Module 3
Induction and Confirmation

Theory and Reality - Chapter 3

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Overview

- The problem of confirmation
- Deduction, induction, abduction
- Hume's problem of induction
- How to understand confirmation:

• Hypothetico-deductivism (problems from logic)

•Instance confirmation (the problem of ravens)

- The new riddle of induction

The problem of confirmation

Observation----------**H**ypothesis

How can **O** confirm **H**?

How does **O** support **H**?

What makes **O** evidence for **H**?

The problem of confirmation

Logical empiricism… Again

(no "state of the art" approaches)

Logical analysis of science

The problem of confirmation

"Logical analysis of science"

P1: **O**bservation 1
P2: **O**bservation 2
Pn: **O**bservation n
Therefore
C: **H**ypothesis (Theory)

The problem of confirmation

Can such inferences from O to H be always deductive?

NO: O → Particular cases

H → Generalization

There is no purely deductive step from particular to general

Types of inference

P1: Socrates is a man

P2: All men are mortal

C: Socrates is mortal

Deduction

True premises guarantee the truth of the conclusion

Types of inference

P1: In January 1997, it rained in Paris

P2: In January 1998, it rained in Paris

P3: In January 1999, it rained in Paris

C: It rains every January in Paris

Induction

True premises make the conclusion plausible (but not certain)

Types of inference

P1: John loves beer

P2: there is an empty bottle of beer on John's table

C: John has drunk a beer

Abduction / Explanatory inference / Inference to the best explanation

True premises make the conclusion plausible (but not certain)

Induction and abduction

Induction and abduction are non-deductive inferences

They are very common in scientific and in everyday reasoning

Any examples?

Induction in science

(Enumerative) Induction
Swan 1 is white, swan 2 is white… swan n is white (**O**)

Therefore

All swans are white (**H**)

Abduction in science

Abduction / Explanatory infer.
There are unusually high levels of some rare chemical elements, such as iridium, in layers of the earth's crust that are about 65 million years old (**O**)

Therefore (**H**)

Induct. logic and form

NOTICE: while inductive logic (unlike deductive l.) cannot provide certainty, some logical empiricists (Hempel) tried to develop a theory of confirmation based on modeling inductive logic on deductive logic in the sense of stressing its formal aspects

Induct. logic and form

P1: Socrates is a man

P2: All men are mortal

C: Socrates is mortal

P1: A is B

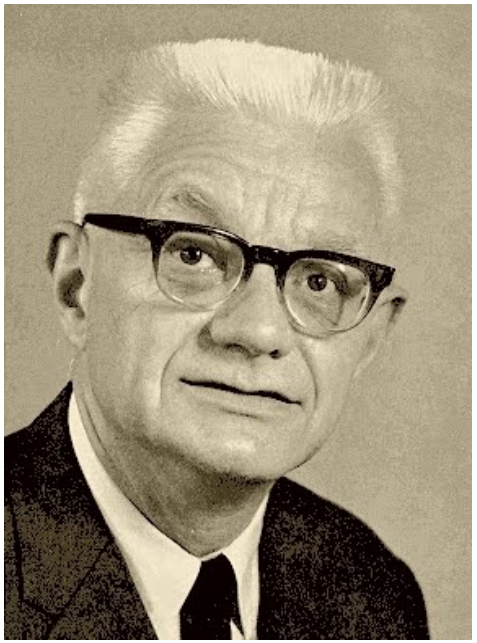
P2: All Bs are D

C: A is D

Induct. logic and form

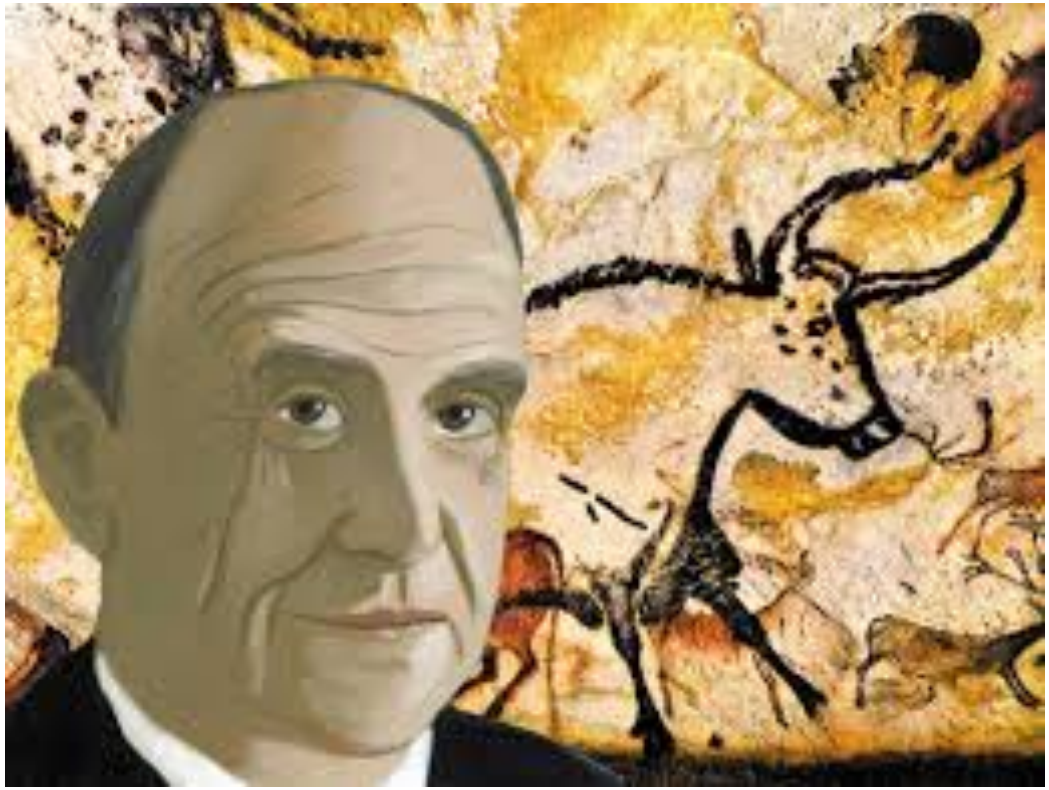
Logical empiricists like Hempel tried to develop a purely formal theory of confirmation – in which inductive inferences can be assessed on the basis of their form

(Carnap worked on the theory of probability)



Induct. logic and form

Nelson Goodman provided reason to believe that this cannot work



Historical digression: the problem of induction

What reason do we have for thinking that the future will resemble the past?

Historical digression: the problem of induction

What reason do we have for expecting the sun to rise tomorrow?

Historical digression: the problem of induction

P: the sun has risen every day so far
C: the sun will raise tomorrow

But in principle the future might differ from the past

Historical digression: the problem of induction

P: the sun has risen every day so far
C: the sun will raise tomorrow

Hume as an **inductive skeptic**: Induction is psychologically natural, but has no rational basis

Hume’s skepticism: videos

Hume's Skepticism and Induction, Part 1

https://www.youtube.com/watch?v=-QpUrSn3cWU

Hume's skepticism: videos

	Relations of ideas	**Matters of fact**
Metaphysical	Necessary	Contingent
Semantical / Logical	Analytic	Synthetic
Epistemological	A priori	A posteriori
Example	"2+2=4"	"Some cats are black"

Hume’s skepticism: videos

Hume's Skepticism and Induction, Part 2

https://www.youtube.com/watch?v=dPlNsyXl-0c

How to understand confirmation in science

2 proposals (and related problems):

- Hypothetico-deductivism
- Confirmation by instances (Hempel's view)

Hypothetico-deductivism

Hypotheses in science are confirmed when their logical consequences turn out to be true

Hypothetico-deductivism

Logical consequence

A: 210000 people live in Padua

B: more than 150000 people live in Padua

If A is true, B cannot be false; If A is true, then necessarily B is true; B follows logically from A

Hypothetico-deductivism

Logical consequence

P1: Socrates is a man

P2: All men are mortal

C: Socrates is mortal

The conclusion of a deductively valid argument is a logical consequence of the premises

Hypothetico-deductivism

A: All swans are white

B: Swans 1, 2… n are white

B is a logical consequence of A

Hypothetico-deductivism

H: All swans are white

O: Swans 1, 2… n are white

Observational statement is a logical consequence of the **H**ypothesis

Hypothetico-deductivism

Observational statement is a logical consequence of the **H**ypothesis

Hypothetico-deductivism: if observational statements derived from H are true, then H is confirmed

Hypothetico-deductivism

If observational statements derived from H are true, then H is confirmed

ISN'T THIS CLEARLY TRUE?

NOT SO FAST!

Problems from simple logic

Logical disjunction (OR)

A: Padua is in Italy

T

B: Stefano Cossara is male

T

AvB: Padua is in Italy or Stefano Cossara is male

T

Logical disjunction (OR)

A: Padua is in Italy

T

B: Stefano Cossara is female

F

AvB: Padua is in Italy or Stefano Cossara is female

T

Logical disjunction (OR)

A: Padua is in France

F

B: Stefano Cossara is male

T

AvB: Padua is in France or Stefano Cossara is male

T

Logical disjunction (OR)

A: Padua is in France

F

B: Stefano Cossara is female

F

AvB: Padua is in France or Stefano Cossara is female

F

Logical disjunction (OR)

A	B	AvB
True	True	True
True	False	True
False	True	True
False	False	False

AvB is false if and only if both A and B are false

Logical disjunction (OR)

A	B	AvB
True	True	True
True	False	True
False	True	True
False	False	False

If A is true, then necessarily AvB is true [the same applies to B]

Logical disjunction (OR)

A	B	AvB
True	True	True
True	False	True
False	True	True
False	False	False

AvB is a logical consequence of A [the same applies to B]

Hypothetico-deductivism

AvB is a logical consequence of A

HvB is a logical consequence of H (H being any scientific hypoth.)

H: The speed of light is 186,000 mi/sec
B: Stefano Cossara is male

Hypothetico-deductivism

AvB is a logical consequence of A

HvB is a logical consequence of H (H being any scientific hypoth.)

"The speed of light is 186,000 mi/sec or Stefano Cossara is male" (HvB) is a logical consequence of "The speed of light is 186,000 mi/sec" (H)

Hypothetico-deductivism

"The speed of light is 186,000 mi/sec or Stefano Cossara is male" (HvB) is a logical consequence of "The speed of light is 186,000 mi/sec" (H)

Hypothetico-deductivism says that hypotheses in science are confirmed when their logical consequences turn out to be true.

Hypothetico-deductivism

"The speed of light is 186,000 mi/sec or Stefano Cossara is male" (HvB) is a logical consequence of "The speed of light is 186,000 mi/sec" (H)

Hypothetico-deductivism says that H is confirmed when (HvB) turns out to be true.

Hypothetico-deductivism

"The speed of light is 186,000 mi/sec or Stefano Cossara is male" (HvB) is a logical consequence of "The speed of light is 186,000 mi/sec" (H)

How to establish when (HvB) is true?

Hypothetico-deductivism

H	B	HvB
True	True	True
True	False	True
False	True	True
False	False	False

If B is true, then necessarily HvB is true

Hypothetico-deductivism

If B is true, then necessarily HvB is true

In order to establish that HvB is true, I just need to check that B is true (Stefano Cossara is male): very easy!

Hypothetico-deductivism

According to hyp-deduct, if HvB is true, then H is confirmed

According to hyp-deduct, if "The speed of light is 186,000 mi/sec or Stefano Cossara is male" is true, then "The speed of light is 186,000 mi/sec" is confirmed

Hypothetico-deductivism

According to hyp-deduct, if HvB is true, then H is confirmed

According to hyp-deduct, if "Stefano Cossara is male" is true, then "The speed of light is 186,000 mi/sec" is confirmed

ABSURD: confirmation too easy!

The ravens problem

(For Hempel’s view)

The ravens problem

How is it that repeated observations of black ravens can confirm the generalization that all ravens are black?

Hempel: all observations of instances of black ravens confirm the generalization that all ravens are black

The ravens problem

All observations of an F that is also G supports the generalization "All F's are G"

The ravens problem

All observations of an F that is also G supports the generalization "All F's are G"

ISN'T THIS CLEARLY TRUE?

NOT SO FAST!

Logical equivalence

Two sentences that say the same thing with different words

Two sentences such that, if the first is true, then the second cannot be false

Logical equivalence

1. John went to the store after he washed the dishes
2. John washed the dishes before he went to the store

The ravens problem

Or ‘paradox’: a set of ideas that seem individually plausible, but give rise to an apparently implausible conclusion

The ravens problem

1. Observations of black ravens confirm the generalization that all ravens are black

2. Any observation that confirms hypothesis H also confirms a logically equivalent hypothesis H’

3. “All ravens are black” equivalent to “All nonblack things are not ravens”

The ravens problem

Observing a nonblack thing that is not a raven confirms “All nonblack things are not ravens”

In virtue of logical equivalence, it also confirms
“All ravens are black”

The ravens problem

Thus, observing a nonblack thing that is not a raven (e.g., a white shoe), confirms "All ravens are black"

ABSURD! "Indoor ornitology"

The ravens problem

Reactions

Hempel: bite the bullet (Observing a white shoe does confirm the hypothesis that all ravens are black, though presumably only by a tiny amount)

The ravens problem

Reactions

Good (1967): Perhaps observing a white shoe or a black raven may or may not confirm "All ravens are black." It depends on other factors.

(Holism)

The ravens problem

Reactions

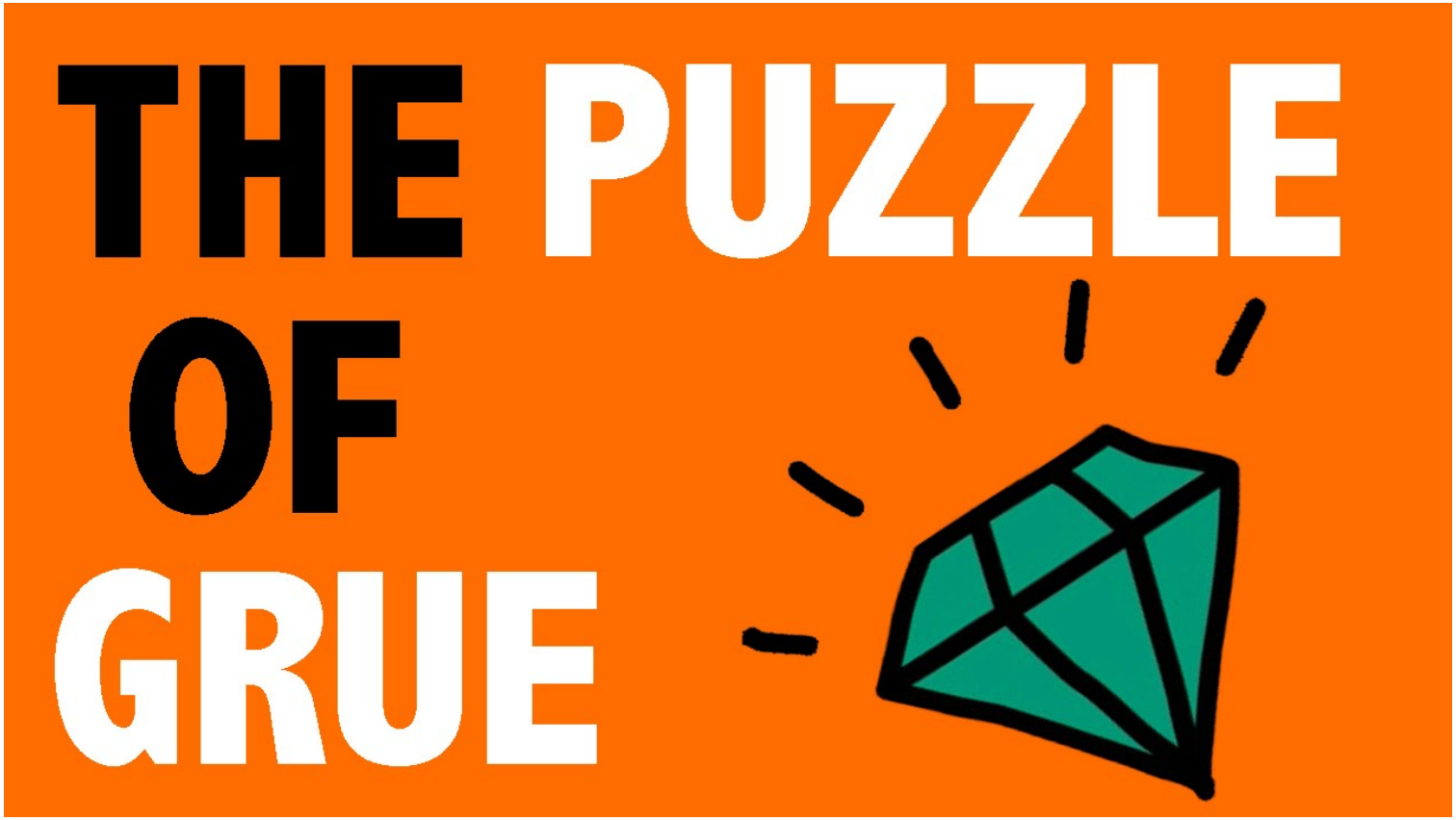
GS: Whether or not a black raven or a white shoe confirms "All ravens are black" might depend on the order in which you learn of the two properties of the object.

The ravens problem

Video

https://www.youtube.com/watch?v=_SKmqh5Eu4Y

The new riddle of induction

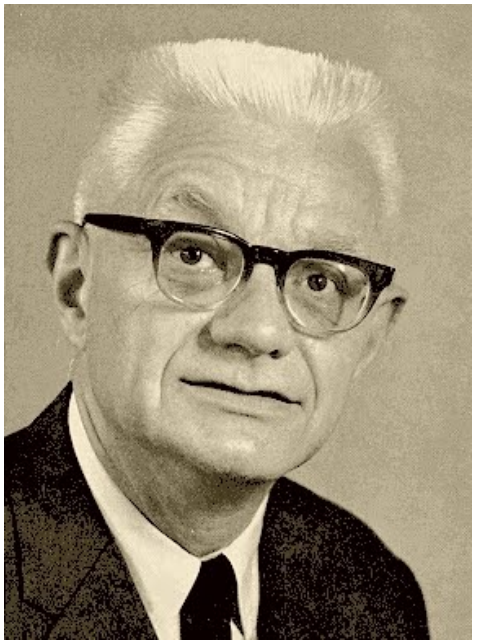


By Nelson Goodman

The new riddle of induction

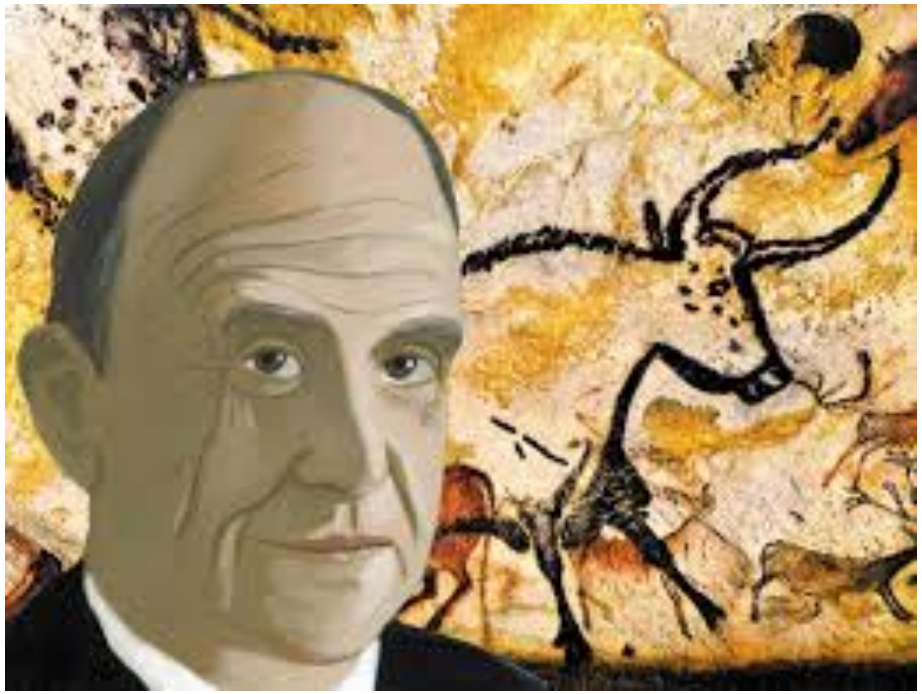
Logical empiricists like Hempel tried to develop a purely formal theory of confirmation – in which inductive inferences can be assessed on the basis of their form

(Carnap worked on the theory of probability)



The new riddle of induction

Nelson Goodman provided reason to believe that this cannot work: there cannot be a purely formal theory of confirmation



The new riddle of induction

Socrates is a man

All men are mortal

Therefore, Socrates is mortal

Socrates is a man

All men are carrots

Therefore, Socrates is a carrot

The new riddle of induction

(The first only contains true premises are true, the second also contains one false premise) BUT

They are both valid: same form

A is B

All Bs are Cs

Therefore, A is C

The new riddle of induction

- The moral: when it comes to validity, only form matters

- The logical empiricists would like a theory of confirmation (based on inductive logic) in which only form matters

- Goodman: no such theory can be constructed

The new riddle of induction

Goodman's reasoning:

- There are ind. arg. with the same form, but one good and one bad
- Therefore, form is not sufficient to distinguish good from bad ind. arg.
- Therefore, a theory of confirmation exclusively focused on form ('purely formal') cannot work

The new riddle of induction

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been green

- Therefore, all emeralds are green

Inductive or deductive? Good or bad?

The new riddle of induction

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been green
- Therefore, all emeralds are green

A good inductive argument

The new riddle of induction

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been grue
- Therefore, all emeralds are grue

Grue: An object is grue if and only if it was first observed before 2018 and is green, or if it was not first observed before 2018 and is blue

The new riddle of induction

Before 2018 Before 2018 Not bef. 2018

Grue: An object is grue if and only if it was first observed before 2018 and is green, or if it was not first observed before 2018 and is blue

The new riddle of induction

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been grue
- Therefore, all emeralds are grue

Inductive or deductive? Good or bad?

The new riddle of induction

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been grue
- Therefore, all emeralds are grue

A bad inductive argument

The new riddle of induction

A - Before 2018

B - Not Before 2018

All emeralds observed before 2018 are like A… Therefore, all emeralds observed starting from 2018 will be like B: **BAD!**

The new riddle of induction

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been grue
- Therefore, all emeralds are grue

A bad inductive argument:

It suggests that emeralds observed in the future will be blue on the basis of previously observed green emeralds

The new riddle of induction

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been green **[good]**
- Therefore, all emeralds are green

- All the many emeralds observed, in diverse circumstances, prior to 2018 have been grue **[bad]**
- Therefore, all emeralds are grue

But they have the same form!

The new riddle of induction

- Two inductive arguments with the same form, but one good, the other bad

- Hence, form is insufficient to distinguish good from bad inductive arguments

- Therefore a purely formal theory of confirmation cannot work – contra logical empiricism

The new riddle of induction

What's wrong with grue?

1) Reference to time ("before 2018 and is green, or if it was not first observed before 2018 and is blue")

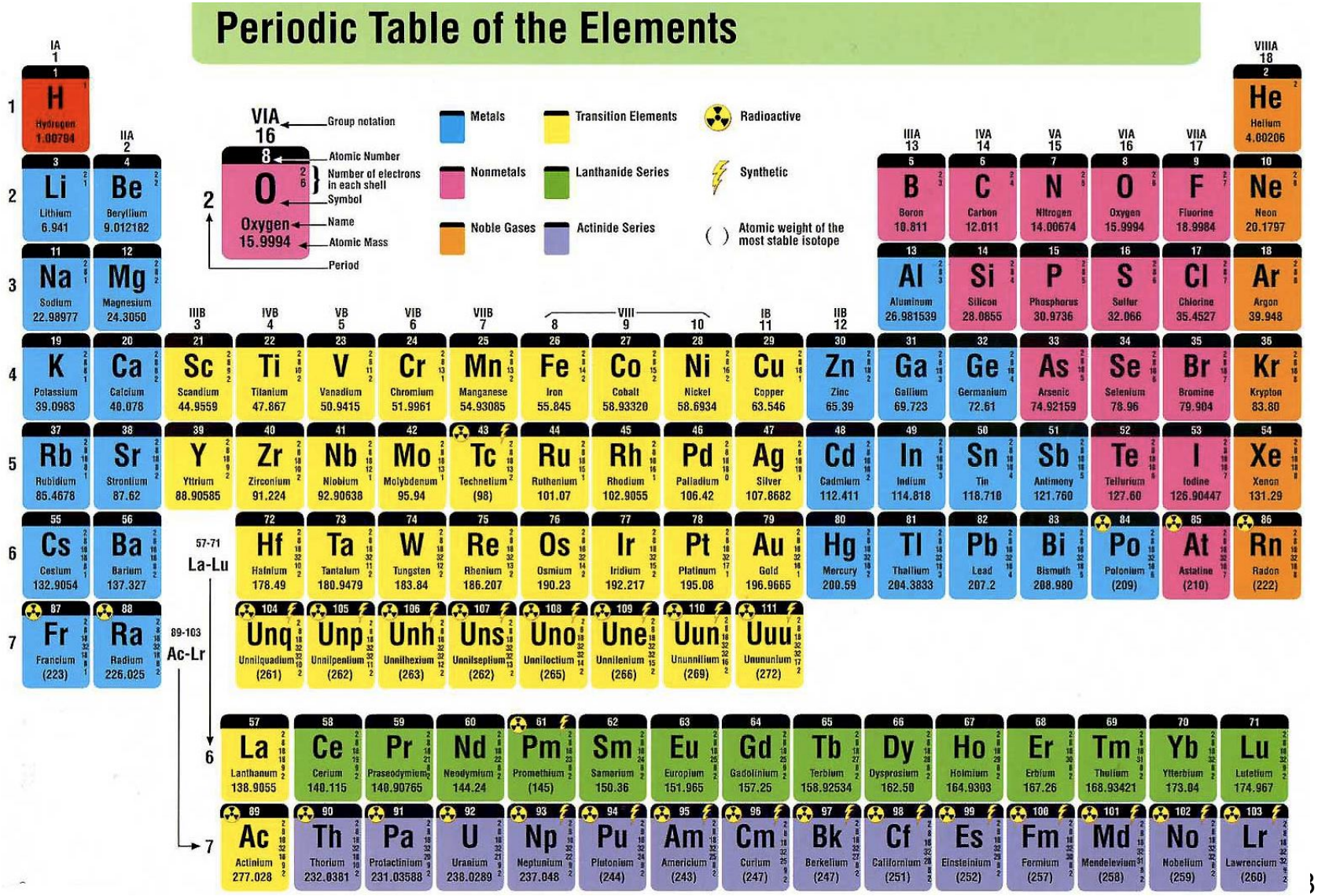
The new riddle of induction

What's wrong with grue?

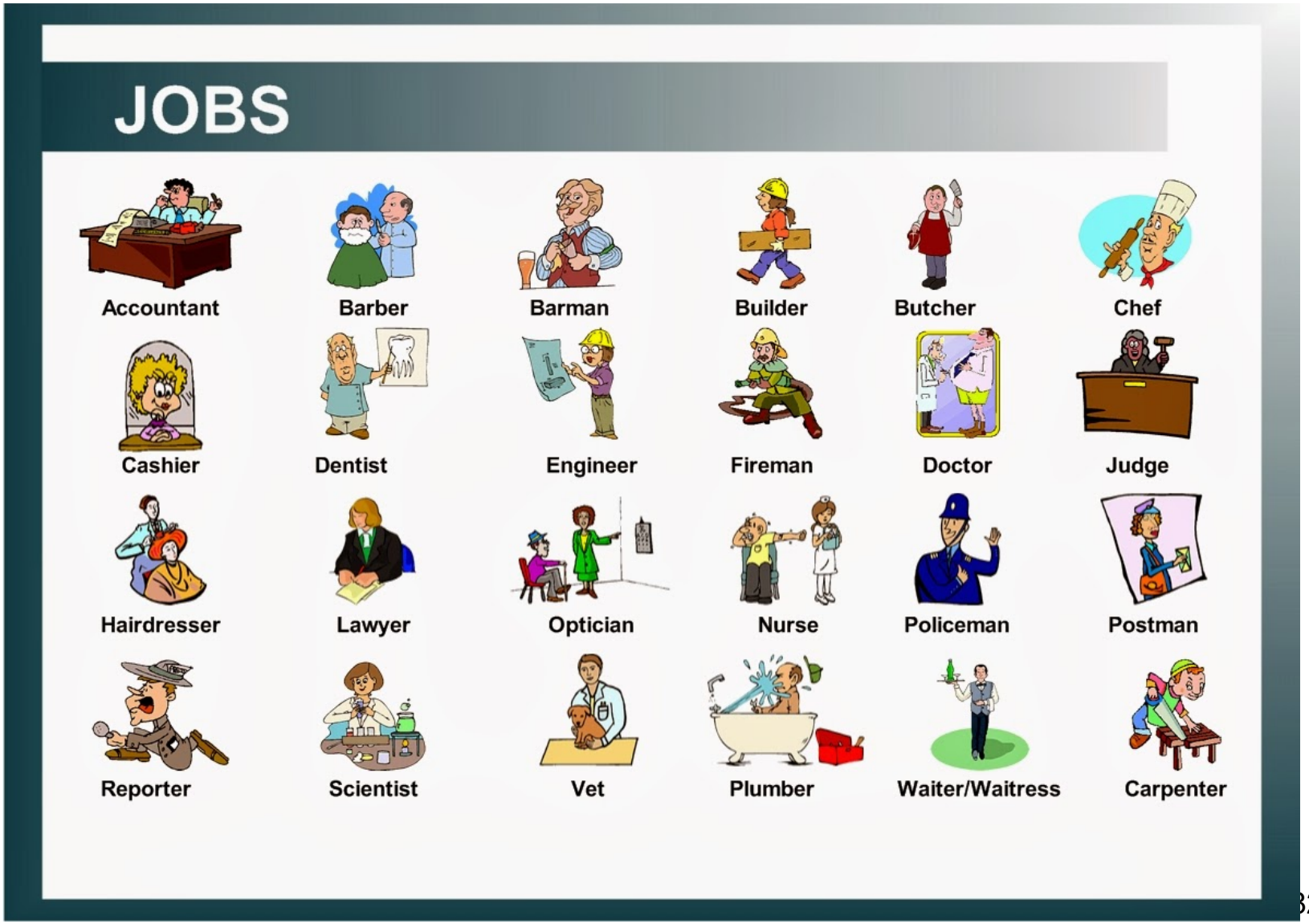
2) 'Green' identifies a natural kind, 'grue' does not

Natural kind=grouping that reflects the structure of the natural world, as opposed to an artificial grouping

The new riddle of induction



The new riddle of induction



The new riddle of induction

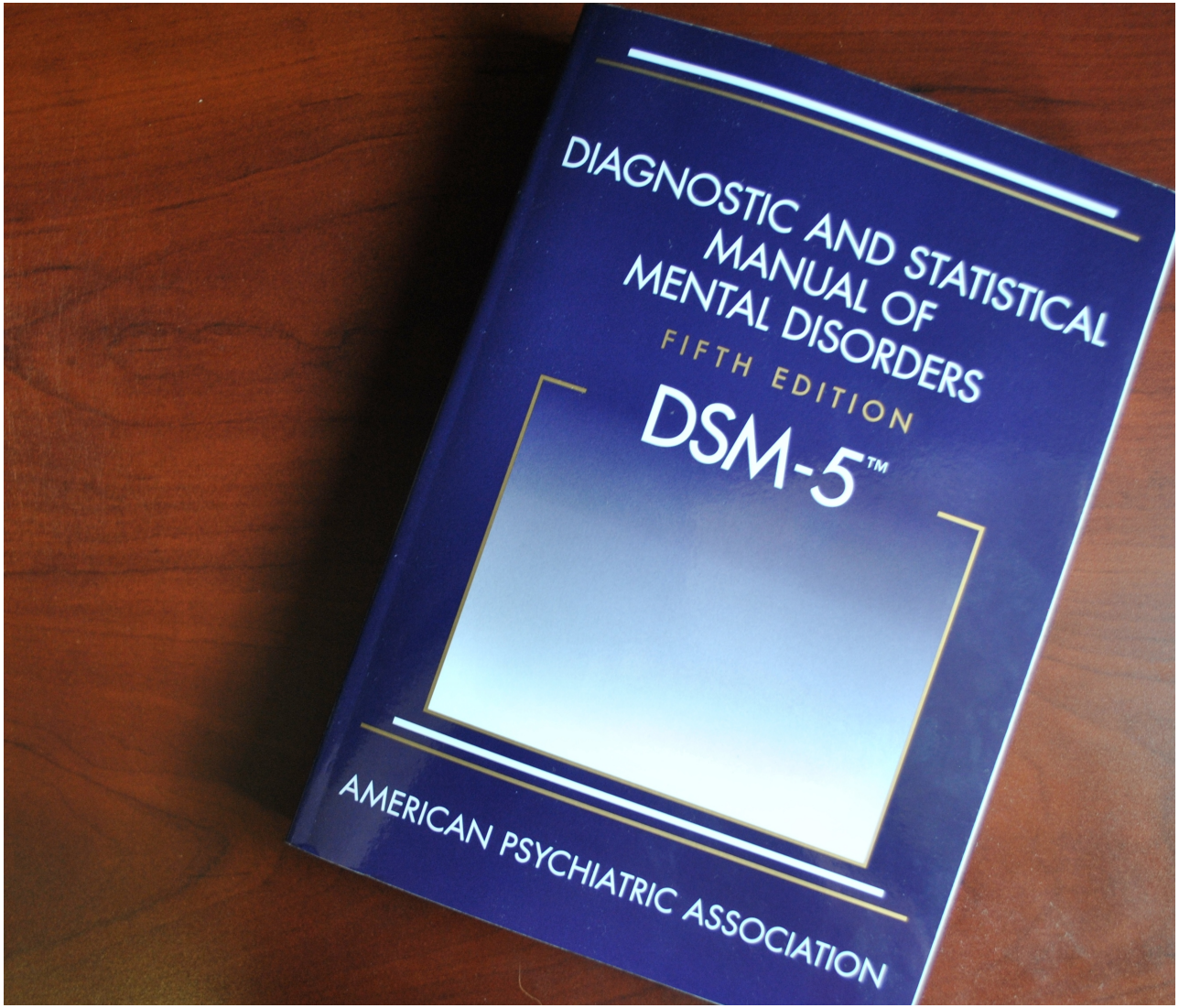
What's wrong with grue?

2) 'Green' identifies a natural kind, 'grue' does not

Natural kind=grouping that reflects the structure of the natural world, as opposed to an artificial grouping

PROBLEM: not always clear which kinds are natural

The new riddle of induction



The new riddle of induction

Video

https://www.youtube.com/watch?v=1rUCyg4Ppso