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Informatics Research Review (IRR)

Lecture 4: Critical Reviewing, Building an Argument, and Structure & Narration

2018/19

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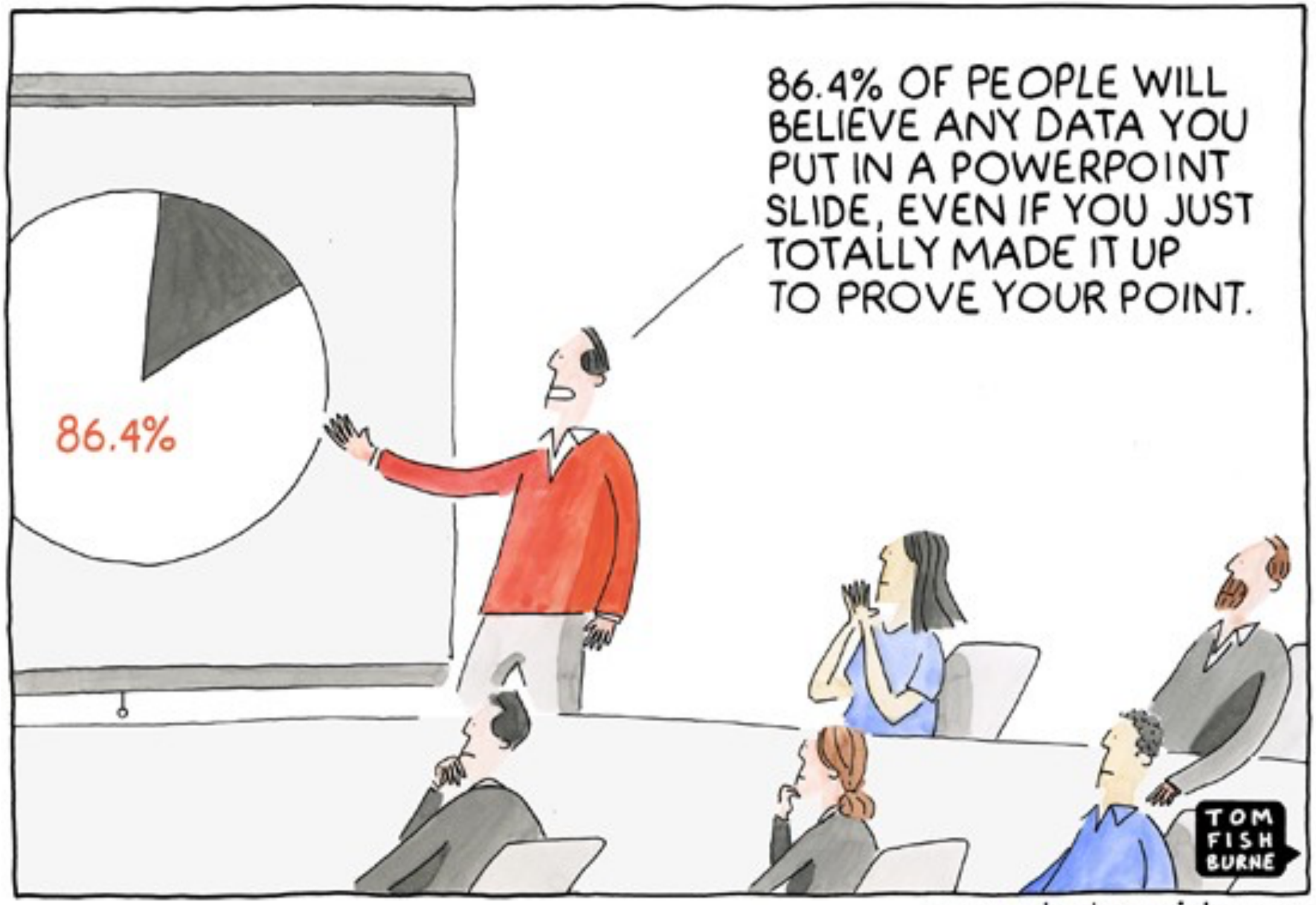
Critical Reviewing


86.4%
86.4% OF PEOPLE WILL BELIEVE ANY DATA YOU PUT IN A POWERPOINT SLIDE, EVEN IF YOU JUST TOTALLY MADE IT UP TO PROVE YOUR POINT.
TOM FISH BURNE
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A ROUGH GUIDE TO SPOTTING BAD SCIENCE

1. SENSATIONALISED HEADLINES

Aa

Headlines of articles are commonly designed to entice viewers into clicking on and reading the article. At best, they over-simplify the findings of research. At worst, they sensationalise and misrepresent them.

2. MISINTERPRETED RESULTS

News articles sometimes distort or misinterpret the findings of research for the sake of a good story, intentionally or otherwise. If possible, try to read the original research, rather than relying on the article based on it for information.

3. CONFLICT OF INTERESTS

Many companies employ scientists to carry out and publish research - whilst this does not necessarily invalidate research, it should be analysed with this in mind. Research can also be misrepresented for personal or financial gain.

4. CORRELATION & CAUSATION

Be wary of confusion of correlation & causation. Correlation between two variables doesn't automatically mean one causes the other. Global warming has increased since the 1800s, and pirate numbers decreased, but lack of pirates doesn't cause global warming.

5. SPECULATIVE LANGUAGE

???

Speculations from research are just that - speculation. Be on the look out for words such as 'may', 'could', 'might', and others, as it is unlikely the research provides hard evidence for any conclusions they precede.

6. SAMPLE SIZE TOO SMALL

In trials, the smaller a sample size, the lower the confidence in the results from that sample. Conclusions drawn should be considered with this in mind, though in some cases small samples are unavoidable. It may be cause for suspicion if a large sample was possible but avoided.

7. UNREPRESENTATIVE SAMPLES

In human trials, researchers will try to select individuals that are representative of a larger population. If the sample is different from the population as a whole, then the conclusions may well also be different.

8. NO CONTROL GROUP USED

In clinical trials, results from test subjects should be compared to a 'control group' not given the substance being tested. Groups should also be allocated randomly. In general experiments, a control test should be used where all variables are controlled.

9. NO BLIND TESTING USED

To prevent any bias, subjects should not know if they are in the test or the control group. In double-blind testing, even researchers don't know which group subjects are in until after testing. Note, blind testing isn't always feasible, or ethical.

10. 'CHERRY-PICKED' RESULTS

This involves selecting data from experiments which supports the conclusion of the research, whilst ignoring those that do not. If a research paper draws conclusions from a selection of its results, not all, it may be cherry-picking.

11. UNREPLICABLE RESULTS

Results should be replicable by independent research, and tested over a wide range of conditions (where possible) to ensure they are generalisable. Extraordinary claims require extraordinary evidence - that is, much more than one independent study!

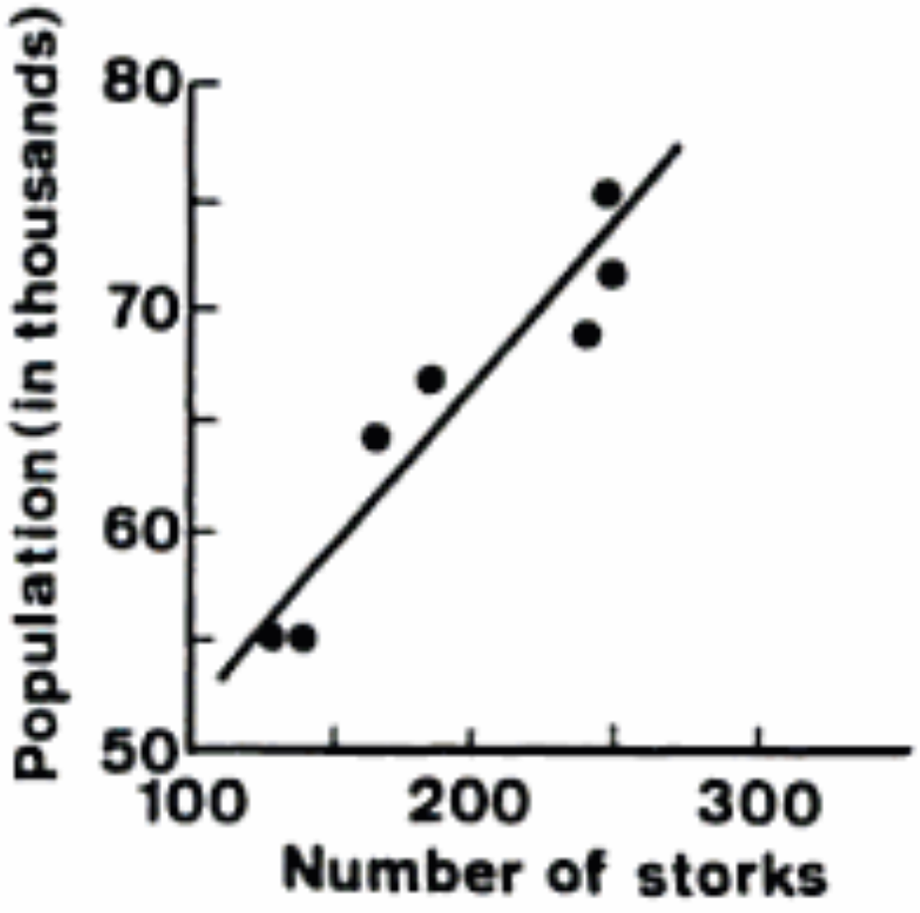
12. JOURNALS & CITATIONS

Research published to major journals will have undergone a review process, but can still be flawed, so should still be evaluated with these points in mind. Similarly, large numbers of citations do not always indicate that research is highly regarded.

2014 COMPOUND INTEREST - WWW.COMPOUNDCHEM.COM

www.compoundchem.com

Correlation & Causation



Robert Matthews. **Storks Deliver Babies (p=0.008).** Teaching Statistics. Volume 22, Number 2, Summer 2000

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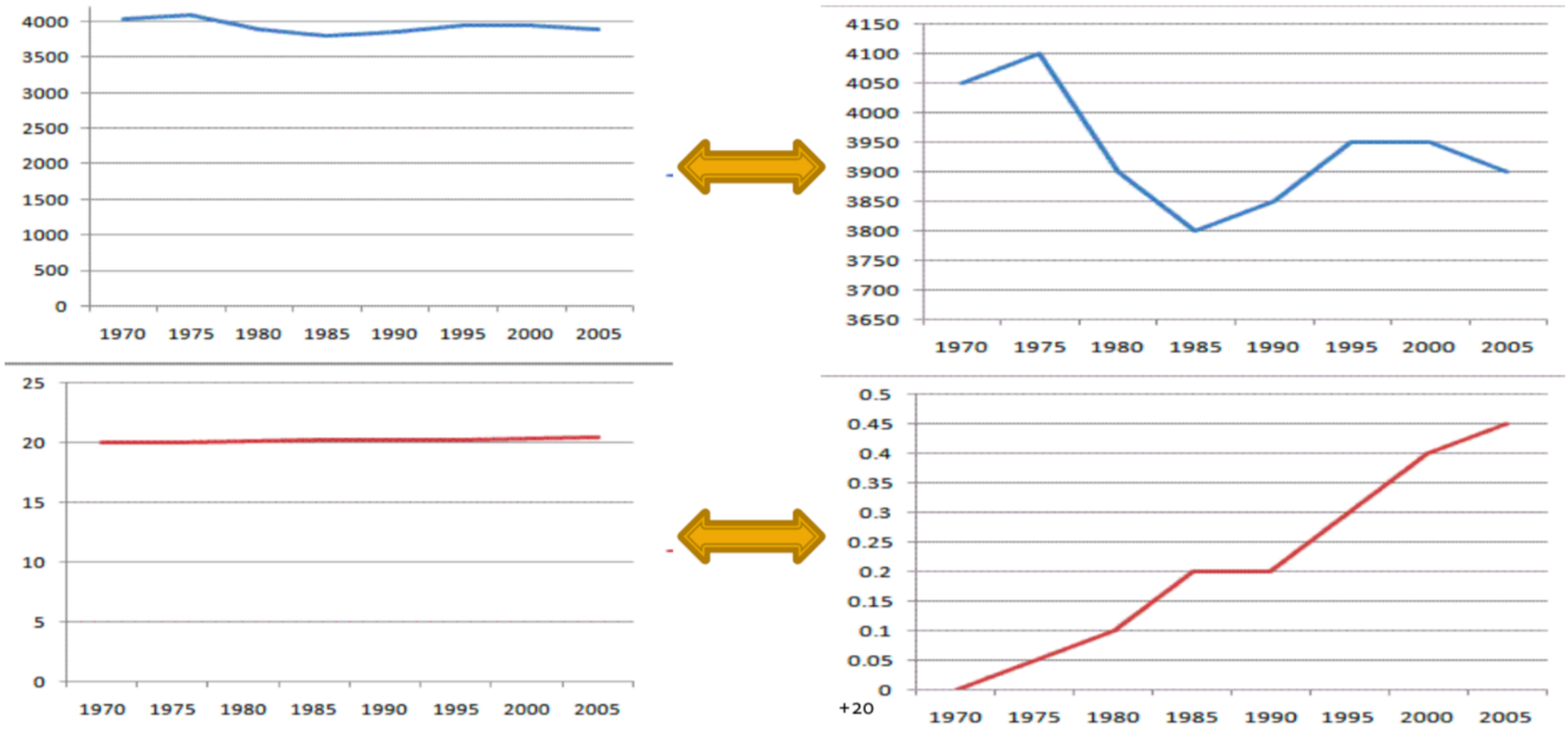
How to Lie, Cheat, Manipulate, and Mislead using Statistics and Graphical Displays.

How to Lie, Cheat, Manipulate, and Mislead using Chart Adjustments



This is real data. The top graph shows the cosmic radiation rate in neutrons per hour. The lower is the temperature change since 1975 when it started. All from the BBC's website. They weren't trying to lie, cheat, manipulate, or mislead! No sirree.

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What I often observe

- Not comparing against the state of the art, but some arbitrary baseline
  - What's the **baseline**? What's the most **up to date competitor**?
- **Cherry-picking** of data points, **non-representative** data points
- **No significance**, e.g. a single run with 3% improvement in a system with 10% noise
- **Solve another/smaller problem** than claim to have solved
- Solution is not a solution
  - Ignoring a (non-technical) aspect: **Solution not practical** in the real world
  - Inappropriate model: **Solution does not translate** to real world
  - Ignoring costly handling of corner cases: **Broken solution**

Critical Questions

- Does this article **fit** with other research in the area? How does it **differ**?
- Does the author **account for variation** from other researchers and findings?
- Have I identified the **major findings** of this author?
- What is the **theoretical framework**, the **rhetorical purpose**, and the **practical perspective** of this author?
- Is the author internally **consistent**?
- Does the author provide **enough evidence** to support the claims being made?
- Are the sources of **evidence appropriate**?
- Do the **conclusions follow from the evidence** or study findings presented?
- Does the **methodology** match the type of question being asked?

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Critically Reviewing your own Work

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Reviewing your Review

- Why did you **include** some of the literature and **exclude** others?
- What is the balance between **description** and **comment**?
- Have you missed out any **important dimension** of the argument, or literature?
- Is the material presented in the most **effective order**?
- Have you been sufficiently **critical** of theories, design or methodological issues?
- Have you indicated when results/ideas were **conflicting** or **inconclusive** and **discussed possible reasons**?

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Reviewing your Review

- Are there places where the reader is left with **unanswered questions**?
- Have you explained to the reader the **relevance** of each piece of evidence?
- Is there any material that is **interesting but which does not contribute** to the development of the argument?
- Have you explained adequately the **justification** for this research approach/topic/question?
- Are the references **complete** and up to date?
- How effective is my **linking** of all the elements?

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Building an Argument

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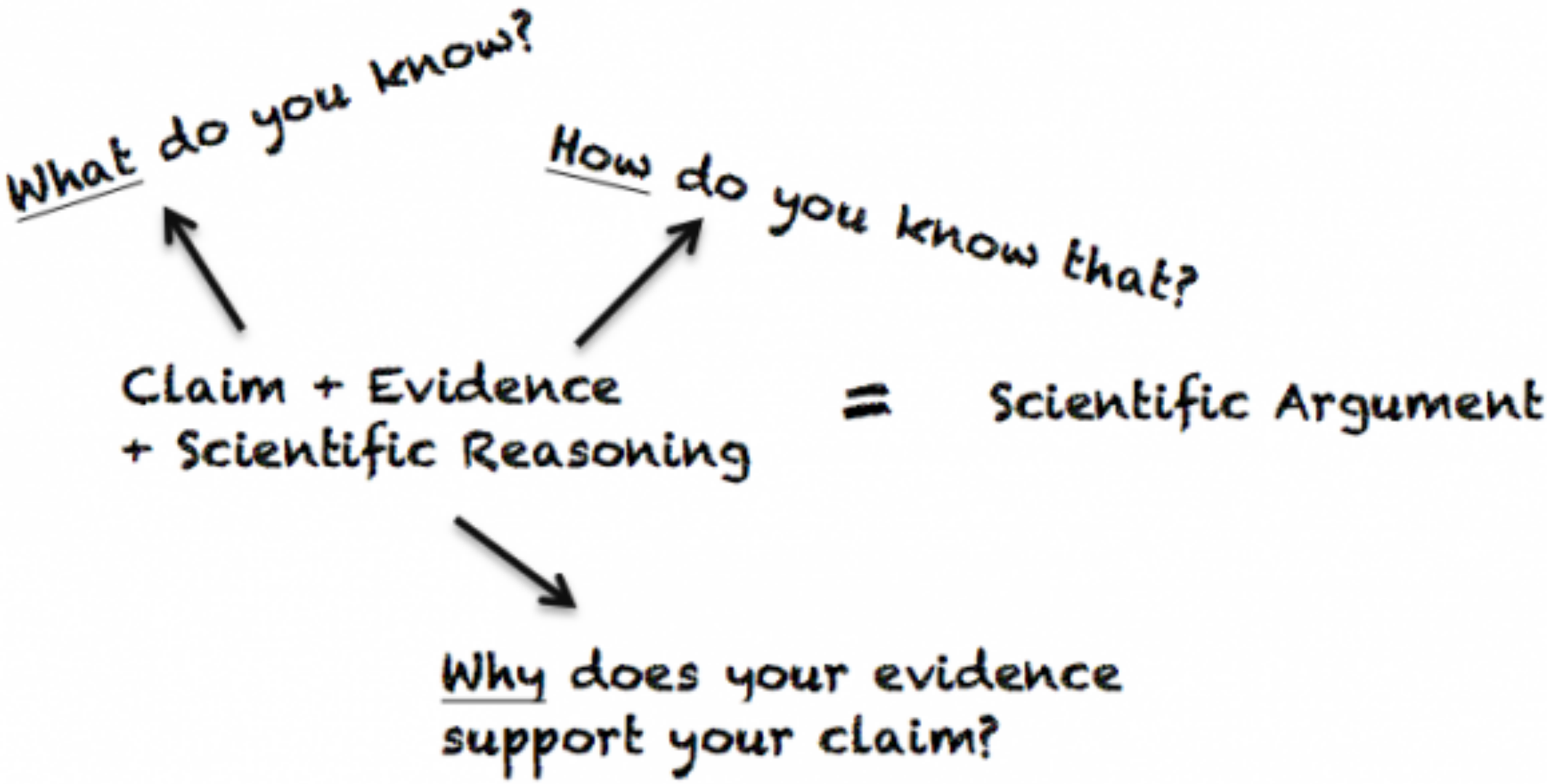
Scientific Argument



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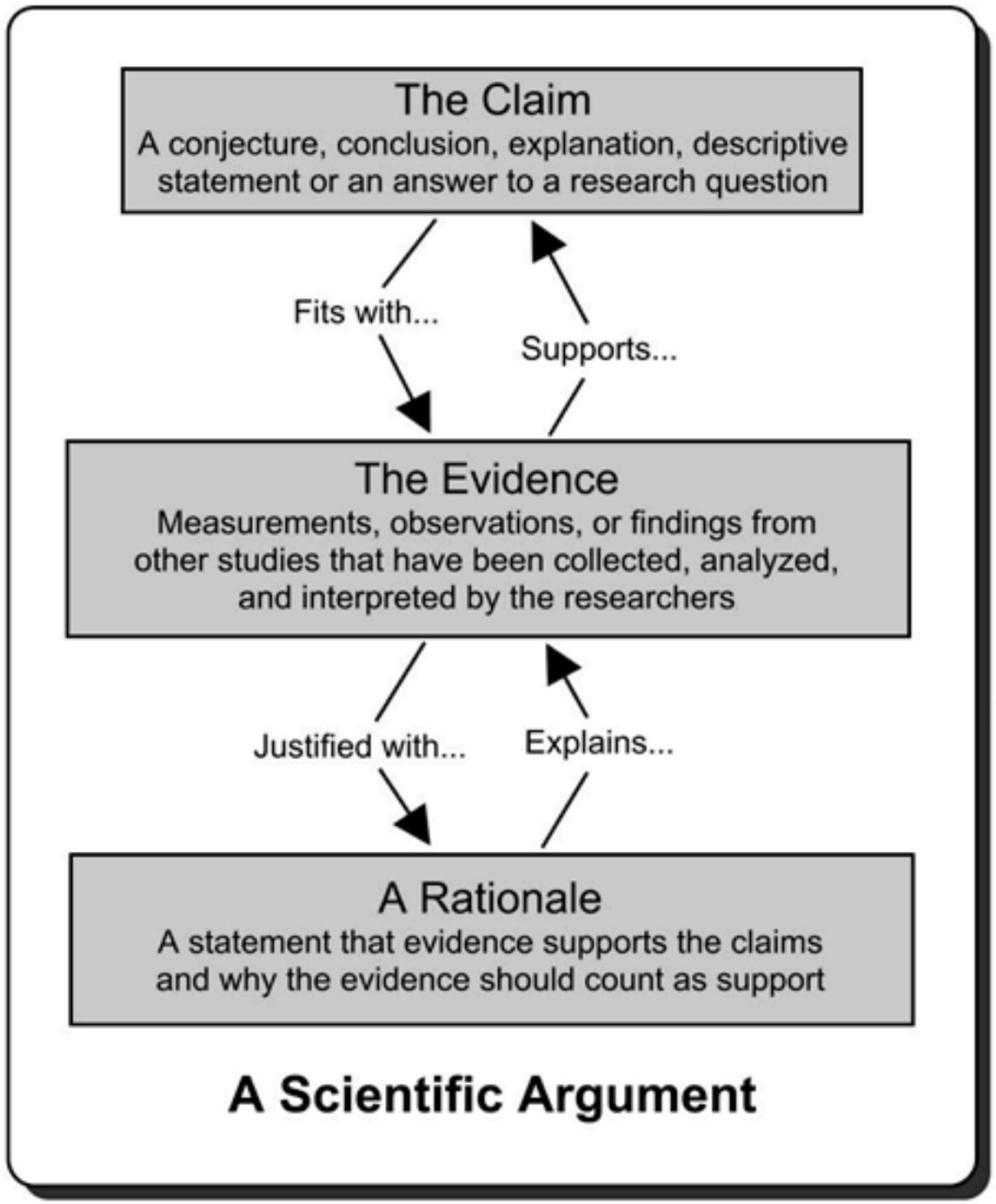
Scientific Argument



Developing your Argument

- Outline your arguments in the **introduction** clearly and precisely
- Use **headings/paragraphs** to separate categories and major/minor arguments
- Revise sentences that indicate subjectivity (we know everything is subjective, but you don't want to water down argument by using "I feel," "I think," or "I believe.")
- Avoid other tendencies such as overusing pronouns and vague references. Be **concrete and specific**.
- If your claims are not original, that's fine. **Cite** the origin(s). Give others **credit** for their ideas.
- Again, **avoid plagiarism**; if the idea or statement is not yours, cite your source.
- **Paraphrasing** is more common than direct quoting in a review (not a hard and fast rule).
- **Remember that a literature review is not really just a "review".** It is your argument, which begins with and builds from and moves beyond the stuff you read.

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Structure and Narration

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Structure

- Introduction
- Body
- Summary & Conclusion
- References

Introduction

- **Define or identify the general topic**, issue, or area of concern, thus providing an appropriate context for reviewing the literature.

- **Point out overall trends** in what has been published about the topic; or conflicts in theory, methodology, evidence, and conclusions; or gaps in research and scholarship; or a single problem or new perspective of immediate interest.

- Establish the writer's reason (**point of view**) for reviewing the literature; explain the **criteria** to be used in analysing and comparing literature and the **organisation of the review** (sequence); and, when necessary, state why certain literature is or is not included (**scope**).

Body

- No one-size-fits-all solution

- **chronologically** - although be careful not just to list items; you need to write critically, not just descriptively;

- **by theme** - this is useful if there are several strands within your topic that can logically be considered separately before being brought together;

- **by sector** - e.g. industrial practice vs academic research

- **by development of ideas** - this could be useful if there are identifiable stages of idea development that can be looked at in turn;

- by some **combination** of the above, or by another structure you create.

Conclusion

- **Summarise major contributions** of significant studies and articles to the body of knowledge under review, maintaining the focus established in the introduction.

- Evaluate the current "state of the art" for the body of knowledge reviewed, pointing out major **methodological flaws or gaps** in research, **inconsistencies** in theory and findings, and areas or issues pertinent to **future study**.

- Conclude by providing some **insight** into the **relationship** between the central topic of the literature review and a larger area of study such as a discipline, a scientific endeavour, or a profession.

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Narrative Thread

Although you clearly need to write in an academic style, it can be helpful to imagine that you are **telling a story.** The thread running through the story is the explanation of why you decided to do the study that you are doing. The story needs to be logical, informative, persuasive, comprehensive and, ideally, **interesting**. It needs to reach the logical conclusion that your research is a **good idea**.

Examples

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From Crisis to Happiness

Problem Description

***Abstract*—Accurate automatic optimization heuristics are necessary for dealing with the complexity and diversity of modern hardware and software. Machine learning is a proven technique for learning such heuristics, but its success is bound by the quality of the features used. These features must be hand crafted by developers through a combination of expert domain knowledge and trial and error. This makes the quality of the final model directly dependent on the skill and available time of the system architect.**

Our work introduces a better way for building heuristics. We develop a deep neural network that learns heuristics over raw code, entirely without using code features. The neural network simultaneously constructs appropriate representations of the code and learns how best to optimize, removing the need for manual feature creation. Further, we show that our neural nets can transfer learning from one optimization problem to another, improving the accuracy of new models, without the help of human experts.

We compare the effectiveness of our automatically generated heuristics against ones with features hand-picked by experts. We examine two challenging tasks: predicting optimal mapping for heterogeneous parallelism and GPU thread coarsening factors. In 89% of the cases, the quality of our fully automatic heuristics matches or surpasses that of state-of-the-art predictive models using hand-crafted features, providing on average 14% and 12% more performance with no human effort expended on designing features.

Claims

Evidence

Crisis

Our Novel Solution

Happiness