How to read a Scientific Paper/Article

This is a brief guide on how to read a scientific paper and the aspects you should consider when approaching scientific literature. Reading scientific literature is a difficult and challenging task and is not the same as reading a book from cover to cover. There is no one correct way to read a paper. Scientific papers are written with technical language and a compressed style due to the fact that there are often word limitations from journals and the author assumes a certain knowledge level of the reader.

When reading a scientific paper, the goal is to understand the scientific contributions the authors are making. This may require you to go over the paper several times or refer to other references in order to fully understand. You should begin by skimming the article and pick out the main ideas, objectives, results,..etc. It is a good idea to think about questions before, during and after reading the scientific paper. You want to think critically and draw inferences based on your own experiences and knowledge. This will improve with experience!

In order to develop an effective reading style for scientific papers, you should know the contents of an article, where to find certain information within the scientific paper, and what questions to consider when reading.

Parts of a paper:

a. **Title** - every paper has a title and a list of authors with their affiliations.

b. **Abstract** – A very brief overview of the paper which says what is in it and allows readers to see if it is relevant to them. Depending on the Journal the abstract can range from 50-400 words or so. It should contain a brief summary of the article with all outline points:

   Introduction & Background
   Methods
   Results
   Discussion & Conclusion

c. **Keywords** - List of terms which describes papers' 'general subject', 'specific subject', etc.

d. **Introduction/background** – This is where authors outline what the paper is about, what did they do and why! It is usually structured as to provide a precise problem definition, overview of state-of-the-art solutions (if any), goal of the paper, key ideas, main contribution and a short outline. This is where the author tries to create a readers interest in the subject and provide them with enough information to understand the article. The last sentences should reveal the main objectives/hypotheses, aims…etc.

   i. Why is this issue relevant?
   ii. What does previous research say?
   iii. What is the theoretical framework?
   iv. What is the research question or hypothesis?
   v. What is the main goal, are there specific aims or objectives?

e. **Methods and Materials** – This section describes the proposed solution/method and details the contributions. The contents are study population/participants, measurement instruments

(exposure and outcome), data collection methods, investigation or intervention methods, and statistical methods.

    i. Which research design is used?
    ii. How is the research question operationalized (exposure / outcome)?
    iii. Which measuring instruments are used?
    iv. What about their validity?
    v. How was the sample collected, what is the population?
    vi. How the was data collected?
    vii. How will the data be analyzed? Does the analysis fit the data/study design?
    viii. Were ethical standards taken into account?
    ix. Could you potentially re-create this study based on the methods described?

f. **Results** – The section describes the experiments conducted and highlights the findings and ties it in with how successful the proposed solution has been in achieving what the study set out to do in the first place. Results are presented without interpretation in the results section (usually no references or citations). Tables, figures, text and/or graphics pertaining to the results are usually presented here. What is mentioned in the statistical analysis section should be reported in the results section and the results section should fit to the objectives/hypotheses.

    i. Interpret the visuals (graphics, tables, figures..etc.)
    ii. Is the actual execution of research correct?
    iii. Do the results make sense?
    iv. Did the authors do what they said they were going to do?

g. **Discussion** – This is where the authors elaborate upon their findings, and explain e.g. What the implications of their findings are, if it supports or contradicts established or provisional methods, etc. In other words, this is where the results are interpreted and critically discussed. The first sentence of the discussion section repeats the main results of the paper. What is reported as results in the results section should also be critically discussed in the discussion section.

    i. Are the results plausible? Why? Why not?
    ii. In which context, are the results consistent with results of previous studies? Or not?
    iii. Strengths – What are the strengths of the study?
    iv. Limitations - What are the limitations of the study? (sometimes a separate Section)

h. **Conclusion** – Briefly reviews the problem and outlines the key ideas and main contributions of the study. It might further emphasize the importance of the results in the field, and ties it in with the previous research. It is also common to outline limitations of the approach and plan future work.

    i. Conclusions ("... in conclusion, we ...")
    ii. Recommendation for clinical practice
    iii. Recommendation for further research ...

i. **References** - A bibliographic list of citations, documenting all of the sources that is used for this research or that has acted as evidence of their work. The citation and reference style varies from journal to journal.

You can also assess an article based on specific **key reporting guidelines** for study designs, for example:

http://www.equator-network.org/

CONSORT (Consolidated Statement of Reporting Trials) - Randomized controlled trials

STROBE (Strengthening the Reporting of Observational Studies in Epidemiology - observational studies

PRISM (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) – Sys. Rev. / meta-analyzes

TATL-Scheme: When skimming an article one could use this scheme to quickly identify main points of a paper-

Title: What does the title say about the study? Is it a review or original work?

Abstract: Special relevance, design, results, Conclusion?

Tables: Are the tables meaningful and self-explanatory? Are they consistent and fitting to the data?

Last paragraph: Mostly a summary of the results with far reaching interpretation - conservative? Justified by the results?

<u>Key points:</u>

- Skim the scientific paper and know its structure

- Use TATL when skimming a scientific paper

- Distinguish the main points of the scientific paper

- Read critically and ask questions

- Draw inferences based on your previous knowledge and experiences

- Take notes

- This is a demanding and challenging task that takes TIME!

References:

http://www.sfu.ca/~amadooei/files/ReadingAdvice.pdf

http://www.owlnet.rice.edu/~cainproj/courses/HowToReadSciArticle.pdf