processing power. Source: Akinlar and Mukherjee: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 p. 73 © 2003 <u>In the following example</u>, two classification results are presented in more detail. Fig. 11 shows the index print of a typical consumer roll. The classification results are shown in Fig. 12. Source: Loui and Savakis: IEEE Transactions on Multimedia, Vol. 5, No. 3, September 2003 p.398 © 2003

- , as shown in the following example:
- In the following example,
- We illustrate this with the following example.

Note: “following” is not countable. It does not take an “S.” The words “as follows” and “in the following examples:” usually need the colon.

Problems using “such as”

Note that a comma is not always required before “such as.”

“Such as” has the same meaning as “for example.”

If you include the complete set of a group then don't use "such as.” In the following sentence, there are only three methods possible in total so they are not “examples.”

X: There are three methods **such as** A, B, and C.

Alternatives

There are three methods: A, B, and C.

There are a number of methods that are commonly used such as A, B, and C.

There are a number of methods used including A, B, and C.

The main methods include A, B, and C.

The most widely used methods are the following: A,B, and C.

GRAMMAR Skill 4: Use colons to classify the main methods and theories in your field of research

A colon (:) <u>not</u> a semicolon (;) introduces a simple list: a, b, and c. The second comma is optional but recommended.

This computer engineering introduction reviews the main approaches in this field:
There are two main approaches: some assume a global parametric motion model and segment the image according to the parameters of the model (for example, [12], [23], [24], [34]), whereas others assume piecewise smooth motion and identify the boundaries along motion discontinuities (for example, [3], [13], [21], [33]). The second approach is potentially more general, and it lies at the base of our proposed method here.
Source: IEEE Transactions on Pattern Analysis and Machine Intelligence, VOL. 30, NO. 7,pp 1171, JULY © 2008

GRAMMAR SKILL 4.1: Use a semi-colon to divide a complex list containing commas

If you have a complex list that includes commas inside the parts of the list use a semi-colon (;) to help make each item clear. You can also use semi-colons for list items that are complete sentences. Using only commas in the list below would make it very hard to read.

EXAMPLE
There were four professors assigned to the task force on improving student writing: Peter Jones, professor of Psychology; Ronald Smith, professor of English; Kim Lee, professor of Education; and Wendy West, professor of Political Science.

Links

A good general guide to punctuation

http://www.ccc.commnet.edu/grammar/marks/marks.htm

A guide to lists in technical writing

http://www.io.com/~hcexres/tcm1603/acchtml/lists.html

Grammar for STEP 2. Show problems with previous research, methods, or theories

GRAMMAR SKILL 5: Evaluate previous research critically

Use adjectives and adverbs to show your positive or negative evaluations of previous research. We can see that this example is not simply a list of previous research, but the adjectives and adverbs themselves clearly show how the author evaluates the research. Using words like "challenging" and "shed light on" show the difficulty of a procedure while words like "limited" imply criticism.

Example
A detailed understanding of the structures and reactivities of lithium enolates, however, has been slow to develop. Although numerous X-ray crystal structures of enolates show dimers, tetramers, and hexamers, analogous structural assignments in solution are both rare and somewhat tentative.[10,11] Colligative properties of enolate solutions shed light on the degree of aggregation[12] but can be technically challenging (especially freezing-point measurements in THF) and afford results that are quite sensitive to adventitious impurities.[13,14] NMR spectroscopy has thus far afforded limited structural details of lithium enolates.
Source: McNeil, et al.: J. AM. CHEM. SOC. 2004, Vol. 126 No. 50 p. 16560 ©2004

When evaluating previous research or responding to reviewers comments, the following sentence structures will help you to keep a polite tone. Just as when we speak, there is a tendency to first give a positive statement first, and then follow with a negative statement.

a) Positive COMPOUND sentence connected with a semi-colon (; however,)

EXAMPLE

The second decision stage chooses the best face location from all possible locations determined by the first stage using only the level 0 template. It was shown in [12] that the scheme shown above can locate the face from a complicated scene successfully; however, it is not guaranteed that the face detection is always successfully.

Source: Kuo et al.: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 p. 9 ©IEEE 2003

b) COMPLEX sentence: ALTHOUGH + STATEMENT, PROBLEM

EXAMPLE

Although nanotubes are a fundamental form encountered in tile based DNA self-assembly, the factors governing tube structure remain poorly understood.

Source: Rothemund et al.: J. AM. CHEM. SOC. 2004, 126, p.16344 ©2004

c) COMPLEX sentence: ALTHOUGH + POSITIVE EVALUATION, + CRITICISM

EXAMPLE

Although these papers present promising applications, the specific guidelines or directions on making use of the descriptors are not sufficient.

d) POSITIVE OR NEUTRAL STATEMENT + HOWEVER , + PROBLEM STATEMENT

Example
The omniscient minimum is about 25% of the MSE of the best fixed method, so the tiny tree is capturing most of the available gain. However, the omniscient performance comes at a cost of 0.45% bit rate overhead (three bits for all 40 286 MBs),whereas a five-terminal node tree takes only about 0.001% bitrate overhead.

Source: Cen and Cosman: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 p.6 IEEE ©2003

You may also want to be even more indirect in your criticism of another paper

Criticize and summarize methods rather than individual researchers.

Summarize previous problems as a present tense fact

EXAMPLE
In other words, these methods cannot be generalized to novel conditions.

b) Passive impersonal criticism using "it." Refer to other research to help you criticize previous research.

In these examples in the field of computer face recognition, the authors use citations to indicate that the methods are not effective rather than directly criticizing them.

EXAMPLES
It has been argued that it is also possible to estimate an unknown template size using the MF [10], in which case the SAF would not provide any advantage.
Source: IEEE Transactions On Signal Processing, VOL. 56, NO. 8, p3818, AUGUST ©2008

But recently it has been claimed that in certain cases antenna coupling has a beneficial effect [3], [6], [12].

Source: IEEE Communications Society Globecom, p3155 ©2004

3) Other words used to describe problems are "insufficient," "is limited by," "inadequate," or "ineffective."

EXAMPLE
We have attempted to fit the spectra without the Fourier transform filter (Figure S2), but the choice of parameters is not unique for the distant atoms, and the confidence of the fitting is limited by the data quality in the high *k* region.

Source: Mishina et al.: J. AM. CHEM. SOC. 9 Vol.126, No. 51, 2004 p.16934 ©2004

These experiments were performed with the same equipment and methodology used to identify color changes in similar systems with pyridine as the acceptor and underscores our position that electrochemical response in the cathodic region is insufficient to confirm the formation of delocalized charge carriers.
Source: Thomas et al.: J. AM. CHEM. SOC. 9 Vol. 126, No. 50, 2004 p.16448 ©2004

Although our implementation of the algorithm is essentially the same as the traditional association graph methods,[7,8] we have incorporated some heuristics because mathematically strict solutions are sometimes found to be inadequate from the biochemical point of view.

Source: Kotera et al.:J. AM. CHEM. SOC. 9 Vol. 126, No. 50, 2004 p.16489 ©2004

The ineffectiveness of FMO theory as a tool for explaining this phenomenon is now widely accepted.

Source: Ohkata et al.:J. AM. CHEM. SOC. 9 Vol. 126, No. 51, 2004 p.16788 ©2004

GRAMMAR SKILL 6: Negative openings

Sentences indicating missing areas, or "gaps" in research in the field usually start with an unusual structure. There is no article in front of the noun. This is one time when you don't have to worry about articles! In fact, you shouldn't use them if you are indicating a lack of research. There is an important difference in meaning between

1. There are few computers (not much, not enough).
2. There are a few computers (some, maybe enough).

Source: (Swales and Feak, 2004, p. 258)

Instead, use Little/Few/No/None of these before a noun.

EXAMPLES

Surprisingly, there is little evidence that such approaches are more accurate …
However, no study has combined the methods effectively …
None of the studies examined the role of ….
Few studies, however, have examined the effects of …, and none, to our knowledge, have compared …

GRAMMAR SKILL 7: How to Use References

Using references is a complex topic. See the using references chapter 5 of this book and the core skills section at www.hanyangowl.org for an explanation of how to use sentences from other articles in your introduction section. If you think you know how to use references, it is good idea to review this section because some students are unaware that they are not using references correctly, particularly unacceptable paraphrasing.

Format of references

Good guides to the different kinds of citations in each field: APA style is standard in Linguistics and many other social sciences, but MLA style is more common in English Literature. IEEE is common in computer engineering but some journals even have their own unique formats. Follow the style of the journal. Do not just copy and paste references from various papers to the references at the end of the paper as the format will end up being inconsistent.

http://www.wisc.edu/writing/Handbook/Documentation.html
http://www.ecf.utoronto.ca/~writing/handbook-docum1b.html IEEE computer engineering

There are simply too many formats. Always check the author guidelines from the journal or from your department or professor.

Understand reporting verbs

Be aware of the type of verbs used to present research. The verb shows the opinion of the writer about the research; it is not just a random choice. Verbs like the following: suggests / considered/ presented / obtained / investigated/ examined / provided / evaluated / proposed / all have slightly different meanings. This is a useful guide to using verbs that introduce research: http://www.utoronto.ca/writing/reporting.html However, make sure that these verbs are commonly used in your field by searching journal article PDF files from your field. To see how go to www.hanyangowl.org and view the PDF search handout on computer-assisted writing.

Notice the word choice and variety in the verbs chosen below to indicate the status of the research.

EXAMPLE
Other methods are using POCS [37], or bayesian approaches [36]. Kokaram suggests a detection method in [26] and a spatial interpolation method in [27] for missing data. In [14], a local analysis of spatio–temporal anisotropic gray-level continuity for film blotch removal is proposed, and in [30] a method for blotch and scratch detection in image sequences is developed.
Source: Jung et al.: IEEE Transactions on Multimedia, Vol. 5, No. 3, September 2003 p.146 © IEEE 2003

For example, “proposed” means that a method has been published, but it has not been widely accepted in the field yet; the method is still under consideration.

Words like “investigated” imply that research was done to solve a specific problem. If you study how verbs are used to introduce research in your field, you will have a more sophisticated writing style. Types of reporting verbs chosen may also differ by field, however. These websites contain useful tips on how to integrate verbs with the correct format for using references. This advice is more for author-date systems such as (Smith, 2002) than numerical systems like [1], however.

http://www.utoronto.ca/writing/reporting.html
http://www.gcal.ac.uk/student/coursework/writing/reporting.html
http://www.uefap.com/writing/citation/citefram.htm
http://iteslj.org/Techniques/Criollo-LitReview.html

6.4. Introduction section checklist

1. I classify the key methods or theories and clearly define the key terms and concepts in my paper using formal definitions where appropriate.	❑
2. I not only list previous research, but I also summarize, analyze, synthesize and evaluate the previous research in my field.	❑
3. I clearly explain the research problem or the lack of research in the area I am working on.	❑
4. I mention the weaknesses or limitations of previous research or methods related to my research problem.	❑
5. I have made the importance of my paper clear by showing how it is different from previous research and why my research is needed in the field.	❑
6. I reintroduce all abbreviations such as scanning electron microscopy (SEM), in the introduction, even if I have introduced them in the abstract.	❑
7. I have chosen the journal I want to send my paper to after I have completed the first draft. I understand that if I send my paper to a general or multidisciplinary journal rather than a specialist journal, I may need to give more background information and definition of key concepts in the introduction.	❑
8. I have read the author guidelines from the journal and have looked at a sample of the journal I am sending my paper to in order to make sure that the correct reference system is being used.	❑
9. I use a variety of verbs to introduce previous research such as “suggested,” “proposed,” “developed,” etc.	❑
10. I have not copied and pasted the exact same sentence in the first line of my abstract and the first line of my introduction, as it is considered poor style.	❑
11. I have not copied and pasted any sentence from another article, even if I have given a reference. Instead I have rewritten the sentence in my own words as well as giving the reference.	❑
12. I have remembered to identify the corresponding author, to include any acknowledgements for those who have helped me, and I have provided the exact grant number for any funding that I have received to do the research.	❑

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See http://www.hanyangowl.org/ for a direct link to this handout and more materials on writing for publication in English across fields.

Email suggestions or corrections to adamturner7@gmail.com

Chapter 7: **Methods Sections**

The methods section is considered the easiest to write, and varies greatly with the kind of research being done. Therefore, this chapter will only give best practices and explain some difficult grammar structures.

7.1. Best Practices for methods sections

BEST PRACTICES 7.1.1	Use transitions to sequence the steps in your methods section

Use transitions words to sequence the steps in your methods section so that the reader can follow your method. If a methods section only consists of a series of sentences in the passive without clear transitions, it is sometimes hard to tell how the steps are sequenced and the relationship between each step. Common transitions for methods sections include words such as first, then, also, after, next, finally, while, as soon as, consecutively, simultaneously, and sequentially.

In addition, transition phrases (see Chapter 4.0) are also used to show relationships between steps in time and space. Here are some common examples.

EXAMPLES
Prior to the deposition of X, …
… before adding the X …
In the next step, we determine …
After X was complete, …

Complex sentences may also contain subordinate clauses that help to clarify the timing of methods being used (see Chapter 3 for further information on subordinate clauses). In this example, the word “while” indicates that two procedures were recorded at the same time.

EXAMPLE
The selected procedure is similar to a conventional test: specimens were monotonically loaded <u>while</u> the applied load (P) and the load point displacement (m) were recorded.
Source: G. Bertolino et al. / Journal of Nuclear Materials 322 (2003) p.59

Here is a good example of the use of transitions in a methods section that helps the reader to clearly follow the steps. The transitions are underlined.

EXAMPLE
Our OTFTs with a pentacene thin film as an active layer were fabricated on a SiO_2/pþ-Si substrate. The thickness of thermally grown SiO_2 was 100 nm. <u>Prior to the deposition of pentacene,</u> the surface of SiO_2 (to be used as a gate dielectric) was ultrasonically cleaned with trichloroethylene, acetone, isopropylalcohol, and deionized water sequentially. Our thermal evaporation chamber was evacuated to a base pressure of 1 _ 10_7 Torr. We <u>then</u> deposited the pentacene film through a shadow mask by

heating an effusion cell containing pure pentacene powder (99.8%, Aldrich) at a rate of 0.5 _A/s at room temperature (RT). The resulting film thickness of the pentacene film was adjusted to 50 nm. The source and drain contacts were patterned by a second shadow mask, through which Au was thermally evaporated to a thickness of about 100 nm. The channel length and width were 100 and 1000 mm, respectively. SnO_2 (to be used as a buffer layer) was then deposited on top of the device by thermal evaporation through a third shadow mask to a film thickness of about 100 nm. Finally, another 80 nm SnO_2 thin film (to be used as an encapsulation layer) was consecutively deposited without breaking the vacuum by IBAD. An end hallion gun was used to increase the SnO_2 adatom mobility.
Source: Japanese Journal of Applied Physics Vol. 44, No. 37, 2005, p. 1174 ©2005

BEST PRACTICES 7.1.2 Also indicate why methods were used

In addition to having good transitions, it is also good writing to explain the purpose of your methods or procedures especially if the methods are not standard. The structures [To +Verb] or [In order to +Verb] enable the author to explain why methods were used.

EXAMPLE
Block size plays an important role in any file system. In the experiments presented in Section III, we used a DFS-block size of 1 MB. In order to determine the effect of DFS-block size on the performance, and to justify our choice of default block size, we ran the following experiments. We fixed the number of clients at six and measured the total read bandwidth attained from the system as we changed the DFS-block size.
Source: Akinar and Mukherjee. IEEE Transactions on multimedia, Vol. 5, No. 1, p.85 © IEEE 2003

EXAMPLE STRUCTURES
- In order to determine …
- To estimate/ To measure/ To calculate/ To verify/ To evaluate/ To define/ To obtain/ To model/ To ensure the reliability of/ To check the validity of/

7.2. GRAMMAR GUIDE: Active and passive sentence structure

Most textbooks and general writing tips advise writers to avoid using passive sentences and to write actively. However, the use of the passive is common as well as necessary in science writing. Unfortunately, it can be quite complex to use properly. Here are some tips on using the passive in methods and other sections of the article. Advice on when to use passive or active sentence structure is also given.

GRAMMAR POINT 7.2.1 Structure of the passive

The basic passive is formed using [Verb be +ed].

EXAMPLES
- Active sentence: I completed the experiment.
- Passive sentence: The experiment was completed.

You can browse this site to review passive sentence structures if you are not sure about the form.
http://owl.english.purdue.edu/handouts/grammar/g_passive.html

GRAMMAR POINT 7.2.2	Use active sentence structure to put emphasis on methodology decisions

> "There is a tendency for passive sentences to indicate routine procedures while active sentences indicate new, deliberately chosen, important, or unexpected procedures" (Swales & Feak, 1994 p. 161).

Use active sentences using "we" or "our" if you want to emphasize YOUR decisions, YOUR method, or YOUR innovation. For standard procedures, generally use the passive structure. In this example, the researchers are explaining why they thought it was important to include a material in their analysis. When they explain their choice they shift to the active tense using we and emphasize that they are doing the analysis by using the key words "our analysis."

EXAMPLE
The infill material considered was mainly concrete: several concrete qualities were studied in order to investigate the influence of variation of the elastic modulus of the infill; moreover the C20 lightweight concrete (LWC) and polyurethane (PUR) were considered as alternatives. As these two materials, especially PUR, offer the advantage of low weight we thought it worthy to include them in our analysis. In addition, PUR seems to be drawing the attention of other researchers as a possible hollow sections infill material [22].
Source: Thomopoulos and Koltsakis. Journal of Constructional Steel Research 59 (2003) p.671 ©2003

In this example, the authors switch to the active "we fixed" when they are describing their choices in simplifying a procedure.

EXAMPLE
Note that in the present investigation, the loading direction was defined by two angles, i.e., β and ω. Loading angle β was varied between 0° and 90°. and the angle ω was set to 90°. for all the cases analyzed. For simplicity in setting-up the test, we fixed the axial loading at β=90° and made starter notches of different inclined angles instead of varying the loading angle β, as shown in the two side elevations of Fig. 1. All the specimens were annealed at 923 K for 1 h before fatigue testing. The fatigue crack was initiated and propagated from the starter notch by subjecting the notched specimen to a constant amplitude, sinusoidal, tension-to-tension loading. This loading was exerted by a 100 kN electro servo-hydraulic MTS testing machine operating at a stress ratio of $R=\sigma_{min}/\sigma_{max}=0.1$, and a frequency of 2.0 Hz.
Source: Bian and Lim: International Journal of Fatigue 25 (2003) 521–531 p.522 ©2003

GRAMMAR POINT 7.2.3	Be careful when using the passive in describing methods or results

These two sentences can have very different meanings in English.

- The temperature was increased by 50 C.
- The temperature increased by 50 C.

The passive is used when the researcher changes the conditions of the experiment, but it is not used when a result that is not known before measurement is just observed. In this first example, it is clear that the researcher is constantly manipulating the temperature.

EXAMPLE
The temperature was increased by about 17 °C/min to 850 °C, where it was held constant for 20 minutes and then decreased again by about 17 °C/min. When the temperature had decreased to 650 °C

the gas was stopped and vacuum was again achieved. The sample was then allowed to cool naturally back to room temperature.
Source: http://www.phy.ilstu.edu/~intreu/colinProj.htm

However, in this example describing global warming, it is clear that no one can change the temperature of the whole planet! It is just the observed result.

EXAMPLE
Over the last 40 years — which is the period with the most reliable data — the temperature increased by about 0.5°F (0.2-0.3°C).
Source: http://www.teachersdomain.org/9-12/sci/ess/watcyc/lp_global2/index.html

In some papers, failure to distinguish the two grammar points may make the experimental procedure used in a paper unclear, or even funny. Imagine a biomedical engineering paper that was testing a new type of bandage on a group of patients, and the researchers wanted to have a bigger sample to get better results.

EXAMPLE
A. The sample size was increased to a total of 110 patients.
B. The sample size increased to a total of 110 patients.

In example B above, it seems like the patients suddenly cloned themselves and expanded! However, it is a difficult grammar point and you will often find misused passive sentences even in published papers.

7.3. Methods section checklist

1. I have explained my criteria for choosing any special materials/equipment or unusual methods that differ from commonly accepted procedures.	❑
2. I use transition signals to show the sequence of steps in my methods section.	❑
3. I have used active sentence structures to emphasize the choices I have made for my methods if necessary.	❑
4. I have provided enough information so that another researcher could replicate (do) the same experiment with the same results (this is not as easy to do these days, but it is still a worthwhile goal in science).	❑
5. I have explained the assumptions made in my model or method if they might be questioned.	❑
6. I not only describe my procedure, but I explain the reasons for choosing my methods where necessary by using sentences beginning with “To +Verb” or “In order to +Verb.”	❑
7. I have checked my paper again for any problems with passive sentence structure.	❑
8. I have checked any complex statistical methods again that I have used with this guide from *Nature*. http://www.nature.com/nature/authors/gta/Statistical_checklist.doc	❑

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Chapter 8: **Describing Data Effectively: Results, Discussion, and Conclusion Sections**

The following advice applies to combined RESULTS and DISCUSSION sections and can apply to separate CONCLUSION SECTIONS. The first paragraph of the DISCUSSION may summarize the purpose of the paper or the most significant findings. Papers that have a combined RESULTS and DISCUSSION section may have a similar pattern but some characteristics from 3-8 may be repeated as each major finding or sections is presented, especially in life sciences. The framework below can generally be found in all fields where an experimental design is used: Introduction, method, results and discussion. Other types of studies such as case studies or papers from applied fields that make recommendations may not follow this pattern but instead may have a separate CONCLUSION section with an emphasis on numbers 1-2-3-4 with only the most important result of the study mentioned and 8-10 below.

8.1. Framework 1 for combined Results & Discussion/Conclusion sections

1. Opening

A. **Review** of the purpose/methodology of the paper OR summary of the major findings of the paper
B. **Background** (background about theory/research aims/methodology used, may include references)

2. Describing a Data Cycle

C. **Result** (with or without reference to specific figure or table data).
+
D. **Claim** (opinion of the researcher based on the data).
+
E. **Expected or unexpected outcome** or outcome that is not understood (OPTIONAL) (are the results surprising or not?).
F. **Explanation** (OPTIONAL) (reasons for expected or unexpected results or differences with previous findings).
G. **Comparison** (OPTIONAL) with previous research including references or other results in the paper.

3. Concluding statements

H. **Limitations** of the study (OPTIONAL) (small sample size, limited variables, only simulation, etc.).
I. **Recommendations** (OPTIONAL) (policy suggestions; changes to business or teaching practices; implications for the field).
J. **Future work** (OPTIONAL) by the researcher or future work needed in the field.

Note that these characteristics are often combined in distinct patterns even in a single sentence, such as **D Claim + G Comparison to previous research.**

8.2. Discussion/conclusion structure examples

Examples of Results and Discussion/Conclusion sections. Different types of papers in Engineering and other scientific fields have different structures. Some papers may have a results and discussion section clearly labeled while others may have a long conclusion section after describing a new design. The following examples are taken from engineering papers to show the common combinations found by applying the discussion/conclusion structure framework. Not all of the eleven functions may be found in every paper. Think of them of the choices available to you. Pick and choose what is important. However, almost all Discussion or Conclusion sections start with a review of the purpose or main results of the paper.

A. Review of the purpose/methodology of the paper OR summary of the major findings of the paper

B. Background (about theory/research aims/methodology used, may include references)

The following example is from a paper that describes a "virtual walkthrough environment," a system that allows you to walk through virtual spaces. First it reviews what was done in the paper and then the importance of simulation in general is explained. In all the examples below the table is just to help the analysis. The examples are continuous paragraphs.

EXAMPLE

V. RESULTS AND DISCUSSION	
We have conducted extensive experiments to quantify the performance of our multiresolution scheme with MRM cache replacement and the effectiveness of various prefetching schemes via simulation as well as on the prototype.	**A. Review** This is a typical start to a results and discussion section which first reviews the purpose of the paper.
The purpose of simulation is a proof of concept, allowing us to experiment the behavior of the mechanisms under diverse situations easily. The prototype provides a study under a real situation. Due to page limit, we present only a representative subset of experiments in this section. We first present a simulated experiment to illustrate the general behavior of the caching and prefetching schemes, followed by a more detail analysis of the performance of the mechanisms using our prototype.	**B. Background** This next section gives additional background to explain the purpose of the paper and to help the reader judge the results.
Source: Chim et al. IEEE Transactions on Multimedia, Vol. 5, No. 4. ©IEEE 2003	

Here we have a full discussion of a Result and its outcome.

C. Result (with or without a reference to a figure or table)

E. Expected or unexpected result or outcome that is not understood by the researcher

In some papers, especially those related to chemistry or biology, the results may be broken down into sections for each major experiment or result. These cycles follow the overall structure of discussion/conclusion sections.

The following example is from a chemical engineering paper that separates the results and the discussion of the results into separate cyles of data description.

EXAMPLE

Deprotonation of *N*-Lithio-*N*-(*tert*-butyl)allylamide 1 inTHF Solvent with Explicit Ethereal Solvation. Experimentally, the deprotonation of 1 was carried out in THF solvent, and consequently this should be accounted for in the calculations. B To model the THF solvent, 2 molecules of Me_2O were coordinated to the ground state and transition state structures previously geometry optimized in the gas phase. A These structures were now reoptimized to the corresponding micro-solvated ground state and the transition state structures (Figure 5).	A Review of the purpose B Background of the methodology
Only small structural changes occurred during the reoptimization of the solvated ground state where both lithium ions are coordinated by three ligands (the methyl anion, the amideoxygen or nitrogen, and one Me_2O molecule in a trigonal plan ararrangement). The transition structure leading to *cis*-vinylicdeprotonation is shown as the top left structure in Figure 5. The transition structure leading to allylic deprotonation is depicted as the top right structure. The structural changes going from the gas phase to the solvated transition structures are also small. The computed activation barriers are 23.1 kcal/mol(allylic) and 31.8 kcal/mol (*cis*-vinylic) (Table 1).	C Results with reference to a figure and table
We do not know how many THF molecules bind to 1 in the ground state; E however, our calculations show that the relative rate of deprotonation at the allylic and the *cis*-vinylic positions is only dependent on the solvation to a small degree F (9.5 kcal/mol allylic preference in the gas phase and 8.7 kcal/mol allylic preferencein Me_2O micro-solvation).	E Outcome that is not fully understood by the researcher F Explanation
Further solvation of these complexes may reduce the activation barrier somewhat. J Source: Haeffner et al.: J. AM. CHEM. SOC. 9 Vol. 126, No. 51, 2004 p.17035 ©2004	J Recommendation for further research or implications of the results

G. Comparison to other research including references or other results in the paper

F. Explanation of expected or unexpected results

EXAMPLE

The measurements of the metrics are depicted in Fig. 12.	C Result
For the moving pattern, the general behavior of the performance from the prototype is similar to that from the simulation. The only difference is a slight increase in hit ratios and visual perception by a few percent in the experiment, across all prefetching schemes.	G Comparison of results
For other moving patterns, the improvement in hit ratios seems to be smaller than that brought about by simulation. This is perhaps due to the	F Explanation of results

object distribution in the experimental environment.	
We are currently investigating this issue. We hope to be able to report our findings in the future.	J Future research projects
The impact on visual perception is similar to that on hit ratios, but at a smaller scale.	D Claim based on the results
Source: Chim et al.: IEEE Transactions on Multimedia, Vol. 5, No. 4 p.513 © IEEE 2003	

A claim is an argument or observation based on the data. Since a clause contains a complete idea, more than one point in the framework may be contained in a single sentence. Claims are supported by results and can often be found in combination with other points in the framework. In the following example there are a number of claims supported by results and comparison.

D) Claim based on the results

EXAMPLE

Response and latency times are not as stable as hit ratio and visual perception, due to their heavy dependency on the available network bandwidth when the prototype is running. However, a general observation can still be drawn about their relative performance. D With caching, latency time is around 0.25 s. C Compared with other prefetching schemes, the schemes generally result in a smaller access latency. G	D. Claim + C Result + G Comparison with other results
We also observe that prefetching leads to a small improvement in latency. D The response time is about 50% higher than the latency, i.e., between 0.3 s to 0.4 s with a cache size of 1% for all movement patterns, and higher with a smaller cache size, as depicted in Fig. 13(c). C	D Claim + C Result with reference to a figure
However, when compared with no caching, G caching alone could improve the response and latency times of the walkthrough application by quite a few times as shown in Fig. 13(c) and (d). C Prefetching also leads to improvement in response times. D Finally, with an increasing cache size, improvement in response and latency times is also observed. D	G Comparison + C Result + D Claim + D Claim
Source: Chim et al.: IEEE Transactions on Multimedia, Vol. 5, No. 4 p.513 © IEEE 2003.	

Papers often detail their limitations, but then show how the results are still valuable despite these limitations.

H) Limitations of the research (limited variables, assumptions, only in simulation, etc.)

Limitations of a study may appear in either the discussion or conclusion section depending on the structure of the article. The following example is a detailed discussion of the limitations of the study chosen. It is good practice to clearly admit the weak points of the design of a research study in any field.

EXAMPLE

Due to the structural polymorphism of G-quadruplexes, it was beyond the scope of this study to simulate all possible antiparallel structures that can be adopted by these quadruplex forming sequences. The two templates were chosen due to the availability of experimental structures for them, which did not then require changes to the G-quartets. Simulations tend to be very dependent on the starting structures used, and changes were therefore limited to the loops. For each loop length we endeavored to find a stable conformation, and not to discriminate between all the possible loop structures. The free energy calculations were carried out for a single antiparallel structure, although of course other potentially more favorable conformations cannot be ruled out. Source: Hazel et al.: J. AM. CHEM. SOC. 9 Vol. 126, No. 50, 2004 p.16415 © 2003	H Limitations of the study

J) Future work by the researchers

This paper on virtual environments concludes with quite a long discussion of future work projects. This is especially common when a paper is designing a prototype system, but can be found in all fields and types of papers, usually in a separate conclusion section. I don't suggest using "We" as often as these authors do, however.

EXAMPLE

We are currently extending our studies along several dimensions. We are investigating other means of prefetching virtual objects and comparing their effectiveness with scheme. We are studying the effectiveness of prioritizing objects for transmission at record level rather than object level on visual perception. We are investigating the effect of multiple clients on the performance of the caching mechanism. are also investigating the situation when objects are dynamic, i.e., an object can move within the virtual environment. This further complicates our caching mechanism as the updated location of each dynamic object needs to be reflected in the object model cached in each client in a consistent manner. Source: Chim et al.: IEEE Transactions on multimedia, Vol. 5, No. 4 p.514 ©IEEE 2003	J Future work projects by this research lab

8.2.1 Separate Conclusion with no Discussion Section Example

In this paper we have an example of a separate Conclusion section of a paper. This is another common structure in engineering papers where the Section opening and concluding statements are the focus rather than a detailed description of the data which would have appeared in the results and discussion section.

EXAMPLE

VII. CONCLUSION	
This work extends the geometric theory of output regulation to linear distributed parameter systems with bounded input and output operators, in the case when the reference signal and disturbances are generated by a finite dimensional exogenous system. **It is shown that** the full state feedback and error feedback regulator problems are solvable, under the standard assumptions of stabilizability and detectability, if and only if a pair of regulator equations is solvable. The regulator equations form a system of Sylvester-type operator equations subject to extra side constraints.	A Summary of the major findings
Concerning solvability of the regulator equations**, it is well known for finite-dimensional systems that** solvability of the regulator problem may be expressed as a nonresonance condition between the system transmission zeros and the natural frequencies of the exosystem. In Section V we have **also** developed such nonresonance conditions for the class of distributed parameter systems discussed in Section IV.	B. Background information to help understand the significance of the results
Several examples are **given to demonstrate applications of the main results.** Using the regulator equations to design state and error feedback control laws we solve a number of regulator problems (with and without additional disturbances) for parabolic and hyperbolic partial differential control systems. For each of these examples the regulator equations reduce to a system of linear ordinary differential equations which can, in general, be readily solved numerically off-line to obtain approximate feedback controls that work very well in practice.	A. Continued review of the major findings
In future work the authors plan to carry out a nontrivial extension of this work to the case of unbounded input and outputs operators (i.e., boundary control and point actuators and sensors) and also the case of infinite-dimensional exosytems (e.g., repetitive control).	J. Future research direction
Source: Byrnes et al. IEEE Transactions on automatic control, Vol. 45, No.12. © 2000 IEEE	

8.2.2 Almost complete discussion section of a medical article

Discussion Section	Interpretation of the data

Among these 38,077 men, alcohol consumption was consistently associated with a lower risk of coronary heart disease, regardless of the type of beverage, the proportion consumed with meals, or the type of coronary outcome. The drinking pattern had an important effect, with the lowest relative risks among men who consumed alcohol three or more days per week, even if the amount consumed per drinking day was small to moderate.	A. summary of the major findings
…Paragraphs omitted here	
We found the strongest associations between alcohol consumption and the risk of myocardial infarction for beer and liquor, the predominant types of alcoholic beverages consumed by this population.	C. Result
Our findings support the hypothesis that the beverage most widely consumed by a given population is the one most likely to be inversely associated with the risk of myocardial infarction in that population. [29]	D. Claim + G Reference to previous research
This may occur because heavily consumed beverages are more likely to be consumed frequently, as confirmed by their closer correlation with the frequency of drinking in our analyses.	F. Explanation + C Result from this study.
The fact that multivariate adjustment strengthened the inverse associations of myocardial infarction with beer and liquor but weakened the associations with red wine and white wine suggests that uncontrolled confounding may explain the greater benefits attributed to red wine in some studies. [30,31]	D. Claim + F Explanation + G. Reference to previous research
…Paragraphs omitted here	
… Our exclusion of former drinkers, the elimination of myocardial infarctions that occurred early in the follow-up period, and the similarity in risk among those who abstained and those who were very light drinkers argue against the "sick quitter" hypothesis [36] as an explanation for our findings.	E. Unexpected outcome + G comparison/ disagreement with previous research
Our ability to separate the associations of the quantity and the frequency of alcohol consumption with the risk of myocardial infarction was limited, because the two were correlated.	H. Limitations of the study
Also, only 3.5 percent of study participants reported consumption of 50 g or more of alcohol daily, a fact that limited our ability to study the detrimental effects of heavy drinking. National guidelines recommend caution when applying the results of epidemiologic studies of alcohol consumption to individual patients, since clinical care requires consideration of the myriad health effects of alcohol and of individual susceptibility to those effects. 35,37	H. Further limitations of the study
We encourage adults to discuss alcohol use with their physicians and together make individualized decisions about appropriate consumption.	I. Recommendations

8.3 Grammar of Discussion/Conclusion sections

These sections are unique to Discussion/Conclusion sections. The grammar point numbers match framework 1 Combined Results and Discussion Sections. The other grammar points are similar to results/discussion paragraph framework.

H. Limitations of a study

Near the end of the discussion section or in the conclusion section of your journal article, you should include a paragraph or two addressing the limitations of your study. This is particularly critical in clinical studies, where not acknowledging limitations could lead clinicians to apply your findings before they have been adequately investigated. Here are some examples adapted from Swales of expressions for limiting claims in the discussion section. **Expressions for limitations of the study:**

It should be noted that this study has been **primarily** concerned with . . .
This analysis has **concentrated on** . . .
The findings of this study are **restricted to** . . .
This study has addressed **only** the question of . . .
The **limitations** of this study **are clear** . . .
We would like to point out that **we have not** . . .

Expressions for stating conclusions that should NOT be drawn:

However, the findings **do not imply**
The results of this study **cannot be taken as evidence** for . . .
Unfortunately, we are **unable to determine** from this data . . .
The **lack of** . . . means that we **cannot be certain** . . .

Expressions for very limited studies:

Notwithstanding its limitations, this study does suggest . . .
Despite its preliminary character, the research reported here would seem to indicate . . .
However exploratory, this study may offer some insight into . . .

I. Making Recommendations

“Should”, “must” or “could” are usually used to make recommendations or suggestions for practice or policy in applied fields.

EXAMPLE

Note that, our early mode selection strategy **could be used** together with almost any fast ME algorithm in the literature (except for those algorithms in which there is a strong dependence between the MV searches of different partitions).
Source: IEEE Transactions On Circuits And Systems For Video Technology, VOL. 18, NO. 2, p164, FEBRUARY ©2008

Different patterns of expression of 57 of approximately 10,000 genes from purified myeloma cells **could be used to** distinguish the two groups of patients (P<0.001).
Source: n engl j med 349;26, p.2484, www.nejm.orgm, December 25, © 2003

The magnitude of and period of the sensor signal **could be used to** determine the fluid properties such as viscosity, which influences the drag and hence the motion of the particle.
Source: J. Appl. Phys. 99, 024912 , p.10 ©2006

The image sequences and the writing activities that arise from them **could be used to** introduce the students to various genres (e.g., narration, description) based on the ways visuals are organised.
Source: TESOL QUARTERLY Vol. 36, No. 2, p.200, Summer ©2002

EXAMPLE

Thus, a balanced reading program for limited English proficient, Spanish-speaking kindergarten children, including story reading, **should also include** phonological awareness instruction for the added benefit of greater change in oral English proficiency.

Source: TESOL Quarterly Vol. 38, No. 1, p. 95, Spring ©2004

Future studies **should be** focussed on basic mechanisms, such as effects affecting DDAH function, not only on possible associations between clinical events and plasma ADMA.

Source: V.-P. Valkonen, R. Laaksonen / Clinica Chimica Acta 348, p.14 ©2004

Our results therefore raise the question of whether routine screening for sleep apnea **should be** performed in patients with heart failure.
Source: n engl j med 348;13, www.nejm.org, march 27,p.1240 ©2003

J. Future research

This section gives advice to other researchers about studies that are needed in the field or it announces the future research projects of the lab.

EXAMPLE

This article is about a virtual training system for heavy machinery and what future research is needed.

To operate an overhead crane, the user has to follow it which makes the overhead crane training a perfect case to build a locomotion-based virtual environment. Although the overhead crane training system presented in this article is a prototype system, it shows a promising impact on the locomotion interface in virtual reality application. Further study is [needed] to improve this training system, so that the trainee can be fully immersed in the training environment.
Source: Omnidirectional Stroll-Based Virtual Reality Interface 50 IEEE Transactions On Multimedia, Vol. 5, No. 1, March © 2003

From the same article the current projects of the lab are announced.

Finally, the gait analysis algorithm presented in this article can not detect the sidestepping at this moment. Further improvement of the gait analysis algorithm is currently under investigation so that the OBDP can detect the walking direction as well as sidestep.

8.4. Framework 2 for paragraphs describing results

The previous framework was designed for the overall structure of the results/discussion/conclusion sections of the paper. This framework is used only to analyze individual paragraphs within the paper that discuss results. It is not designed for separate conclusion sections.

STRUCTURE	VERB TENSE USED
1. Background Optional). Information that is helpful to understand the data before the actual results are reported.	Definitions or facts are in the present tense.
2. Location (Optional). Indicates which figure or table or other type of data is being discussed.	Present tense is always used to indicate tables or figures: • Fig. 8 shows… • As shown in Figure 2, the effect increases with increasing temperature.
3. Method (Optional) Explanation of the specific methods used to obtain the specific data being discussed in the particular paragraph.	Past tense is used to describe the specific methods used to get the data.

4. Description (Optional). Physical features of the figure or table such as type of line: dotted, dashed; Patterns; colors in images; X and Y axis values; inset (image inside or blown up larger to show detail in figure) etc.	Use present tense to describe the physical characteristics of the figures or table.
5. Process (Optional) Instructions or explanation of how something works or is designed rather than describing data, for example description of a model, design, algorithm, prototype, etc.	Present tense refers to procedures and processes that can be repeated, not based on an individual result: algorithms, code, mechanical functions etc.
6. Results: Reports the most important data in the figure or table.	Past tense is used to give results of an individual experimental result completed by the authors.
7. Claim (analysis of the researcher based on the data).	Present tense is usually used to analyze the data or make conclusions or generalizations beyond the data of the individual experiment.
8. Hypothesis (OPTIONAL) supported or not. More common in social sciences.	Past tense because it reports the results of the study.
9. Explanation (OPTIONAL) (Reasons for unexpected results or data that is difficult to interpret, differences with previous findings. **10. Comparison** (OPTIONAL) with previous research including references or other results in the paper such as simulation/theoretical and empirical results. **11. Problems** (OPTIONAL, not common) with the data or methods (problems should be explained).	Present tense also indicates a generalization or conclusion based on the data.. Modal forms and modifies such as “may, could, might” etc. are often used to try to explain data that is difficult to interpret. Weak verbs such as suggest, appears, seems, are often used. Hedging words like “is likely to be, generally, probably” etc. are often used. (See grammar section).
12. Conclusions	Modal forms and modifies such as “may, could, might” etc. are often used to “hedge” or more cautiously make conclusions or recommendations. This depends on how confident the researcher is of the data and varies greatly between fields.

8.4.1 Samples of paragraphs describing results

EXAMPLE from computer engineering

Fig. 8 **provides** results for the 260.4-kHz clockwise direction and 29.0 V_{RMS}.	**2. Location-Present tense** is used to indicate tables and figures.
The response of the system to the input signal **was larger** at the higher frequency, requiring the lower voltage. The drop in torque seen at 87.1 mN did not occur at 260.4 kHz, and the rotation speed reached 565 r/min. However, the efficiency **was** inferior at a maximum of only 39% at 87.1 mN preload and 164 r/min.	**6. Results-Past tense** indicates individual completed results.
Though the trend of the torque/speed curve with respect to the voltage **matches** the counterclockwise results in Fig. 9, the shape of the efficiency curve **remains** generally the same at the three voltages tested for this system, dropping slightly at 36.9 V_{RMS}. Source: Friend et al.: IEEE /ASME Transactions on Mechatronics, Vol. 9, No. 3, p.472 ©IEEE 2004	**7. Claim-Present tense** generalization about data and summary of the results

Example paragraph of results in physics

III. RESULTS AND DISCUSSION The atomic force microscope (AFM) images of the fabricated devices, Fig. 2(b), **showed** individual bundles of SWNTs, 1.5–4 nm in diameter, clearly bridging between Au electrodes.	**6. Results** Past tense report of data. 2. Location of Figure.
The SWNT bundles **reach across** the 7.5 um gap between contacts because they grow as long, straight tubes rather than short and curled, which would require multiple SWNTs overlapping one another in order to bridge a gap of this size.	**1. Background information** to help the reader understand the data.
The devices (bridging SWNT gaps) **were numbered** sequentially.	**3. Method** used by the researcher.
The AFM images of any gap **performed** at different locations showed several SWNT channels.	**6. Results.** Past tense used to report results.
In fact, from the measured output current (*I*) of the purely semiconducting devices, which averages 709 uA with a 300 mV drain bias and using a previously reported30 value of output current for a sc SWNT, **we estimate that** any gap contains between 375 and 750 nanotube bundles physically bridging the Au pads.	**7. Claim** in present tense. Notice the use of **"in fact"** to draw attention to interesting results.
This gives a maximum current value of 1.9–0.9 uA carried by any single bundle at a 300 mV drain bias, which **correlates with the previously reported** value.[30] Source: Journal Of Applied Physics p. 99, 024302 ©2006	**10. Comparison.** Present tense with similar research.

8.4.2. Grammar of Describing Results from Framework 2

These numbers refer to the sections of the "Framework for paragraphs discussing results" page 9.

8.4.2.1 Grammar of Location Sentences

The article "THE" indicates WHICH ONE? Since a numbered figure or table can only be one case "THE" is never used.

~~The~~ Figure 3 shows the increase in the level of achievement of students after receiving the treatment.

COMPARE:

The dashed line indicates the development of the control group, while the solid line shows the improvement in the patients.

Since there are two lines we need the word "THE" to help indicate which one we are talking about "dashed" or "solid."

8.4.2.2 Grammar of indicating more than one figure

The letter "S" is added to sentences that refer to two different figures:

Fig**s**. 2 and 3 both indicate that the improvement was substantial.
Insets and multiple images in a single figure are not considered different figures.
Fig. 1(a) and (b) shows images of the case before and after treatment.

8.4.2.3 (Optional) Description of a process or description of a model, prototype, design, etc.

Figures and Tables do not only show results but may explain a process. Other diagrams such as flowcharts are also in the present tense. The following example is all in the present tense because the reference to the figure does not describe an individual result but a process or how something works. Engineering papers and some sciences are more likely to have present tense descriptions than other fields when reporting results because they often describe how something works, not just experimental results.

EXAMPLE

C. Fast Rewind

Fig. 10(a) **shows** the ideal fast rewind operation. When the customer **issues** a fast rewind command, the video program is played in the reverse order at a fast and constant rate. Fig. 10(b) **shows** the approximate fast rewind operation. It **plays** a small portion of video at the normal rate, then **skips** a previous portion, then **plays** a small portion, and then **skips** a previous portion, etc.

Source: DESIGN OF AN INTERACTIVE VOD SYSTEM IEEE TRANSACTIONS ON MULTIMEDIA, VOL. 5, NO. 1, p.137, MARCH © 2003

8.5 General Grammar of Reporting results

8.5.1 Be careful of Problems with the passive

The basic passive is formed using [be + ed].

- **PASSIVE: The mice were sacrificed after ten days.**
- **ACTIVE: We killed the mice after ten days.**

Use of the passive is very important in research writing. However, most textbooks and general writing advice is to avoid the passive. Clearly, the use of the passive is much more complex in science writing. Here are some tips on using the passive in methods and results sections.

Browse this review of all passive sentence structures if you are not sure about this grammar point:

http://owl.english.purdue.edu/handouts/grammar/g_passive.html

Be careful when using the passive in describing methods or results

What is the difference between these two sentences?

The temperature was increased by 50 C.

The temperature increased by 50 C.

The passive is used when the researcher changes the conditions of the experiment.

In this first example it is clear that the researcher is changing the conditions of the experiment in this physics example.

EXAMPLE

The temperature was increased by about 17 °C/min to 850 °C, where it was held constant for 20 minutes and then decreased again by about 17 °C/min. When the temperature had decreased to 650 °C the gas was stopped and vacuum was again achieved. The sample was then allowed to cool naturally back to room temperature.

[Researcher changing the conditions of the experiment].

Source: http://www.phy.ilstu.edu/~intreu/colinProj.htm

In this example describing global warming, it is clear that no one can control the effects of warming the whole planet!

EXAMPLE

Over the last 40 years — which is the period with the most reliable data — the temperature increased by about 0.5°F (0.2-0.3°C).

[observed result, Not known or expected result].

Source: http://www.teachersdomain.org/9-12/sci/ess/watcyc/lp_global2/index.html

8.5.2 Help your reader to interpret the data: Draw attention to surprising or very interesting results

"Sentence initial adverbs like *interestingly*, *surprisingly*, *importantly*, *unfortunately*, significantly" and phrase like, "*Of note*, Note that the …" are also often used by authors to draw attention to interesting results as well as "Indeed, In fact,"

EXAMPLES

Surprisingly, engineering classroom teaching is also especially marked along Dimension 4, overt expression of persuasion, perhaps reflecting the same reliance on physical displays and demonstrations, and classes in which students are expected to consider alternative analyses and argue for a preferred solution.

Source : Biber, D., et al. Speaking and Writing in the University: A Multidimensional Comparison. *TESOL Quarterly*, 36, p.40 © 2002

The complexity of the proposed algorithm is **significantly** reduced compared with the conventional methods, regardless of the sequence types, as illustrated in Tables II and III.

Source: IEEE Transactions On Circuits And Systems For Video Technology, VOL. 14, NO. 11, p..1268 NOVEMBER © 2004

Specifically, visually important edge features are computed as multi-scale first-order derivatives. **Interestingly,** this gradient extractor imitates certain characteristics of visual cortex [13]–[15]. As the exact relationship between the gradient features of the decoded image and the distortion image is unknown, a neural network—referred to as the neural network visual model (NNVM)—is trained to learn this relationship.

Source: IEEE Transactions on Circuits And Systems For Video Technology, VOL. 11, NO. 4, p.1 APRIL ©2001

Most **importantly,** the out-of-plane permittivity was found to be much lower than the in-plane permittivity. The grain boundaries had a lower permittivity compared with that of grains.

Source: J. Appl. Phys. **104**, 124110,p.5 ©2008

8.5.3 Use qualifiers, adjectives and adverbs to more precisely describe your results.

Combine these words to more accurately demonstrate your results.

Adjective	**Result keyword**
dramatic rapid abrupt marked pronounced significant insignificant small sharp slight negligible gradual steady	increase improvement decrease change drop fall decline trend pattern shift development

Adverb	**Adjective/noun**
highly very clearly significantly extremely steadily	accurate efficient high higher low lower

Vocabulary in 8.5.3 derived in part from Hyland (2004) as cited in Graf Handbook of Biomedical Research Writing. http://www.hanyangowl.org/media/biomedical/handbookbiomedicalwriting.pdf

It is also useful to collect key phrases that appear together. Learn the prepositions and the articles that normally appear in the pattern rather than only the main vocabulary words. For more on this technique see the handout on computer-assisted learning at www.hanyangowl.org.

Mixed terms	
negligible change in gradual improvement in steady improvement in	insignificant drop in small shift in rapid shift in

pronounced improvement on rapid fall in gradual fall of slight decline in abrupt decline in dramatic decline in	Extremely higher than significantly lower than very accurate Marked pattern of

8.5.4 Negative results

Sentences showing poor results often start with an unusual and difficult grammar structure called a Negative opening: **Little/Few/No/None of these…** with NO article (a, the) in front. This can be combined with other modifiers like other results.

No significant differences between the two groups were found after 16 weeks of treatment …
No clear trends could be found in the data
No significant change was observed in the sample.
No additional decrease in the resistance occurred under the given current was found.
None of these results were conclusive.
None of the students preferred the proposed method…
Few patients showed improvement …
Few respondents had experience of … in the exploratory research.
Few interesting findings were revealed.

8.5.5 Correlation and inverse relationships

Correlation and inverse relationships are commonly found in research, but the grammar can be difficult to express. Here are some structures and examples as a guide.

Structure	Example

A increases/decreases with increasing/decreasing B	The film thickness at the cup edge is shown to **decrease with decreasing** volume flow rate, **with increasing** cup rotation speed, **with increasing** cup radius and **with decreasing** cup slope angle. Source: Y Y Zhao Simul. Mater. Sci. Eng. 12 (2004) p..959 ©2004 However as shown in the figures, MSE usually **decreases with increasing** tree size as well. Source: Cen and Cosman: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 P.5 ©2003
Increasing/decreasing A increases/decreases B	**Increasing** the bin width of a histogram **decreases** the length of the histogram. Source: Hadjidemetriou et al.: IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 26, No. 7, July 2004 P.839 ©2004 **Increasing** the loop length from T to T3 **increased** the rms deviation of each loop, related to the increasing degrees of freedom (Table 3 and Figure 7). Source: Hazel et al. Loop-Length-Dependent Folding of G-Quadruplexes J. Am. Chem. Soc. 9 Vol. 126, No. 50, 2004 P.16410 ©2004 They found that **increasing** the grain size from 1–2 to 100 µm **decreased** the average positron lifetime in the samples, which was attributed to positron trapping at grain boundaries. Source: Garay et al. J. Appl. Phys. 99, 024313 (2006) P.024313-2 ©2006 **Decreasing** the value of the threshold further would drastically **increase** the number of false alarms. Source: Lelescu and Schonfeld: Statistical Sequential Analysis IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 P.114 ©2003

A increases/decreases with increasing/decreasing B	The low-momentum fraction **decreases** markedly **with increasing** temperature. Source: Garay et al. J. Appl. Phys. 99, 024313 (2006) P.024313-3 ©2006 As shown in Fig. 2, the degradation of DBT varies slightly with the increasing of cell content when the ratio of carrier solution volume to cells weight was below 20, and the degradation of DBT significantly **decreased with** the **decreasing** of the bacteria content while the ratio of carrier to cell exceeded 20. Source: Y. Hou et al. Fuel 84 (2005) 1975–1979 P.1978 ©2005

8.5.6 Strengthening and weakening results, explanations, and conclusions

Especially in the social sciences, education, life sciences, and medicine it is important not to present your results too strongly. This is also called "hedging" in writing. We must be cautious when reporting generalizations or conclusions. On the other hand, we can also choose vocabulary carefully to clearly show when we have important results. You can also use these grammar strategies to modify claims or conclusions:

A. **Qualify your argument.** Use quantifiers (almost all, a majority of, most, many, some, few etc.)

B. **Use modals or verbs** to soften or strengthen your conclusion.

C. **Indicate tendency, probability or frequency:** Use *tend to*, *are likely to*, *usually*, *generally*

D. **Use a comparison with a similar group:** compared to, in comparison to, in contrast to, etc.

E. **Be specific: use adjectives, adverbs, and exact nouns with modifiers to more precisely describe your conclusions and generalizations.**

F. **Soften and distance the claim:** "based on the limited data available, in the view of some experts, according to this preliminary study, based on an informal survey, this initial investigation into, this exploratory study, etc. (Swales and freak, 2004)."

General vocabulary for weakening a claim

(Use adobe searches to determine whether these words are commonly used in your field)

Vocabulary derived in part from Hyland (2004) as cited in Graf Handbook of Biomedical Research Writing. http://www.hanyangowl.org/media/biomedical/handbookbiomedicalwriting.pdf

Adverbs	Verbs	Adjective	Nouns
apparently approximately generally largely likely mainly normally partly partially perhaps possibly predominantly presumably probably quite relatively seemingly somewhat in theory, theoretically typically	appear deduce discern doubt estimate hypothesize imply infer interpret perceive postulate predict presume seem speculate suggest suppose surmise suspect tend to	about a certain + noun around consistent with open to question plausible questionable uncertain unclear	assumption to a certain extent contention implication possibility prediction probability tendency

General vocabulary for strengthening a claim

(Use adobe searches to determine whether these words are commonly used in your field)

Vocabulary derived in part from Hyland (2004) as cited in Graf Handbook of Biomedical Research Writing. http://www.hanyangowl.org/media/biomedical/handbookbiomedicalwriting.pdf

Adverbs	Verbs	Adjective	Nouns
always assuredly certainly clearly conclusively convincingly decidedly doubtlessly necessarily particularly patently precisely reliably surely unambiguously undoubtedly unequivocally unmistakably rightly	conclude confirm convince demonstrate determine we find that we know that it is known that prove show we think that	assured certain that clear conclusive essential inevitable precise reliable unambiguous undeniable undoubted unequivocal unmistakable unquestionable well-known strong	certainty claim without question

The Academic word list for self-study also contains useful vocabulary

http://www.victoria.ac.nz/lals/staff/averil-coxhead/awl/sublists.html

8.5.7 Using modals to strengthen or limit a claim or conclusion

Modals (can, may, could, etc.) can strengthen or weaken a conclusion. In fact, modals are probably the most common way to show degree of certainty.

Level of CERTAINTY	Description	Examples
Present tense verb/ "be" verb	Certain results; Usually proven mathematically (is caused by, demonstrate, show, prove).	▪ Results of several simulations demonstrate the validity of the proposed approach. ▪ Experiments show that the proposed approach outperforms techniques that do not account for A.
WILL	Confident Prediction about the future. Usually overused by students but is quite rare in research conclusions.	Future improvements using A will also reduce computation time to an even greater degree.
CAN	Possibility; Some degree of certainty; Used to indicate that it is possible to achieve something difficult. Often used to indicate that something can be achieved that was thought to be too difficult previously.	Simulation results show that the internet download time can be significantly improved.
SUGGESTS APPEARS SEEMS THAT	Cautious reporting of results; Common in many fields.	Our results further suggest that errors tend to occur with greater frequency when …
SHOULD	Reasonable expectation; Often used to make a prediction that something is likely.	**Reasonable expectation:** Application of our proposed technique **should** result in much greater accuracy.
WOULD	Some doubt as some conditions are assumed. Often used with IF subordinate clauses. Limited by a condition.	However, this improvement in computation time would probably come at the price of an unacceptable decrease in accuracy. **Condition:** Using a different model **would** greatly increase results **if the problem of** A was solved.
MAY/ MAY NOT/ MAY HAVE	Some doubt; Often used to "hedge" or report results cautiously;	Numerical results show that this error may significantly affect performance in many

BEEN	commonly used.	common applications.
COULD/MIGHT	More doubt; More cautious than CAN; Also past tense of CAN. Often used to indicate something that could be done but has not yet been tried.	This technique could also be extended to use in mobile applications.

Compare the certainty of these Engineering papers

EXAMPLES

Our method clearly outperforms and differs from the results achieved in the past [15], [16], [18].

Source: De Vleeschouwer et Al.: Circular Interpretation Of Bijective Transformations 103 104 IEEE Transactions on Multimedia, Vol. 5, No. 1 ©March 2003

Experimental results prove the effectiveness of the approach and its suitability for implementations on modern superscalar DSPs and multimedia processors.

Source: IEEE Transactions on Multimedia, VOL. 5, NO. 3, p.317, September ©2003

to the uncertainty of this medical paper. *May* is mentioned three times!

EXAMPLE

It may be argued that shrunken glomeruli may not have been detected with our sampling technique and that we may thus have underestimated the number of glomeruli.

Source: n engl j med 348, January 9, p.107 ©2003

Generally those fields that have fewer variables or variables that can be controlled in the laboratory or tested or simulated mathematically are much more likely to use the present tense to give their conclusions. Those fields especially social sciences involving human beings or natural process that are hard to isolate in life sciences and medicine are more like to use model forms (may etc) to discuss results. In this sense, biology is more similar to education than engineering.

CAN/CAN BE + V-ed

The word “can” puts the emphasis on things that were not thought possible before but the results of the paper show that now it can be done. Notice the patterns that the word CAN appears with, especially difficult words like prepositions. For more on computer-assisted search techniques see www.hanyangowl.org

It was shown that a combined thermodynamic, volumetric, and structural approach can provide a new level of understanding of a phenomenon, such as the sphere-to-rod transition.
Source: B J. AM. CHEM. SOC. p.8, ©2004

It had been demonstrated that GaN **can be made to** grow over a mask such as silicon dioxide in a lateral direction with a three orders of magnitude reduction in dislocation density.

Source: SAND2001-3645 Unlimited Release, p.10, November ©2001

The proposed method **can be used in** the study of binding characters of dipyridamole on the cell membrane.

Source: G. Zhu et al. / Clinica Chimica Acta 348, p.101 ©2004.

It is worth noticing that the proposed DHS algorithm **can be applied** practically in electric appliances, especially in mobile handset due to its simplicity.
Source: IEEE Transactions on Consumer Electronics, Vol. 51, No. 4, p.1300, NOVEMBER©2005

Our proposed two hardware architectures **can provide** low cost, high utilization and less area overhead when supporting VBSME compared to six previous approaches.
Source: IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—I: REGULAR PAPERS, VOL. 53, NO. 2, FEBRUARY ©2006

COULD BE USED TO/ + V-ed

The word "could" is chosen when something has not been done yet but could be tried. In the cases below, these methods have not yet been used but could be.

These results suggest that such interactions **could be used to** form and to manipulate stable surface structures without the need to move each individual component into its precise position

Source: GS McCarty, PS Weiss - J. Am. Chem. Soc, p.5 ©2004

The protein structure prediction problem **could be solved using** the current PDB library.

Source: PNAS _ January 25, 2005 _ vol. 102 _ no. 4 _ 1029–1034, p.1 @2004

It was suggested that the incidence of radiation-induced chromosome aberrations in human lymphocytes **could be used to** determine the magnitude of an unknown exposure [80].

Source: S.W. Maluf / Clinica Chimica Acta 347, p.7 @2004

May

The word “MAY” is used when the author wants to cautiously report results or is not sure of why some results have occurred. It is very common in fields such as medicine and social sciences where it is difficult to prove causes.

But, in video sequences with very homogeneous motions, model-based prediction **may provide a** slightly better performance. Therefore, if we adaptively combine the minimum bitrate prediction scheme with the model-based one according to the distribution of neighboring motion vectors, we can expect improvement
in coding efficiency.

Source: IEEE Transactions on Image Processing, VOL. 8, NO. 8, p.1119, AUGUST @1999

This proposition is not yet proven and **may need re-evaluation** in light of calculations examining the influence of electronic effects on the geometry of a series of complexes

Source: J. AM. CHEM. SOC. [9] VOL. 126, NO. 51, p.10 @2004

Therefore, it has been proposed that in particular the ubiquinol-10/ubiquinone-10 ratio **may be a** sensitive marker for studying disturbances in the prooxidant–antioxidant balance in human blood

Source: Clinica Chimica Acta 349, 121–127,p.2 @2004

WOULD

Would is used for hypothetical situations (not true) in the future or past or if something happens only under some conditions. It is often used with “IF.”

If this is the case, **it would provide an alternative** route for exploring the effects of these covalent linkages on heme function that avoids the inherent experimental complications associated with the mammalian peroxidase enzyme.

Source: 16248 J. AM. CHEM. SOC. [9] VOL. 126, NO. 49, p.7 @2004

8.5.8 Determining if hypotheses are supported or not

Directly writing the hypothesis is not that common in engineering. However, it is common in social sciences writing as this example shows.Tourism article on why tourists visit the same place again. Hypothesis testing and explanation.

If tourists return to an area already visited, their estimated mean spending in their country of origin and in the Balearics is greater than if they had never visited the area. For expenditure in their country of origin, there is an increase of 4.21% but, as previously indicated, it would only be statistically significant at the

8.4% level. Expenditure in the Balearics by repeaters to the same area is 16.5% higher than expenditure by first-timers. **These results contradict the hypothesis that more information about a destination would lead to lower expenditure.** According to proposed models of consumer behavior, **this result could be associated with two possible hypotheses.** **With the first hypothesis,** repeat visits to the same area would imply an emotional attachment to the place, and this would be associated with a willingness to spend more. **The second hypothesis** is that for tourists returning to an area, any higher expenditure can be offset against the lower risk and lower non-monetary costs that their stay involves. With the information available in the survey, it is unfortunately impossible to test the validity of these hypotheses.

Source: Annals of Tourism Research, Vol. 33, No. 3, pp. 684–706, ©2006

8.5.9. Explanations

In this physics example, the author brings attention to interesting results and tries to explain them "This can be attributed to". It is also clear that this is a new result in this field and that they are trying to explain it and provide some background information to support their interpretation.

When CNTs begin to be mixed with a small fraction of molecular junctions, _c decreases. Figure 4 depicts Pperc for different mole fractions _xx_ of X junctions. As more molecular junctions are mixed with CNTs, a percolating network can be formed at a lower value of t . The same trend is observed for the mixture of Y junctions and CNTs. The value of _c is decreased by up to 40%. **This suggests that** if CNTs are mixed with molecular junctions, one can create a conductive material with a smaller number of CNTs, thus enhancing the transparency of the material. Considering that the agglomeration of CNTs usually hinders the formation of percolating networks**, it is interesting that** molecular junctions enhance the formation of percolating networks even though molecular junctions are constructed by clustering CNTs as in agglomerations. **This can be attributed to the fact that** while the agglomeration results in a lower value of the effective aspect ratio of the CNTs, molecular junctions usually have more branches than CNTs, which provides a higher chance to make contact with other molecules.

Source: Applied Physics Letters **94**, 193108 , p.3 © 2009

8.5.10 Comparison with previous results

A is supported by B

A is not supported by B

A is contrary to the findings of B

(Author A) also reported that …

These findings are similar to A who reported that

EXAMPLE

Our results show that **none of these** fundamental changes in A significantly affects B **supporting the hypothesis put forth by others that …**

Source: J. AM. CHEM. SOC. 9 VOL. 126, NO. 50, 16289, p.2 © 2004

8.5.11 Structures that show Comparison

Structure	Example
Is also likewise, similarly,	Pictures will include any visual material such as stills, motion videos, and animations, etc. **Likewise**, *context* brings focus on the interpretation of the pictures to the meaning intended by the author, brings out the feeling of the storyteller, and stimulates more detailed recall. Source: Loui and Savakis: IEEE Transactions on Multimedia, Vol. 5, No. 3, September 2003 p.390 ©2003
in the same manner in the same way	The classification results are reported **in the same manner** as for the previous experiment. Source: Kwak and Pedrycz: IEEE Transactions on Systems, Man, And Cybernetics—Part B: Cybernetics, Vol. 34, No. 4, August 2004 p.1673 ©2004
like A just as A is just as A similar to A	These methods will lead to the wrong disk localization when there are large areas of bright lesions **similar to** optic disk in an image. Source: Li and Chutatape: IEEE Transactions on Biomedical Engineering, Vol. 51, No. 2, February 2004 p.246 ©2004
A is as + (adj) as B A is the same as B	Detections are made on a block-by-block basis where the duration of the detection block is **the same as** the duration of the staging epoch. Source: Agarwal e*t al.*: IEEE Transactions on Biomedical Engineering, Vol. 52, No. 8, August 2005 p.1391 ©2005
A is also/ too + (adj) A is also… A is similar to B	The idea **is similar to** the self-adjusting weight in the sense that it also includes the concept of feedback. Source: Li and Chutatape: IEEE Transactions on Biomedical Engineering, Vol. 51, No. 2, February 2004 p.249 ©2004
Similar to A, B is… A and B are alike/ similar A like B is …	**Similar to** the experience of Cootes *et al.* [5], we too found that the modeling of gray-level information near the object boundaries provides valuable additional information for a model placement and improves the robustness and stability of the iterative optimization scheme. Source: Kelemen e*t al.*: IEEE Transactions on Medical Imaging, Vol. 18, No. 10, October 1999 p.838 ©1999

both A and B either A or B neither A nor B not only A, but also B whether A or B	The full transmission then has to include **not only** the encoded data values, **but also** the coded model parameter values. Source: Davies e*t al.*: IEEE Transactions on Medical Imaging, Vol. 21, No. 5, May 2002 p.528 ©2002 The resonant frequency of the coil was determined using a Hewlett-Packard 4195A network analyzer and without utilizing **neither** tuning **nor** matching capacitors on any of the rods. Source: Ibrahim e*t al.*: IEEE Transactions on Biomedical Engineering, Vol. 52, No. 7, July 2005 p.1281 ©2005

8.5.12 Structures that show Contrast

Structure	Example
conversely, however, instead, nevertheless,	For instance, Gaussian kernel Gram matrices do not have zero eigenvalues unless some of the patterns are duplicates [19]. **Nevertheless**, good approximations are possible, since the eigenvalues of Gaussian kernels decay rapidly (e.g., [38]). Source: Schölkopf e*t al.*: IEEE Transactions on Neural Networks, Vol. 10, No. 5, September 1999 p.1010 ©1999

By comparison, In comparison, In comparison to In contrast, On the other hand,	Both effects indicate that the overall performance should increase if the segmentation scheme were improved. **On the other hand**, segmentation failures more often lead to images being classified as abnormal than normal and abnormal images are more likely to suffer from segmentation failures, as can be verified from Table II. Source: Van Ginneken e*t al.*: IEEE Transactions on Medical Imaging, Vol. 21, No. 2, February 2002 p.146 ©2002 This is because RND, due to its simple implementation, checks more instantiations per second than the other algorithms. GCSA, on the average, yields slightly better performance than RND, **but in comparison to** CSII and CSSA requires more time to reach a solution above the target similarity. Source: Papadias e*t al.*: IEEE Transactions on Multimedia, Vol. 5, No. 2, June 2003 p.214 ©2003
as opposed to instead of rather than unlike whereas , while	
A is much + (adj)…than B	A is much faster than B
A is different from B A is dissimilar to B A differs from B	At the same time, the additional variation information is only partially relevant since half of the profile spans the background which in many cases **is different from** case to case. Source: Duta and Sonka: IEEE Transactions on Medical Imaging, Vol. 17, No. 6, December 1998 P.1054 ©1998
Compared to/with A, B is… To compare A and B, we must first …	**Compared to** the TB database, the abnormal areas are spread more evenly over the lung fields with a preference for the lower lung fields. Source: Van Ginneken e*t al.*: IEEE Transactions on Medical Imaging, Vol. 21, No. 2, February 2002 P.140 ©2002

8.6 Computer-assisted Writing: Analyze grammar patterns and words that go together in your field

These handouts will show you how to use advance Adobe PDF search and Google Scholar searches to help you find vocabulary and correct grammar problems while you are writing.

http://www.hanyangowl.org/media/computerassisted/googlegrammarsearch.pdf

http://www.hanyangowl.org/media/computerassisted/googlegrammarsearch.pdf

In short, a collection of PDF files from your field of research can be used like a database of example sentences. A quick search of the word “increase” in physics articles reveals these common patterns. In English linguistics these are called “collocations” or “lexical phrases” words, and patterns, respectively, that are often found with certain words. They can be quickly collected for study and analysis using the Adobe Advanced Search method. Google scholar searches can also be used to find examples even more quickly. If you use “*” as a wildcard in Google Scholar, the computer will search for any words in that particular place in the grammar structure.

EXAMPLES from Physics:

further increase in the
slight increase in the
gradual increase in the
dramatic increase in the
rapid increase in the
abrupt increase in the

See what prepositions and articles always go together, not only the main keywords. They will often be found in larger patterns.

Other useful keywords for finding results are as follows:

A <u>increases</u> with increasing B
A <u>correlates</u> with B
A is <u>associated</u> with B
A <u>decreased</u> by up to 40%
A have been shown to be <u>upregulated</u> in B

You can also select the “stemming” (유사성) checkbox to get all variations of a single word: increase/s/ed/ing with single word searches in the Korean version. In the English version this function is with any type of search.

You can also determine which combinations of words go together in a particular field. For example, is “full set” or “entire set” more common in engineering to describe a group? To improve vocabulary, you can also check a thesaurus http://www.m-w.com/ or (http://www.thefreedictionary.com/important scroll down) to find words that have a similar or opposite meaning. Then you can use an Adobe search exact phrase search to determine which combinations are common in your field and appropriate for academic writing. For example, instead of “big” what word combinations are acceptable in engineering: Big problem, enormous problem, huge problem, gigantic problem, terrible problem, major problem, massive problem?

8.7 Checklists for results/discussion/conclusion sections

Checklist for the format of figures and tables

1. My Tables have titles on the top but my figures have captions on the bottom.	❑
2. No articles (THE, A) at the beginning of figure captions	❑
3. I have printed out and looked at my figures and tables on paper to make sure that the text is not too small.	❑
4. My figures do not depend on color information that cannot be seen in black and white print.	❑
5. I have looked at a sample paper from my target journal to see if there is a period at the end of every caption.	❑
6. I have looked at a sample journal article to see the correct format for figure captions: Fig. 1. / Figure 1. / FIG. 1	❑

Results section checklist

1. I do not merely describe all of the results, but interpret the important results for the reader. I use words like "significant, moderate, unexpectedly, surprisingly and interestingly," to interpret the results and not just give a list of results.	❑
2. If appropriate, I have pointed out any problems or inconsistencies with the data (not the same as limitations of the paper).	❑
3. If my results are statistical, I have done all the necessary tests to determine the validity of the results.	❑
4. If my paper does not have a separate "Discussion" section, I have included references that compare my findings with the results in previous research papers.	❑
5. I have used the past tense to talk about the specific results of my paper but I have used the present tense to talk about descriptions of figures or tables and generalizations based on my results of general statements about my whole field.	❑
6. My Tables have titles on the top but my figures have captions on the bottom.	❑

Discussion/Conclusion section checklist

1. I discuss only the most significant findings and do not simply repeat the results section with more commentary.	❑
2. I have noted any problems with the methods or data. I note the implications of these problems and how they might affect the validity of my conclusions.	❑
3. My discussion section includes references from other papers to either support or compare my research.	❑
4. I have identified and clearly explained the importance of the findings for the field as a whole.	❑
5. I have mentioned whether my results support or differ from previous research in the field. If they differ, I have attempted to explain why.	❑
6. I have mentioned some possible areas for further research, the importance of the findings or the implications and possible applications of the research (not all are required in all fields).	❑
7. I have analyzed the structure of papers in my field to understand the relationship between the results, discussion and conclusion sections.	❑

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Chapter 9: **Journal and Conference Abstracts**

Despite their short length, many researchers find abstracts difficult to write. Writing a good abstract is increasingly important as some readers only read abstracts to follow their field. Also, the abstract is a separate piece of writing that will determine if a reader is going to read your paper or not. Abstracts usually follow the general structure of the research paper. However, different fields may omit some of these categories. Some fields or highly specialized journals may not have a concluding sentence or much background introduction. Instead, they might just focus on the results of the paper. Like the rest of this book, this framework is based specifically on an analysis of abstracts in engineering, which are distinct from other fields.

9.1 Framework for the structure of the abstract

Structure	**Notes**
1. Introduction	These introduction characteristics may not appear in order. Some engineering papers may start with a significant result and then describe the method.
A. Background of the research	
B. Research problem or research question	
C. Gap or lack of research in the field	More common in social sciences and almost required in dissertation writing to show that your work is a significant document that contributes knowledge to your field.
D. Purpose of the paper	Many sciences and engineering abstracts do not have much background, but start with the purpose of the research or even the method.
E. Description of the paper	Summarizes what the paper does or contains often because there is not enough space to fully explain the findings or argument.
2. Methods	Methods sections are relatively longer in dissertations.
3. Results	Many scientific abstracts concentrate more on the results rather than the introduction or conclusion.

4. Conclusion	Main contribution of the paper. May be hard to distinguish from results.
F. Blueprint: introduction of topics or issues that will be discussed	More likely in papers that are not based on an experimental design and in business or social sciences.
G. Recommendations	More common in other fields, but recommendations for building codes or standards occur in engineering.
H. Implications for the field	Importance of the results for the field as a whole. Results and conclusion may be mixed together in some abstracts.

To show how the framework in 9.1 can be used for the analysis of abstracts, a sample from a journal and a dissertation have been analyzed here. This framework can help you evaluate the effectiveness of abstracts from published journals as well as to help you write your own. Abstracts are not always well-written, even in published papers.

9.1.1 Example of a journal article abstract analyzed

1. Abstract— Language is grounded in sensory-motor experience. Grounding connects concepts to the physical world enabling humans to acquire and use words and sentences in context.	1. Introduction A. General background
Currently most machines which process language are not grounded. Instead, semantic representations are abstract, pre-specified, and have meaning only when interpreted by humans.	B. Definition of the research problem
We are interested in developing computational systems which represent words, utterances, and underlying concepts in terms of sensory-motor experiences leading to richer levels of machine understanding. A key element of this work is the development of effective architectures for processing multisensory data.	C. Purpose of the research
Inspired by theories of infant cognition, we present a computational model which learns words from untranscribed acoustic and video input.	E. Description of the paper
Channels of input derived from different sensors are integrated in an information-theoretic framework. Acquired words are represented in terms of associations between acoustic and visual sensory experience.	2. Methods
The model has been implemented in a real-time robotic system which performs interactive language learning and understanding. Successful learning has also been demonstrated using infant-directed speech and images. Source: Roy: IEEE Transactions on Multimedia, Vol. 5, No. 2, p.197 © IEEE 2003	3.Results

9.1.2 Suggested analysis of a conference abstract

This paper proposes energy efficient real-time multi-task scheduling (EDF and RM) algorithms by using buffers.	1.E. Description of the paper
The buffering technique overcomes a drawback of previous approaches by utilizing the slack time of a system fully.	1.B. Research Problem
It increases the CPU utilization and averages the workload of a system, so it enhances the effectiveness of the DVS technique.	3. Result
We target multimedia applications where a slight buffering delay is tolerable within a latency constraint. We modify the state transition and queue handling mechanism of multi-task scheduling in the kernel.	2. Method
In experiments, our algorithms achieve up to 44% of energy consumption saving for EDF scheduling and 49% for RM scheduling with realistic task set configurations and reasonable machine specifications. Source: Im and Ha: LCTES'04, June 11–13, Washington, DC, USA © 2004	4.H Conclusion (note the exact results)

9.1.3 Suggested analysis of a Ph.D. student dissertation from the US

The majority of Web site design literature mainly concentrates on the technical and functional aspects of Web site design.	1.A. Background
There is a <u>definite lack of literature</u>, in the IS field, that concentrates on the visual and aesthetic aspects of Web design.	1.C. Lack or "gap" in research
<u>Preliminary research</u> into the relationship between visual design and successful electronic commerce Web sites was conducted.	1.E. Description
The emphasis of this research was to answer <u>the following three questions</u>. What role do visual design elements play in the success of electronic commerce Web sites? What role do visual design principles play in the success of electronic commerce Web sites? What role do the typographic variables of visual design play in the success of electronic commerce Web sites?	1.B. Research questions
Forty-three undergraduate students enrolled in an introductory level MIS course used a Likert-style survey instrument to evaluate aesthetic aspects of 501 electronic commerce Web pages. The instrument employed a taxonomy of visual design that focused on three dimensions: design elements, design principles, and typography. The data collected were correlated against Internet usage success metrics data provided by	2. Methods

Nielsen/NetRatings.	
Results indicate that 22 of the 135 tested relationships were statistically significant. Positive relationships existed between four different aesthetic dimensions and one single success measure. The other 18 significant relationships were negatively correlated. The visual design elements of space, color as hue, and value were negatively correlated with three of the success measures. The visual design principles of contrast, emphasis radiated through contrast, and contrast shape were negatively correlated with three of the success measures. Finally, the typographic variables of placement and type size were both negatively correlated with two of the success measures.	3. Results
This research provides support to the importance of visual design theory in Web site design. This preliminary research should be viewed as a realization of the need for Web sites to be designed with both visual design theory and usability in mind. Source: http://wwwlib.umi.com/dissertations/fullcit/3126565	4.H Implications

9.2. BEST PRACTICES: Abstract writing

BEST PRACTICES 9.2.1	Choose the journal or conference BEFORE you write the abstract

The type of journal or conference should affect how you write the title, the abstract, and the introduction of your paper. A multidisciplinary or more general journal might require you to give more general background. Some famous journals like *Nature* do not even have traditional abstracts, but longer summaries for a more general reader instead. Other journals have different word limits for abstracts.

BEST PRACTICES 9.2.2	Check the author guidelines carefully

Each journal will have “information for authors” that will tell you the number of words the abstract should be and often even the number of keywords for the journal, which is usually around five.

Many organizations have official lists of keywords or index words for their own field. Check a website from an engineering organization in your field to find them. Due to the increase in electronic publication and computer searching, keywords are becoming more and more important.

BEST PRACTICES 9.2.3	Understand the real purpose of an abstract

There are three reasons to write an abstract:

1) To get someone to read your paper.

2) To get someone to accept your paper for a conference.

3) To get someone to come to your presentation.

4)

An abstract does more than just summarize the paper. You need to persuade the reader or conference attendee that you have something new and significant to talk about. It shows the relationship between your own research and what is important in your field of study.

BEST PRACTICES 9.2.4	Represent each section of the paper with at least one line in the abstract

It is a good idea to follow the same pattern as your paper when you write the abstract and you will produce more structured writing. Although not required, it is good practice for each section of the paper (method, results etc.) to be described by at least a line in the abstract.

BEST PRACTICES 9.2.5	Clearly define the research problem or purpose of the research

Although not absolutely required, it is a good idea to clearly define the research problem or purpose of the research. The beginning of this computer engineering abstract clearly shows the research challenge taken on in this paper, and helps the reader understand the importance of the field.

EXAMPLE
Abstract—The quality of service limitation of today's Internet is a major challenge for real-time voice communications. Excessive delay, packet loss, and high delay jitter all impair the communication quality. A new receiver-based playout scheduling scheme is proposed to improve the tradeoff between buffering delay and late loss for real-time voice communication over IP networks.
Source: Liang et al. IEEE Transactions on multimedia, Vol. 5, No. 4. p. 532 ©IEEE 2003

BEST PRACTICES 9.2.6	Write the abstract as if the rest of the paper did not exist

"Because the abstract will be published separately by abstracting services, it must be complete and understandable without reference to the text."

Source: Journal of Infection and Immunity author guidelines.

- Some review or abstracting journals consist only of abstracts. Researchers also read abstracts to keep up with what is happening in the field and may not read your article at all.
- If you spell out an abbreviation in the abstract such as voice over Internet protocol (VoIP) you must spell it again in the introduction. If you do not repeat the abbreviation in the abstract, you do not need to introduce the abbreviation until the introduction section.
- Don't include references except when talking about research instruments or giving the name of a model or theory. How could anyone find the references without referring to the

paper? The instructions for submissions for a few extended abstracts for conferences may ask for or require references, but this is an exception.

- Define new terms, abbreviations, or theories that are not well-known in your field in both the abstract and the introduction.

BEST PRACTICES 9.2.7	Emphasize how your research is new or different from previous work

Many papers have a neutral title and do not even mention that a new method is being introduced. The purpose of a paper is to show that you have made a contribution to the field. The abstract below clearly states to the reader that something new was found in the paper.

EXAMPLE
Abstract: Direct experimental evidence that can be unambiguously attributed to the need of an ensemble of a minimum number of neighboring Pt atoms for methanol electro-oxidation has been observed for the first time. This was realized by a Pt coverage-dependent investigation of methanol and …
Source: J. Phys. Chem. B, Vol. 109, No. 38, p.17775 ©2005

BEST PRACTICES 9.2.8	State directly what you found rather than discuss what the paper will talk about

Avoid wasted words such as "the results are discussed." Why wouldn't you discuss the results; it is a research article! It is clear that the editor of this journal is tired of receiving abstracts that are not precise.

"It should not contain literature cites, reams of data, or **meaningless** clauses such as **'the results are discussed'**."
Source: http://www.int-res.com/journals/ame/ameInstruct.html

Instead report directly what you found with as much detail as possible within the word limit. The following sentence provides very little information for the reader to evaluate the paper. What does "effectiveness" mean here exactly? How effective is it compared to the detailed result given below.

EXAMPLES

X: Simulation results showing the effectiveness or our proposed approach are discussed.

CORRECT: The proposed method significantly reduces the number of sinusoidal operations and multiplications in computing the coefficients of ART. Moreover, the memory requirements needed to store the ART basis functions in lookup tables are only 25% of the conventional method.
Hwang And Kim: IEEE Transactions on Image Processing, VOL. 15, NO. 1, p. 112 ©IEEE 2006

BEST PRACTICES 9.2.9	Make a clear connection between research in your field and your article

Although not required, the best written abstracts often discuss the importance and relationship between the results and the greater field of research. What are the implications of your research? Areas for future research? Practical applications of your research? Recommendations?

EXAMPLE
As a result of the study, use of an experimentally verified finite element technique in conjunction with fatigue crack growth experiments is suggested as a potential means of developing future crack growth rate models in terms of the traditional fatigue parameters of strain range and mean strain.
Source: Dougherty et al.: Engineering Fracture Mechanics Vol. 56, No. 2, 1997 p.189 ©1997

BEST PRACTICES 9.2.10	Show "gaps" in previous research

Although it is more common in dissertation and thesis abstracts, and in social sciences, it is useful to show a "gap" (Swales and Feak, 2004) or a lack of research concerning a problem that is the focus of your research paper. This structure can be found in introduction sections as well.

EXAMPLE
Fatigue may occur in undercarriages and support systems of trailers, haymakers, graders and swing-ploughs made up of thin-walled tubular sections with wall thicknesses less than 4 mm. Little research has been done on the fatigue of thin-walled tubular sections below 4 mm thickness. The weld profile and weld undercut may affect the fatigue crack propagation life of welded joints especially for thin-walled sections.
Source: Mashiri et al. Thin-Walled Structures 39 (2001) p.261–285

EXAMPLE
None of the previous methods have explored the possibility of incorporating homogeneity of segmented regions of the image to regulate the smoothing on the compressed image.
Source: Weerasinghe et al.: IEEE Transactions on Circuits and Systems for Video Technology, Vol. 12, No. 10, p. 891 © IEEE 2002

BEST PRACTICES 9.2.11	Explain the background and research problem in one or two sentences for non-experts

Authors regularly overestimate the specialist knowledge of their readers. Potential readers of your research may be graduate students, people with backgrounds in other areas of your field, researchers doing cross-disciplinary work who are not specialists in one field, or managers looking for new ideas in applied fields. Not everyone reading your paper will be a research specialist in your field.

9.3. Grammar for abstract writing

GRAMMAR POINT 9.3.1 Verb tenses

There are many ways to start an abstract in engineering. Unlike the social sciences, some abstracts begin with a sentence describing the purpose or main result of a paper. However, it is generally a good idea to first give a sentence of background information before discussing the results. A simple present statement of fact, a formal definition, or a sentence reviewing the state of the art with a present perfect tense verb is often used. The first line of the abstract or

the first paragraph of an introduction can describe the background information or current situation in the field to help the reader understand why the author's study is important.

One verb tense that is difficult for many Korean speakers is the present perfect verb tense or present perfect passive. It is used to give background information that is not specific to one time in the past, but gives a general overview of the field. It is formed as follows:

PRESENT PERFECT: has / have+ past participle+ed for regular verbs

EXAMPLE
The addition of salts has been reported to shift chromatograms of coal-derived liquids to longer elution times (i.e. smaller molecular masses). The observation has been attributed to the disagglomeration of sample molecules. The aim of this work is to investigate whether size exclusion chromatograms (SEC) obtained, using NMP (1-methyl-2-pyrrolidinone) as eluent, are free from sample agglomeration.
Source: F. Karaca et al.: Fuel 84 (2005) p.1805 ©2005

Links

This page compares how to use present perfect tense vs past tense:
http://web2.uvcs.uvic.ca/elc/studyzone/410/grammar/ppvpast.htm

This page gives clear information on when and how we use the present perfect:

http://www.englishpage.com/verbpage/presentperfect.html

See GRAMMAR POINT 6.3.1 in the chapter on writing introduction sections for more detail on how to use the present perfect.

GRAMMAR POINT 9.3.2 Negative openings to show a "gap" in the research

Sentences indicating missing areas or "gaps" in research in the field usually start with an unusual and difficult grammar structure with no article. This is one time when you don't have to worry about articles! In fact, you shouldn't use them if you are indicating a lack of research:

There is an important difference in meaning between

1. There are few computers (not much, not enough).
2. There are **a** few computers (some, maybe enough).

Use **Little/Few/No/None of these…** in the beginning of a sentence to indicate a gap.

Source: (Swales, 2004 p.258)

EXAMPLES

- However, no study has combined the methods effectively …

- Few studies, however, have examined the effects of …, and none, to our knowledge, have compared …

GRAMMAR POINT 9.3.3 Grammar for certainty of results/conclusion statements

The last line of the abstract often contains a sentence that summarizes the main result or conclusion. The grammar of describing results is quite difficult, however. The degree of certainty in results/conclusions runs from the present tense to various modal forms to indicate the certainty of the conclusions. In natural sciences and engineering where data is mathematically tested or simulated, there is a greater tendency to use the present tense.

Generally, those fields that have fewer variables or variables that can be controlled in the laboratory or simulated mathematically are much more likely to use the present tense to give their conclusions. Fields like the social sciences involving human beings, or natural processes that are hard to isolate as in life sciences and medicine, are more likely to use modal or other weaker forms (may, tend to, suggests, etc) to discuss results. In this sense, biology is more similar to education than engineering.

See GRAMMAR POINT 8.8.6 for details on the use of words like “can” and “could” in concluding sentences. There are also many other grammar points of interest in chap. 6.

9.4. Common abstract writing mistakes

A) Holding back significant points or information to try to get the reader to read the article.

An abstract is not a mystery story. Rather, it should contain all the significant points of the article.

B) Including references such as (Kim et al., 2000) or [1] or [1] in the abstract.

Only very few conferences may ask for conference abstract proposals that include references.

C) Including paragraphs

Since abstracts are put in databases, they don’t usually have paragraphs. Even most 350 word

dissertation or thesis abstracts don’t have paragraphs. Individual university departments may be flexible, however.

D) Wasting introduction sentences

Although it is a good idea to give a sentence or two of background information in an abstract, a lead sentence should not be too general; it should include the topic of your paper. Here is an example of a wasted first sentence. The statement is too general and there is not enough information to give the reader the purpose of the paper. They following sentence could easily be combined into one.

EXAMPLE

Global warming is an increasingly important issue these days and concern for the environment is growing. One way to reduce pollution is to increase battery duration in hybrid vechicles.

E) Using the same sentence for the first line of the abstract and the first line of the introduction.

It is considered poor writing style.

9.5. Frequently asked questions

9.5.1. How can I count the number of words for my abstract?

The computer can automatically count the number of words for you. First, highlight the text you want to count with your cursor. Then in the MS WORD menu, select Tools -> Word count.

9.5.2 How long should an abstract be?

Almost all English thesis and dissertation abstracts I receive at the writing center are too long. Here are the word limit guidelines for the Proquest database for dissertations. You might be surprised about the length requirements.

"An abstract of not more than 350 words for dissertations or not more than 150 words for master's theses should accompany the manuscript. Also, a completed agreement form should accompany the material."
Source: http://www.proquest.com/products_umi/dissertations/graddefault.shtml

General guidelines

- Journal articles range from short communications or letters with abstracts ranging from 50-125 words to full length articles with abstracts of around 150-250 words.
- Conference abstracts: 150-600 words
- Master's thesis: 150-300 words
- Dissertation: 350 words see http://wwwlib.umi.com/dissertations/ for examples
- However, always check the author guidelines for the journal or conference and check with your department for thesis or dissertation guidelines.

9.5.3 Why pay attention to word limits?

A) The journal or publisher's website might reject your manuscript.

"Please take note of Abstract word limits - Manuscript Central will not accept any abstracts exceeding this word count [200]."
Source: http://www.blackwellpublishing.com/submit.asp?ref=1600-6135

B) Other indexing services or review journals of abstracts may simply cut your abstract off after the word limit.

See PROQUEST http://wwwlib.umi.com/dissertations/ for examples of US dissertations, which are only 350 words and some have simply been cut off at the word limit.

C) It makes you look more professional as a scholar.

Links

- How to write an abstract, from Professor Koopman of Carnegie Mellon University http://www.ece.cmu.edu/~koopman/essays/abstract.html

- This website contains examples of thesis and dissertation abstracts and the first 24 pages of dissertation introductions in a wide range of fields for study and analysis. Check Hanyang Library as well. http://wwwlib.umi.com/dissertations/gateway
- Other abstract writing links

  http://www.rpi.edu/dept/llc/writecenter/web/abstracts.html

  http://darwin.bio.uci.edu/%7Esustain/Abstract.html

This checklist may help when writing your abstract for full journal articles that have an experimental structure.

9.6. Abstract writing checklist

1. I have found and followed the "guidelines for authors" from the journal website.	❑
2. The abstract is the correct number of words.	❑
3. I have written my abstract as a complete text. The reader can understand the key results of my research without reading the whole paper.	❑
4. The main keywords or index words are contained in the title and abstract.	❑
5. I have used as many index words as possible (usually 5) to make it as easy as possible to search my article online. I have consulted the official keywords in my field if if appropriate. I have included both general (for non-specialists) and specific (for specialists) key words for interdisciplinary journal papers.	❑
6. I have fully spelled any abbreviations that should be spelled in my field. I have reintroduced those abbreviations in the introduction since the abstract should be written as a separate document.	❑
7. I do not include references from other individual papers directly in the abstract. I only describe my own research, well-known theories or methods, or problems of the field in general.	❑
8. I have included a sentence describing the research methodology used in the paper.	❑
9. I did not copy and paste any of the sentences from the paper directly into the abstract—especially the first two sentences of the introduction.	❑
10. There are no weak verbs such as "discuss," or "examine," or unclear terms such as "various methods." I have described precisely how I did my research and what I found.	❑

11. (Recommended but not required.) The sentences of my abstract follow the same general structure as the rest of my paper: introduction, methods, results, and discussion.	❑
12. I have specifically stated the exact results, implications, and/or importance of the findings. I have quantified (used numbers or %) if possible.	❑
13. In the first few sentences of the abstract, I have shown how my paper addresses a research problem, a limitation of previous methods, or an issue or "gap" in the research in my field (not required but a characteristic of well-written abstracts in any field).	❑

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Definition of non-commercial use
http://ocw.mit.edu/OcwWeb/web/terms/terms/index.htm#noncomm

See http://www.hanyangowl.org/ for a direct link to this handout and more materials on writing for publication in English across fields.

Email suggestions or corrections to adamturner7@gmail.com

Chapter 10: **Word Choice Problems**

See also www.hanyangowl.org for updates

What makes vocabulary words appropriate to research writing? English, like many languages, has absorbed vocabulary words from other languages. Just as the Korean language has many academic and philosophical words of Chinese origin, English has many words of Latin and Greek origin that are widely used in academic writing. The original old English words are sometimes seen as less formal.

In this section, we will first discuss some basic characteristics of academic writing and then give some tips on the most common problems in word choice by Korean writers in engineering papers received at the Writing Lab.

10.1. Academic writing style

10.1.1 Verb choice

When there is a choice between words of Latin origin or original English words, the Latin forms tend to be used in research writing. This is a complex topic, but, in simple terms, choose a single word rather than a multi-word verb when describing your methods or research. Here are some examples.

get out → remove

put together → combine

take apart → separate

10.1.2 Contractions

Short forms of words, contractions like “gov’t,” “can’t,” or “doesn’t” are not used in research writing. You must spell the full form. You must also spell “cannot” as one word. However, in textbook writing like this book, writing lectures, or giving informal presentations, the contracted form is commonly written or spoken.

EXAMPLES

X: don’t
O: do not
X: can’t

O: cannot (spelled as one word)

10.1.3 Compounding

Key words or keywords? Sometimes it is difficult to determine if a word should be spelled as a single word, two words, or with a hyphen. Here are some guidelines from NASA.

Compound words

http://stipo.larc.nasa.gov/sp7084/sp7084ch3.html#3.8.4

Hyphens

http://stipo.larc.nasa.gov/sp7084/sp7084ch3.html#3.8

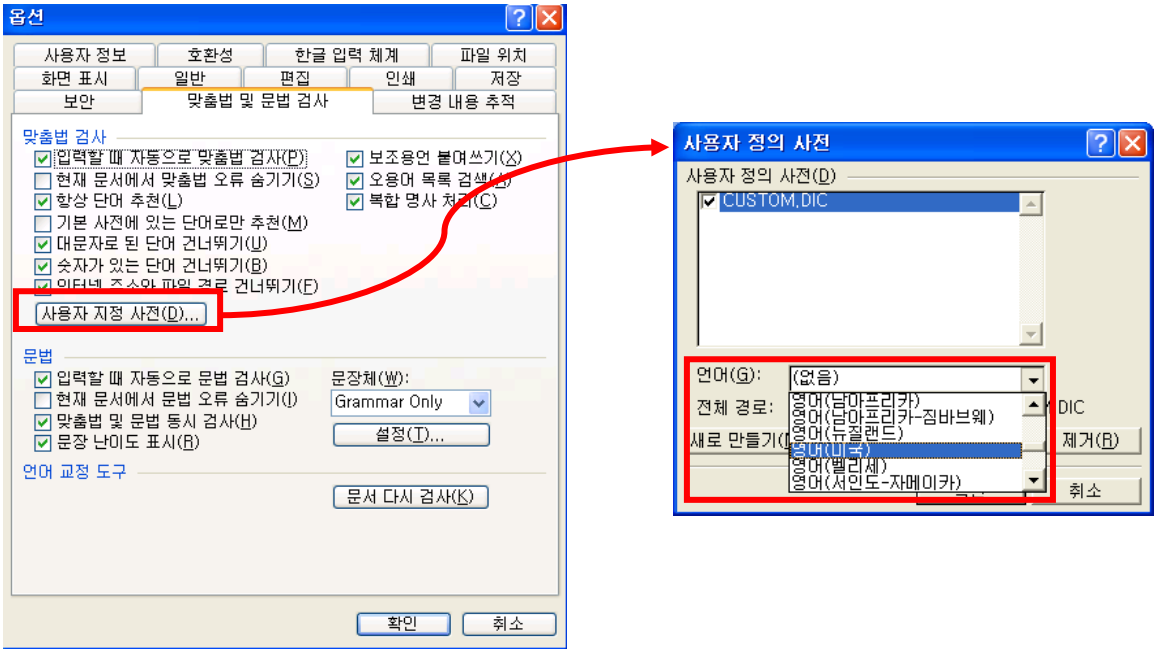
10.1.4 American and British English

Note that there are some differences between American and British punctuation, grammar, and spelling. For example, center vs. centre or recognize vs. recognise. If a European journal or conference requires British English in the author guidelines, you can change the settings of your spell check in MS WORD.

See http://esl.about.com/library/writing/blwrite_spelldiff.htm

You can also change the settings of your spell and grammar check to British or other varieties of English as follows.

In MS WORD select Tools (도구) → OPTIONS (옵션). On the pop-up window for OPTIONS (옵션), click Spelling and Grammar (맞춤법 및 문법검사) → Custom Dictionaries (사용자 지정 사전). Select the language.



10.2. Commonly misused or misunderstood words

Here is a long list of words commonly confused by native speakers such as the difference between affect and effect.

http://www.wsu.edu:8080/~brians/errors/errors.html

The rest of this list contains some difficult word usage problems for Korean graduate writers.

And so on

Etc.

Such as the following:

The words “such as” include the idea of a few examples, but not the total set of possible choices. Therefore, don’t use “such as” with “and so on” or etc. in the same sentence. It is redundant.

The words “and so on” are generally seen as being casual or spoken language, but not appropriate for research writing. Also, don’t use “like” to give examples. The term “etc.” always has a period and is the abbreviation of etcetera. You may occasionally find it in published papers, but it is not recommended.

Phrases with “the following” usually introduce a list and have a colon, “such as/including/includes/ the following:”

EXAMPLE
Their observations include the following: (1) Generally, austenitic stainless steel weld metal solidifies by primary separation of austenite or ferrite from the melt…
E J, Rao et al./Theoretical and Applied Fracture Mechanics 27 (1997) p.145

But

Use "However" or other words instead of "But, ..." at the beginning of a sentence in research writing. Other types of writing like newspaper writing has different standards. Also avoid using "So, ..." at the beginning of a sentence. Only rarely use "And, ..." at the beginning of a sentence for emphasis.

See http://hanyangowl.org/course/view.php?id=22 for materials on how to connect sentences.

Chapter

Use the word "chapter" for a book, master's thesis, or PhD dissertation. Use the word "section" for parts of a journal article.

Words like "chapter" or "section" should be capitalized only if they have a specific number.

EXAMPLE
In Chapter 4 we will report the results of our study.

but

We will discuss these complex issues in the next section of this article.

Color

Do not use the name of a color next to the word color.

X: I like blue color.
X: The blue color area indicates X.
CORRECT: The area in blue indicates X.

In case of

Use of articles is very difficult for Korean speakers. However, not putting the article correctly in the following expression changes the meaning dramatically. The phrase “in case of” is only used for emergency situations. The correct form needed in most engineering papers is “in <u>the</u> case of” meaning, in a specific example.

Fig. 8 shows SEM fractographs of crack initiation regions of treated and non-treated specimens. <u>In the case of treated samples</u> [Fig. 8(a)], the observation of large numbers of facets and secondary cracks could be associated with the martensitic transformation.
P. J. Singh et al. / Engineering Failure Analysis 10 (2003) p.11

Here is an example of a New York Times headline on May, 14, 2006 that shows the emergency sense.

“In Case of Disaster, Have a Backup Plan for Your PC”

You can take this quiz to make sure you understand the difference.

http://www.usingenglish.com/handouts/256.html

Like

For a more academic style avoid using the word "like" for comparison or to introduce examples. Instead, use

is similar to
almost the same as

For introducing examples use these words rather than "like"

for example
for instance
such as
including the following:

On the contrary

This expression is used to correct some previous information. Like "on the other hand" it is not a simple contrasting word.

on the contrary

In opposition to what has been stated or what is expected:

*I'm not sick; on the contrary, I'm in the peak of health.*Source: http://www.thefreedictionary.com/on+the+contrary

On the other hand

The phrase "on the other hand" is generally used for two sides of an issue such as a PRO and CON decision. It is not a simple contrasting word like "however" or "In contrast" as many Korean dictionaries seem to suggest. It is rarely used correctly in academic writing by Korean speakers. It is also more common in speech than in writing.

Something that you say when you are speaking about two different facts or two opposite ways of thinking about a situation *On the one hand, I'd like more money, but on the other hand, I'm not prepared to work the extra hours in order to get it. On the one hand, you complain that you're lonely, and on the other hand you won't come to parties with me.*
Source: http://idioms.thefreedictionary.com/on+the+one+hand...on+the+other+hand

Part

Try not to use the word “part” too often, especially when describing figures. Use more exact words such as quadrant or upper right hand corner, rather than “top part,” “another part,” or “side part.”

X: My research part is …
CORRECT: My research area is …

PhD candidate vs. PhD student

There is an official difference between Ph.D. student and Ph.D. candidate. A Ph.D. candidate is considered to have finished taking courses and is currently researching or writing a dissertation whereas a Ph.D. student is still taking classes. Although many people are not aware of this difference, it might be a good idea to follow this usage for job, scholarship, or post-doc applications.

Thesis and Dissertation

http://www.phys.unsw.edu.au/~jw/thesis.html

In English, the word "thesis" is only used to describe the long research document required at the end of a master's degree in American English, but for a Ph.D in British English. In British English, a dissertation is written at the end of a master's degree. Some honors programs require undergraduate students to write a B.A. Thesis as well. The word "thesis" is not used to mean a journal article, however. Many Korean students overuse the word "thesis" for 논문. The Korean word 논문 seems to have a wider meaning than the English word "thesis." If a Korean student sends me an email asking me to review their thesis, it is sometimes unclear if they mean a journal article or their master's research.

The word "thesis" is also used in general academic writing to indicate an argument that is being made in a paper. It is often called a thesis statement. This type of writing is not common in engineering, however.

10.3. Words not used in research writing

A number of uses of words are not really cases of grammar mistakes; they are just only used in casual or spoken speech and are not appropriate for engineering writing. Below is a list of the most common problems.

10.3.1 Problems with words that start a sentence

There are quite a number of words that can be used to start a sentence, but the words in this section are generally not appropriate for engineering writing.

And, But, So, at the beginning of a sentence

A sentence should not begin with "So," in research writing. Most academic styleguides do not recommend starting sentences with "But," either. The word "And" is only rarely used to begin a sentence in engineering writing. In contrast, the use of "but" or "and" is commonly used to start sentences in journalism while "So," is commonly used in written dialogue. Use "therefore" or "however" instead to start or connect sentences in English.

Actually

Actually is only used to correct a previous fact or opinion. It is not used in engineering writing at the beginning of a sentence.

After all

This word does not mean “in summary” or “in conclusion” in English. It is not used in engineering English. It is used to add an additional reason like the word “Besides,” at the beginning of a sentence.

At last

This does not have the same simple meaning as “Finally,” or “In conclusion,”. It is used to emphasize that something has finally happened after a long wait in general English.

Besides,

Don’t use “Besides,” at the beginning of the sentence as a transition. It can be acceptable as part of a phrase, however.

X: The method was not efficient enough. Besides, it was also expensive.

CORRECT: Besides the benefit of lower cost, the proposed method increases the processing speed.

Especially,

Although not grammatically wrong, the word "especially" is generally not used at the beginning of a sentence in English academic writing.

In particular,

Is a good alternative.

First of all,

First of all does not simply mean first. It is rarely used in engineering writing, and to a native speaker, it can indicate a sense of anger or casual instructions. It is not appropriate for methods sections of research papers.

Nowadays

This word is too casual for engineering writing. Use “currently,” “recently,” or “X is increasingly being used as”, instead.

10.3.2 Problems with words showing type or amount

kind of, sorts of

Use “type of” instead of “kind of,” “many kinds of,” or “many sorts of …” in research writing.

10.4 Problems with plural and singular nouns

Data

Data is plural in research writing, but can be found either as singular or plural in everyday English. Datum is the singular form, but it is rarely ever used.

X: Many datas, a data, this data

CORRECT: The data show, these data, our data, some data

Equipment

“Equipments” is never countable.

X: Many equipments had to be replaced.

CORRECT: Much of the equipment had to be replaced.

Research

Don’t use forms such as “a lot of research,” “tons of research,” or “many researches.”

Instead use “much research” or “little research.” Although some dictionaries differ, the word “research” is generally not used as countable in scientific English.

X: Many researches have been done …
CORRECT: Much research has been done …
CORRECT: Little research has been done on …

Staff and faculty

The words “staff” and “faculty” are almost never plural unless you are talking about different groups in different organizations. The word faculties is also often used for university departments but it is not a plural form of faculty, meaning group of professors.

“The Faculty of Engineering at Monash University is one of Australia's largest engineering faculties and has an international reputation for excellence in engineering teaching and research.” Source: http://www.eng.monash.edu.au/

In this example two different groups of staff will be having a meeting.

The USATLAS Tier 1 & Tier 2 Network Planning Meeting will bring together the network engineering staffs of Brookhaven National Laboratory (BNL) and their counterparts at USATLAS Tier 2 sites to begin detailed planning of the USATLAS Wide Area Network (WAN). Source: https://www.bnl.gov/usatlasnpm/

X: Our company hired many new staffs this year.

CORRECT: The staffs from the marketing, finance, and human resources departments will have a joint meeting on Tuesday.

Vocabulary

Vocabulary is not countable if you are referring to words in the plural.

X: I learned many English vocabularies studying for the GRE test.

CORRECT: I had to learn many new vocabulary words to pass the GRE test.

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See http://www.hanyangowl.org/ for a direct link to this handout and more materials on writing for publication in English across fields.

Email suggestions or corrections to adamturner7@gmail.com

English Writing Lab

교수학습개발센터 Hanyang University Center for Teaching and Learning

APPENDIX

Common format and punctuation errors in English research writing

The PPT and the PDF file of this appendix can be **downloaded** for web viewing and presentation at

http://hanyangowl.org/course/view.php?id=26

Section1
Common format errors

• Note for instructors: the writing term “mechanics” is not well-known in East Asia.

English Writing Lab http://www.hanyangowl.org
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Index to common format errors

1. Contractions 단축형 are not used in research writing.
2. Do not use batang, gulim, or malgun gothic fonts.
3. The format of abbreviations 생략형
4. The format of figures and tables
5. International format for measurements in the sciences
6. Incorrect use of < > in titles and subheadings

Index to common punctuation errors

1. The clause in English
2. Using commas
3. How to use a colon and a semi-colon in a list
4. Punctuation of equations
5. British and American English quotation marks
6. IEEE and APA style reference format basics
7. How to use an En dash (–) and an Em dash (—)

1. Contractions 단축형

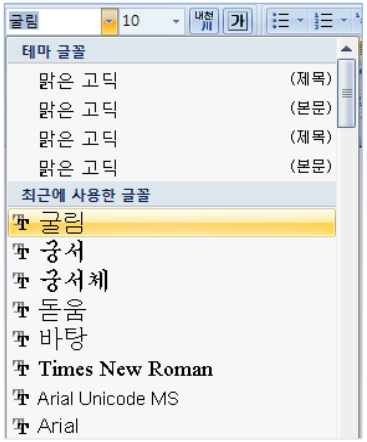
Contractions (shortened forms of words) are not used in research writing. Always spell words fully.

However, contractions are considered acceptable for personal and most business and newspaper writing as well as TOEFL, GRE, or IELTS essay tests. Teaching materials also often use contractions. Note the following:

X: don’t
→ do not

X: can’t
→ cannot (← note that this is one word)

2. Don’t use “batang, gulim or malgun gothic” fonts



The fonts “바탕, 굴림 or 맑은 고딕” are common defaults for English on Korean computers but should not be used for English documents.

- Times (new roman) is the standard for academic body text and Ariel is usually used for headings for Windows users.
- Helvetica is a popular choice for Apple users.
- Calibri is Microsoft’s own default choice for Word 2007 but is not recommended.

There are different standards for web and print documents, and for academic and creative design. For the history of fonts see http://www.urbanfonts.com/blog/font-histories/

3.1 How to format abbreviations

Manual region matching replaces computerized extraction of the region of interest (ROI).

… the region of interest (ROI).

One space before a parenthesis. Note that there is no space in Korean.

Spell first then abbreviation (생략형) in parentheses.

Period at the end.

Always capitalize.

Source: Pietka et al. IEEE Transactions on Multimedia., Vol. 20, No. 8, August 2001 p.718 © IEEE 2001

3.2 Abbreviations:

Don't introduce abbreviations for words that are only used once

If a word is only used once in a paper, acknowledgement, or abstract section then there is no need to introduce the abbreviation. The abstract is not considered part of a paper since we can read it separately and it doesn't contain references. Any abbreviations introduced in the abstract need to be introduced again in the body of the paper.

As another example, there is no need for the abbreviations below since the words are obviously only used once in this paper.

Acknowledgement

This work was supported by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korean ministry of Education Science and Technology (MEST) (No. R19-2008-099-0361)

3.3 Abbreviations:

Don't introduce abbreviations in subheadings

Correct:

3.6. Water solubility index

The water solubility index (WSI) increased when both temperature and chlorine concentration increased.

Abbreviations in body text only

No abbreviations in subheadings

Incorrect:

3.6. Water solubility index (WSI)

The water solubility index (WSI) increased when both temperature and chlorine concentration increased.

Modified Source: M.M. Sa´nchez-Rivera et al.: Partial characterization of banana starches oxidized by different levels of sodium hypochlorite, Carbohydrate Polymers 62 (2005) 50–56 p. 55 © 2005 Elsevier

3.4 Abbreviations:

Don't introduce abbreviations in keywords

Correct:

Abstract

Integral imaging , which used to be called

…

KEYWORDS: three-dimensional display, integral imaging, and integral photography

1. Introduction

Abbreviations in text only

Various techniques for fabricating autostereoscopic three-dimensional (3D) displays have been actively investigated for decades. Integral imaging (InIm), which was originally called integral photography, is one of the most attractive technologies in the field of 3D displays.

Incorrect:

Abstract

Integral imaging , which used to be called

…

KEYWORDS: three-dimensional (3D) display, integral imaging (InIm), and integral photography

Choose abbreviations **OR** fully spell words but not both in keywords

1. Introduction

Various techniques for fabricating autostereoscopic three-dimensional (3D) displays have been actively investigated for decades. Integral imaging (InIm), which was originally called integral photography, is one of the most attractive technologies in the field of 3D displays.

Modified source: J.-H. PARK et al.: Jpn. J. Appl. Phys., Vol. 44, No. 1A (2005) p.216 © *2005 The Japan Society of Applied Physics*

4. 1 How to format tables and figures

EXAMPLE

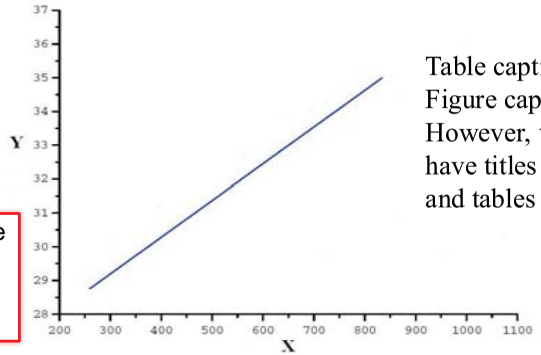


Table captions are on the top. Figure captions are on the bottom. However, these days journals may have titles on the top of all figures and tables (but very rarely).

The format can be
Fig. 1.
Figure 1.
FIG. 1.

Fig. 1. Comparison of X and Y.

No period after the word : "figure" if spelled:
X: Figure. 1.
O: Figure 1.

Period usually here.

Some journals include a period here; Others do not. Check the style of each journal.

4.2 How to format tables and figures in text

EXAMPLE

- As shown in **Figure 1,** the increase in …
- This increase can be clearly seen in **(Fig. 1c)**

(Fig. 1c)

Put a period when referring to a table or a figure only if it is abbreviated.

Always capitalize the first letter of numbered figures or tables.

4.3 How to format tables and figures in text

EXAMPLE

"Figure" is not an abbreviation.

X: As shown in figure. 1., the increase…
X: This effect can be seen in the results in table. 2. show the ….

O: The last method in Table 2 was employed only for three frames.
O: The change was significant, as shown in Fig. 2. The increase is demonstrated by the effect of …

Capitalize the first letter.
One space after the abbreviation: Fig.

4.4 How to refer to tables and figures

The article "THE" indicates **WHICH ONE?** Since a numbered figure or table can only be one case "THE" is never used.

~~The~~ Figure 3 shows the increase in the level of achievement of students after receiving the treatment.

"The" is also used to distinguish groups in the same category. In this example, there are two lines indicating two different groups, we need the word "THE" to help indicate which results "dashed" or "solid" and which group "patient" or "control" we are talking about.

EXAMPLE:
The dashed line indicates the development of **the** control group, while **the** solid line shows the improvement in **the** patients.

5.1 SI Unit rules

SI is the international standard system of measurement in science. In addition to the SI units, there is also a set of non-SI units accepted for use with SI. Visit http://physics.nist.gov/cuu/Units/checklist.html for more information

SI Unit Symbols		Non SI Unit Symbols	
Full word	Symbol	Full word	Symbol
seconds	33 s	Degrees Celsius	20 ℃
kilograms	80 kg	hertz	79 Hz
meter	10 m	minutes	30 min
kelvin	173 K	hours	6 h

5.2 SI Unit rules

Basic rules

1. There is always a space between the numerical value and the unit symbol, except for superscript units for plane angles
   X: 10min
   O: 10 min
   O: an angle of 2°
2. No plural form
   X: 10 secs
   O: 10 sec
3. No period after the unit symbol unless it is at the end of a sentence.
   X: The experiment took 10 min. to complete.
   O: The process takes 10 min.

Source: http://physics.nist.gov/cuu/Units/index.html

5.3 SI Unit rules

EXAMPLE

The spectrum analyzer used to capture the Power Spectral Density (PSD) data swept the 79 **MHz** ISM band for 33 **ms** twice a second. During the 33 **ms** sweep, the oven completed 2 full periods of operation to produce the resulting spectrum of Figs. 1 and 2.

A space between the numerical value and the unit symbol

No period after the unit symbol. Square brackets […], "33 [ms]" are not used for measurements.

Source: T. W. Rondeau et al.: Residential Microwave Oven Interference on Bluetooth Data Performance IEEE Transactions on Consumer Electronics, Vol. 50, No. 3, AUGUST 2004 p.857 ©IEEE 2004

5.4 SI Unit rules

EXAMPLE

Cooked 10% waxy maize starch slurry was also digested by pullulanase (20 ASPU/g) for 6 **h**, reheated (121 **°C** for 30 **min**), and stored at 4 **°C** for 3, 6, 12, and 24 **h** and 2, 4, 6, and 8 **days** or -20, 4, and 20 **°C** for 2 **days**.

A space between the numerical value and unit symbol even for degrees Celsius.

No plural form

Unit symbols are not followed by a period unless at the end of a sentence.

Source: M. Miao et al.: Effect of pullulanase debranching and recrystallization on structure and digestibility of waxy maize starch, Carbohydrate Polymers, p. 2 ©2008

6. Headings and subtitles:
Do not use angle brackets "< >" for titles, captions, or subheadings

Don't use "angle brackets" in subheadings or table or figure captions when writing in English. It is acceptable in Korean, however.

Correct:

1. Introduction

Banana is a climacteric fruit and, in Mexico, is consumed when the fruit is ripe. For this reason, high quantities of fruit are lost during their commercialization due to poor postharvest handling.

Incorrect:

No angle brackets in subheadings

< 1. Introduction >

Banana is a climacteric fruit and, in Mexico, is consumed when the fruit is ripe. For this reason, high quantities of fruit are lost during their commercialization due to poor postharvest handling.

Source: M.M. Sa´nchez-Rivera et al.: Partial characterization of banana starches oxidized by different levels of sodium hypochlorite, Carbohydrate Polymer s 62 (2005) 50–56 p.55 © 2005 Elsevier

Section2
Common punctuation errors

* This material was designed for graduate students writing for publication in English at Hanyang University in Seoul, Korea. However, it is useful for academic writers from any language background.

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See http://www.hanyangowl.org/ for more materials on writing for publication in English. Email suggestions to adamturner7@gmail.com

Index to common punctuation errors

1. The clause in English
2. Using commas
3. How to use a colon and a semi-colon in a list
4. Punctuation of equations
5. British and American English quotation marks
6. IEEE and APA style reference format basics
7. How to use an En dash (–) and an Em dash (—)

1.0 The clause in English

To fix sentence structure punctuation errors, you must first understand the importance of the “clause” 절 in English sentences.

1.1 The clause in English

A clause consists of a subject and a verb. A clause that makes sense as a complete sentence is a “main” or “independent” clause.

The company will expand in Asia

Subject Verb

1.2 The dependent clause in English

A clause consists of a subject and a verb. A clause that depends on or needs the main clause to make sense is a “dependent” or “subordinate” clause.

Main clause

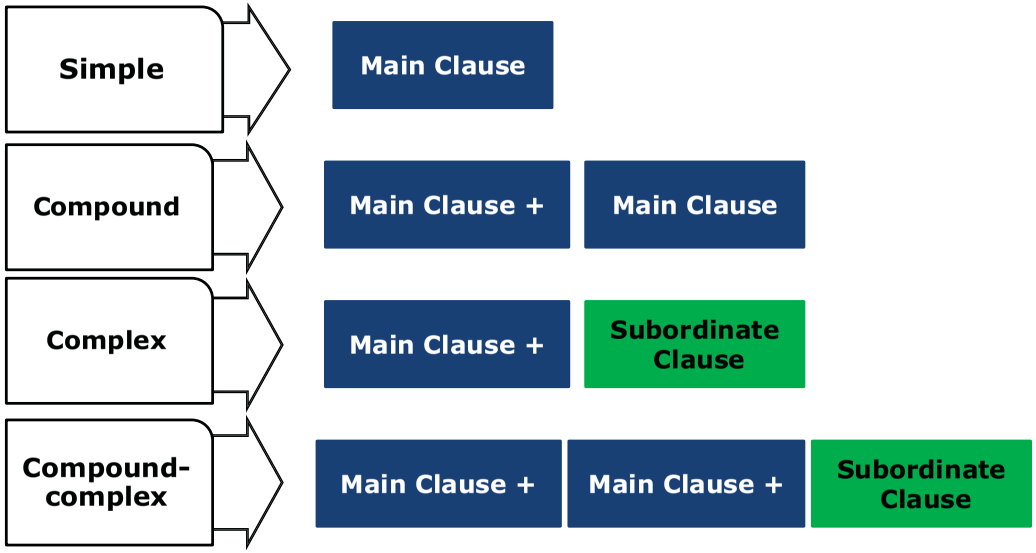
The company will expand in Asia because young consumers have shown an interest in its new mobile product line.

Subordinate clause

The clause **“because young consumers have shown an interest in its new mobile product line”** does not make sense by itself. It needs more information to make sense, so it must be a dependent or subordinate clause.

1.3 There are four types of sentences in English

that give information. They are made of up different combinations of clauses.



2.0 Common errors using commas

Many common sentence structure problems can be fixed by understand clauses. If you are not sure what a clause is, please review the first section of this handout.

2.1 Commas with compound verbs

The word "and" can join words, phrases, or clauses. There is **no** comma before the word "and" if the subject of both verbs is the same.

X: The company will expand in Asia**,** and increase its mobile product line.

→ The company will expand in Asia and increase its mobile product line.

The word "company" is the subject of both verbs.

No comma before "and"

2.1.1 Commas with compound sentences

The words "So," and "but," should not be used in academic writing at the beginning of a sentence (unless it is quoted speech in qualitative research). Their job is to combine two main clauses in a compound sentence. Using "and" at the beginning of a sentence in academic writing should generally also be avoided.

X: Educational technology is always changing. **So,** teachers need support and training to use it effectively.

→Educational technology is always changing, so teachers need support and training to use it effectively.

2.2 Commas with "because"

The word "because" always joins two clauses: a main clause and a subordinate clause.

X: We had to look for less expensive software. **Because** our budget request was not approved.

X: We had to look for less expensive software**, because** our budget request was not approved.

→ We had to look for less expensive software because our budget request was not approved.

If the word "because" introduces the second clause in the sentence, no comma is necessary.

2.2.1 Sentences starting with "because"

The word "because" always joins two clauses (subject and verb). Like other subordinate clauses, it can come at the beginning of a sentence. However, a comma is necessary before the second clause.

X: Because our budget request was not approved we had to look for less expensive software.

→ Because our budget request was not approved, we had to look for less expensive software.

Comma required

2.3 Commas with "however"

If words like "however" or "therefore" join two clauses, then a semi-colon and comma are required.

X: There are many textbooks on English writing in Korea, **however,** few textbooks explain sentence punctuation in English.

→ ***There are*** many textbooks on English writing in Korea; however, ***few textbooks explain*** sentence punctuation in English.

A semi-colon and a comma are needed. This type of connecting word is called a "conjunctive adverb."

There are two subjects and two verbs (two main clauses) in this compound sentence, so commas are not enough to connect them.

2.3.1 Commas with "however"

If words like "however" or "therefore" only interrupt a single clause then commas should be put around them.

→ Understanding clause structure is essential to proper punctuation. However, Korean students are usually taught about sentences structure in a way that does not stress combining clauses.

→ Understanding clause structure is essential to proper punctuation. Korean students, however, are usually taught about sentence structure without this emphasis.

Subject

Verb

There is only one subject and verb in this simple sentence.

3.0 How to use a colon in a simple list

- A colon (:) not a semicolon (;) introduces a simple list: A, B, and C.
- The comma before the last item is optional, especially in American business English, but recommended.

EXAMPLE

There are three main approaches: frequency, spatial, and temporal.

approaches: frequency, spatial, and temporal.

No space before a colon, but one space after it.

Put a comma between the listed terms. The second comma is optional.

3.1 How to use a semi-colon in a complex list

Use a semi-colon (;) to help make complex lists that contain commas in each item clear. You can also use semi-colons for list items that are complete sentences. Using only commas in the list below would make it almost unreadable.

EXAMPLE

There were four professors assigned to the task force: Peter Jones, professor of Mathematics; Ronald Smith, professor of English; Kim Lee, professor of Education; and Wendy West, professor of Political Science.

Semi-colons separate the items in the list.

A colon introduces any type of list including a complex one.

4.0 How to punctuate equations

Equations follow normal sentence grammar. The equals sign = is a verb. Sentences that end with an equation should have a period like any other type of sentence.

For $k = L - 1$, A is a square matrix. Assuming that the inverse of A exists, which requires are linearly independent [35], the vector is given by

$$\underline{w}^H = \underline{e}_1^T A^{-1}. \tag{37}$$

In case the steering vectors are not linearly independent, A is not invertible, and its pseudo inverse can be used in its place.

There is no colon after "by." There are also no colons after "is" or "as."

Period after the equation

Capital letter and indent after the period because it is a new paragraph

PROCEEDINGS of the IEEE, VOL. 85, NO. 8, AUGUST 1997, Page 7 ©IEEE 1997

4.1 How to punctuate equations

In this second example, a colon introduces the equation because there is a full sentence before it. Also, the sentence has not ended, so "where" is not capitalized. The equation is part of the sentence.

EXAMPLE

The desired weight vector is the solution of following simultaneous equations:

$$\underline{w}^H \underline{s}_0 = 1 \tag{32}$$

$$\underline{w}^H \underline{s}_i = 0, \qquad i = 1, \cdots, k. \tag{33}$$

Using matrix notation, this becomes

$$\underline{w}^H A = \underline{e}_1^T \tag{34}$$

where A is a matrix with its columns being the steering

The sentence has no period yet, so "where" is not capitalized or indented

Colon for introducing the equation

Proceedings of the IEEE, VOL. 85, NO. 8, AUGUST 1997, page 8

5.0 How to format quotation marks

The format of British and American quotation marks is different.

5.1 How to format quotation marks

American English

Three metrics are proposed: “loss distance,” “loss frequency,” and loss period.”

In American English, the punctuation is inside the quotations marks.

In American English, double quotations marks are used for single words as well as full sentences.

5.2 How to format quotation marks

British English. Organizations like IEE ask for British English format. British English is also common in international organizations. However, double quotations are used by some British organizations. Check the author guidelines and sample papers carefully.

Three metrics are proposed: ‘loss distance’ ‘loss frequency’, and ‘loss period’.

In British English, commas and periods are outside the quotation marks.

In British English, single quotations marks or ‘*inverted commas*’ are used for single words as well as full sentences.

Text adapted from: Cen and Cosman. IEEE Transactions on Multimedia, Vol. 5, No. 1, p.1 © IEEE 2003

5.3 How to format quotation marks

Note that there is no difference between quoting single words or entire sentences when choosing British or American style. Use single or double quotations consistently throughout the paper. The only exception is the rare case where there is a quoted word or words inside a quotation. In this case, American English uses single quotations inside the normal quotations and British English is the opposite.

6.1 IEEE style reference format [1]

IEEE: Institute of Electrical and Electronics Engineers and other fields of engineering and sciences use the following format for references.

EXAMPLE

This effect has been previously observed by Kim et al. [11].

Kim et al. [11].

Put a period after square brackets [...] at the end of the reference, not before it.

Some journals have “*et al.*” in italics follow the style of the journal.

One space between the word and the square bracket.

Put a period after “al.” but not “et”

6.2 References: format of "et al."

The word "et" simply means AND in Latin so it is not an abbreviation and does not require a period. The word "al." is an abbreviation of "*alia*" meaning "and others," so it requires a period.

Because this term is now common, et al. does not require *italics*, although you will see the italics in many published papers. Follow the style of the journal. In British English "al" may not have a period.

6.3 Format of quotation marks in APA style:

(common in social sciences and education)

Family name only. Don't confuse it with the style of references at the end of the article.

Quotations must be introduced. Full sentence quotations cannot be just put into a paragraph without introducing words.

Direct quotations must be integrated into the grammar of the sentence so it reads like a normal sentence.

Sanaoui and Lapkin (1992) also found that "considerable growth occurred in French-speaking skills and possibly listening and reading comprehension as well, which implies that an explicit focus on one area can have an effect on the other skills" (p. 544).

No period

One space

Period

Source: Stepp-Greany, J. (2002). Student perceptions on language learning. *Language Learning & Technology, 6*(1), 165-180. See http://www.hanyangowl.org for more APA style materials.

7.0 How to format dashes in English

There are three types of dashes in English:

hyphen (-) en dash (–) em dash (—)

7.1 How to format the "En" dash

The "en dash" is used to express a simple range of numbers such as 3–5 days. In math the ~ sign means "approximately equal to" as this example makes clear. In pure math and physics the sign ≈ is often preferred.

The thickness of the layer is ~ (120–135) µm, but the results of measuring the micro hardness over the cross-section gives ~ (140–168) µm.

(140–168) µm.

There are no spaces between an En dash and numbers.

Use an En dash (–) not a tilde (~) to express a simple range between two numbers such as days, hours, etc.

Source: Huryn et al.: Materials Science, Vol. 39, No. 6, 2003 p. 837 ©2003

7.2 How to format the "Em" dash

Use an "em dash" to make a comment within a sentence. It is very similar to the use of (parentheses). Note that there is no space between words connected with an em dash (—).

EXAMPLE

… the AMCD and NAMCD algorithms exhibit a form of statistical smoothing, by not reacting to changes that do not permanently affect the video shot—a desirable behavior.

No Spaces

Source: Lelescu and Schonfeld: IEEE Transactions on Multimedia, Vol. 5, No. 1, March 2003 p.116 © IEEE 2003

7.3 Format: Hyphen (-) En dash (–) Em dash (—)

1. You can just type in **Hyphen (-)** on your keyboard.
2. In WORD 2003, 2007 : Insert (삽입) → Symbol (기호) → General character (일반문자부호) → **En dash (En 대시)**
3. In WORD 2003, 2007: Insert (삽입) → Symbol (기호) → General character (일반문자부호) → **Em dash (Em 대시)**
4. In WORD 2003, 2007: Insert (삽입) → Symbol (기호) → Mathematical operators (수학연산자)→ **Approximately equal ≈**

Note that these characters may not always view correctly in other programs or on webpages. See http://en.wikipedia.org/wiki/Dash for more information.

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