National Technical University of Athens

Research and popular science articles

Week 7

Goni Togia

Source material

- The following sources have been used:
  - Glasman-Deal, H. 2010. *Science Research Writing*. London: Imperial College Press.
  - Ifantidou, E. (2011). *Genres and Pragmatic Understanding*. Athens: Patakis Publications.
  - Parkinson, J and Adendorff, R. (2004) The use of popular science articles in teaching scientific literacy. *English for Specific Purposes*, 23 (4), 379-396.
  - Wallwork, A., 2016, *English for Writing Research Papers*, 2nd.ed., Springer, Heidelberg,.

1. Your task: Brainstorming

- Have you read any research papers in Greek and/or in English?
  - If yes, for what reason(s)?
- Do you read popular science articles?
  - If yes, which (online) magazines/newspapers do you read?
- What is an abstract?
- What is a popular science article?
- List at least three (3) differences between research papers and popular science articles with regard to structure and language.

Description: research article/paper (RA)

- It is a publication in a scientific journal aiming at publicising the results of research work.
- Audience: the scientific community.
- Function: to inform the scientific community of recent research in a particular field.

Description: popular science article (PSA)

- It is an informative, insightful, easy-to-understand text addressing the general public.

- Audience: a wider audience with a good all-round education and with some specialised knowledge.

- Function: to inform and/or challenge.

2. Your task: Research Articles (RAs)

- In groups of 2-3, study the RAs on Helios and discuss their structure.
  - How are the RAs organised?
  - What is the function of each part?

Research article: structure

- The typical structure of a research article is:
  - Title
  - Abstract
  - **I**ntroduction
  - **M**ethods
  - **R**esults
  - **D**iscussion
  - Conclusions
  - References
  - Appendices (optional)
    - In some cases, the results, discussion, and conclusion are in the same section.
  - The IMRAD structure.

3. Your task: Popular Science Articles (PSAs)

- Now, study the PSAs on Helios and discuss their structure.
  - How are the RAs organised?
  - What is the function of each part?

- Then, compare the structure of the RAs and PSAs and discuss similarities and differences.

Popular science article: structure

- In the popular science article, the various parts are integrated.

- It is the journalist who chooses the best way to communicate the message and make the contents of the article easy to understand as well as interesting to a layperson.

Popular science article: structure

- The most interesting part is presented at the beginning of the article and not held back until the final sentence.

- Usually, a *lead paragraph/sentence* follows after the title; a few lines acting as a teaser.
  - This paragraph/sentence highlights the key message and gives the reader a hint of what will follow in the article.

Popular science article: structure

- Some examples:

- How Materials Science Will Determine the Future of Human Civilization
  - If Moore's law continues, electronic devices will consume more than half the world's energy budget within 20 years. To prevent that, we need a fundamentally new material.

- A robot scientist will dream up new materials to advance computing and fight pollution
  - Kebotix is using AI and robotics to brainstorm—and then test—novel compounds.

Research article abstracts

What is an abstract?

- An abstract is like a mini paper. It summarises the sections of a research paper in an interesting manner.
- An abstract is judged in isolation from the accompanying paper.
- Abstracts are sometimes called Summaries but they're written in a different way from a summary.

What is an abstract?

- To decide what to include in your abstract, go through your paper and highlight what you consider to be the most important points in each section.

- Remember that an Abstract is NOT an introduction to your paper, it is a summary of ALL your paper.

Where is the Abstract located?

- A typical first page of a research paper for publication in a journal contains the following headings (not necessarily in this order):
  - 1. Title
  - 2. Name(s) of author(s)
  - 3. Article DOI
  - 4. Abstract
  - 5. Key words
- Not all journals require keywords.

How important is the Abstract?

- Incredibly important!
- Editors may decide whether or not to send a paper for review exclusively on the basis of its abstract.
- Reviewers will probably read the abstract first before reading any other parts of a paper.
- If they do not like the abstract they may simply stop reading and reject the paper, rather than wasting their time reading and evaluating the rest of the paper.
  - A poor abstract is very often the sign of a poor paper.

How important is the Abstract?

- The title and the abstract will generally be the only parts of a paper that are available online at no cost.

- Therefore, when a potential reader locates a paper in a research database, they will use the abstract to help them decide whether to buy/download the full version of the paper.

4. Your task: Structure of abstracts

- In groups of 2-3, study the following abstract and discuss:
  - The function of each sentence.
  - The tenses used for each of the functions.

  - Filename of abstract on Helios: sample_abstract.pdf

Abstract information

- Title: A sustainable approach for the utilization of PPE biomedical waste in the construction sector.

- Authors: H. T. Mohan, K. Jayanarayanan and K. M. Mini
- Journal: Engineering Science and Technology

One of the major challenges the COVID-19 pandemic has posed is the disposal of huge volumes of biomedical waste. It is the need of the hour to find out methods to handle the waste generated and explore novel and sustainable ways for their disposal. Personal Protective Equipment (PPE) is the main medical waste generated during the pandemic and may continue to accumulate in the post-pandemic era. This paper portrays a study on generating construction material composites from PPE waste along with the sand fillers. The work has been carried out with two different sand, River sand and Manufactured sand, in three different filler ratios. The different properties such as tensile, compression, and flexural strength of the prepared composite are detailed and compared with the existing construction materials. Durability properties such as acid resistance and moisture absorption have been studied to validate the efficacy of the developed material in the construction sector. It is observed that the PPE waste composite displays superior performance in compression, tension and flexure while compared to the other construction materials like mud bricks and cement blocks. The water absorption and acid degradation are minimal, as a result, its strength is not affected after exposure to such adverse conditions. The thermal conductivity of the composite is found to be less compared to the conventional concrete which makes it an ideal choice in tropical areas as thermal insulation material. Moving forward, this study is expected to set a new sustainable approach to utilize biomedical plastics waste to substitute cement-based construction material and hence aid a negative carbon cycle.

Order of information in an abstract

- The typical order of information of an abstract is the following:
- 1. Background/Context (optional):
  - The first sentence or two (the situation) outline the context of the current situation by providing only relevant background information.
- 2. Research Gap: it mentions a gap the current work is attempting to address.
- 3. Objective: it summarises the purpose of the current study.
- Therefore, 1-3 answer the following questions:
  - Why did you carry out your research and why are you writing this paper?
  - What gap in the current knowledge do you hope to fill?

Order of information in an abstract

- 4. Methods: it summarises the main features of the methodology by answering the questions:
  - What is the innovative contribution of your work?
  - What did you do and achieve?
  - What makes it different from previous research?
- 5. Results: it summarises the key results of the work by pointing out its innovative contribution in relation to the research gap.
  - What is new compared to previous results?
- 6. Implications: it highlights the significance of the work.
  - What are your conclusions and recommendations? What do you plan to do next?

Abstract length

- A typical research paper abstract word limit is 150 to 250 words.
  - However, the abstract of a Diploma thesis is frequently slightly longer (usually 300-350 words)
- If your abstract runs too long, it will possibly be rejected.
- Therefore, it is important to write it at the end after careful evaluation of key information in each section of your paper.

Tenses in the abstract

- The most commonly used tenses in all kinds of abstracts are the present simple (*we show*) and the past simple (*we showed*).

- The present tense is mostly used to outline the:
  - Background information.
  - Conclusions/implications.

- The past tense is mostly used to outline the:
  - Methods
  - Results.

Other tenses in the abstract

- Other tenses that can be used in the abstract are the present perfect and the present perfect continuous.

- This is typical when you are providing the context / background.

  - In the last few years there *has been* considerable interest in …
  - Since 2015 attention *has focused* on …
  - To date , there *has not been* an adequate analytical model…
  - For more than a decade data analysts *have been developing* new ways to …

How much background info should you include?

- An abstract is not an introduction to a paper.

- Therefore, context setting (i.e. background information) should never take up more than 25% of the whole abstract, as it probably contains information that the reader already knows.

What do you think of this?

- In the last few years 5G cellular batteries have become increasingly popular in the telecommunications and computer industries. Many authors have studied the various features of such batteries and noted that the lifetime of a 5G cellular battery, in particular those used in the most recent generations of mobile phones, may be subject to the number of times the battery is recharged and how long it is charged for. In addition, it has been found that there is no adequate analytical model to predict this lifetime. Such an accurate model is necessary in order for producers and consumers alike to be able to predict how long the batteries will last and also, in some cases, how they can be recycled. In this work, an analytical model is developed which describes the relationship between the number of times a battery is recharged, the length of time of each individual recharge, and the duration of the battery.

What do you think of this?

- In the last few years 5G cellular batteries have become increasingly popular in the telecommunications and computer industries. Many authors have studied the various features of such batteries and noted that the lifetime of a 5G cellular battery, in particular those used in the most recent generations of mobile phones, may be subject to the number of times the battery is recharged and how long it is charged for. In addition, it has been found that there is no adequate analytical model to predict this lifetime. Such an accurate model is necessary in order for producers and consumers alike to be able to predict how long the batteries will last and also, in some cases, how they can be recycled. In this work, an analytical model is developed which describes the relationship between the number of times a battery is recharged, the length of time of each individual recharge, and the duration of the battery.

- The background information in the abstract represents about 4/5 of the total abstract!

- This, together with the fact that there's no reference to:
  - Methodology,
  - Results,
  - Any conclusions/implications from the model.
- means that the abstract is unacceptable.

A revised abstract

- (1= situation) The lifetime of a 5G cellular phone battery may be subject to the number of times the battery is recharged and how long it is charged for. (2=research gap) To date, there has not been an adequate analytical model to predict this lifetime. (3=solution) In this work an analytical model is developed which describes the relationship between the number of times a battery is recharged, the length of time of each individual recharge, and the duration of the battery. (4=model validity, not necessary for every abstract) This model has been validated by comparison with both experimental measurements and finite element analyses, and shows strong agreement for all three parameters. (5=results) The results for the proposed model are more accurate than results for previous analytical models reported in the literature for 5G cell phones. (6=implications) The new model can be used to design longer lasting batteries.

What NOT to mention in your abstract

- Background information that is too general for your readers.
- Claims that are not supported in the paper.
- Terms that are too technical or too generic – this will depend on your audience.
- Definitions of key terms.
- Mathematical equations (unless the whole paper revolves around these equations).
- Subjective adjectives (e.g. *innovative, interesting, fundamental*).

What NOT to mention in your abstract

- References to other papers (citations).
  - However, if your whole paper is based on extending or refuting a finding given by one specific author, then you will need to mention this author's name.

What about limitations in your research?

- The limitations of a study form an important part and should certainly be mentioned at some point in the paper.

- However, given that an abstract is designed to 'sell' the research, the limitations are usually mentioned in the Discussion.

Research article titles

5. Your task: RA and PSA titles

- In groups of 2-3, go back to the RAs and the PSAs in tasks 2 and 3 and examine their titles.
  - What information do you find in the RA title about the content of the article?
  - What information do you find in the PSA title about the content of the article?
  - Are there any differences between the two?

Titles

- Research article titles:
  - They are lengthy, descriptive and state the focus of the study.
  - They use gerunds, infinitives, and noun phrases instead of full sentences.

- Popular science headlines:
  - They are short, attractive, and catchy.
  - They do not provide all the details.

An example

- The following titles refer to the same study.

- Research paper title:
  - Potential-dependent dynamic fracture of nanoporous gold.

- Popular science title:
  - Designing crack-resistant metals.

Titles: examples

- Research article titles:
  - Fabrication and characterisation of hydrophobic magnetite composite nanoparticles for oil/water separation.
  - Transistors: High-Mobility Transistors Based on Large-Area and Highly Crystalline CVD-Grown $MoSe_2$ Films on Insulating Substrates.
  - Solution self-assembly of flower-like ZnO nanostructures with nanosheets and their optical properties.

- Popular science titles:
  - Materials could capture CO_2 and make it useful.
  - Is graphene really a wonder-material?
  - Unusual molecules shine light on new applications.

How do you generate a research article title?

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

- Answers to these questions help generate a suitable research article title.
  - If your paper is not about results but proposes a particular methodology, then your title should encapsulate why your methodology is novel and useful.

Use prepositions in the title

- Most titles of more than about three words require prepositions.

- Look at these examples:
  - Model dimension estimation →
    - Estimating the dimension *of* a model
  - Classical theory of elasticity crack problems →
    - Crack problems *in* the classical theory of elasticity

Should I try to include some verbs?

- In some cases using the *-ing* form of verbs rather than abstract nouns might make your title more readable.

- Look at these examples:
  - The *Specification* and the *Evaluation* of Educational Software in Primary Schools →
    - *Specifying* and *Evaluating* Educational Software in Primary Schools
  - Silicon Wafer Mechanical Strength *Measurement* for Surface Damage *Quantification* →
    - *Quantifying* Surface Damage by *Measuring* the Mechanical Strength of Silicon Wafers

Use mostly nouns as keywords

- The keywords in your title are likely to be nouns.
  - So choose these nouns very carefully.
- Use adjectives that indicate the unique features of your work, e.g.
  - *low cost, scalable, robust, etc.*

What about adjectives such as *innovative* or *novel*?

- The problem with these adjectives is that they give no indication as to how something is novel.
  - No one is likely to include the words *novel* or *innovative* when googling papers in their field.

- Look at the following title:
  - A novel method for measuring work efficiency.
- What does 'novel' mean here? A more explicit word/phrase is required to understand the focus of the research.
  - For instance, *computerised, low-cost, work sampling as a method,* etc.

Should I use a question in my title?

- Titles with questions work particularly well for abstracts submitted to conferences.
- They are generally much more informal and because of their question form they immediately get readers thinking about what the answer might be.

- However, they are not particularly common in research papers.

Summary: How can I assess the quality of my title?

- You need to check that your title is:
  - understandable (no strings of nouns)
  - a reflection of the content of your paper expressed in a form that is acceptable for a journal
  - in correct English – in terms of syntax, vocabulary, spelling and capitalization

Research articles and popular science articles

6. Your task: RAs and PSAs

- In groups of 2-3, summarise the differences between RAs and PSAs in terms of:
  - A. Purpose
  - B. Structure
  - C. Source of information
  - D. Reference to research
  - E. Use of technical terms.

A. Purpose

- Research articles:
  - Aim at persuading readers of their knowledge claims.
  - As a result, academic texts focus on theories and methods.

- Popular science articles:
  - Report on new research, not yet (necessarily) endorsed as fact by the research community.
  - Therefore, popular texts focus on people and what they say and think.

B. Structure

- RAs typically follow the IMRAD structure, while the structure of PSAs depends on the journalist who chooses the best way to communicate the message and make the contents of the article easy to understand as well as interesting to a layperson.

C. Source of information

- Research articles:
  - It is written in a way which shows that the research findings are not the result of the writer's subjective beliefs, but reflect what was objectively observed.
  - What is written is the result of objective observation.

- Popular articles:
  - Information comes from the work of different researchers on a topic that interests the magazine audience.
  - What is written is based on what the experts say (and not on the writer's own opinions).

D. Reference to research

- RAs:
  - They follow the conventions of specific style guides, e.g. IEEE, ASME, ACS, etc. (For more details, see the material in Week 4).
  - The way citations and references are used is dictated by the supervisor, the journal, the publisher, etc.

D. Reference to research

- PSAs:
  - To gain credibility for the claims made, the authors of popular science articles, personalise human participants by mentioning the following:
    - Researcher's title.
    - First name.
    - Research institute.

    - Example:
    - "The basic science question we tried to answer is how can we make a material that's highly deformable but resistant to high temperature," said Huajian Gao, a professor in Brown University's School of Engineering and a corresponding author of the research.

D. Reference to research: examples

- Research paper citation:
  - Smith [1] or Smith *(1)* or Smith (2019).

- Reference to research in popular science:
  - Dr. Christopher Smith of Harvard University.
  - Christopher Smith, a professor at Harvard University.

D. Reference to research: examples

- The following are examples of citations used by first year students in their academic writing:
  - 1. John Epstein [1] found that heat increases the entropy of the surrounding environment.
  - 2. This was supported by an experiment by John Epstein.
  - 3. Paul Reiter who is the chief engineer at the UK Space Agency argues that what is needed is a strategy to overcome the issued mentioned above.
- In these examples the students have selected the popular rather than the academic way of citing their references while retaining the formality of academic writing.

E. Technical terms

- Research papers:
  - Specialised terms are heavily used.

- Popular science articles:
  - Few specialised terms are used and when they are used they are explained.
    - These may be words, acronyms and/or abbreviations that non-specialists would not know.
    - Technical language used in popular magazines reflects the level of knowledge of the target readership.

Some general remarks

- Academic texts are objective and impersonal.
- Cautious language is typical of academic texts while absolute statements are typical of popular texts.
  - Academic: '…there is currently no firm evidence supporting its value…'
  - Popular:'…it's not valuable …'.

- The following expressions are typical of popular texts:
  - '…it is of utmost importance for scientists to discover…'
  - 'However, the real concern must refer to…'
  - '…the aggressive free-fall…'
  - '…an undeniable truth…'

Some typical expressions in PSAs

- Notice the sensational language, the absolute expressions and the use of the word 'scientists', which implies reference to a more general audience.
  - Great indicator...
  - False claims can only make matters worse...
  - Nothing is certain...
  - Scientists are anxious...
  - Scientists are not able to predict the exact time...
  - Devastating results...
  - Jones, who led a research team...