Reading a Scientific Article

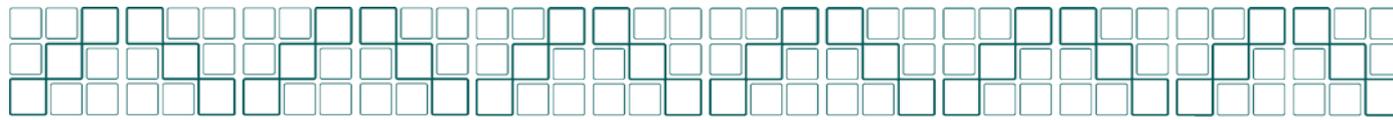**R**ocio Benabentos, PhD
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Overview

- 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**
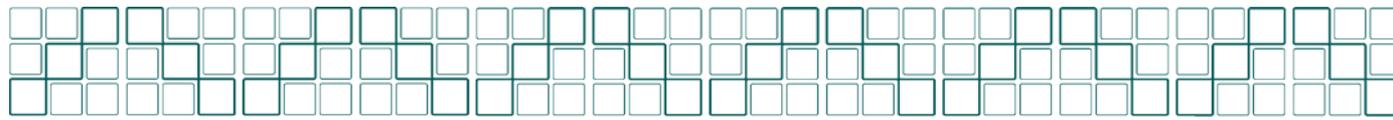
Structure of a Scientific Paper

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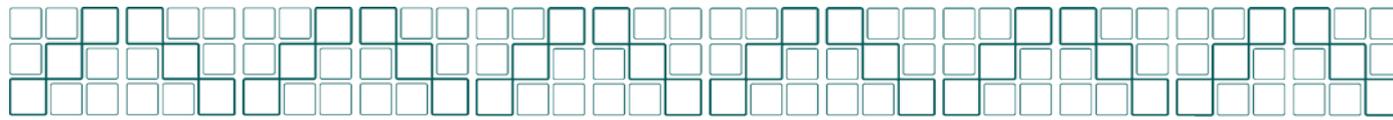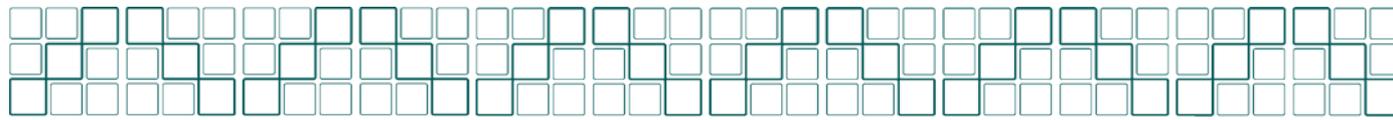
Title

- Concise and descriptive

- Example:

  - <u>Title:</u> "Neurotransmitter Switching in the Adult Brain Regulates Behavior" *Science* (2013)

  - <u>Authors</u>: Davide Dulcis, Pouya Jamshidi, Stefan Leutgeb, Nicholas C. Spitzer
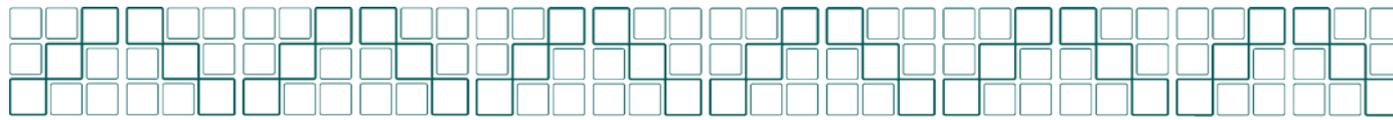
Abstract

- 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
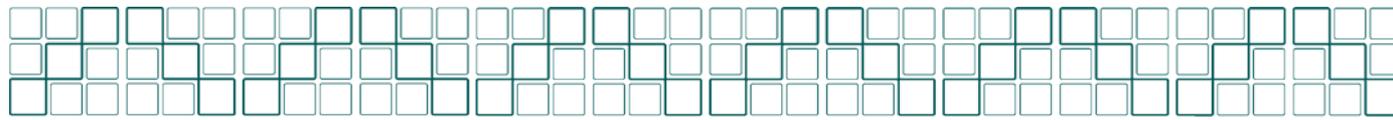- Minimal interpretations of the data
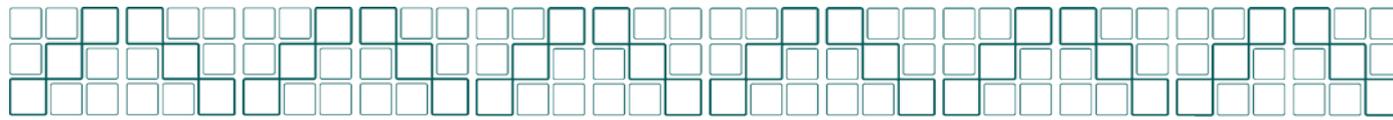
Discussion

- 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
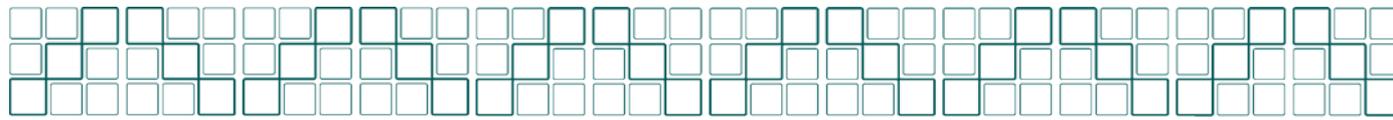
- Suggest future directions

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
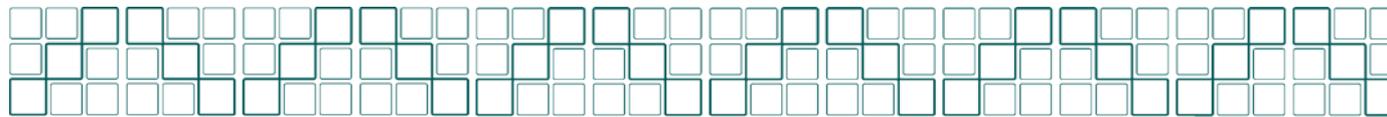
Get an Overview

- 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?
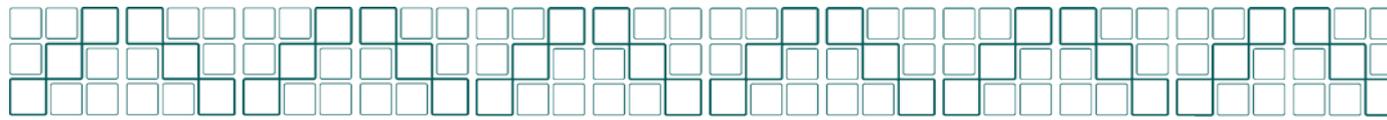
Critically Evaluate the Paper

- 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

- Basic Structure and Types of Scientific Papers. Effective Medical Writing, Singapore Med J, 2008

- 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

- Efficient Reading of Papers in Science and Technology: http://www.cs.columbia.edu/~hgs/netbib/efficientReading.pdf