MSc Research Skills

Topic: Critical reading and abstracting

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Topics

1. **Critical reading** of a research paper

2. **Abstracting** a research paper or thesis

These two are linked: to abstract a paper you must be able to find the most important information.

You will have to write an abstract of your own thesis; this is the same skill as abstracting a research paper.

Topic: Critical reading

The discussion of critical reading includes these topics:

1. **Purpose** of a research paper
   - Why are they written?

2. **Difficulties** reading a research paper
   - Unfamiliar methods and terms, compact style, many references . . .

3. Reading **strategies**
   - What to read first, how to skim, which details to read . . .

4. **Levels of understanding**: Comprehension, evaluation, synthesis
   - What is your opinion of the work? How can it help you?

Key points

1. The **research paper** is the **primary unit of scientific production**.
   - They have defined quality standards.
   - Most of your information should come from these.

2. Research papers are written for **specialists** with a strong background in the subject matter.
   - A beginning student does not usually have such a background.
   - So that student may have to strengthen background (read items in the reference list or textbooks) to be able to understand the paper.

3. Your goal is to **extract** the information **you** need from the paper.
   - You may not need all the information (maybe only a method? or a conclusion?)

(continued . . .)

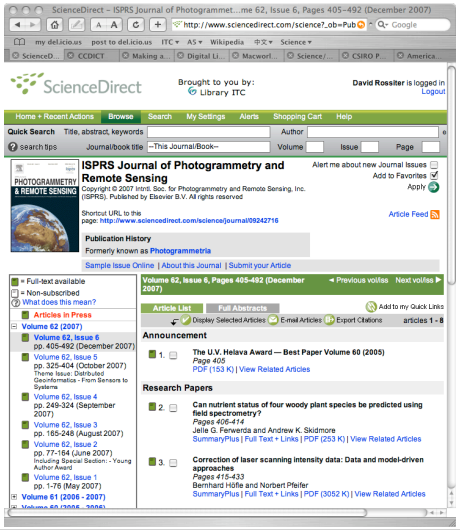
Key points (continued)

4. At the same time, you must **evaluate the reliability** of the paper.
   - This requires **experience** and **common sense**.
5. And, it can help you **plan your own research**.
   - Unanswered questions can motivate your research questions;
   - Methods may be applicable to your work;
   - Conclusions can be compared to your anticipated conclusions.

What is a research paper?

- The **primary unit of scientific production**
- Presents **original work** done by the authors, along with a claim for the work's **novelty** and **significance**.
- Attempts to answer one or more **research questions**, identified by the authors, which have not previously been answered by others.
- Published in a **peer-reviewed** scientific journal
  - A **peer** is an expert worker in the same field, who is qualified to evaluate the proposed paper before it is accepted for publication.
  - Original meaning of "peer" from English social system: "A person of the same civil or ecclesiastical status or rank as the person in question; an equal before the law" [OED]
  - The peer reviewers and journal editor have done some **quality control**

Journal Table of Contents



Difficulties reading research papers

It can be **intimidating** ("scary") to read research papers, giving the beginner the feeling that they won't be able to understand it:

- The specialized **vocabulary** may be unfamiliar
- The advanced or specialized **methods** may be unfamiliar
  - modern research uses sophisticated methods, well beyond textbooks
- The **writing** is compact . . .
  - The audience is experienced research scientists with a knowledge of the field covered by the journal;
  - Thus many arguments have limited **warrants**; these are implicit as backing, accepted by expert readers.

(continued . . .)

Difficulties (continued)

- A good paper will be fairly **comprehensive** ("deep")
  - The **argument** may be sophisticated and require a good background to understand.
- A good paper will refer to a large amount of **other work** in the field
  - You must understand these before you can fairly evaluate this paper's claims.

Why read a research paper?

Of course, you can read purely out of curiosity, but in the context of research:

- The research paper should help you **plan and execute your own research**.
  - The **literature review** should be largely based on research and review papers.
- So, your goal is to **extract what is useful to you** in your own research.
  - There is usually no need to understand everything in the paper.
  - Especially methods that are not relevant to you; the peer reviewer has ensured that these are applicable and correctly-applied.
- You do need to understand how it all fits together, i.e. the structure of the **argument**.

How to approach a research paper

Not all papers are equally useful to you. So:

1. first **skim** (scan, browse)
   - See what the paper is about, its relevance to you
2. then **go deep** as necessary
   - Extract the information you need, evaluate it

Strategy

1. Read the **title** (is the subject relevant?)
2. Read the **abstract** (maybe this is all you need)
3. Skim the paper for its **structure** (organization)
4. Read the **introduction** (context and purpose of the research)
5. Identify the research **objectives** and **questions**;

   (continued . . .)

   At this point you should know how deeply you need to go into the paper.

Strategy (continued)

If you need to know more:

6. Read the **conclusions**
   - Were objectives met, questions answered?
   - How does this fit with other work?
   - What are the implications for future work (theirs or yours)?
7. Read the **methods** (how was the research carried out?)
8. Read the **results** (what was discovered?)

While reading ...

- Decide what parts of the paper you need to **understand in depth** and what parts you can safely **skim over**;
- Identify the **vocabulary** you don't understand and learn it from the listed references or a textbook;
- Follow the **references** (citations) for explanations in depth
  - for **methods**
  - to verify the authors' **interpretation of other works**
- Critically evaluate the **claims** in the paper.
  - Do you accept the author's argument?
  - Can you find flaws in their logic?

A three-step approach to reading

Following P W L Fong[1]:

1. **comprehension** of what the authors are saying;
2. **evaluation** of their claims;
3. **synthesis** and motivation for your own research.

These are explained in detail in the textbook, in outline here.

[1] http://www2.cs.uregina.ca/~pwlfong/CS499/reading-paper.pdf

Comprehension

The first step is to figure out what the authors claim:

- **Why** was this research done? What was the **objective** or **problem**?
  - To gain knowledge of something in the real world?
  - To develop or improve a method for this?
  - To design or develop a device or system? ...
- How do the authors **claim** to solve the problem or meet the objective?
- What do they claim is **new** ("novel", "innovative")?
  - The approach, the results, the methods ...
- What **methods** were used to address the problem?
  - Experiments (lab, field); simulations; computer programs; observations; interviews ...

(continued ...)

Comprehension (continued)

- What is the **result** of applying these methods?
- Are there any **case studies**?
- What makes the claims **scientific** (based on facts and logic), not just opinions?
- How do the authors **substantiate** (back up) their claims?
- What **conclusions** do the authors draw from their results?
- Do the authors make any **recommendations**, e.g. for further research on the same or related topic?

At this point we know what they did. But is it valid? That is the next step.

Evaluation

The second step is to evaluate how successful the authors were:

What do **you** think of their claims? This requires experience in the field and critical thinking.

- How **significant** is the research **problem**?
  - Important, unsolved, difficult vs. unimportant, mostly solved, easy.
- How **significant** is the **contribution** to solving the problem?
  - Do the authors solve all, part or none of the problem?
- How **valid** is the **approach**? Is the method adequate? Are the assumptions and limitations of the approach respected?
- How **valid** are the **claims** of success?

Be skeptical!

Remember, the authors (and reviewers) are humans; the scientific enterprise is also a human enterprise. So . . . **don't believe everything you read** at face value.

Some work requires extra skepticism:

- Work with an obvious **commercial** or **political** interest
- Work that claims to be **completely novel** (outside of existing paradigms)
- Work with results that are in almost **perfect agreement with the authors' hypotheses**. The authors may be guilty of **wishful thinking** (at best).
- Work that claims to **overturn** a large body of previous results.

"Precisely because of human fallibility, **extraordinary claims require extraordinary evidence**." – Carl Sagan (1997), *The demon-haunted world*

Synthesis

Here we put the paper in **context**, see where it fits in the overall **research agenda**, and determine whether we can do **better**

This requires a **strong background** in the research field; you will have to do a lot of **reading and comparing** to do step this properly.

- What, finally, is the **essential research problem** that was addressed, and **how well** was it addressed?
- Could the research be **improved**? Deepened? Extended? If so, how?
- Are there **other approaches** to the research problem? Did the authors pick the most suitable, or can you think of another approach that might be more fruitful?

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Synthesis (2/2)

- Did the authors get **full value** from their approach and data? Could a **deeper analysis** have been done, to gain additional insight into the problem?
- Do the authors make a good argument to back up their claims, or can you think of a **stronger argument**?
- Can you make an **argument against** the case made by the authors? I.e. can you think of a counter-argument that would explain their results but with a different explanation? Can you think then of some way to **determine which argument is correct**?
- Are the research results valid in a **wider context**? Is more research needed to determine this? What aspects of the research might be different in another context?
- What are the **unsolved problems** related to this research?

Final thoughts

- Reading a research paper is difficult but rewarding: for your understanding and to support your own research.
- It can be read on several levels (skim, then deep)
- **Comprehension** may be time-consuming but it is straightforward
- **Evaluation** requires strong background and **critical thinking**
- **Synthesis** directly motivates your **own research**

Topic: Abstracting

1. Importance
2. "Paper in miniature" structure
3. Structure

Importance of the abstract

- The abstract is often **the only part of your work that will be read**
  - it may be all that is **available** to the reader (e.g. via on-line abstracting services, without expensive full-text access)
  - the reader has **limited time** and a lot of literature to read
- The abstract is used by many readers to **decide whether to read the whole paper**
- Some readers **only need the most important information** from the paper
  - Not their specialty, but they need the main results or methods

Intended audience for the abstract

1. Colleague **researchers** in the **same** research field
   - They may well go on to read the full paper if the abstract interests them, they can get the details they need from the full paper
2. Colleague **researchers** in **related** research fields
   - They are unlikely to need the full paper, they want to main conclusions.

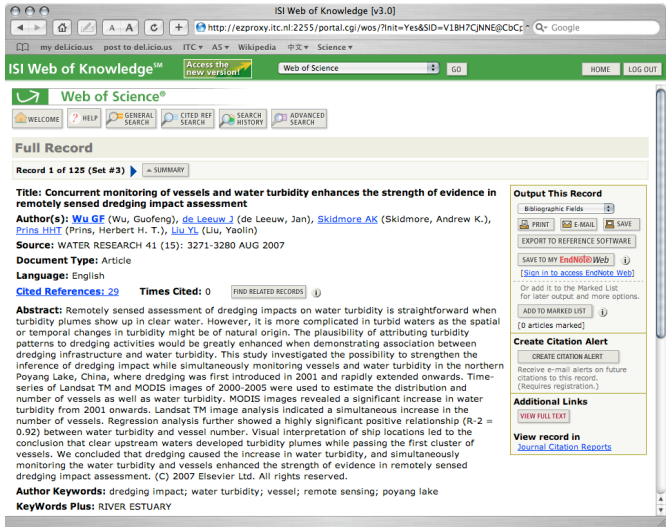
Not intended for:

- Scientifically-literate **policy makers** (they need **executive summaries**)
- **General public** (they need **popular-science news articles**)

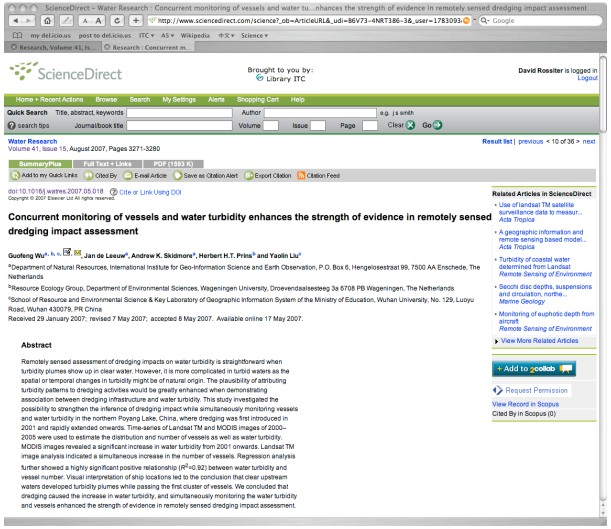
Where are abstracts found?

- At the head of the paper in the **printed journal**
- At the head of the paper in the **on-line journal**
- In **on-line abstract databases**, e.g. Web of Science

Web of Science abstract database



Abstract in the on-line journal



The "Paper in Miniature" abstract

Various styles of abstract, but most common in research is:

- the **paper in miniature** style
- everything that is **important** in the paper goes in the abstract
- **abbreviated**
  - writing must be **compact** ("terse", "concise")
  - no room for **detailed reasoning**
  - no room for **justification**
  - **compact** writing style

Format of the abstract

Usually:

- **one** continuous paragraph;
- **limit** of 250 to 300 words, depending on journal;
- **no citations** unless specifically answering another paper;
- **no formulas** unless they are the key result.

Structure of the abstract

As the thesis or paper, with one or more sentences for each section.

Typical structure:

1. **Rationale** (motivation, context)
2. **Hypothesis** and **objectives**
3. **Methods** (what was done)
4. **Results and discussion** (what was found and how to interpret it)
5. **Conclusions** (take-home message for readers)

These are not labelled as such in the abstract, they are implied in the structure.

Balance

Depends on the main purpose of the paper.

- Where the **research results** are most important:
  1. Rationale 5%
  2. Hypothesis and objectives 15%
  3. Methods 25%
  4. Results and discussion 40%
  5. Conclusions 15%
- Where the **methods** are most important, reverse Methods and Results.

Style points

- **Compact** writing
  - Omit: "The results show that . . . ", "The analysis reveals" etc.
  - Sentences from the paper are generally **condensed**
- Be **specific**
  - *Not*: "Accelerated soil erosion is recognized as a serious problem in many of the world's poorer areas"
  - *Instead*: "Accelerated soil erosion in the Shiyan watershed has doubled since the abandonment of traditional cultivation practices in the late 1980's"

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Abstract Style (2/2)

- Do not refer to the main body of the text ("will be discussed" or "as shown in Table 2"); the **abstract must stand alone**
- Do not refer to tables or figures in the body of the paper.
- Limit the use of non-standard **abbreviations**, and define the ones you do use.
- Do not include any **citations** unless the main purpose of the paper is to discuss another work.

Final thoughts

- A good abstract is the most important means to **communicate research** to **fellow scientists**.
- It is **difficult** to write an informative abstract.
- Writing must be **clear but compact**.
- **Maximum information** in **minimum space**.
- Check balance against balance of the main message of the paper.
- **Write**, then **re-write**, then **re-write again**!