Cognitive (Neuro) Psychology

II. Experiments in Psychology

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NATURE | NEWS FEATURE

How scientists fool themselves – and how they can stop

Humans are remarkably good at self-deception. But growing concern about reproducibility is driving many researchers to seek ways to fight their own worst instincts.

Regina Nuzzo

07 October 2015

Illustration by Dale Edwin Murray

Overview

- Psychology as a scientific discipline
- Variables
- Hypotheses
- Components of an experiment
- Practical steps in an experiment

Bar psychology ...

- birds of a feather flock together
- opposites attract

- actions speak louder than words
- Rome wasn't built in a day

- can't judge a book by its cover
- first impression

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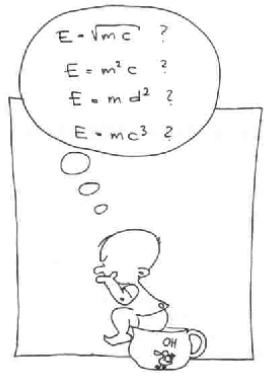
... contains a number of statements which are not being tested with respect to their consistency or validity

Common sense

- objects fall down if you release the grip
- birds fly, foxes don't

...



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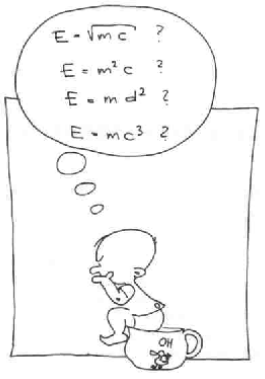

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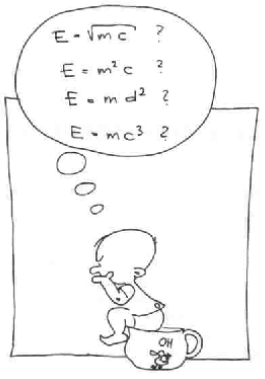

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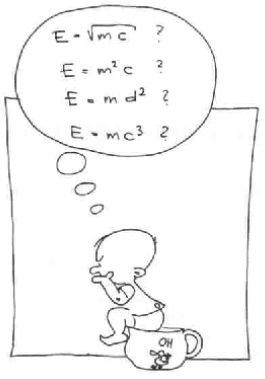

- folk-physics, biology, medicine, psychology...
  - mix of true and false beliefs
  - prejudices and stereotypes
  - full of contradictions

  ! common sense wisdom does not undergo critical testing with scientific methods

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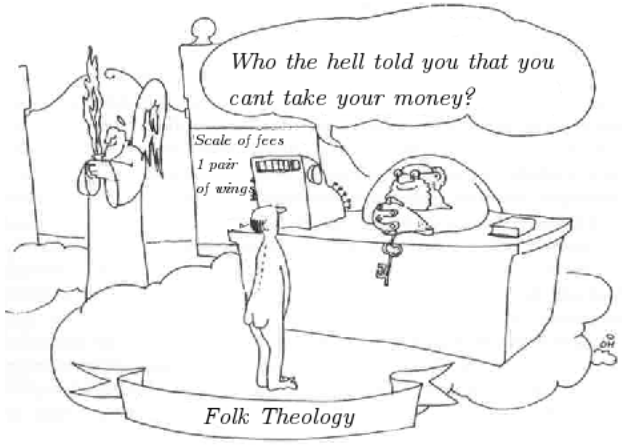

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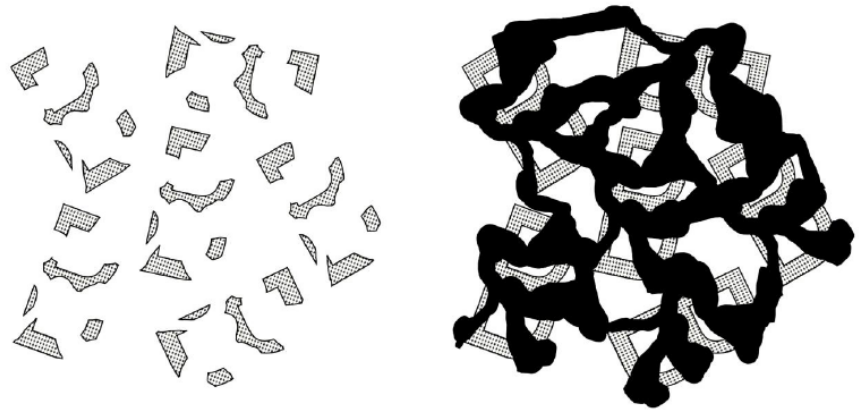
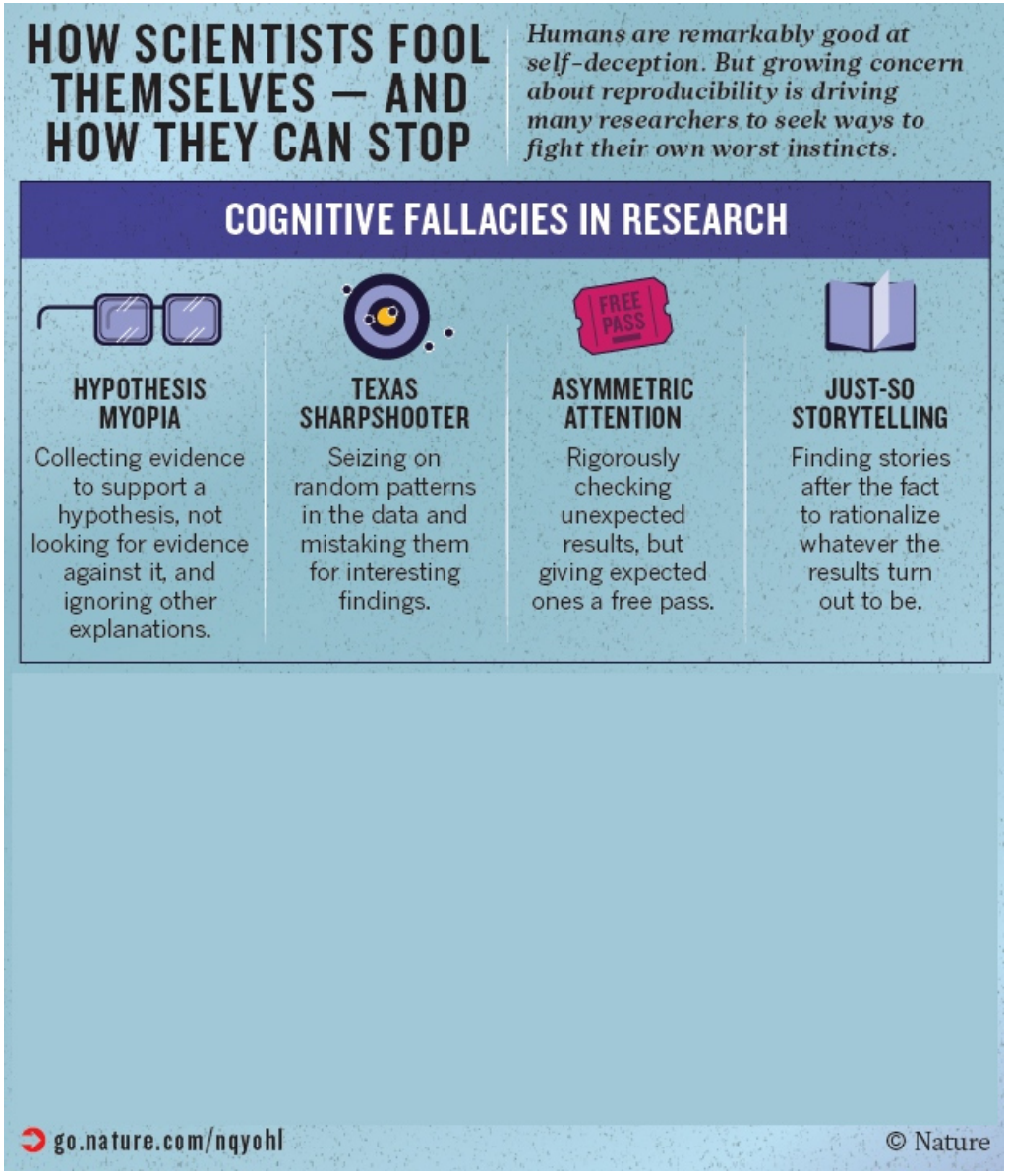
4. The knowledge content of folk psychology is used to explain events **post-hoc**. Plausibility of the explanation is more important than accuracy.

Perceptual vs cognitive biases



Perceptual vs cognitive biases

Cognitive biases in science



Hypothesis myopia

- 1999 British woman guilty of murdering two of her sons
- relative likelihood of sudden infant death syndrome:

  1 out of 297.000 families

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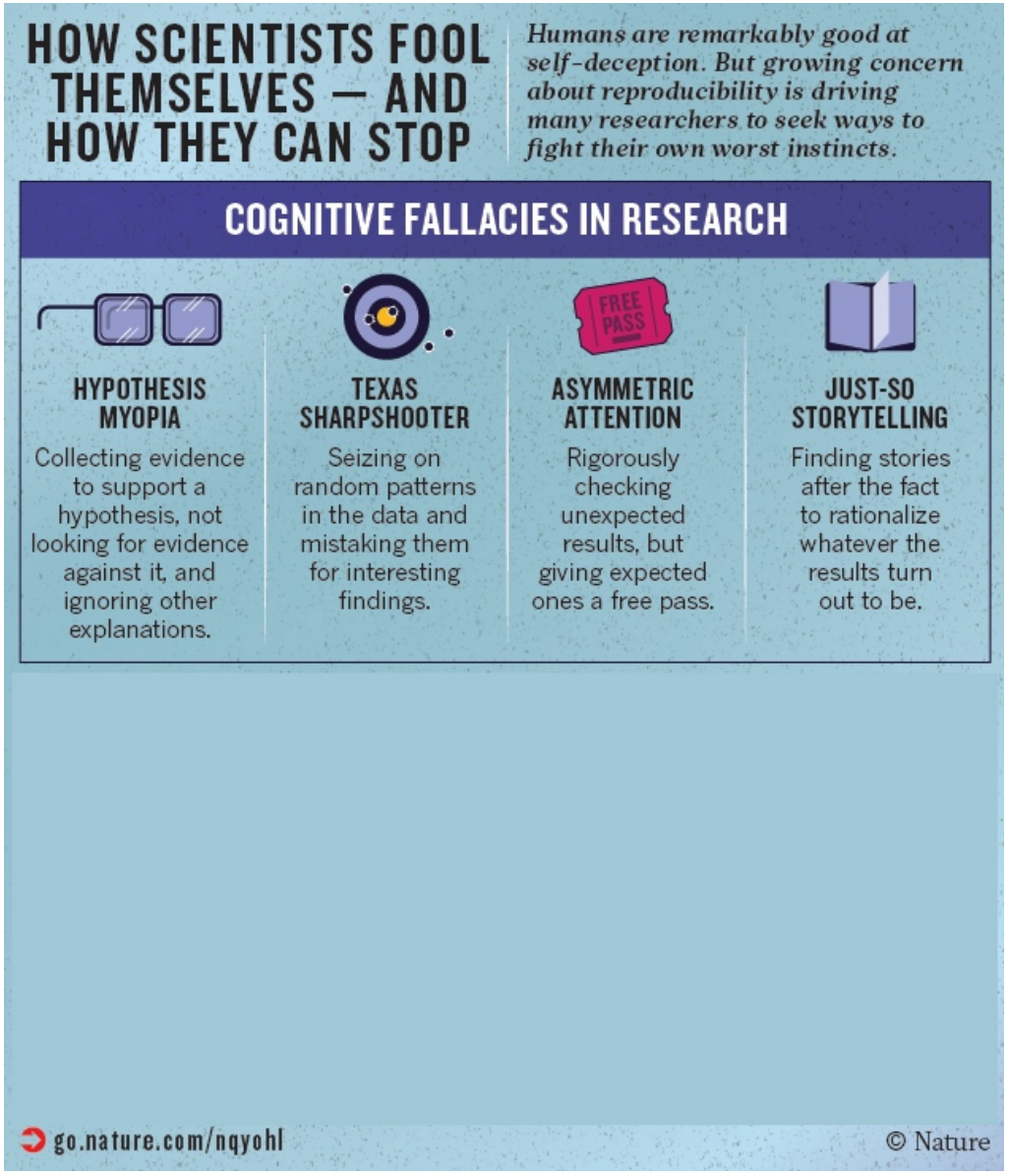


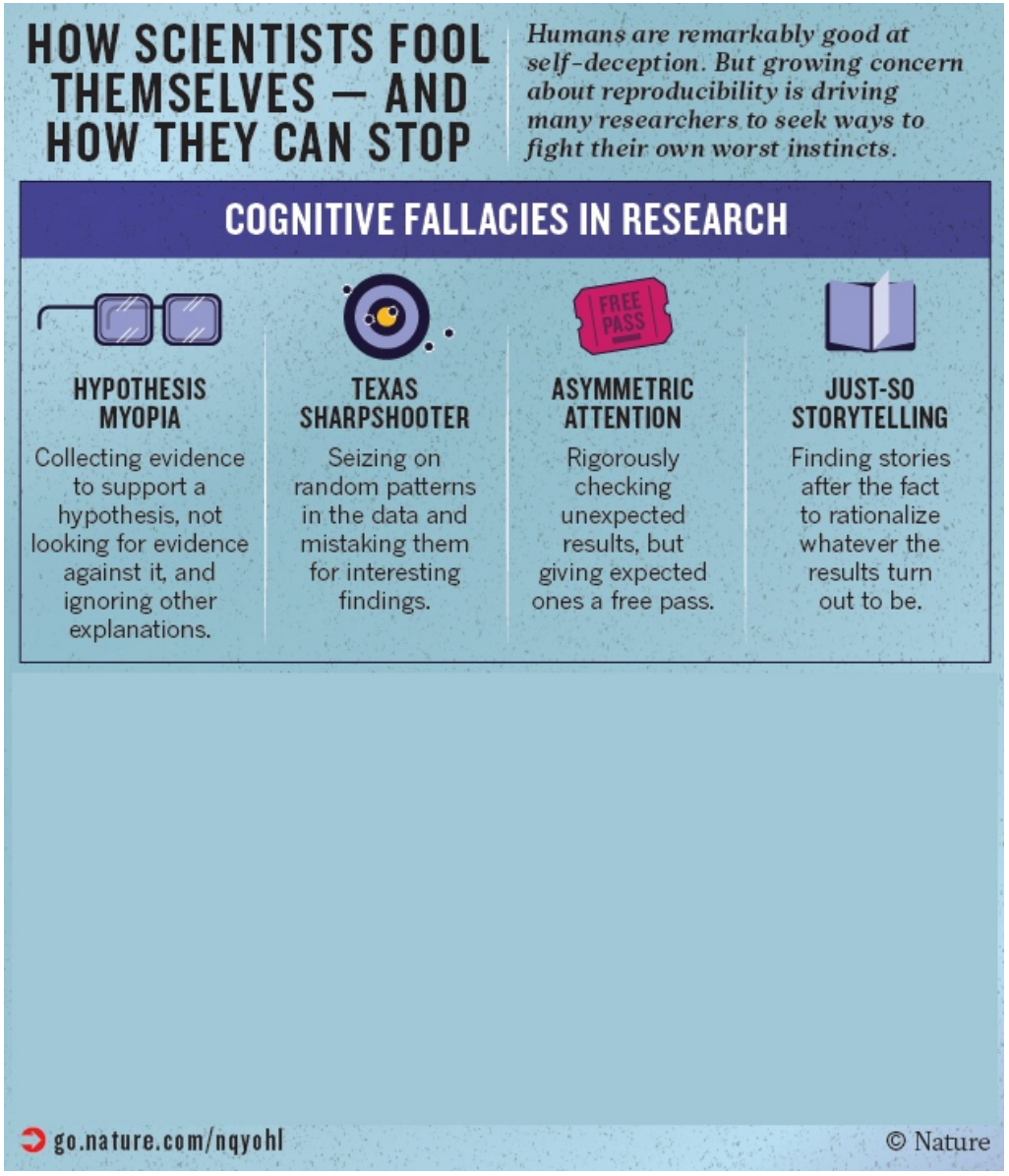
Hypothesis myopia

- 1999 British woman guilty of murdering two of her sons
- relative likelihood of sudden infant death syndrome:

  1 out of 297.000 families
- relative likelihood of double murder

  1 out of 2.7 m families

Cognitive biases in science



Texas sharpshooter

- fire random pattern of bullets

→ draw bullseye around cluster

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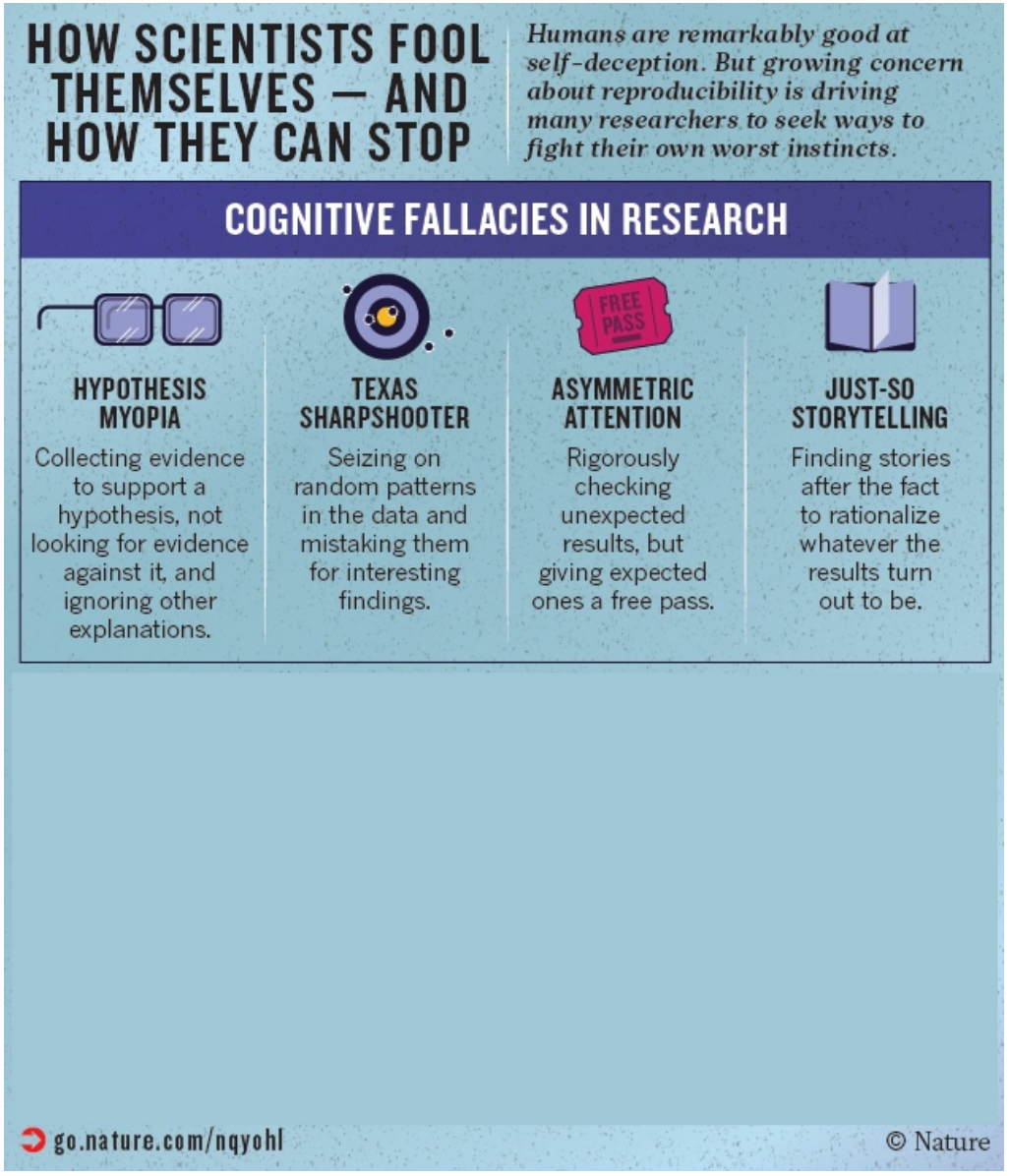

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- p-hacking

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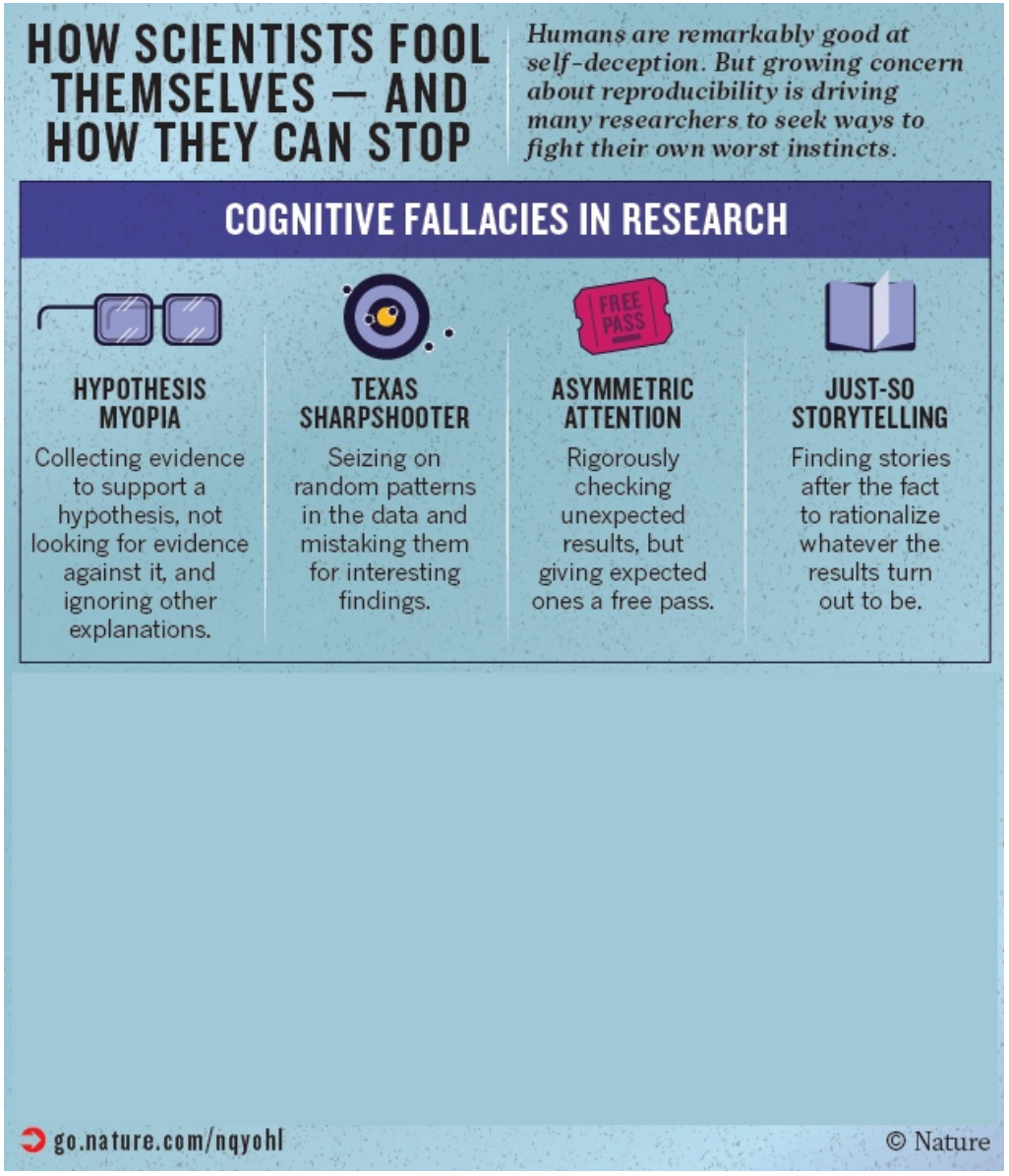

Asymmetric attention

- disconfirmation bias
- double checking of unexpected results

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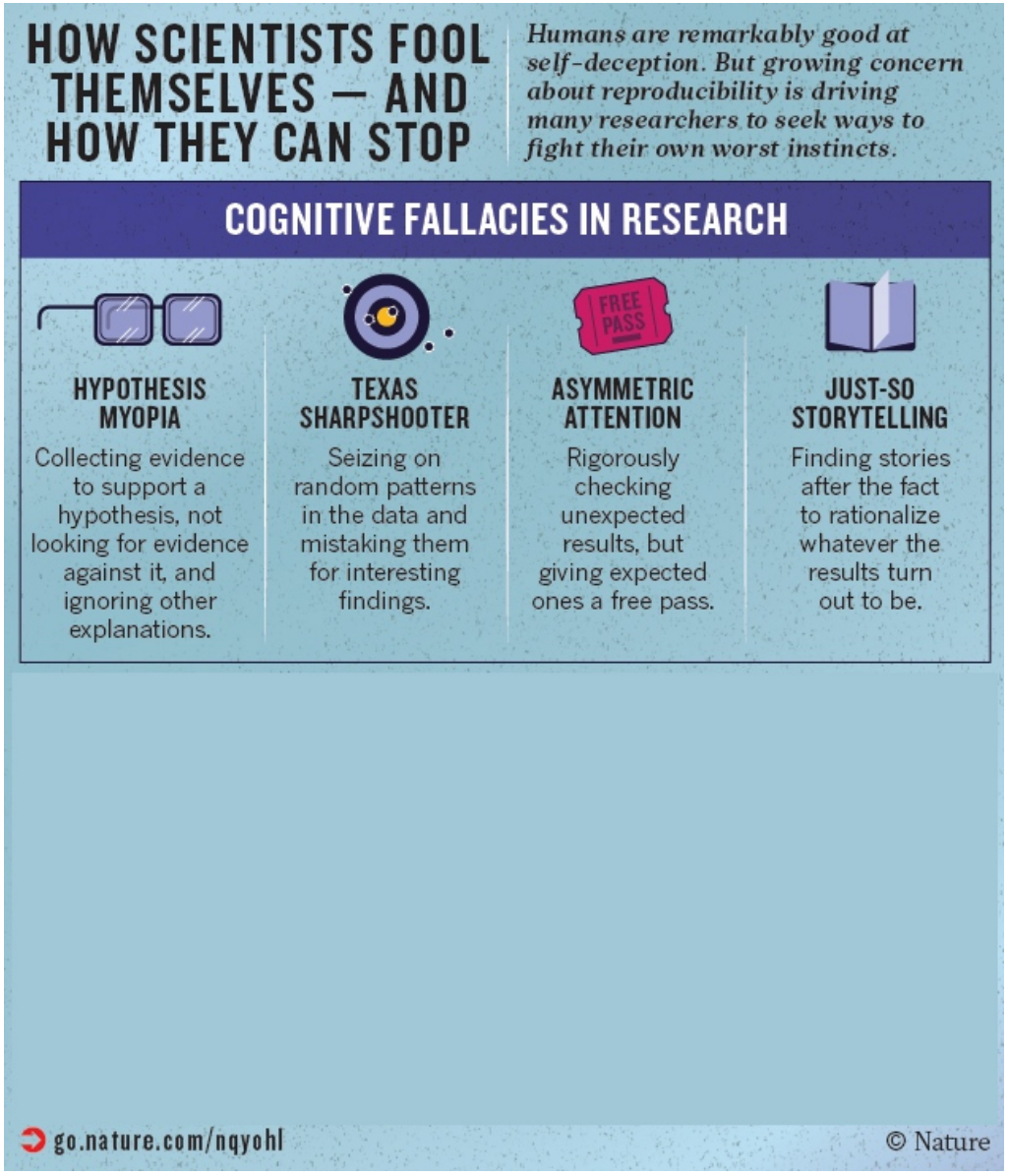

Just-so storytelling

- how the leopard got its spots
- post-hoc rationalization

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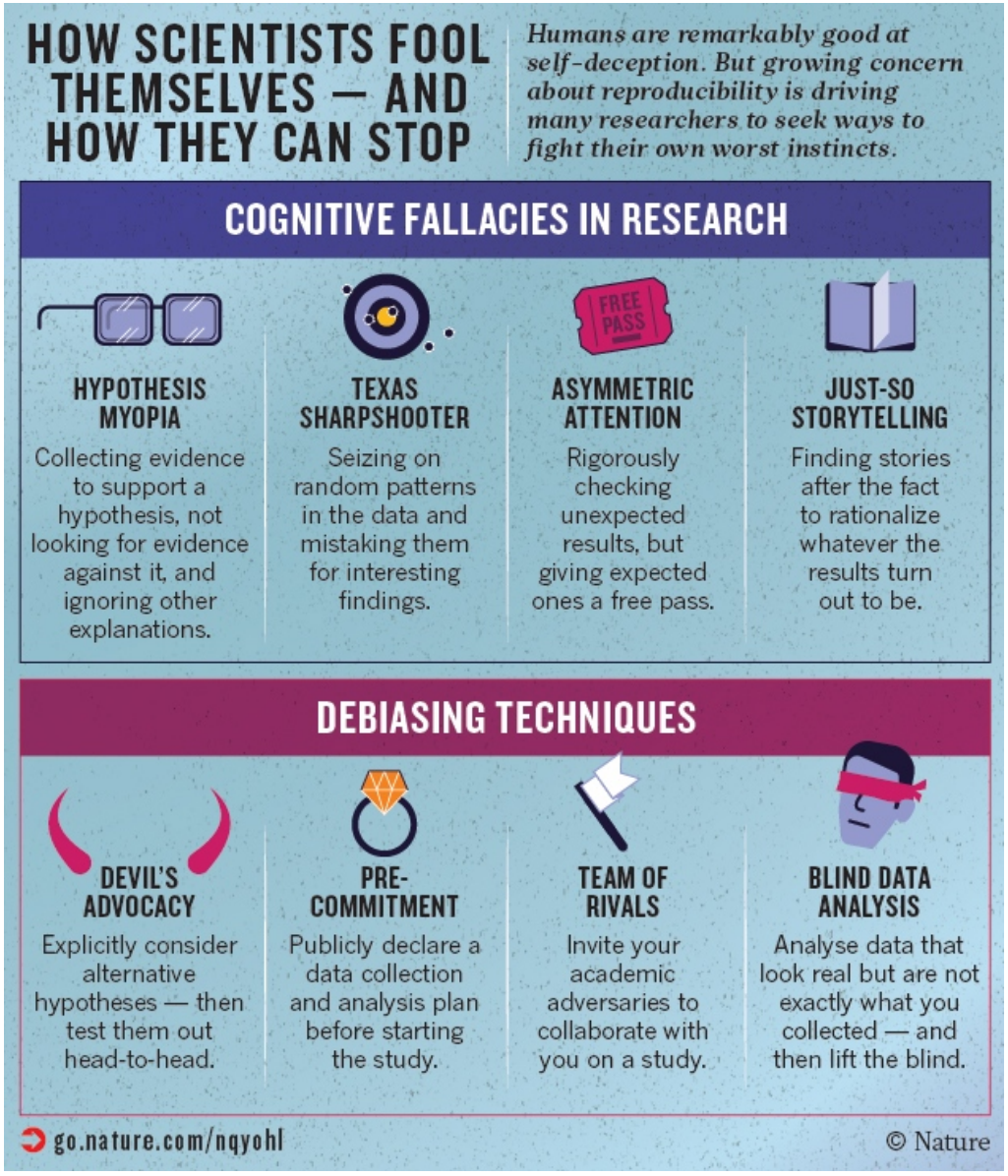

Systemic biases in Science

"As a researcher, I'm not trying to produce misleading results, but I do have a stake in the outcome." And that gives the mind excellent motivation to find what it is primed to find. (Nuzzo, 2015)

The scientific method

- How to distinguish science from non-science?

  The demarcation problem
- When is one theory better than another?

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Philosophy of science - 3 main schools of thought

1. militant positivism: program to find definition that puts every theory in its proper place
2. scepticism, cultural relativism: demarcation problem is unsolvable, because there is no demarcation line, no progress but changing fashions
3. elitist authoritarianism: there is a demarcation line, but there are no demarcation criteria, belief in a wise judge (great scientist)

The scientific method

Mertonian norms of science (R. Merton, 1910-2003)

Communalism: common ownership of scientific ideas

Universalism: claims to truth are evaluated in terms of universal or impersonal criteria

Desinterestedness: scientists are rewarded for acting in ways that outardly appear to be selfless

Organized scepticism: all ideas must be tested and are subject to rigorous, structured community scrutiny

Strong inference

- devise alternative hypotheses
- devise a crucial experiment (or several of them), with alternative possible outcomes, each of which will, as nearly as possible, exclude one or more of the hypotheses
- carry out the experiment(s) so as to get a clean result

Variables

- concept to describe characteristic attributes of human beings, animals, objects, systems etc...

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- take at least 2 different values, but only one at a time, e.g. fear of spiders - yes or no; emotions: joy, sadness, fear, shame, curiosity; intelligence: 70, ...145
- varying levels of abstraction: age vs. political attitudes
- more or less directly observable: soup intake vs. intelligence

$\rightarrow$ **operationalization**

How to select variables?

Write down all the variables that would allow a complete description of yourself in the current situation!

How to select variables

Appearance: shoe size, hair colour, form of nostrils, ...

Social relations: son/daughter, mother/father, personally acquainted with, friend of, contemporary of, neighbour of, boss of, ...

Personality attributes: neurotic, cooperative, curious, ...

Goals/desires/preferences: artistic, work-related, study-related, personality-wise, ...

Physiological Variables: blood pressure, heart rate, size of liver, ...

Individual history: childhood memories, family situation, ...

Knowledge: German grammar, memory of locations, soccer results, cooking skills, ...

Variable selection

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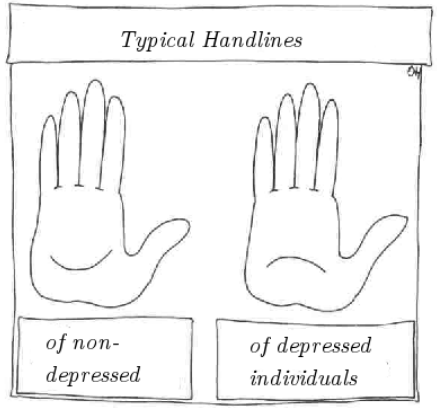
Example: Theoretical accounts of depression

- Hippocrates - black bile
- middle ages - obsessed by the devil
- characteristic hand lines (Höping, 1689)
- psychoanalysis - early childhood experiences
- cognitive theory - thinking patterns (Beck)
- theory of learned helplessness (Seligman)
- neurotransmitter imbalance



Important part of psychological research is:

- to identify variables that are crucial for answering a certain question
- to assign observable variables to theoretically interesting variables

Scientific research starts with questions

- Is intelligence inherited?
- Is therapy x more effective than therapy y to cure disorder Z?
- What are the factors that influence whether a person is attracted to another or not?
- Under which conditions do humans behave aggressively?
- At what age do kids have an understanding or the concept of 'probability'?
- How do people in their 30ies think about death?

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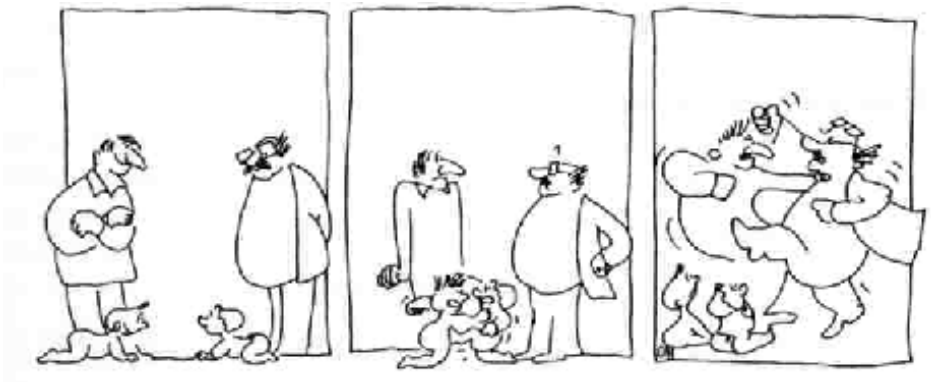
! empirical hypotheses allow predictions about and comparison with reality

Example:

If aggressive behavior is learned by imitation,

then the observation of an aggressive model should increase the probability that a person will act aggressively herself (Model learning, learning by imitation).



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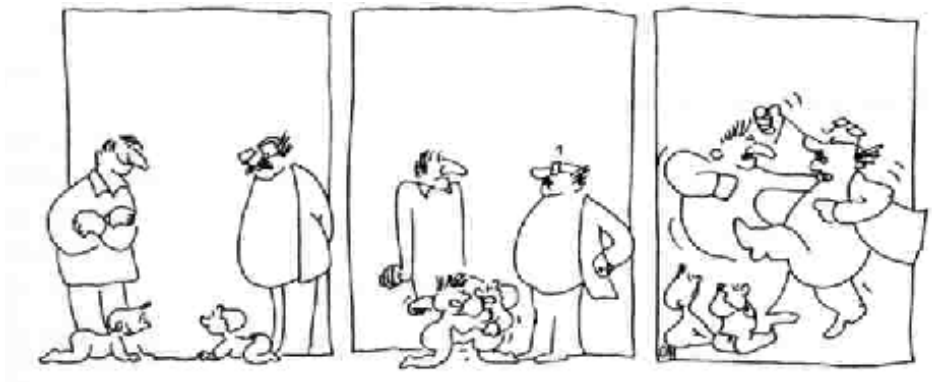
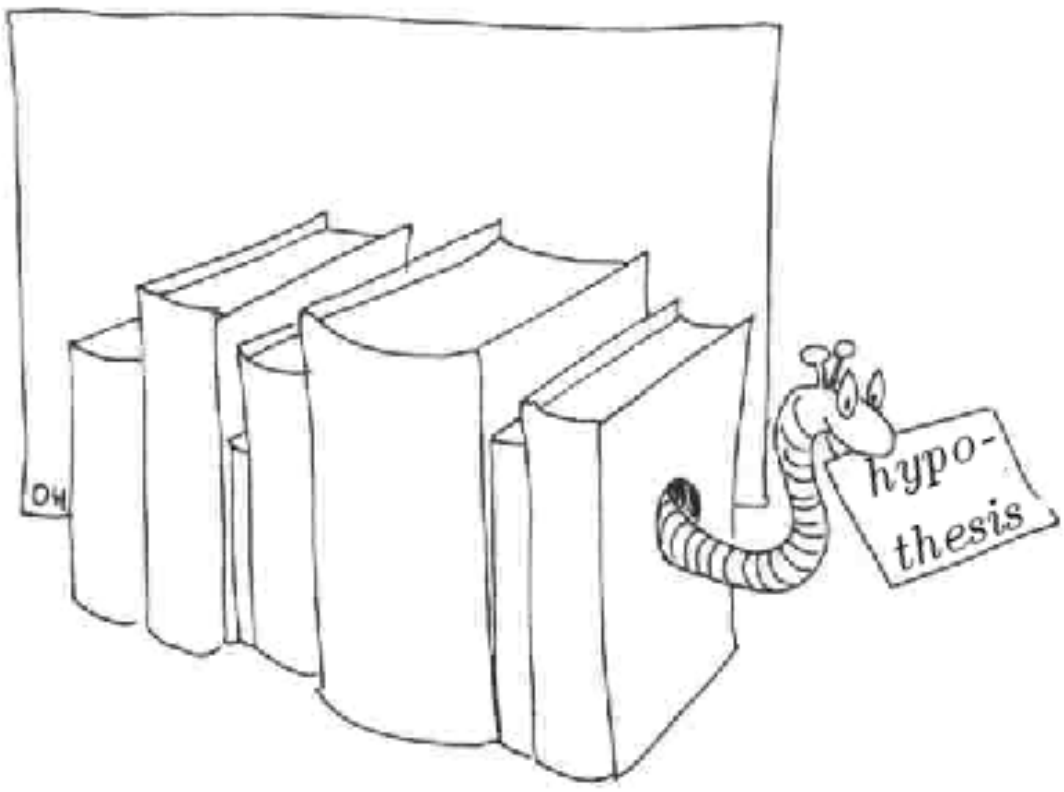


Empirical hypothesis

- Guests in a restaurant who observe an aggressive model are more likely to react aggressively in response to a cold soup than guests who do not observe an aggressive model.

Formation of hypotheses



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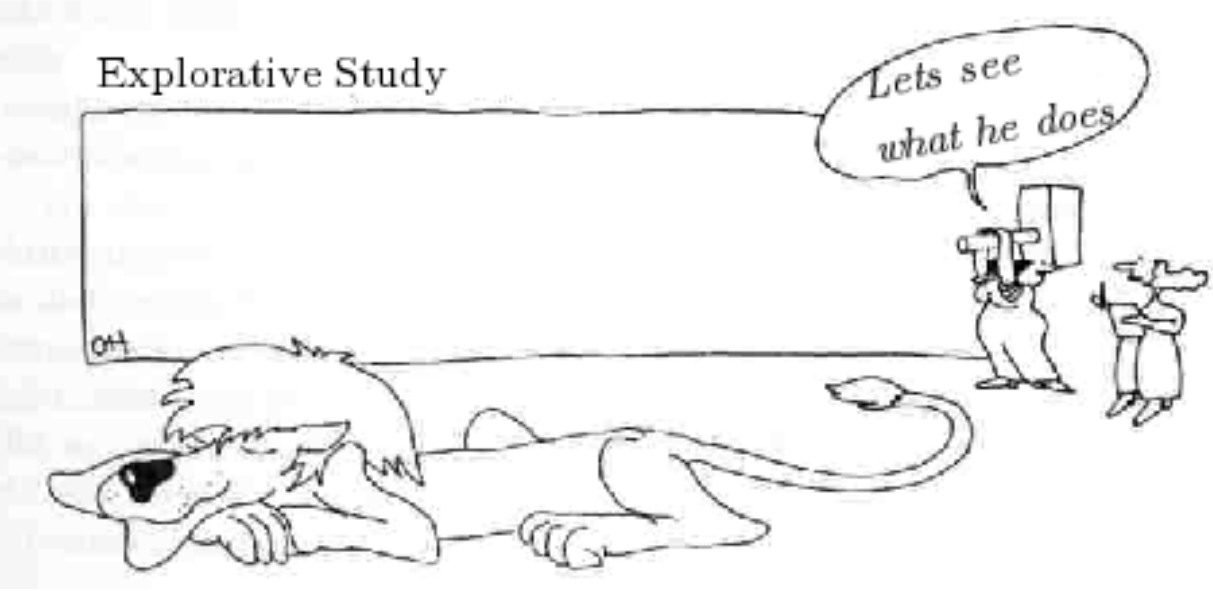

Testing of hypotheses

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- The power of examples can be explained by the observation, that the subjective probability for an event is influenced by the ease of which we can find examples for it in our memory

= availability heuristic (Tversky & Kahneman, 1973)

Preconditions for hypothesis testing

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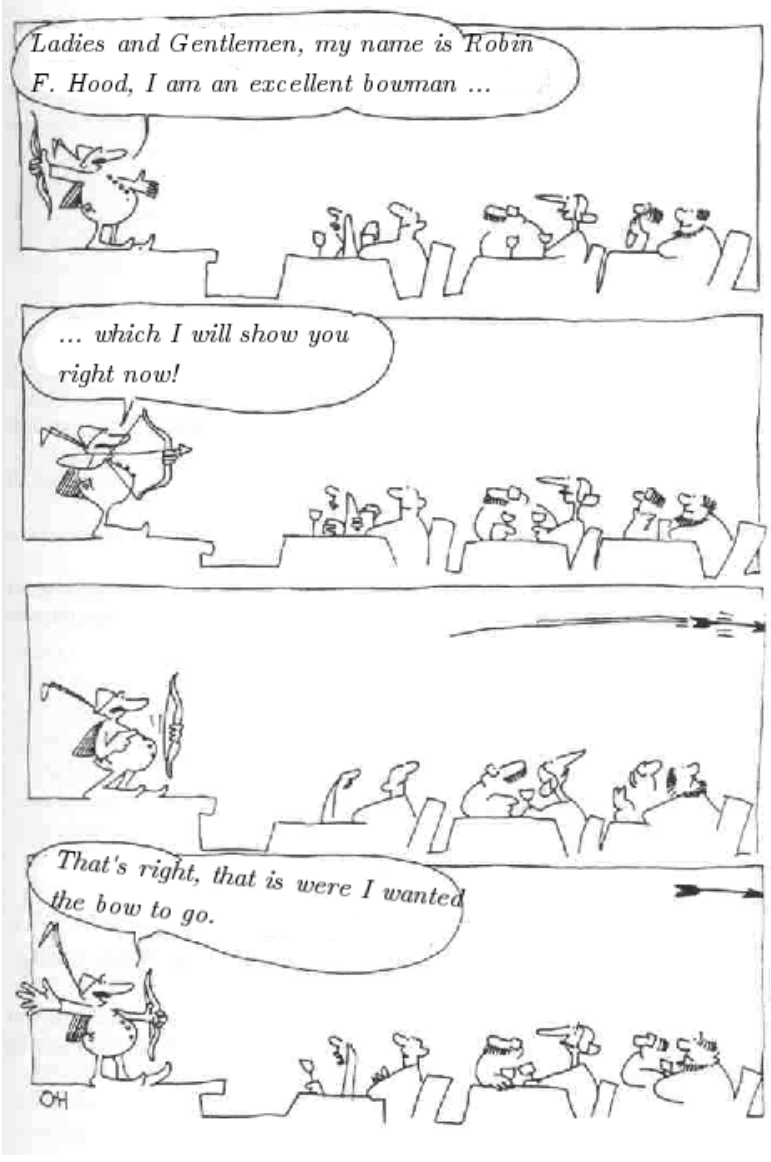

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Research Question

- unanswered question: *What are the causes for aggressive behavior?*
- ... studying the literature ...

$\Rightarrow$ Does an aggressive exemplar (role model) influence aggressive behavior?

Hypotheses

If a person *A* observes the aggressive behavior of person *B* in a certain situation, **then** this increases the probability that also person *A* will act aggressively in that situation.

IV: observation or non-observation of aggressive model

DV: aggressive behavior of person A

Operationalization

Write down indicators of aggressive behavior!

Operationalization

- loudness of voice
- adrenaline level
- heart rate
- verbal statements
- body posture
- interpersonal distance
- physical attacks
- report

Goodness of operationalization

- background knowledge helps
- a theoretical context helps even more
- critical discussion is minimum
- different ways to operationalize one and the same variable/concepts usually indicates necessity to redefine the concept - lack of construct validity
- the more abstract the construct of interest the more challenging the operationalization e.g. consciousness

Experimental design

- logical structure of the experiment
- e.g. 1 independent variable with 2 levels

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group 1	IV - level 1	DV
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	time 1	**time 2**
group 1	aggressive model	loudness of voice
group 2	neutral model	loudness of voice

Experimental design

- logical structure of the experiment
- e.g. 1 independent variable with 2 levels

	time 1	**time 2**
group 1	IV - level 1	DV
group 2	IV - level 2	DV

	time 1 pre-test	**time 2**	**time 3** post-test
group 1	DV	IV - level 1	DV
group 2	DV	IV - level 2	DV

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group 1	DV	IV - level 1	DV
group 2	DV	IV - level 2	DV

	t1	**t2**	**t3**	**t3**
1 group	IV - level 1	DV	IV - level 2	DV

Control of confounding variables

Factors of the participants:

- e.g. gender, age, intelligence,...

$\Rightarrow$ **Matching** (variable needs to be known and measurable, small groups)

- e.g. intelligence, motivation, mood, ...

$\Rightarrow$ **Randomization**

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Factors of the experimental setup:

- Noise, experimenter effects, ...

$\Rightarrow$ **Elimination**

- time of the day, number of sessions per week, ...

$\Rightarrow$ **Constancy**

$\Rightarrow$ **Random variation**

$\Rightarrow$ **Control group**

Control of confounding variables

Factors of the social situation:

- Rosenthal or Pygmalion effect, Self-fulfulling prophecy

others, even animals (Rosenthal & Fode, 1963). As Rosenthal explained,

> Fode and I told a class of 12 students that one could produce a strain of intelligent rats by inbreeding them to increase their ability to run mazes quickly. To demonstrate, we gave each student five rats, which had to learn to run to the darker of two arms of a T-maze. We told half of our student-experimenters that they had the "maze-bright" intelligent rats; we told the rest that they had the stupid rats. Naturally, there was no real difference among any of the animals.
>
> But they certainly behaved differently in their performance. The rats believed to be bright improved daily in running the maze—they ran faster and more accurately—while the apparently dull animals did poorly. The "dumb" rats refused to budge from the starting point 29 percent of the time, while the "smart" rats were recalcitrant only 11 percent of the time.
>
> Then we asked our students to rate the rats and to describe their own attitudes toward them. Those who believed they were working with intelligent animals liked them better and found them more pleasant. Such students said they felt more relaxed with the animals; they treated them more gently and were more enthusiastic about the experiment than students who thought they had dull rats to work with. Curiously, the students with "bright" rats said they handled them more but talked to them less. One wonders what students with "dull" rats were saying to those poor creatures. (Rosenthal, 1976, p. 58)

- Hawthorne, observer effect

  experiments studying the effects of light levels on productivity at the Hawthorne Works (1924-32)

Control of confounding variables

... in the example:

- degree of identification with the model
- aggressive tendencies
- behavior of the experimenter
- time of the day, weather, differently pleasant rooms, ...

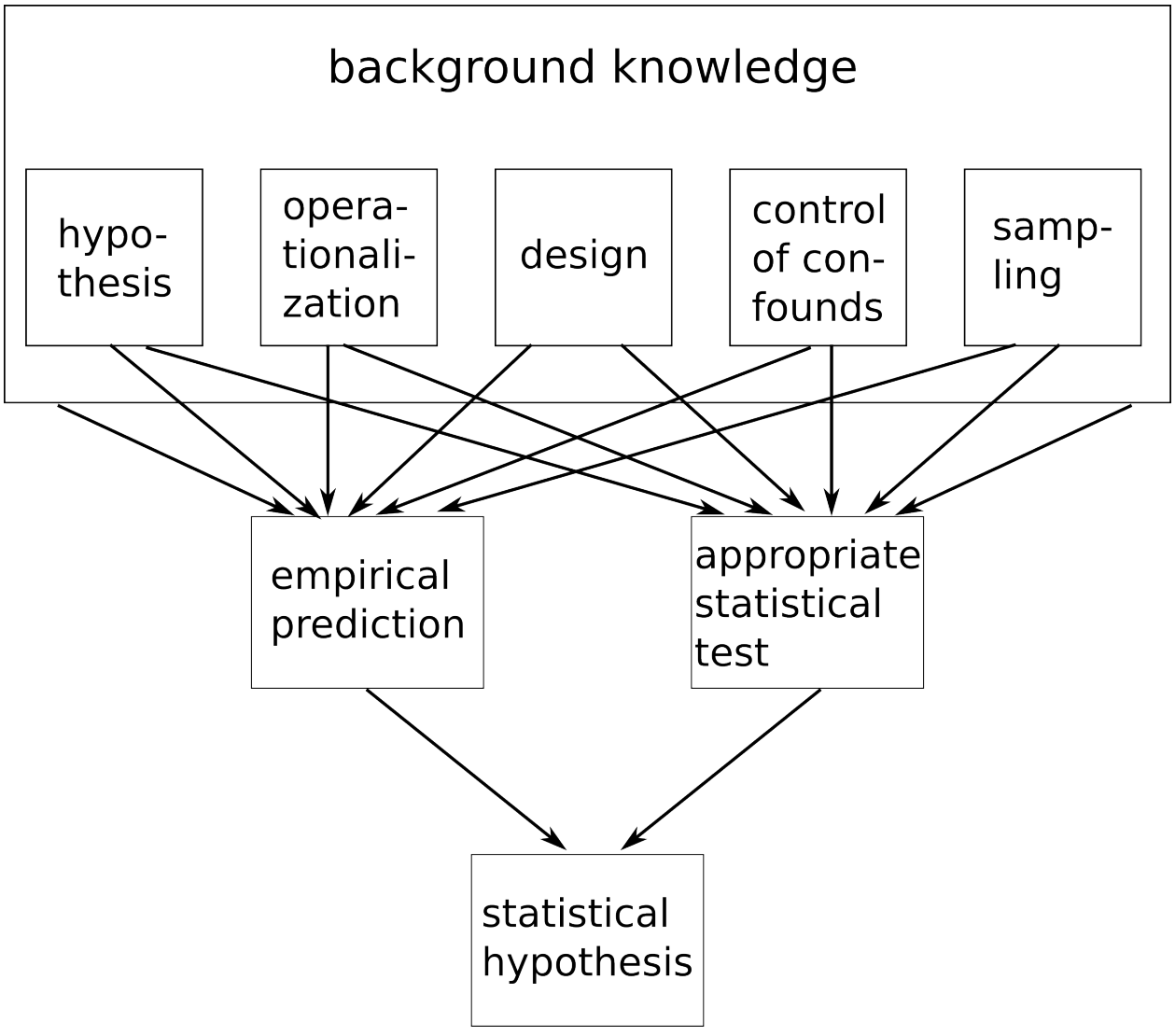
constant value

- videotaping the model
- written instructions
- identical rooms

random variation

- random assignment of observers to groups (sampling)

Summary


background knowledge
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Reference

This lecture is based on the following book:
Oswald Huber (2009). Das psychologische Experiment: Eine Einführung. Bern: Huber.