



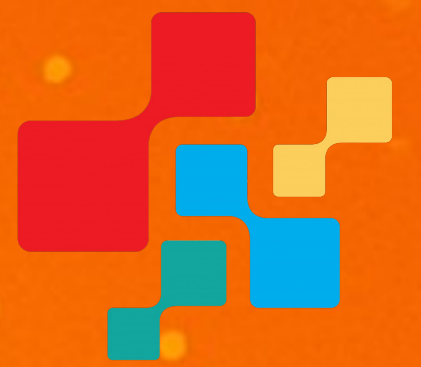
# Scientific pitfalls

193.052 Seminar Wissenschaftliches Arbeiten

Institut für Visual Computing & Human-Centered Technology (193)

Florian Michahelles

<http://media.tuwien.ac.at>

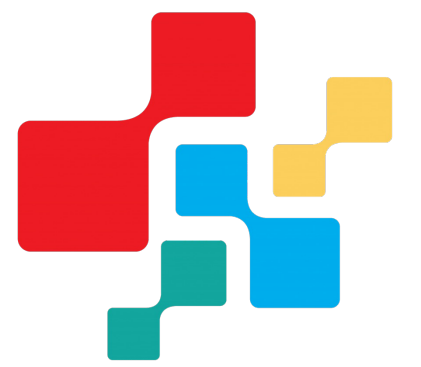


# Scientific pitfalls

# Cognitive biases

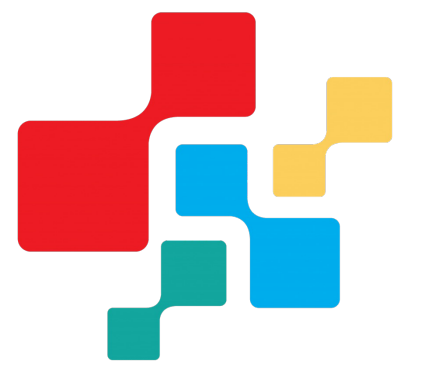
Florian Michahelles

# Goals of this video



- Recognize cognitive biases that distort reasoning
- Understand their impact on CS research
- Strategies for mitigation

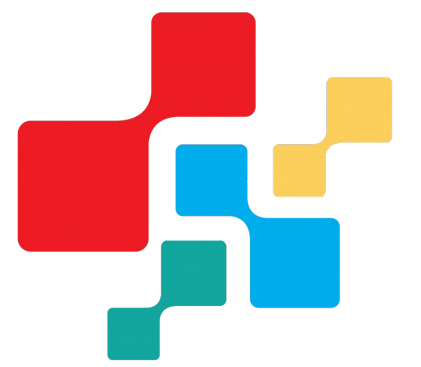
# Cognitive bias



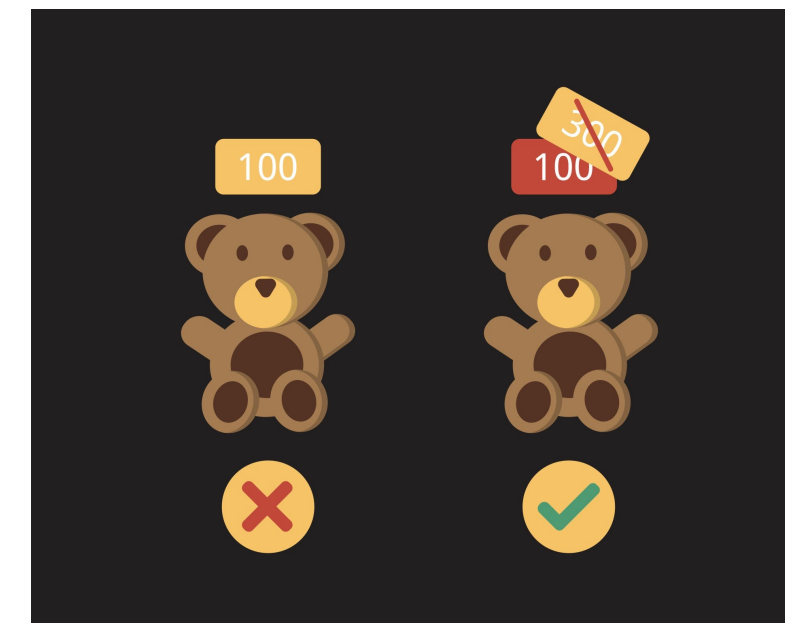
- Confirmation Bias
- Anchoring
- Availability Heuristic
- Overconfidence Bias
- Framing Effect
- Loss Aversion
- Sunk Cost Fallacy
- Fundamental Attribution Error
- Halo Effect
- Self-Serving Bias
- Ingroup Bias
- Hindsight Bias
- Recency Effect
- Peak-End Rule
- False Memory
- Selection Bias
- Publication Bias
- Survivorship Bias
- Observer Expectancy Effect

- a pattern of poor judgment, often triggered by a particular situation.
- existence of cognitive biases listed been verified in psychology experiments.

# Key Biases



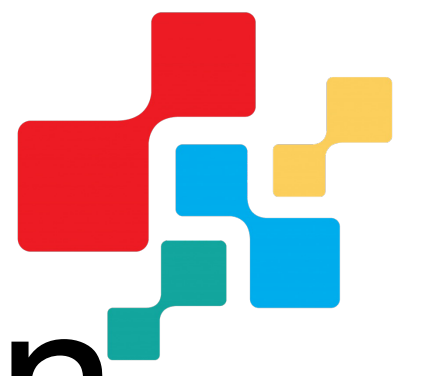
Confirmation Bias



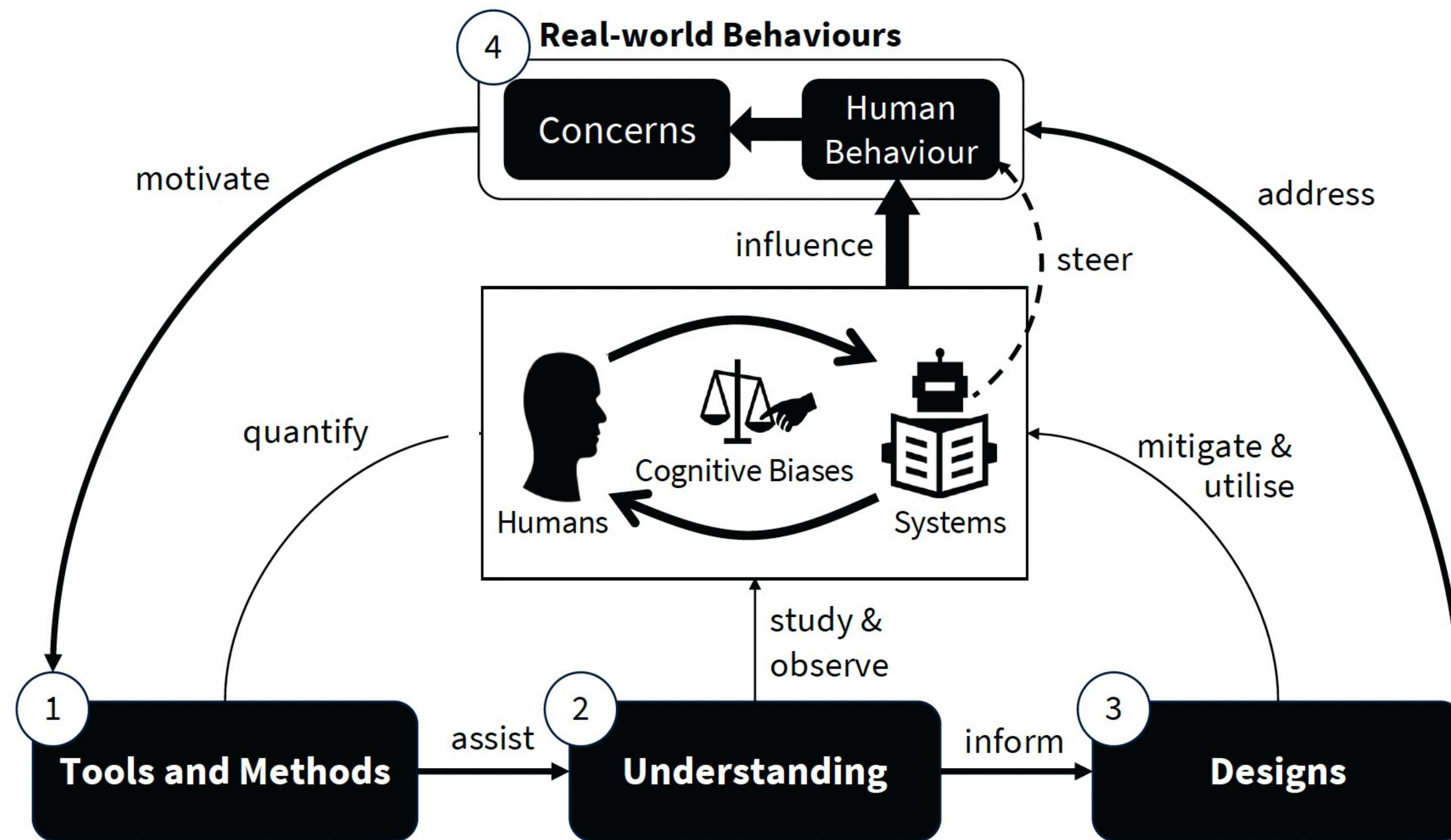
Anchoring Bias



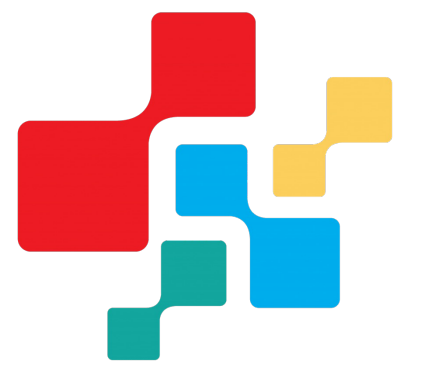
Availability Heuristic



# Cognitive bias in human-computer interaction



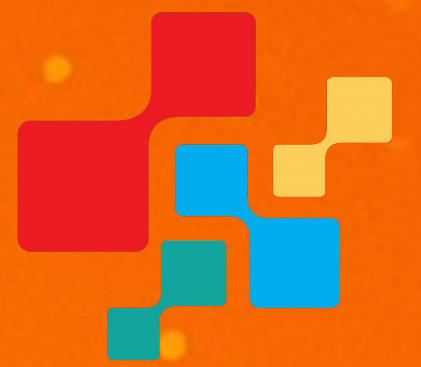
# Mitigation of biases



- ◉ Awareness
- ◉ Design strategies
- ◉ Process safeguards

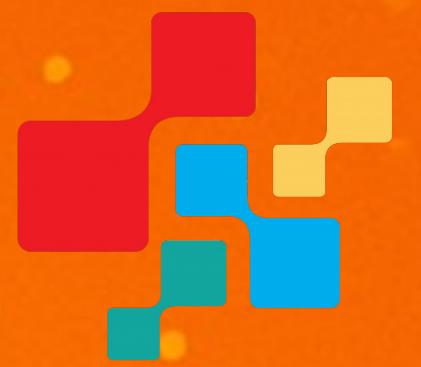


# Summary



- Bias is natural but must be addressed
- Research needs objectivity
- Understanding of biases informs new research





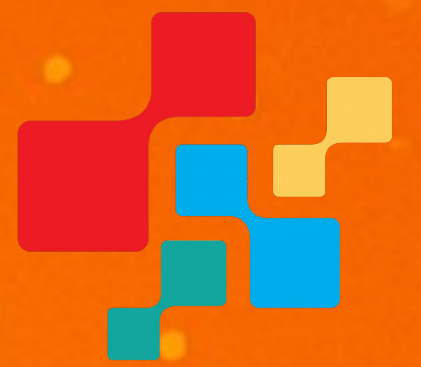
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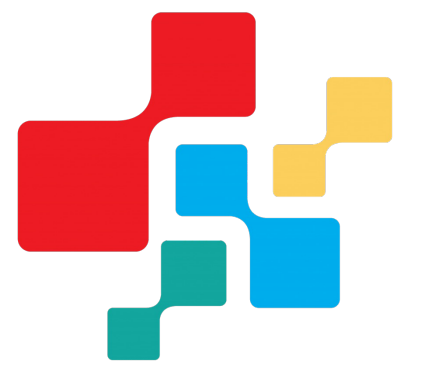


# Scientific pitfalls

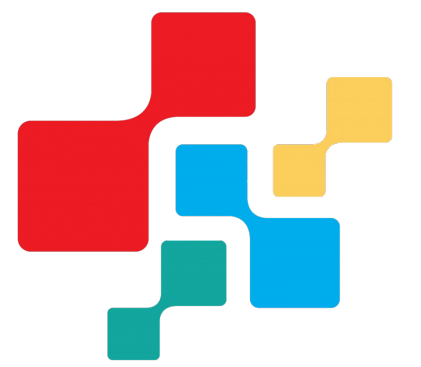
# Logical fallacies

Florian Michahelles

# Goals of this video

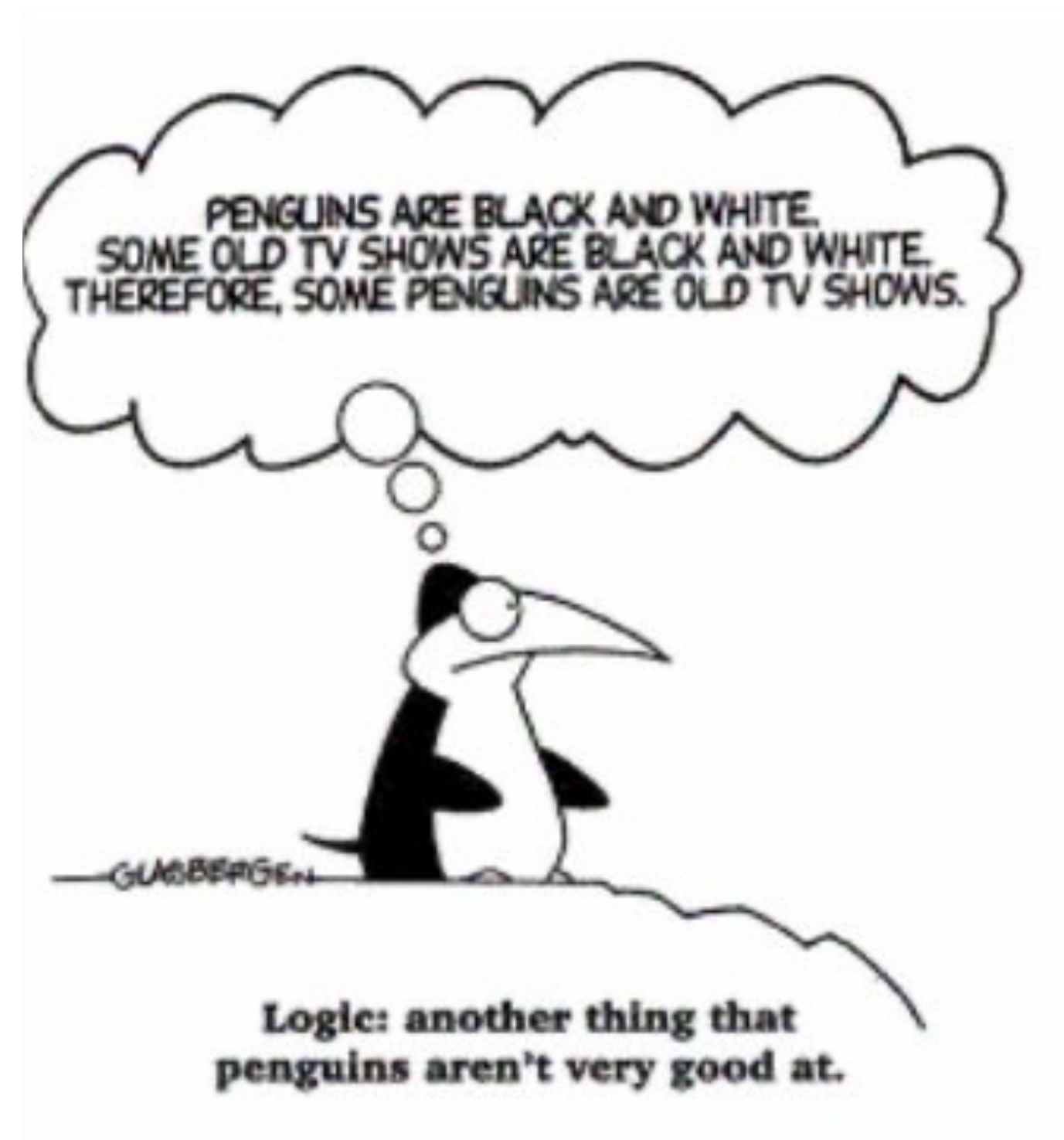


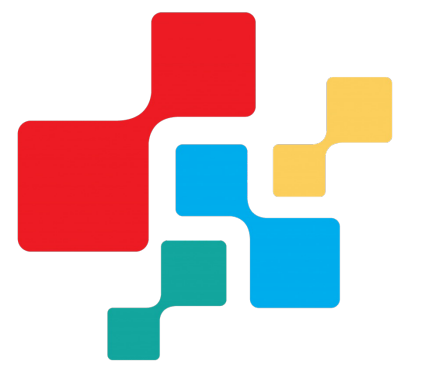
- ◉ what is a logical fallacy
- ◉ examples of fallacies
- ◉ mitigation



# Logical Fallacies

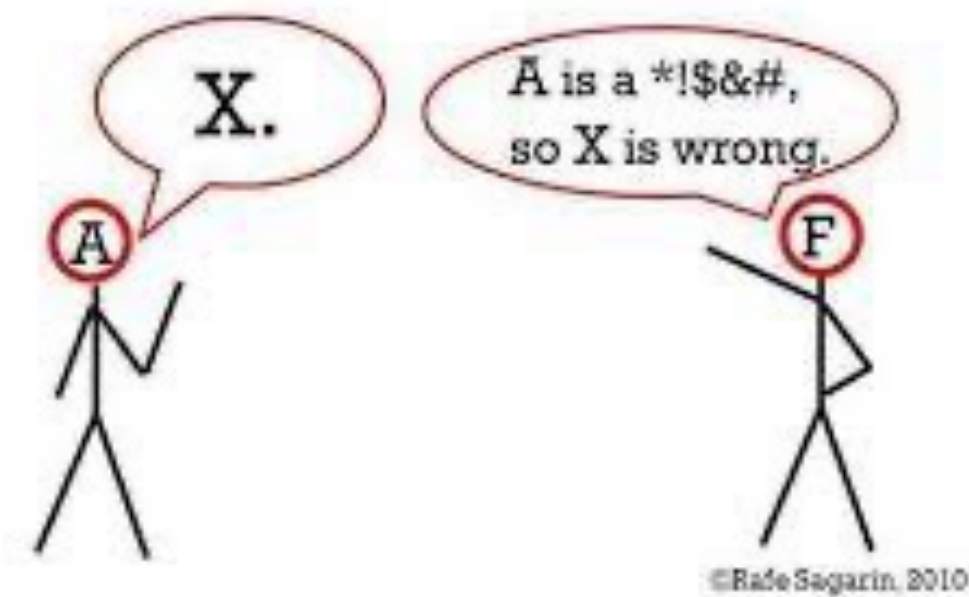
- fallacy = mistake in reasoning
  - illicitly applied method of science
  - appearance of scientific evidence where there is little or none



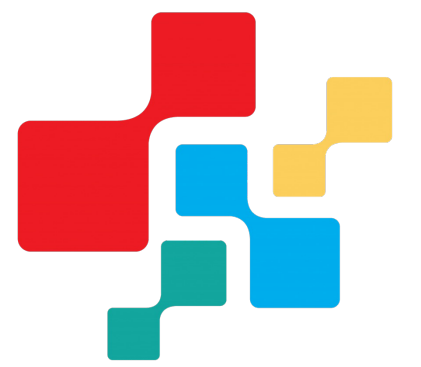


# A list of fallacies

Ad Hominem ("Against the man")



- ◉ *argumentum ad hominem*: attacking the person rather than her argument
- ◉ *false anomalies*: make something appear mysterious by omitting facts
- ◉ *argument by elimination*: argue for one alternative while ignoring other explanations
- ◉ *illicit causal inference*: correlation, concomitant variation, A precedes B
- ◉ *unsupported analogies*: applying a working explanation from one case to another
- ◉ *untestable explanation*: turn lack of evidence into evidence to be right
- ◉ *redundant prediction*: extend a theory to explain x without testing the theory
- ◉ *ad hoc rescues*: question the method, e.g. shy-ness effect
- ◉ *red herring*: diverting attention from real to irrelevant

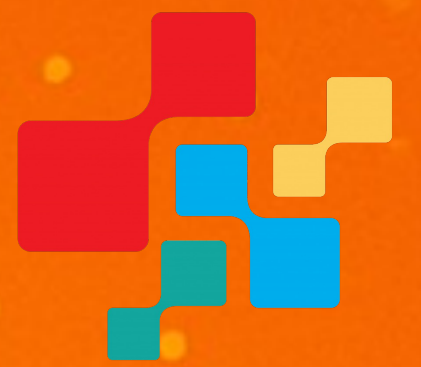


# Mitigation of fallacies

- ◉ **Check for stringency**
- ◉ **Use Structured Argumentation**
- ◉ **Consider Alternative Explanations.**
- ◉ **Validate Causal Claims Carefully**
- ◉ **Promote Transparency and Openness**
- ◉ **Avoid Distractions and Stay Focused**



# Summary



- Fallacies are around.
- Be suspicious about “science has proven”.
- Check the source, check the method.





# Scientific pitfalls

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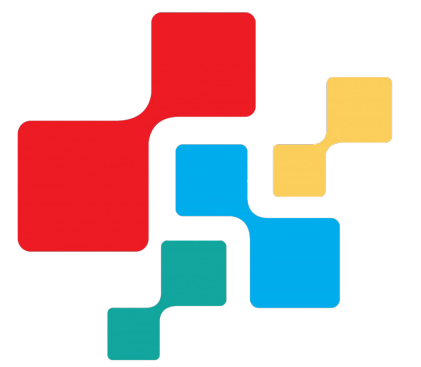


# Scientific pitfalls

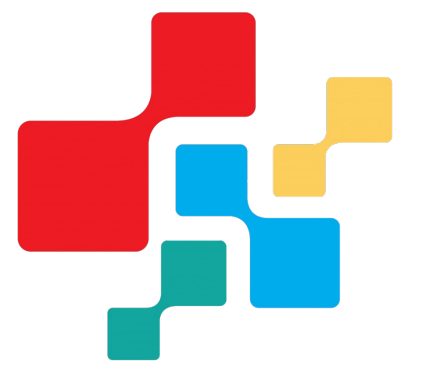
## Clever Hans

Florian Michahelles

# Goals of this video



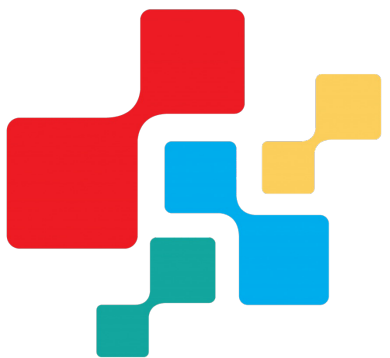
- ◉ Recap of bias and expectation
- ◉ Clever Hans
- ◉ Learnings for experiment design



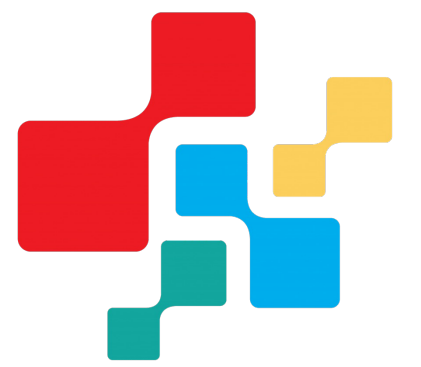
# Bias and expectation

- ◉ Experiments need to **control for potential causal factors**
- ◉ Experimentor **bias** can influence the outcome
- ◉ Clever Hans is an historical example

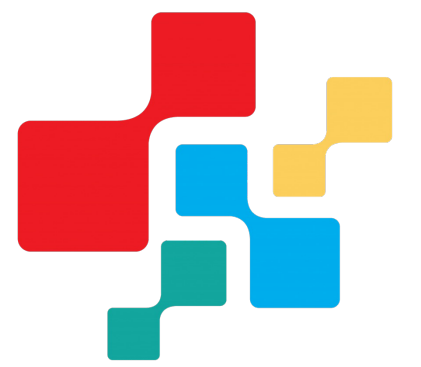
# Clever Hans – an exceptional horse?



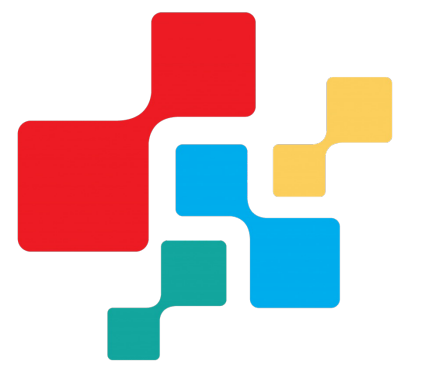
# Clever Hans on stage



# Clever Hans on trial

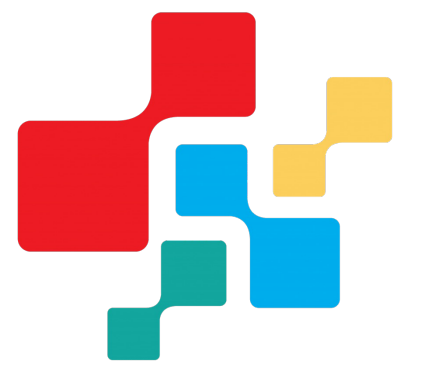


# Clever Hans - findings



- ◉ no fraud
  - ◉ horse got questions right without its owner von Osten
- ◉ questioner must know the answer, horse must see questioner
- ◉ unintentional cueing vs not genuine intellectual ability

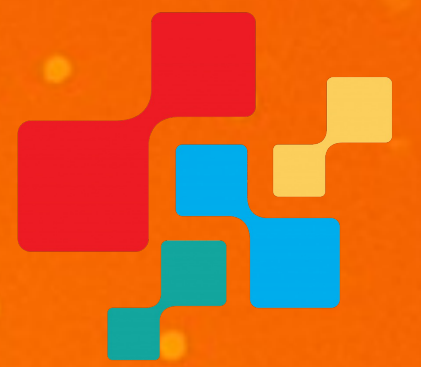
# Clever Hans effect



- The Clever Hans effect occurs when an animal—or a person—appears to perform a complex task, but is actually responding to subtle, unintentional cues from humans rather than demonstrating true understanding or skill. It highlights how expectations and unconscious signals can influence behavior and experimental outcomes.
- double blind studies
  - neither experimenter nor subjects know conditions
- reactivity
  - subjects behave different under observation
- AI
  - classification based on artifacts instead of meaningful content

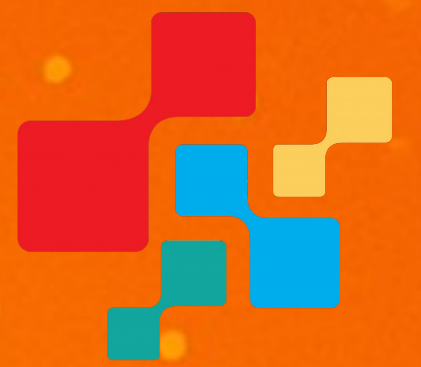


# Summary



- unintentional keys can overwrite true understanding
- AI systems may learn unintended patterns





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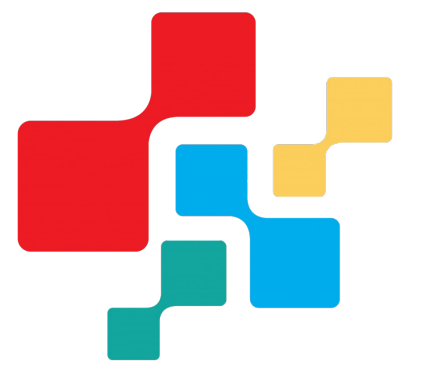
# Scientific pitfalls

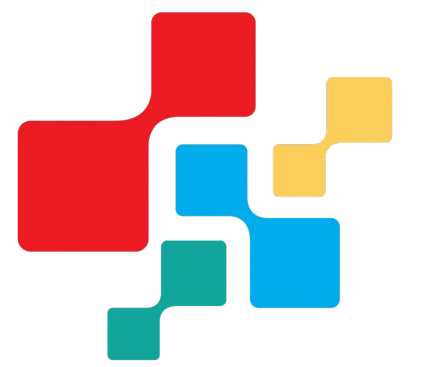
# Pseudo-science and demarcation

Florian Michahelles

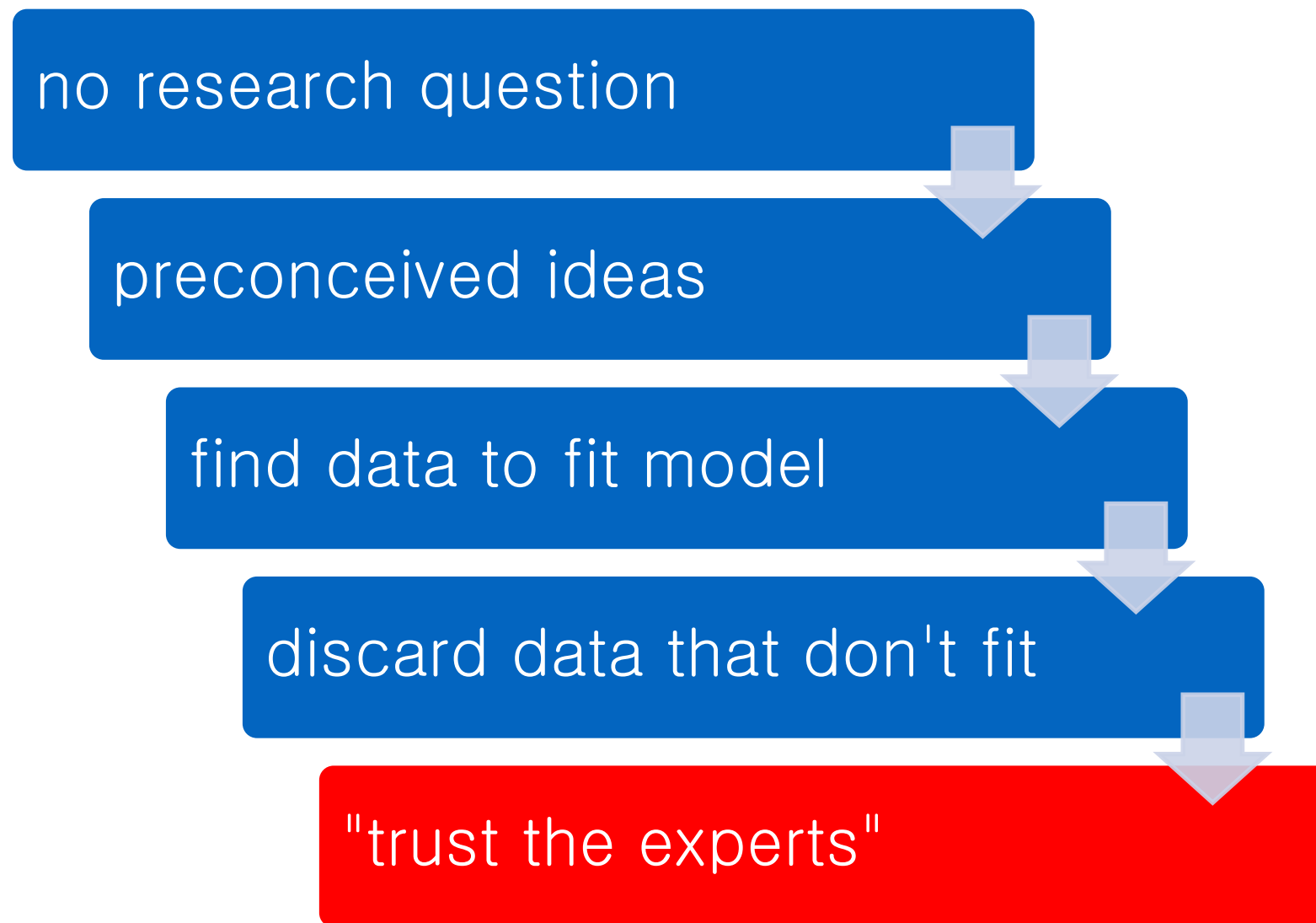
# Goals of this video

- Compare Science vs pseudoscience
- Characteristics of pseudoscience
- Computer science examples

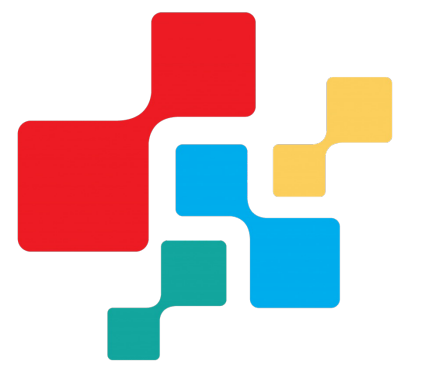




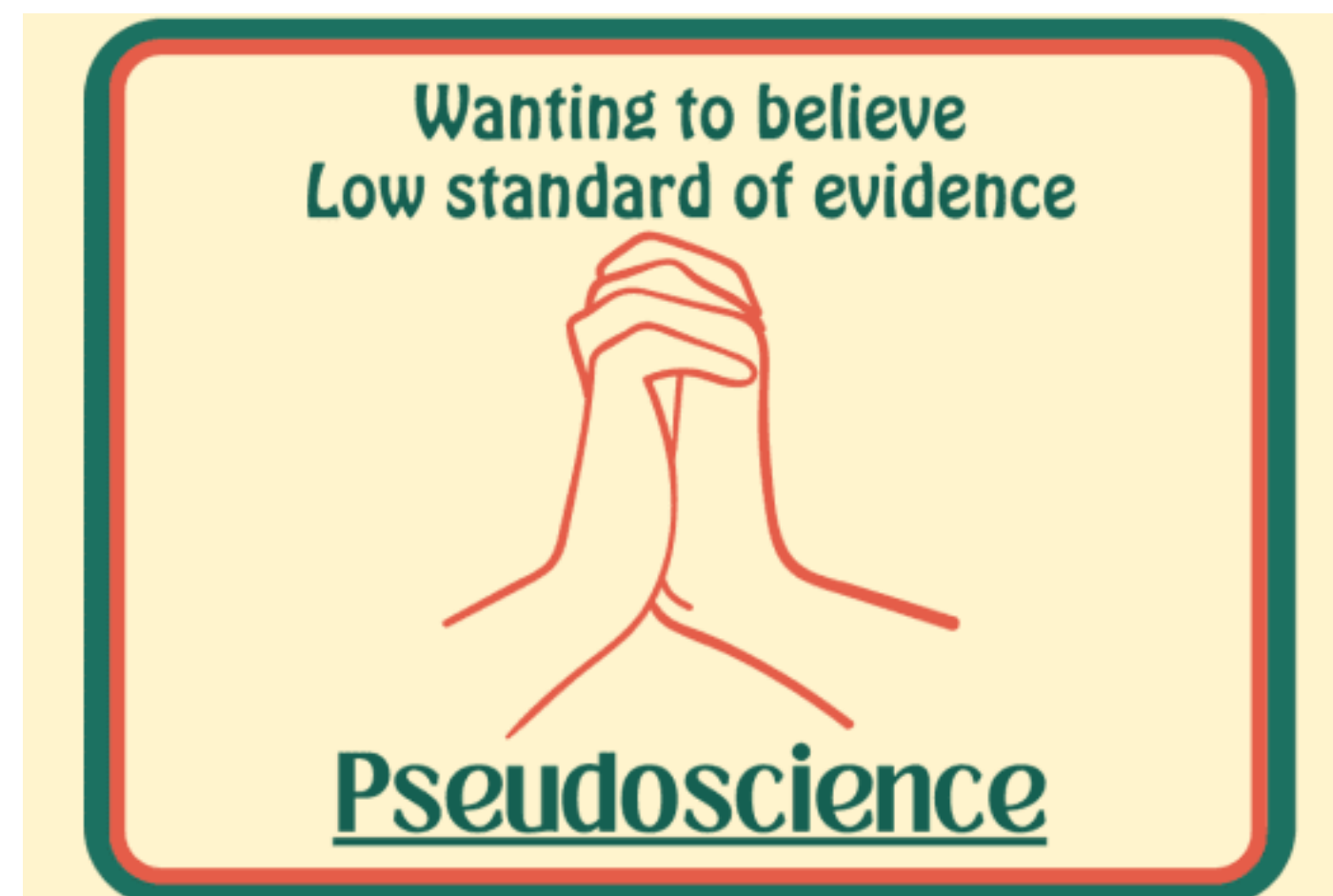
# Science and pseudoscience



<https://www.australianenvironmentaleducation.com.au/education-resources/what-is-the-scientific-method/>

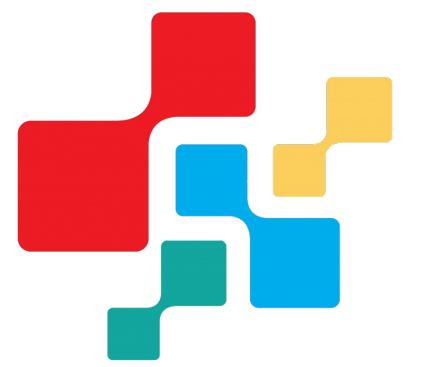


# Characteristics of pseudoscience



<https://thinkingispower.com/science-and-its-pretenders-pseudoscience-and-science-denial/>

- Non-falsifiable claims
- Reliance on anecdote, no peer review
- Lack of progress or self-correction



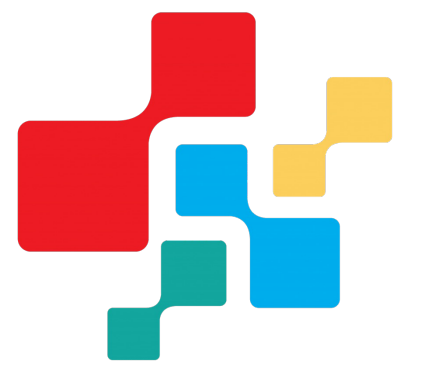
# Examples

- Phrenology
- Astrology
- Creationism
- ESP
- Free energy
- Paranormal science
- 5G conspiracies



<https://www.abc.net.au/news/2023-08-26/phrenology-the-discredited-pseudoscience-that-took-off/102737464>

→ critically review the methods



# Computer science examples



<https://www.youtube.com/watch?v=giT0ytynSgg>

- ⦿ AI “sentience”
- ⦿ 100% hack-proof systems
- ⦿ Bug-free code generators
- ⦿ Mind-reading through brain–computer interfaces
- ⦿ AI secretly taking over the world



# Summary



- Pseudoscience mimics science without rigor
- Scientific claims must be testable and open to doubt
- CS is vulnerable to techno-hype

