

Cognitive (Neuro) Psychology

II. Experiments in Psychology

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Overview

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

Overview

- 1 Psychology as a scientific discipline
- 2 Variables
- 3 Hypotheses
- 4 Experiments

Common sense psychology ...

contains a number of statements which are not being tested with respect to their validity:

- birds of a feather flock together
- actions speak louder than words
- can't judge a book by its cover
- ...
- German products are usually high quality ... (VW)
- German trains are on time ...

Common sense psychology

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



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→ basic understanding of concepts in physics, biology, psychology, etc. ... without studying them

- folk-physics, psychology, biology, ...



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- mix of true and false beliefs
- prejudices and stereotypes
- full of contradictions

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Common sense is ...

- mix of true and false beliefs
 - prejudices and stereotypes
 - full of contradictions
- ! common sense wisdom does not undergo critical testing with scientific methods

Why don't we notice the inadequacy of folk wisdom?

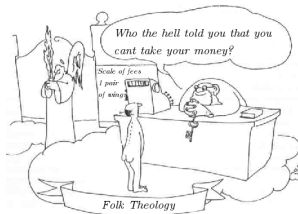
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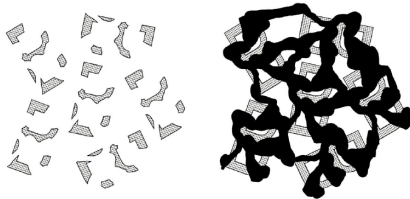
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3. The way we interpret and remember events is influenced by our expectations. We selectively attend to evidence in favour of our beliefs.
4. The knowledge content of folk psychology is used to explain events **post-hoc**. Plausibility of the explanation is more important than accuracy.

Perceptual vs cognitive biases



Perceptual vs cognitive biases



Cognitive biases in science

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.

COGNITIVE FALLACIES IN RESEARCH



HYPOTHESIS MYOPIA

Collecting evidence to support a hypothesis, not looking for evidence against it, and ignoring other explanations.



TEXAS SHARPSHOOTER

Seizing on random patterns in the data and mistaking them for interesting findings.



ASYMMETRIC ATTENTION

Rigorously checking unexpected results, but giving expected ones a free pass.



JUST-SO STORYTELLING

Finding stories after the fact to rationalize whatever the results turn out to be.

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DEBIASING TECHNIQUES



DEVIL'S ADVOCACY

Explicitly consider alternative hypotheses — then test them out head-to-head.



PRE-COMMITMENT

Publicly declare a data collection and analysis plan before starting the study.



TEAM OF RIVALS

Invite your academic adversaries to collaborate with you on a study.



BLIND DATA ANALYSIS

Analyse data that look real but are not exactly what you collected — and then lift the blind.

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 outwardly appear to be selfless

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

How scientists fool themselves – and how they can stop

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Regina Nuzzo

07 October 2015



The scientific method

“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)

Overview

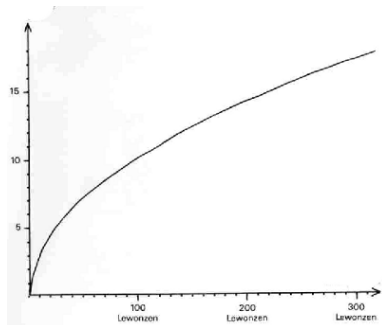
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Goals of scientific research

Accumulation of knowledge



Investigation of lawful relations



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

→ **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, ...

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

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

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theoretical account influences variables under study

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Example: Theoretical accounts of depression

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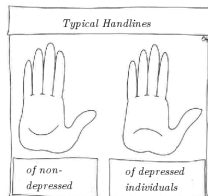
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- neurotransmitter imbalance

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

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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 of the concept of 'probability'?
- How do people in their 30ies think about death?

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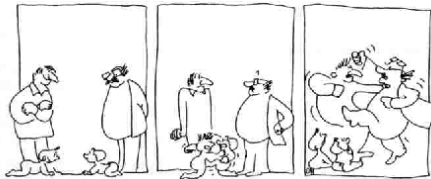
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- ! empirical hypotheses allow predictions about and **comparison with reality**

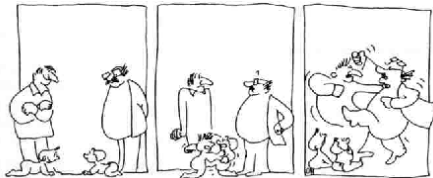
Example:

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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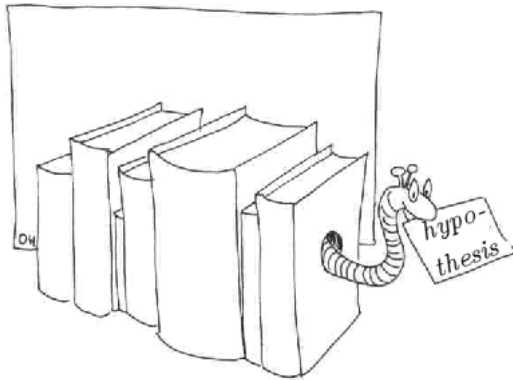
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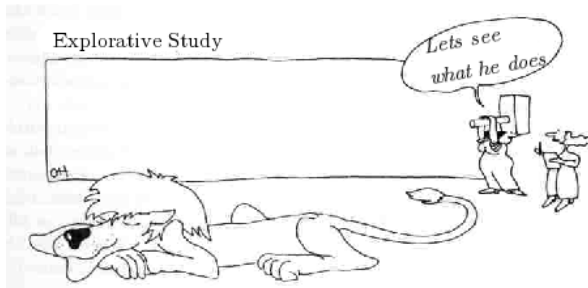
Empirical hypothesis

- 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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- I am deeply convinced, that ...
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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

1. consistency

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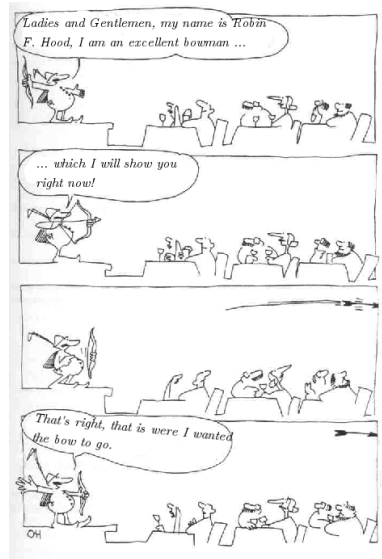
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3. operationalizability

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4. generation **before** the test



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 - ...

Research Question

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

Measurement

- assign numbers to measurement items (e.g. to be measured individuals, objects, events) such that characteristic empirical relations between the measurement items are represented by the corresponding numerical relations in the numbers
- resulting numbers are called scale values

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⇒ Why cant we just describe the variation verbally?

- assignment of the right scale: nominal, ordinal, interval, ratio, absolute
- validity and reliability, ...

Experimental design

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

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	time 1	time 2
group 1	IV - level 1	DV
group 2	IV - level 2	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 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,...
- ⇒ **Matching** (variable needs to be known and measurable, small groups)
- e.g. intelligence, motivation, mood, ...
- ⇒ **Randomization**

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Factors of the experimental setup:

- Noise, experimenter effects, ...
- ⇒ **Elimination**
- time of the day, number of sessions per week, ...
- ⇒ **Constancy**
- ⇒ **Random variation**
- ⇒ **Control group**

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, ...

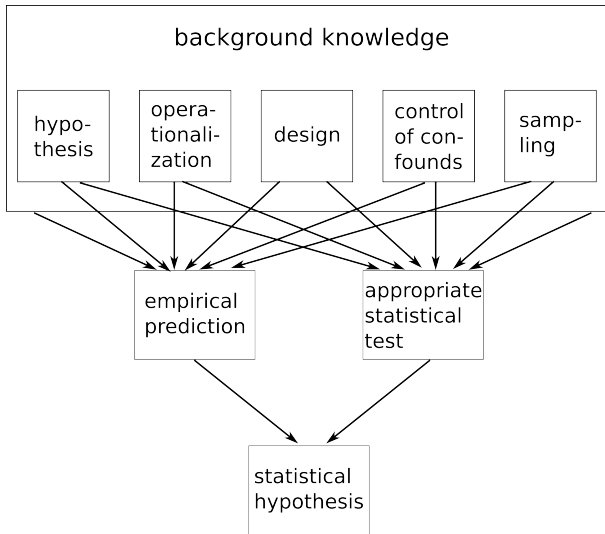
constant value

- videotaping the model
- written instructions
- identical rooms

random variation

- random assignment of observers to groups
(sampling)

Summary



Reference

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

