

Logic & Argumentation

Empirical & Theoretical Research Methodology
Fall Semester 2026, Lecture 5

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Overview & Learning Goals

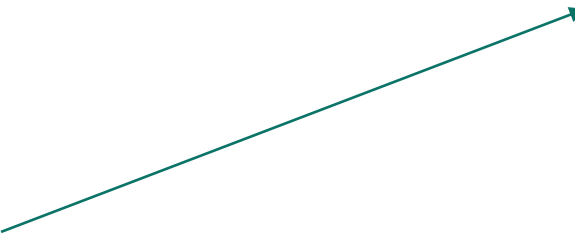
- Learn the difference between validity and truth
- Learn how to evaluate an argument
- Learn about deductive and inductive arguments
- Learn how to analyze arguments through reconstruction and what the criteria for good reconstruction are
- know the most common argumentative fallacies

Recap: Basics of Logic

Central Elements

- Propositions (declarative statements *aka* atomic units, written as $p, q, s, \dots$)
- Logical operators
- Conclusion (after $\therefore$, often named C)

Liars Paradox: This statement is false



Propositional Logic: the study of the **meanings** of, and the inferential **relationships** that hold among, **sentences** based on the role of logical operators (**propositional connectives**) have in determining those sentences' **truth** conditions.

Recap: Basic Logical Operators

$\neg$ negation (not)

$\wedge$ conjunction (and)

$\vee$ disjunction (or)

$\rightarrow$ conditional (if then)

Premise 1: If it rains, the street is wet

Premise 2: It rains

Conclusion: The street is wet

P1: $r \rightarrow w$

P2: r

$\therefore w$

Recap: Basic Logical Operators

$\neg$ negation (not)

$\wedge$ conjunction (and)

$\vee$ disjunction (or)

$\rightarrow$ conditional (if then)

Contradiction: g is green and g is not green

$$g \wedge \neg g$$

Tautology: the door is open or it is not open

$$d \vee \neg d$$

Recap: Syllogisms

- Syllogism
 - “Logischer Schluss”
 - Specific form: two premises and a conclusion
 - If the premises are true and the syllogism is valid, the conclusion must be true
 - *Think of it like language grammar*

$P \rightarrow Q$ P	$P \rightarrow Q$ $\neg Q$	$P \rightarrow Q$ $Q \rightarrow R$	$P \vee Q$ $\neg P$	$P \rightarrow Q$ $\neg P$	$P \rightarrow Q$ Q
$\therefore Q$	$\therefore \neg P$	$\therefore P \rightarrow R$	$\therefore Q$	$\therefore \neg Q$	$\therefore P$
P1: If you touch the stove, you'll get burned P2: You touch the stove $\therefore$ You got burned	P1: If the store was open, lights would be on P2: Lights are not on $\therefore$ The store is not open	P1: If you miss the bus, you will be late for work P2: If you're late for work, you'll get fired $\therefore$ If you miss the bus, you'll get fired	P1: You pay the bill or your power gets shut off P2: You didn't pay the bill $\therefore$ Your power gets shut off	P1: If you study hard, you'll pass the test P2: You didn't study hard $\therefore$ You won't pass the test	P1: If she is a genius, she has good grades P2: She got good grades $\therefore$ She is a genius
Modus Ponens	Modus Tollens	Hypothetical Syllogism	Disjunctive Syllogism	Fallacy of the inverse	Fallacy of the converse

Evaluation of Arguments: Validity

*An argument is **valid** if it is **impossible** for all its **premises to be true** and yet its **conclusion be false**. The truth of the premises of a valid argument guarantees the truth of its conclusion. [Source]*

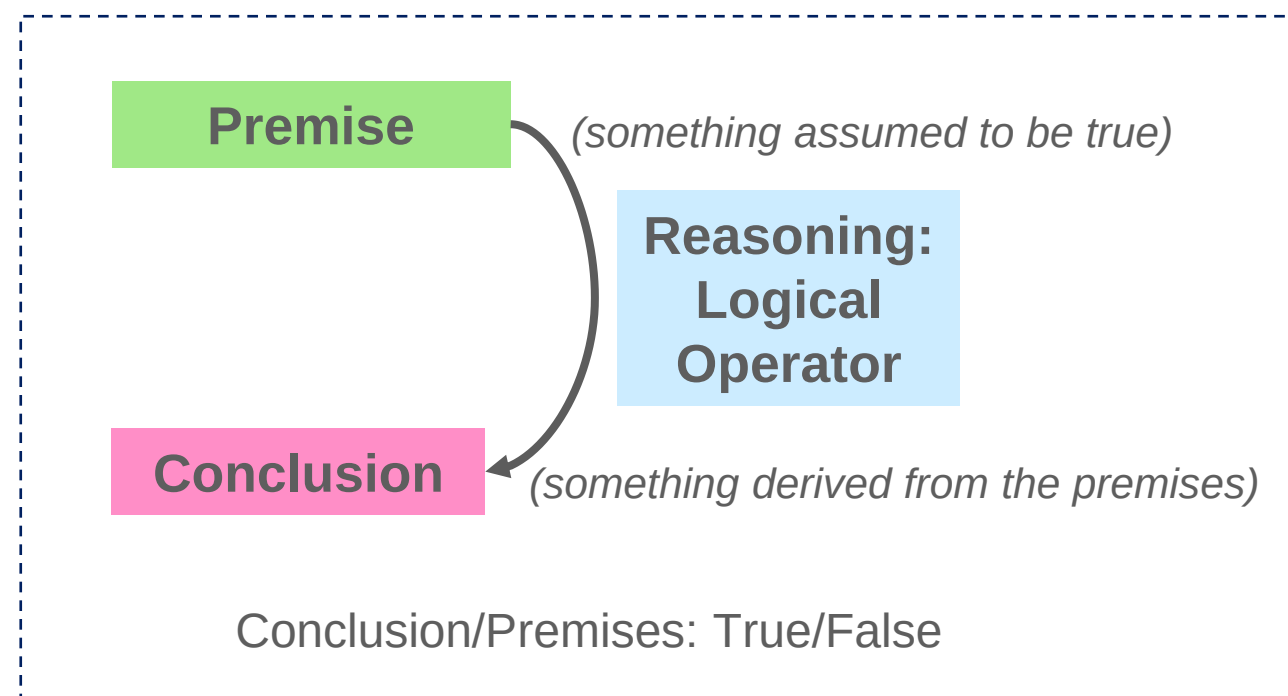
- Validity: the “combination” of all premises necessarily support the conclusion
- Validity $\neq$ Truth: Arguments can be valid, although the premises are false
- Soundness: a valid argument with true premises only
- Soundness $\neq$ Truth: Soundness is a property of an argument, truth is a property of propositions

Arguments

*"An argument, in the sense used in logic, is a set of **statements consisting of premises and a conclusion**. The premises are statements that (are intended to) give supporting evidence; the conclusion is what is allegedly supported by these statements."*

[Source].

The Argument



Argument/Reasoning: Valid/Invalid

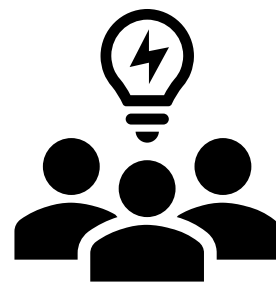
Evaluation of Arguments: Validity

Make a mind-map with your classmates!

Use the terms:

*argument, deductive, cogent, false, inductive, invalid, premise,
sound/Soundness, true/Truth, Validity/valid, weak*

How do the terms relate?



Different Types of Arguments

1. Deductive Arguments

P1: If you touch the stove, you'll burn your hand

P2: You touch the stove

Conclusion: You burned your hand

2. Inductive Arguments

Premise 1: The sun has risen on day 1

Premise 2: The sun has risen on day 2

...

Premise N: The sun has risen today

Conclusion: The sun will rise tomorrow

Different Types of Arguments

1. Deductive Arguments

True premises lead to true conclusions with absolute certainty

Category for evaluation: validity & soundness

2. Inductive Arguments

True premises lead to true conclusions with (high) probability

Category for evaluation: cogency

The Problem of Induction: no number of confirming observations in the past can definitively prove a universal statement

Evaluation of arguments

For deductive arguments

- Arguments are either valid or invalid (logical operators)
- Valid arguments with true premises are sound (good)
- Arguments with false premises can be valid, but never sound

For inductive arguments

- Arguments are either strong or weak
- Strong arguments with true premises are cogent (good)
- Strong Arguments with false premises are never cogent

Understanding Arguments: Reconstruction

*Reconstructing arguments is one of the most important philosophical skills.
Once you learn to dissect and reconstruct an argument, evaluating and
analyzing the argument will become much easier.*

Chris Bobonich

- Make implicit premises explicit
- State premises clearly
- Sort out the right order of the argument
- Beyond true premises and sound arguments, is the argument *good*?

Understanding Arguments: Reconstruction

Criteria for good reconstruction of a target argument:

1. The reconstruction respects the target argument
2. The reconstruction is a valid argument in the standard form
3. There are no redundant premises: Each premise of the reconstruction is necessary in order to make the reconstruction valid
4. The reconstruction is a charitable reading of the target argument

Understanding Arguments: Reconstruction

Step by step guide:

1. figure out the **conclusion** of the complex argument
2. figure out the core of the argument, the **central premises**
3. figure out the **supporting premises**
4. (if necessary): **sub-premises** for the central and supporting premise
5. put it all together; write it down in a logical form

Exercise I

Philosophy is valueless because it cannot help us make money.

P1: If a thing cannot help us make money, then it is valueless.

P2: Philosophy cannot help us make money.

C: (from P1 and P2) Therefore, philosophy is valueless.

Exercise II

Government mandates for zero-emission vehicles won't work because only electric cars qualify as zero-emission vehicles, and electric cars won't sell. They are too expensive, their range of operation is too limited, and recharging facilities are not generally available. [Source]

P1. Electric cars are too expensive.

P2. Electric cars' range of operation is too limited.

P3. Recharging facilities for electric cars are not generally available.

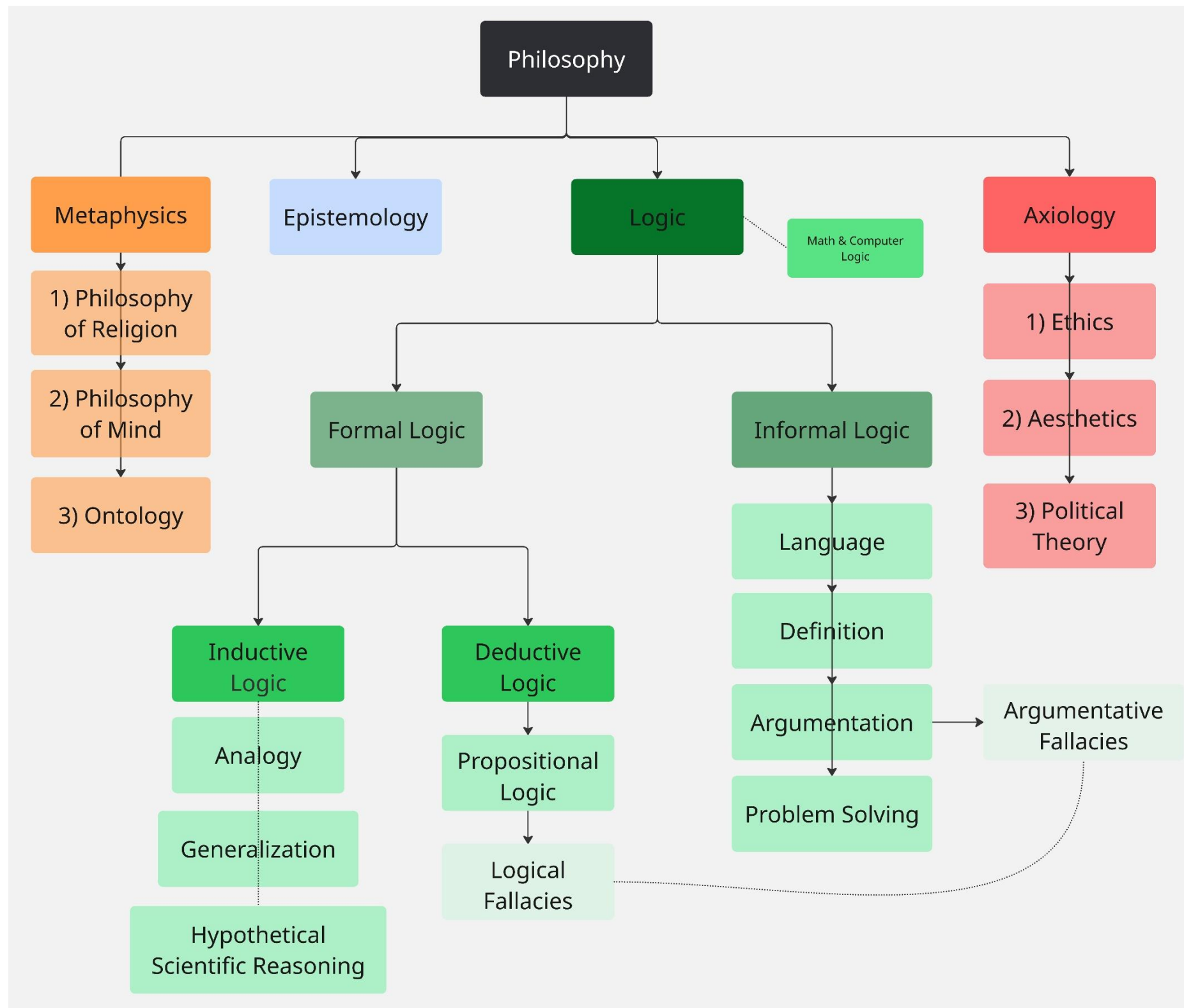
P4. If P1, P2 and P3, then electric cars won't sell.*

C1 (from P1, P2, P3 and P4) Therefore, electric cars won't sell.

P5. Only electric cars qualify as zero-emission vehicles.

P6. If C1 and P5, then government mandates for zero-emission vehicles won't work.*

C2 (from C1, P5 and P6) Therefore, government mandates for zero-emission vehicles won't work.



Arguments & Argumentation

- Argument (logical form) = premise + conclusion
- Argumentation (communicative action) =
“activity of producing and exchanging reasons in order to support claims or defend/challenge positions, especially in situations of doubt or disagreement”
[Source]

Further References about Writing and Argumentation

- Three hour essay recipe

Argumentative Fallacies

- Circularity

repeating the premises in the conclusion

Example:

You should not cut class because you are obliged to attend all classes.

Argumentative Fallacies

- Circularity

repeating the premises in the conclusion

Example:

Premise 1: This book is the best because it's the most highly recommended

Premise 2: It's the most highly recommended because it's the best

Conclusion: Therefore, this book is the best.

Argumentative Fallacies

- Circularity

repeating the premises in the conclusion

- Ignorance

something is claimed to be true or false because of a lack of evidence to the contrary

Example:

No one has prove P, so P is false

No one has disproven Q, so Q is ture

Argumentative Fallacies

- Circularity

repeating the premises in the conclusion

- Ignorance

something is claimed to be true or false because of a lack of evidence to the contrary

- Appeal to authority

Authority as evidence to support the argument

Example:

God exists because the Bible says so, and the Bible must be right because it is the word of God.

Argumentative Fallacies

- Circularity

repeating the premises in the conclusion

- Ignorance

something is claimed to be true or false because of a lack of evidence to the contrary

- Appeal to authority

Authority as evidence to support the argument

- Ad hominem

Attacking some attribute of the source of the argument

Example: „You're just a high school graduate, so your opinion on this topic doesn't matter”

Argumentative Fallacies

- Circularity

repeating the premises in the conclusion

- Ignorance

something is claimed to be true or false because of a lack of evidence to the contrary

- Appeal to authority

Authority as evidence to support the argument

- Ad hominem

Attacking some attribute of the source of the argument

- Ad populum

Believing a claim is true because many people think so

Example: „Most Americans support this policy, so it must be the right thing to do.”

Readings on Moodle

Optional, but interesting

- On argumentation in management science
- On feminist perspectives on argumentation
- On argumentative and logical fallacies
- YouTube Video on Liars Paradox

Optional, but highly recommended

- Logic exercise



Qualitative & Quantitative Research Methods

Empirical & Theoretical Research Methodology
Spring Semester 2025, Lecture 6

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(Peculiar?) Science

- Authority of Science
- Funding and Resources
- Science-society contract



Special role of scientific knowledge
against pseudo-science
against skepticism



Scientific Explanation

Water evaporates at temperatures over 100°C .

This pot of water has a temperature of 120°C .

Thus, the water evaporates.

Scientific Explanation

Deductive-nomological Model

General **Law** (L): Water evaporates at temperatures over 100°C.

Initial **Condition** (C): This pot of water has a temperature of 120°C.

Explanation (E): Thus, the water evaporates.

$$\begin{array}{c} L \\ C \\ \hline E \end{array}$$

- Deductive: explanation is deduced from
- Nomos: general laws
- L & C are the explanans
- E is the explanandum

Deductive-nomological Model

Structure of Explanation

In the DNM, explanation, prediction, and design have the same structure:

	Given	Sought	Question
Explanation	E, C	L	How did this happen?
Prediction	C, L	E	What will happen?
Design	E	C, L	How do we achieve something?

L
C

E

Deductive-nomological Model

Advantages of the Deductive-Nomological Model

- Provides a simple and clear answer to **what an explanation is**
- Contains immediate **implications for practical research** → hypothetical-deductive method
- Facilitates stringent and **critical examination** of scientific statements
- Systematic **comparison** of many diagnoses and design proposals regarding the underlying assumptions about conditions and mechanisms of the phenomena in question

Example

„A hungry mob is an angry mob“

Robert „Bob“ Marley: Them Belly Full



- Bob Marley makes a (probabilistic) law hypothesis
 - For all civil protest actions X , the following applies:
 - The greater the extent of deprivation DP , the higher the potential for escalation EP
- In terms of the DNM, this can be formalized as follows:

C: The absolute poverty rate in Jamaica has increased significantly

L: $DP \uparrow \rightarrow EP \uparrow$

E: The risk of a violent uprising in Jamaica is high

Example

„A hungry mob is an angry mob“

Robert „Bob“ Marley: Them Belly Full



- The DNM is helpful because it allows us to systematically examine the individual elements of an explanation:

C: The absolute poverty rate in Jamaica has increased significantly

L: $DP\uparrow \rightarrow EP\uparrow$

E: The risk of a violent uprising in Jamaica is high

- *C* and *E* can be tested separately as empirical statements

Example

„A hungry mob is an angry mob“

Robert „Bob“ Marley: *Them Belly Full*



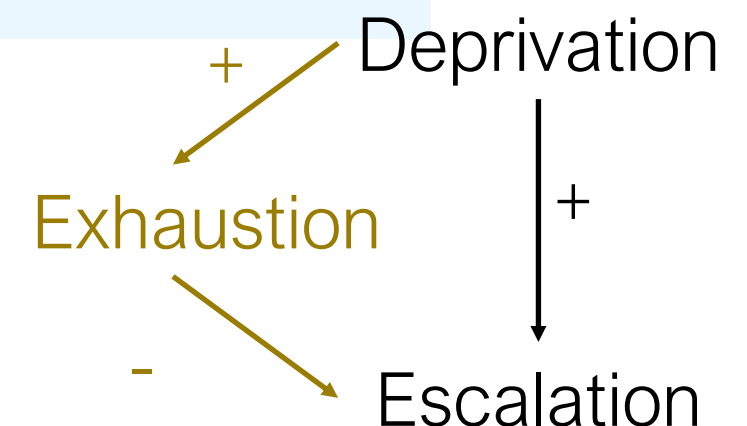
- The DNM is helpful because it allows us to systematically examine the individual elements of an explanation:

C: The absolute poverty rate in Jamaica has increased significantly

L: $DP\uparrow \rightarrow EP\uparrow$

E: The risk of a violent uprising in Jamaica is high

- L describes the law hypothesis and needs to be critically examined: **have important variables been overlooked?**

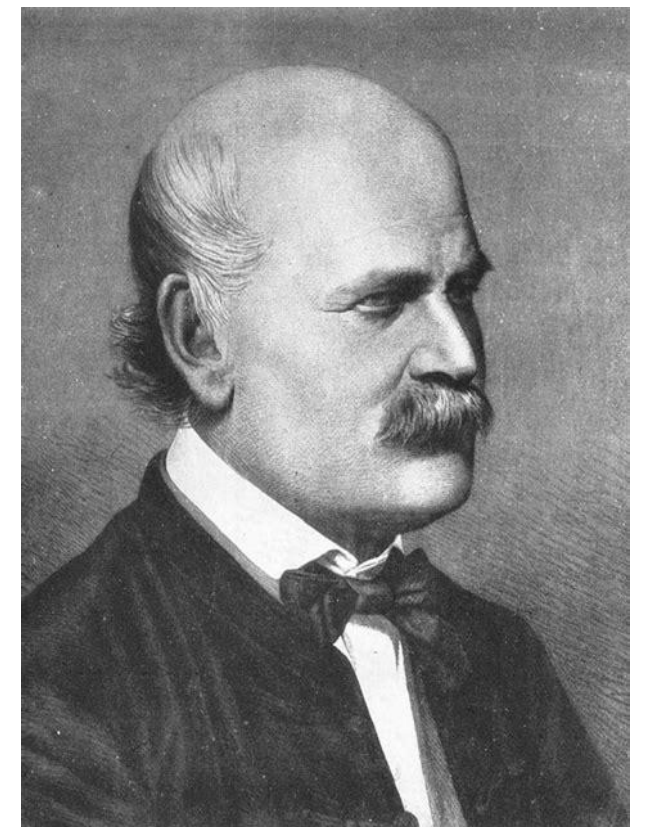


Implications of the DM Model

- The **classical positivist approach to research** can be derived from the DNM (Deductive-Nomological Model).
- In this tradition, the task of science is seen solely as **testing previously derived hypotheses**
 - The exploratory aspect of science (deriving new hypotheses) is left out
- The goal of science: to identify more **general and true laws**
 - Ideal state: everything can be explained by a few universally valid laws.
- To achieve this, an ideal-typical procedure was developed, which, despite fundamental problems, remains prominent to this day: **the Hypothetico-Deductive (H-D) method**

The Hypothetico-Deductive method

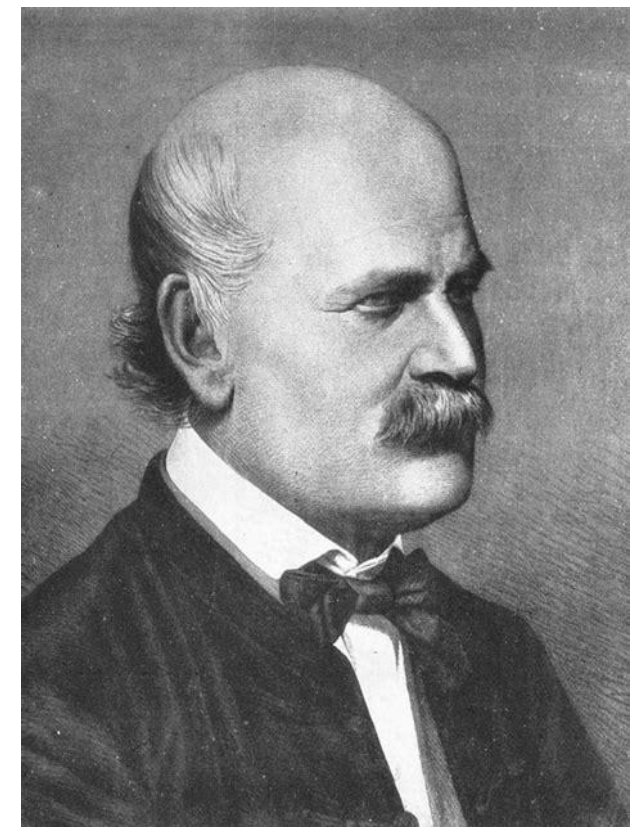
- Ignaz Semmelweis was a physician in Vienna between 1844 and 1848
- Problem: high mortality rate and childbed fever at one division of the hospital
 - No such high rates at second division of the hospital
- Semmelweis used the hypothetico-deductive method and hypothesized
 - H1: Epidemy
 - H2: overcrowding in division 1
 - H3: incompetence of medical staff
 - H4: stress due to priests rushing in and out
 - H5: sepsis due to lack of hygiene



Ignaz Semmelweis 1818 - 1865

The Hypothetico-Deductive method

- After testing, H1 to H4 had to be refused
 - H1: Epidemy ✗
 - H2: overcrowding in division 1 ✗
 - H3: incompetence of medical staff ✗
 - H4: stress due to priests rushing in and out ✗
 - H5: sepsis due to lack of hygiene
- Only H5 **was not falsified** and lack of hygiene was identified as a causal factor for high mortality rates



Ignaz Semmelweis 1818 - 1865

Motivation: Why care about Methods?

- Methods determine what we can know and how we know it
- Analyzing and understanding the limitations of studies
 - Different ontological and epistemological assumptions
 - Methodological Pluralism
- Critical reflection of methods and their biases

Relevance for management (studies)?

- Management as problem-solving
 - Evidence-based decision making
 - Framing of problems constrains potential solutions

Qualitative and Quantitative Methods

Underlying Philosophy	
Quantitative Methods	Qualitative Methods
Positivism	Constructivism
The world as external and objective	the world as socially constructed and subjective
Hypothetico-deductive research logic: Testing Theory or Hypothesis	Holistic-inductive logic: Developing Theory or Hypothesis
Researcher neutrality and value-free inquiry	Researcher subjectivity and reflexivity
Measure and investigate causal relationships	Illuminating multiple realities through controlled interpretation
Discovering social laws	Describing and understanding

Qualitative and Quantitative Methods

Research Design	
Quantitative Methods	Qualitative Methods
Relationship between variables	Meaning, Context, Process
How many? How much? What is the relationship between x and y?	How? Why? What is the nature of?
<i>Example: What is the relationship between leadership style and employee productivity?</i>	<i>Example: how do employees experience organizational change?</i>

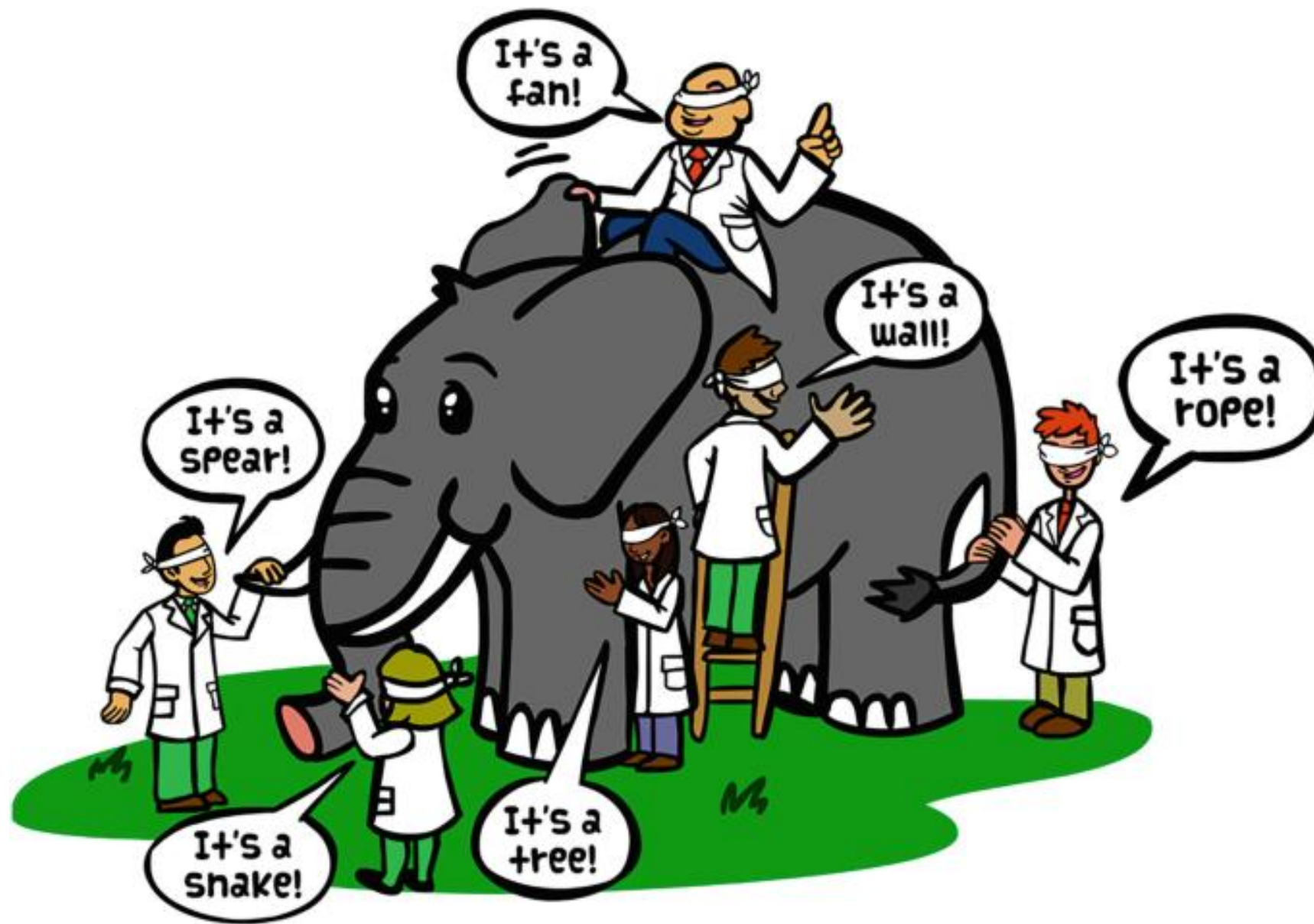
Qualitative and Quantitative Methods

Data	
Quantitative Methods	Qualitative Methods
Numerical data	Narrative, textual data
Large N	Small N
Statistical Analysis	Interpretive Analysis

Qualitative and Quantitative Methods

Outcome	
Quantitative Methods	Qualitative Methods
Breadth of understanding	Depth of understanding
Easier to replicate Generalizable knowledge	Harder to replicate Context-specific knowledge
Testing and refining theory	Developing new concepts and theories

Methodological Pluralism



Methodological Pluralism

- Mixed methods: one research question is answered with a combination of qualitative and quantitative research methods
- Methodological pluralism: employing a multitude of methods on a disciplinary level
 - Plurality vs. pluralism
 - On the levels of ontology, epistemology and *methodology*
 - Different forms of pluralism: consensual, agonistic, antagonistic pluralism
 - Plays out on a disciplinary level, not in regard to one single research question
- Key take-away: different methodological approaches can reveal different aspects of social phenomena that might be missed by a single method

Wrap Up

- Basics of Logic to understand and analyze argument
 - Logical Operators
 - Argument Reconstruction & Argumentative Fallacies
- Scientific Explanation: Deductive-Nomological Model & Hypothetico-Deductive Method
- Strengths and Drawbacks of Qualitative and Quantitative Methods

For next week: Texts on the Website (and Moodle)

References

Slide 7, 8: Kahane, Howard, Hausman, Alan and Boardman, Frank (2021). *Logic and Philosophy A Modern Introduction*, Thirteenth Edition, Hackett Publishing. Page 4.

Slide 17: William Campbell, “Technology Is Not Good Enough”; quoted from Hurley, Patrick J. (2000), *A Concise Introduction to Logic*, Seventh Edition, Wadsworth Publishing, Page 66.

Slide 19: Lewiński, Marcin and Dima Mohammed, 2016, “Argumentation Theory”, in *The International Encyclopedia of Communication Theory and Philosophy*, Klaus Bruhn Jensen, Robert T. Craig, Jefferson Pooley, and Eric W. Rothenbuhler (eds.), Hoboken, NJ: Wiley.