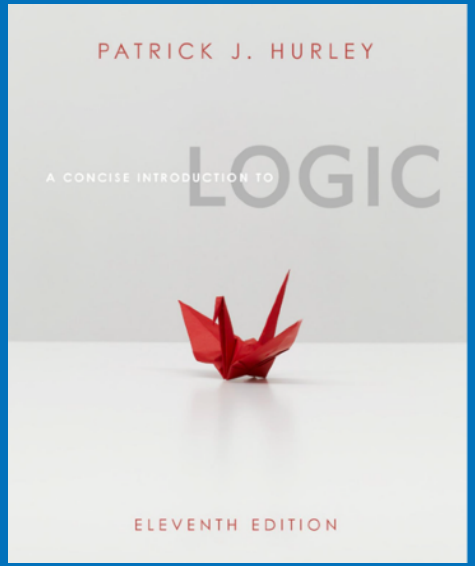
Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Wissenschaftstheorie & Einführung in das wissenschaftliche Arbeiten

Wissenschaftstheorie & Erkenntnistheorie I: Reasoning and truth

Dr. Blazej Baczkowski (Błażej Bączkowski)

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG



Brief intro to logic
— the anatomy of thinking (Locke)

Argument (ein Argument) — examples

Example 1:

Hamburg is a city in Germany.

Germany is in Europe.

Therefore, Hamburg is a city in Europe.

Example 2:

Hamburg has the area of about 755 km^2.

Therefore, most people living in Hamburg is wealthy.

Argument
— a group of statements

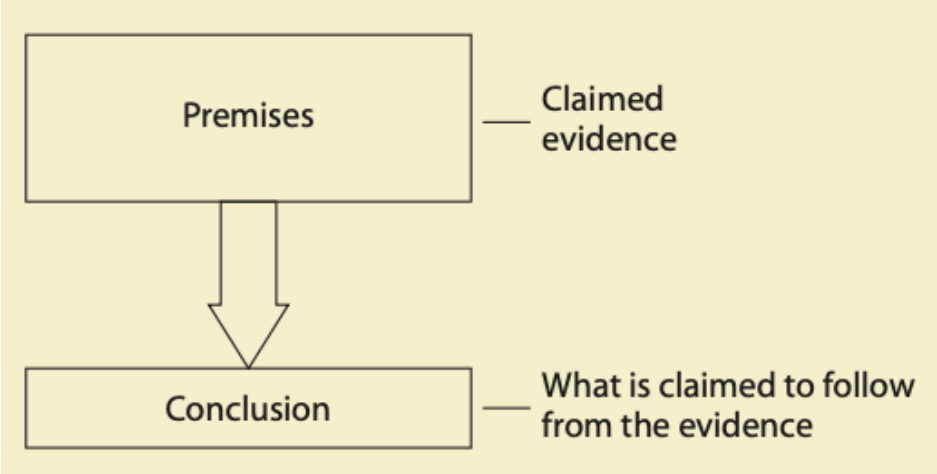
Statement (=Proposition)	Sentence
“Hamburg is a german city”	“Hamburg is located in Germany” “One of german cities is Hamburg”

Argument
— Premises (Prämisse) and Conclusions (Konklusion)

Essential components of an argument:

(1) First premise
(2) Second premise
(3) …

Therefore, conclusion



Hurley (2012)

“Dissecting” arguments

“The space program deserves increased expenditures in the years ahead. Not only does the national defense depend on it, but the program will more than pay for itself in terms of technological spinoffs. Furthermore, at current funding levels the program cannot fulfill its anticipated potential.”

P1: The national defense is dependent on the space program.

P2: The space program will more than pay for itself in terms of technological spinoffs.

P3: At current funding levels the space program cannot fulfill its anticipated potential.

C: Therefore, the space program deserves increased expenditures in the years ahead.

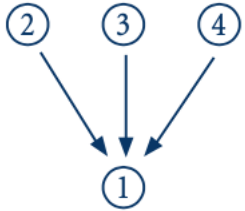
Extended arguments — vertical pattern

“(1) The selling of human organs, such as hearts, kidneys, and corneas, should be outlawed. (2) Allowing human organs to be sold will inevitably lead to a situation in which only the rich will be able to afford transplants. This is so because (3) whenever something scarce is bought and sold as a commodity, the price always goes up. (4) The law of supply and demand requires it.“

Hurley (2012)

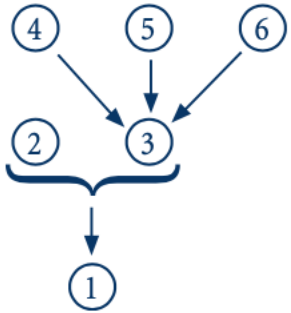
Extended arguments — horizontal pattern

"(1) The selling of human organs, such as hearts, kidneys, and corneas, should be outlawed. (2) If this practice is allowed to get a foothold, people in desperate financial straits will start selling their own organs to pay their bills. Alternately, (3) those with a criminal bent will take to killing healthy young people and selling their organs on the black market. (4) In the final analysis, the buying and selling of human organs comes just too close to the buying and selling of life itself."



Extended arguments — example (conjoint arguments)

“(1) Government mandates for zero-emission vehicles won’t work because (2) only electric cars qualify as zero-emission vehicles, and (3) electric cars won’t sell. (4) They are too expensive, (5) their range of operation is too limited, and (6) recharging facilities are not generally available.” (William Campbell, “Technology Is Not Good Enough”)



Hurley (2012)

Non-arguments
— explanations (Erklärung)

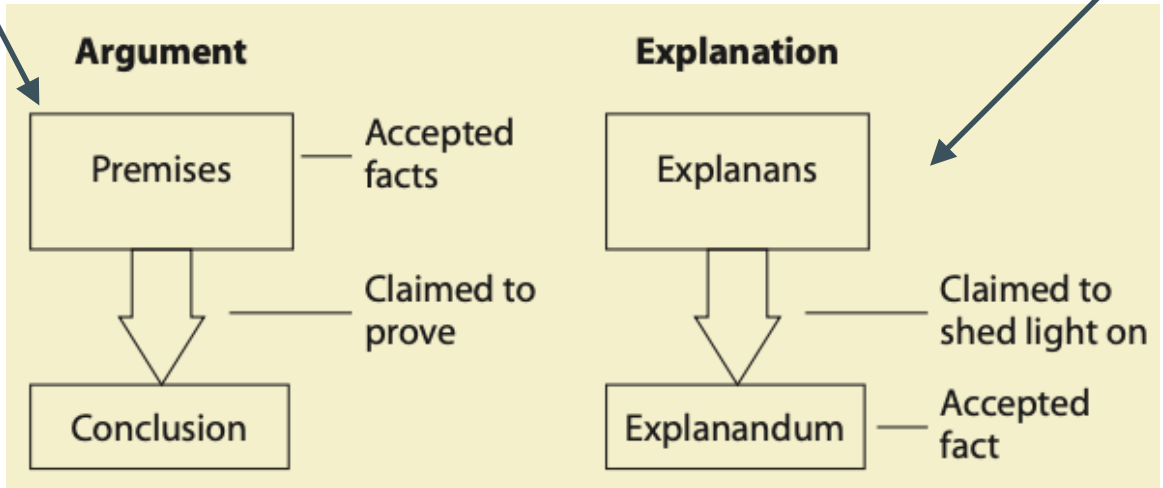
“The sky appears blue from the earth’s surface because light rays from the sun are scattered by particles in the atmosphere.“

The explanation is composed of the explanandum, i.e. a fact (or a phenomenon) that is to be explained, and the explanans, i.e. what does the explaining.

Arguments vs explanations

The purpose of premises is to prove **that** something is the case

The purpose of explanans is to show **why** something is the case



Non-arguments:
— conditional statements (die Subjunktion)

- In a conditional statement, there is no claim that either the antecedent or the consequent presents evidence. Rather, there is only the assertion that if the antecedent is true, then so is the consequent.
- A conditional statement as a whole may present evidence, because it asserts a relationship between statements. But there is still no argument, because there is no separate claim that this evidence implies anything.

Hurley (2012)

Non-arguments:
— conditional statements (die Subjunktion)

Sufficiency:

If X is a dog, then X is an animal.

(being a dog is sufficient to be an animal)

Necessity:

If X is not an animal, then X is not a dog.

(being an animal is necessary for being a dog)

Inferential claims
— deductive and inductive arguments

Deductive

(Argument is good based purely on its form.
The conclusion does not add to that which is already known.)

Inductive

(The content of the conclusion "goes beyond" / extends the content of the premises.)

Factual claim

(P1) All entertainers are extroverts

(P2) David Letterman is an entertainer.

(K) Therefore, David Letterman is an extrovert.

(P1) The vast majority of entertainers are extroverts.

(P2) David Letterman is an entertainer.

(K) Therefore, David Letterman is an extrovert.

Inferential claim

Inferential claims
— deductive and inductive arguments

- Arguments in science can be either deductive or inductive (in empirical sciences, arguments are usually inductive).
- Formulation of a scientific law is usually based on generalisations (induction). Yet, its application to a specific situation is deductive.
- Usually, inductive arguments proceed from the particular to the general, while deductive arguments the other way round. Yet, it is not always the case:
  - (P1) All emeralds previously found have been green.
  - (K) Therefore, the next emerald to be found will be green.

Deductive arguments — validity and soundness

Example of a valid but unsound argument:

(P1) All men are mortal.

(P2) Google is a man.

(K) Therefore, google is mortal.

Sound argument =
valid argument + true premises

Premises	Conclusion	Validity
T	T	?
T	F	Invalid
F	T	?
F	F	?

Valid argument form
— Modus ponens & Modus tollens

(P1) If twelve million children die yearly from starvation, then something is wrong with food distribution.

(P2) Twelve million children die yearly from starvation.

(K) Therefore, something is wrong with food distribution.

Modus ponens
if p then q
p
_____
therefore, q

(P1) If Japan cares about endangered species, then it has stopped killing whales.

(P2) Japan has not stopped killing whales.

(K) Therefore, Japan does not care about endangered species.

Modus tollens
if p then q
not q
_____
therefore, not p

Inductive arguments — strong / weak and cogent

Note: “strong” does not mean “good”; here, it means “precise” / “bold” / “risky”

Example of a strong but un-cogent argument:

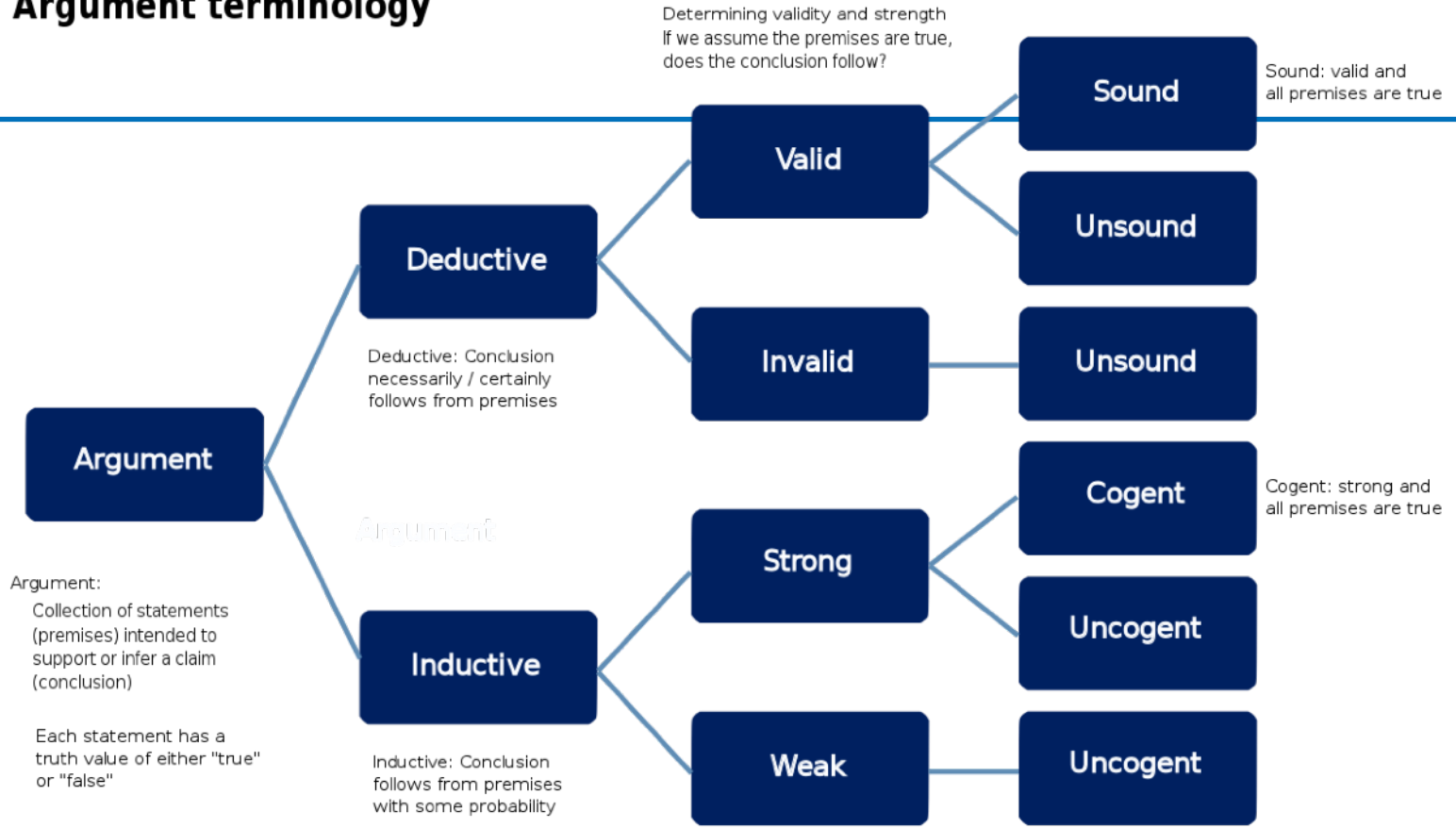
(P1) All previous US presidents were dentists.

(K) Therefore, probably the next US president will be a dentist.

Cogent (“justified”) argument = strong argument + true premises

Premises	Conclusion	Strength
T	prob. T	?
T	prob. F	Weak
F	prob. T	?
F	prob. F	?

Argument terminology



Source information: Patrick J. Hurley, "A Concise Introduction to Logic, 12th Ed."

Fallacy
— a defect in an argument beyond false premises

Formal fallacies (structure)

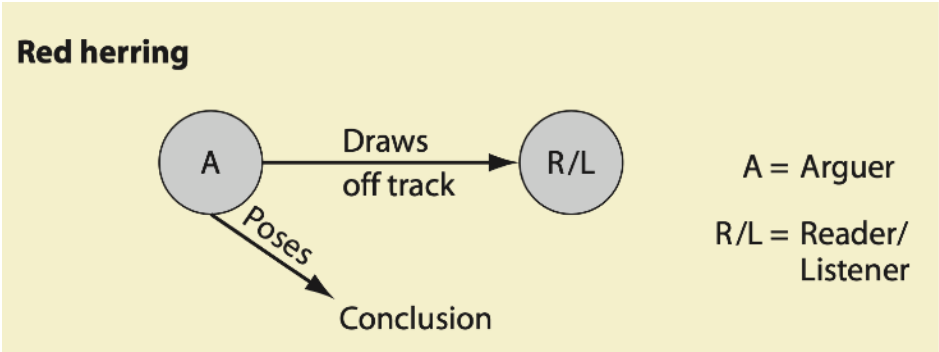
(P1) All A are B.
(P2) All C are B.
(K) Therefore, all C are B.

(P1) If A, then B.
(P2) B.
(K) Therefore, A.

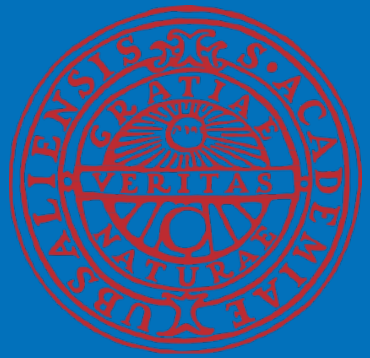
Informal fallacies (content)
(P1) The Brooklyn Bridge is made of atoms.
(P2) Atoms are invisible.
(K) Therefore, the Brooklyn Bridge is invisible.

Red herring fallacy
— fallacy of irrelevant conclusion

"There is a good deal of talk these days about the need to eliminate **pesticides** from our fruits and vegetables. But many of **these foods are essential to our health.** Carrots are an excellent source of vitamin A, broccoli is rich in iron, and oranges and grapefruit have lots of vitamin C."



Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG



Freie Universität Berlin

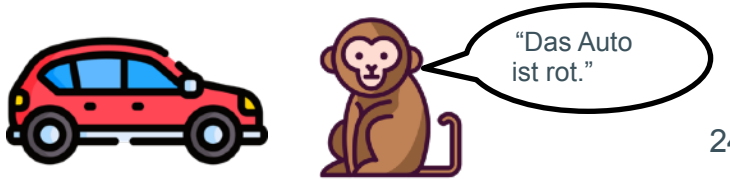
Theories of Truth

Some useful terminology — truth-bearers and truth-makers

- A truth-bearer (Wahrheitsträger) is an entity that has a truth value (is either true or false).
  - the term is used to remain neural about what that entity is (propositions, sentences, thoughts, utterances)
- A truth-maker (Wahrmacher) is anything that makes some truth-bearer true
  - again, the term is used to remain neutral among different options (facts, state of affairs, events, things, properties)

The correspondence theory of truth (die Korrespondenztheorie der Wahrheit)

- (semantic version) Aristotle in *Metaphysics*: “To say that that which is, is not, and that which is not, is, is a **falsehood**; therefore, to say that which is, is, and that which is not, is not, is **true**”.
  - medival definition: A (mental) sentence is true if and only if, as it signifies, so it is (sicut significat, ita est)
- (metaphysical version) Thomas Aquinas: "Veritas est adaequatio rei et intellectus" (“Truth is the equation of thing and intellect”)
  - (“A judgment is said to be true when it conforms to the external reality”)
- Basic idea: Something that we state, believe, claim, assume etc. is true if it corresponds to the way things actually are (if it bears a specific relation to a specific part of reality).



Simple version (I): being accord with facts

X is true if and only if, x corresponds to some fact;

x is false if and only if, x does not correspond to any fact.

“Schnee ist weiß” is true if and only if there is some fact about the world that corresponds to that statement.

“Schnee ist weiß” is false if and only if there is no fact about the world that corresponds to that statement.

Simple version (II): being accord with “state of affairs”

X is true if and only if, x corresponds to some state of affairs that obtains;

x is false if and only if, x corresponds to some state of affairs that does not obtain.

“Schnee ist weiß” is true if and only if the state of affairs, snow being white, actually obtains.

“Schnee ist weiß” is false if and only if the state of affairs, snow being white, does not obtain.

What do you mean by “does not obtain”? — problem of falsehood

- Advocates of “state-of-affairs” version hold that facts *are* states of affairs that obtain, i.e., they hold that their account of truth is in effect an analysis of the fact-based account of truth.
- Falsehood is more problematic:
  - Fact-based: to say that a fact does not obtain means, at best, that no such fact exists (falsehood = absence of truth)
    - “x does not correspond to any fact”
    - things that do not bear truth (e.g., snow) are false because they do not correspond to any fact; things are either true or false (bivalence)
  - State-of-affairs: commits to there being (existing) entities that nevertheless fail to obtain (e.g., snow being green).
    - “x corresponds to some state of affairs that does not obtain”
    - snow being green exists, it just does not obtain (Meinongianism)

Simple version (III): mis-corresponding with facts

X is true if and only if, x corresponds (agrees) with some fact;

x is false if and only if, x mis-corresponds (disagrees) with some fact.

“Schnee ist weiß” is true if and only if there is some fact about the world that corresponds to that statement.

“Schnee ist weiß” is false if and only if there is some fact about the world that mis-corresponds to that statement.

Problem:

- what is meant by “mis-correspondence”
- a truth-bearer that is true can be also false if it corresponds to one fact and mis-corresponds to another.

Arguments for the correspondence — obviousness

- Descartes: “I have never had any doubts about truth, because it seems a notion so transcendentally clear that nobody can be ignorant of it...the word ‘truth’, in the strict sense, denotes the conformity of thought with its object” (1639, AT II 597).
- Kant: “The nominal definition of truth, that it is the agreement of [a cognition] with its object, is assumed as granted” (1787, B82).
- William James: “Truth, as any dictionary will tell you, is a property of certain of our ideas. It means their ‘agreement’, as falsity means their disagreement, with ‘reality’” (1907, p. 96).
- *The Oxford English Dictionary*: “Truth, n. Conformity with fact; agreement with reality”.

Arguments against the correspondence: — what really is the correspondence?

The central notion of “correspondence” carries unacceptable commitments and/or cannot be accounted for in any respectable manner.

- The correspondence is a resemblance; but things that are true or false do not resemble anything in the world (Berkeley’s “an idea can be like nothing but an idea” -> the word “pencil” does not resemble any pencil)
- The correspondence is a mysterious relation (a relation between any time and space?)
- What is mean by “facts”?; they are ad-hoc “truth-bearers” in disguise only proposed to allow for correspondence to work; spurious sentence-like slices of reality… Seems like they are strange entities.

Solution (I): — isomorphism

If an item of kind K corresponds to a certain fact, then they have the same or sufficiently similar structure: the overall correspondence between a true K and a fact is a matter of part-wise correspondences, i.e. of their having corresponding constituents in corresponding places in the same structure, or in sufficiently similar structures.

“Schnee ist weiß”. This fact of the world corresponds to the statement such that “Schnee” is a particular and corresponds to an object / substance while “ist weiß” is a predicate and corresponds to a property of that substance.

Problems:

- This requires a sufficient theory of meaning.
- But what about statements that include logical operators such as “and”, “or”, “implies”, etc.? What kind of reality is isomorphic to such operations?

Solution (II): — logical atomism

The truth-definition is restricted to a special sub-class of truth-bearers, so called atomic truth-bearers, whose truth is said to consist in their correspondence to atomic facts:

if x is elementary, then x is true if and only if x corresponds to some atomic fact.

“Die Katze liegt auf einem Tisch.” is an atomic statement and it is true if it corresponds to some fact in the world.

“Es ist nicht so, dass die Katze auf einem Tisch liegt.” is a molecular statement. This molecular statement is made false based on the logical rule of negation because the atomic statement is true

Objections

- Objection to isomorphism: fails to work for actual everyday language (works only for ideal logical languages)
  - We can attribute truth value to such things as “average psychologist’s salary” but molecular isomorphism cannot break them down any further.
  - isomorphism projects the features of our language onto reality (J. L. Austin)
- Objection to logical atomism:
  - how to encompass such structures as counterfactuals and subjunctives (e.g., “If I had have gone to a lecture, I would have enjoyed myself”)?
  - how to deal with such universal generalisations as “All humans are mammals” to be a part of the world?

The coherence theory of truth (Die Kohärenztheorie der Wahrheit) — from corresponding to cohering

A belief is true if and only if it is part of a coherent system of beliefs.

Where the correspondence theory of truth allows a truth-bearer to be true if it corresponds to some truth-maker in the world, the coherence theory allows truth-bearers to be true if they cohere with other truth-bearers. (carneades.org)

what exactly constitutes the coherence relation

what constitutes the set of truth-bearers that can bear this relation to a proposition

(carneades.org)

What constitutes the coherence relation (I) — logical consistency

- The coherence relation is simply consistency: a new truth-bearer is true if and only if it is logically consistent with the set of propositions already held. In other words, there is no contradiction among all truth-bearers at the same time.
- “Schnee ist weiß” is true if there is a world where this truth-bearer can be true along with all other truth-bearers (there is no set of truth-bearers that implies contradiction with “Schnee ist weiß”)
  - Objection:
    - it is possible for a set of truth-bearers to be consistent with both of two contradictory truth-bearers.
    - For example, if our set of beliefs says nothing about a new truth-bearer such as “Schnee ist weiß”, then both “Schnee ist weiß” and “Schnee ist nicht weiß” are consistent with the already held set but they are inconsistent with each other. This leads to a contradiction.

What constitutes the coherence relation (II) — (logical) entailment

- A proposition coheres with a set of propositions if and only if it is entailed by members of the set.
- As a consequence, there is no way that the truth-bearer in question could be false.
  - The contradiction is avoided because if the set entails “Schnee ist weiß”, then the set cannot be consistent with “Schnee ist nicht weiß”.

What constitutes the set of truth-bearers to which the new truth-bearer coheres?

- Usually, the set of beliefs consists of already accepted propositions
- But the scope of these beliefs and who believes them differ:
    1. it is the largest consistent set of propositions currently believed by actual people
    2. it is a set of propositions which will be believed when people like us (with finite cognitive abilities) have reached some limit of inquiry
    3. it is a set of propositions held by an omniscient God (theistic idealist)

Arguments for the coherence theory of truth — two roads

- Methaphysical (one is an idealist)
  - idealists believe that there is no ontological distinction between beliefs and what makes beliefs true (in contrast to the advocates of the correspondence theory of truth).
  - Reality is a collection of beliefs (there are no physical states). Consequently, a belief cannot be true because it corresponds to something which is not a belief.
  - This usually leads to the view that truth comes in degrees (to the degree it coheres with other beliefs)
  - Comment: Being a coherentist does not entail being an idealist. Coherentists may not deny the outside world, but they do deny that there is any connection to truth. The physical world goes in some separate way than what we say about it.
- Epistemological (one is already a coherentist about justification)

Coherence in justification vs coherence in truth

Coherence theory of justification

If a truth-bearer coheres with our (personal) set of beliefs we are justified in holding it.

Consider knowledge as **justified true belief**: *S* knows that *p* if and only if (1) *p* is true, (2) *S* belies that *p*, and (3) this belief is justified.

Coherence theory of truth

If a truth-bearer coheres with some specified set of beliefs then it is true.

Coherence is what makes a belief true, not what gives us a reason to hold it.

(carneades.org)

Objections
— the specification objection

- Coherence theorists have no way to identify the specified set of propositions without contradicting their position
- Each of two statements (1) “Jane Austen was hanged for murder”, and (2) “Jane Austen died in her bed” cohere with a different set of propositions. Yet, clearly only one of them can be true.
- Response:
  - choose the set that corresponds to the facts (this makes coherence theory just a complicated version of the correspondence theory)
  - choose the set that satisfies some criterion: it is larger, it is more comprehensive, it is simpler, etc.
    - what if sets are equally large or simple?
    - what if a preferred set contains the very criterion that tells us which system we should pick; if there are two such sets, there is no way to decide which set should be held
  - Yet, coherentists do not believe that the truth of a proposition consists in coherence with any arbitrarily chosen set of propositions, but a set of beliefs held to be true. Hence, nobody actually holds the set of propositions that cohere with statement 1. Therefore, the statement 1 is false and there is no contradiction.

Pluralist theories of truth — there is more than one way of being true

- Most traditional theories of truth are **monist** (there is one property which makes a proposition true)
- Not all (declarative) sentences in all domains are true in exactly the same way: “2 + 2 = 4”, “Schnee ist weiß”, “It is worth studying psychology”.
- Truth is constituted by different properties for true propositions from different domains of discourse (alethic pluralism)
- The term “true” is univocal, expressing one property (truth being true) but one that can be realised / manifested in different properties (correspondence, coherence, or yet something else)
- Contemporary directions:
  - It seems difficult to sort propositions into distinct kinds according to the subject matter they are about (“Killing is morally wrong”, “Immoral acts happen in time-space.”)
  - How exactly can such different properties (correspondence, coherence) account for the truth itself? Truth can be defined as a functional property / role characterised by a range of principles that articulate such features of truth as its objectivity, its role in inquiry, and related ideas considered in various theories of truth.

Pragmatist theories of truth — truth is the end of inquiry

- There is no difference in meaning without a difference in practice (what is the practical effect of the meaning of our terms / thoughts)
- Scientific inquiry aims at truth (stable belief — belief that will not have to be given up in the face of further information) and achieves it through scientific method (to formulate hypotheses that survive experimental tests; revise hypotheses in light of new evidence)
  - correspondence: truth is correspondence with reality
  - pragmatism: truth is what science aims at
- “The opinion which is fated to be ultimately agreed to by all who investigate, is what we mean by the truth, and the object represented in this opinion is the real. That is the way I would explain reality.”
  - Comment: Truth is a kind of coherence with the ideal limit of scientific inquiry
  - Problems:
    - If we haven’t all agreed yet, then are our current theories false?
    - Does the agreement simply makes things true?

Charles Sanders Peirce (1839 - 1914)

Next time…

- On scientific inquiry…

Schlüsselwörter

- Argument (argument), Prämisse (premise), Konklusion (conclusion)
- Erklärung (explanation), explanans, explanandum
- die Subjunktion, Notwendige und hinreichende Bedingung (Conditional statements, necessary and sufficient conditions)
- deduktive und inductive Argumente (deductive and inductive arguments)
- deduktive Gültigkeit und Korrektheit (validity and soundness of deduktive arguments)
- inductive Stärke und Stichhaltigkeit (strength and cogency of inductive arguments)
- Modus ponens, modus tollens
- Fehlschluss (fallacy), “red herring fallacy”
- Wahrheitsträger (truth-bearer), Wahrmacher (truth-maker)
- Die Korrespondenztheorie der Wahrheit (correspondence theory of truth), die Kohärenztheorie der Wahrheit (coherence theory of truth), pluralistische Theorien der Wahrheit (pluralist theories of truth), pragmatische Theorien der Wahrheit (pragmatist theories of truth; Pierce)
- kohärentistische Begründung vs die Kohärenztheorie der Wahrheit (coherence in justification vs coherence in truth)
- Definition von Wissen: eine wahre und gerechtfertigte Überzeugung (Justified true belief)

Ergänzende Literatur / Quellenmaterial

- Hurley, P. (2012). A Concise Introduction to Logic. Belmont, CA, USA: Wadsworth.
- https://plato.stanford.edu/entries/truth/
- https://plato.stanford.edu/entries/truth-correspondence/
- https://plato.stanford.edu/entries/truth-coherence/
- https://plato.stanford.edu/entries/truth-pluralist/
- https://plato.stanford.edu/entries/pragmatism/
- https://www.youtube.com/playlist?list=PLz0n_SjOttTdtycrFYOrO9zxszamWbSim (Carneades.org, “You can’t handle the truth!”)