Reading a Scientific Article

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Overview

- Basics
  - Types of scientific papers
  - Structure of a scientific paper
- Why do we read scientific papers?
- How to decide which scientific papers to read?
- Reading effectively
Types of Scientific Literature

- Primary Literature
  - Original Articles
  - Case Reports
  - Technical Notes

- Secondary Literature
  - Review Articles
  - Books, Textbooks, and Manuals

- Tertiary Literature

- Gray Literature
Structure of a Scientific Paper

- Conventional structure
  - Title and Abstract
  - Introduction, Methods, Results, and Discussion
  - Acknowledgements and References

- Variations

- Supplementary Materials
Title

- Concise and descriptive

- Example:
  - **Title:** “Neurotransmitter Switching in the Adult Brain Regulates Behavior” *Science* (2013)
  - **Authors:** Davide Dulcis, Pouya Jamshidi, Stefan Leutgeb, Nicholas C. Spitzer
Abstract

- Brief summary of the paper

- Parallels paper structure
  - Introduction
  - Methods
  - Results
  - Discussion
Abstract Example

- **Abstract Introduction:**
  - “Neurotransmitters have been thought to be fixed throughout life, but whether sensory stimuli alter behaviorally relevant transmitter expression in the mature brain is unknown.”

- **Abstract Methods/Results:**
  - “We found that populations of interneurons in the adult rat hypothalamus switched between dopamine and somatostatin expression in response to exposure to short- and long-day photoperiods. [...]”

- **Abstract Discussion:**
  - “Natural stimulation of other sensory modalities may cause changes in transmitter expression that regulate different behaviors.”
Introduction

- Introductions serve two purposes
  - Get potential readers interested
  - Provide enough background information to understand the article

- Common structure of introductions
  - Broad: What is known in the field?
  - Specific: What specific set of findings are critical?
  - Unique: What question is being asked?
Materials and Methods

- Describe materials and steps used to carry out experiments and analyze data
- Use very technical language
- Should be detailed enough to allow for replication
  - However, in practice, descriptions are highly compressed
  - Often, to understand a method, you will have to refer to earlier papers
Results

- Description of experiments and data
  - Reference the data shown in figures and tables
  - Often include several different experimental approaches
- Minimal interpretations of the data
Discussion

- Interpret the data
  - What do the data mean?
  - How do the data support the conclusion?
  - What are the limitations of the experiments?
- Relate findings to previous reports
- Place findings in a broader context
- Suggest future directions
Other Sections

- Acknowledgements
- References
Why Do We Read Scientific Papers?

- Provide general background information
- Provide current information on research field
- Contain detailed and useful methodology
- Teach you how to write
Deciding Which Papers to Read?

- Set a clear objective for reading a particular paper
  - What do you want to get out of it?
    - Get an overview of a topic
    - Deeply understand a topic or experiment

- Identify the main finding of the paper
  - Read the title and abstract
  - Decide if you should read, save for later, or skip it
How to Read a Scientific Paper

- Have a clear idea of what your goal is

- Move from general to specific
  - Start broad to get an overview of the paper
  - Then read carefully to critically evaluate work

- Consider following a non-linear approach
  - Papers should not be read like a textbook

- Remember that reading a scientific paper is an active process
Get an Overview

- Focus first on title and abstract
  - Read title and abstract carefully
  - Remind yourself what you know about the topic
- Skim the article and analyze the document as a whole
  - Section Headings
  - Figures and Tables
  - First and last paragraph of Introduction and Discussion
Read in Depth

- Find a reading order that works for you
  - Introduction, Results, Discussion
  - Discussion, Introduction, Results
  - Figures, Discussion, Methods
  - Methods can be read last or referred to as needed
  - Continuously refer to figures and tables

- Look for key words or phrases
  - “surprising”, “unexpected”
  - “in contrast with previous work”
  - “has seldom been addressed”
  - “we hypothesize”, “we propose”, “we introduce”
  - “the data suggest”
Question your Understanding

Before, during, and after you start reading ask yourself:

- Who are these authors? What journal is this?
- What are the main question(s) being asked?
- What data/results emerged from the study?
- What did the authors conclude?
- What is the significance of these findings?
- How does this article relate to others I have read?
- What questions are still unanswered?
Critically Evaluate the Paper

- Examine the questions addressed in the paper
  - Descriptive, Comparative, or Analytical
- Examine the evidence and the statistics
- Examine the conclusions of the paper
- Determine if the data support the conclusions
  - Is there a logical connection between data and conclusion?
  - Are there any other interpretations?
- Relate the findings to what you already know
- Consider the merits and limitations of the paper
Read Actively

- Find a quiet place free of distractions
- Take notes as you read
- Highlight major points
- React to the main points discussed in the paper
- Summarize what you read
Conclusions

- There are many different types of scientific literature
- Original articles are divided in discrete sections
- When reading a paper:
  - First get an overview
  - Read carefully to critically evaluate results and conclusions
  - Take an active role when reading
References

- The Different Types of Scientific Literature: http://www.um.edu.mt/__data/assets/file/0006/42981/The_different_types_of_scientific_literature.pdf
- How to Read a Scientific Paper – University of Arizona: http://www.biochem.arizona.edu/classes/bioc568/papers.htm
- How to read a Scientific Article – Rice University: http://www.owlnet.rice.edu/~cainproj/courses/HowToReadSciArticle.pdf