Scientific realism

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Plan

1. Scientific realism and the 'no miracles argument'
   - Characterising scientific realism
   - The 'no-miracles argument' (NMA)
2. Antirealism and antirealist arguments
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   - The pessimistic meta-induction
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   - The base rate fallacy
   - The implications for the debate on scientific realism
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Stating scientific realism

Bas van Fraassen (1980). *The Scientific Image*. Oxford University Press.

Characterisation (Scientific realism)

"Science aims to give us, in its theories, a literally true story of what the world is like; and acceptance of a scientific theory involves the belief that it is true." (van Fraassen 1980, 8)

Realism more generally: common-sense realism

Peter Godfrey-Smith ([2]2021). *Theory and Reality: An Introduction to the Philosophy of Science*. University of Chicago Press.

Characterisation (Common-sense realism)

"We all inhabit a common reality, which has a structure that exists independently of what people think and say about it, except insofar as reality is comprised of, or is causally affected by, thoughts, theories, and other symbols." (Godfrey-Smith [2]2021, 224)

Common-sense realism is part of scientific realism, but it may or may not be part of scientific antirealism.

The 'no-miracles argument' (NMA)

Source: Greg Frost's blog

`http://obscureandconfused.blogspot.com`

- advocates: Smart, Putnam, Boyd
- Schema of abductive inference:

  (1) p
  (2) q is the best explanation of p

  ∴ q

The 'no-miracles argument' in favour of scientific realism:

(1) Mature scientific theories are predictively successful.
(2) The (approximate) truth of mature scientific theories is the best explanation of their predictive success.

∴ Mature scientific theories are (approximately) true.

Antirealist strategy in the face of the NMA

- Empirical adequacy or instrumental success are sufficient to account for the success of science.
- reason: scientific theories are constructed to be empirically adequate/instrumentally successful
- By having to deal with the anomalies of previous theories, successor theories have to be more empirically appropriate/more instrumentally successful.
- 'Darwinian' selection ensures that new theories are more 'adapted' than their predecessors in exactly this way.

$\Rightarrow$ There is no need to invoke the 'truth' of theories in order to explain their success.

NMA: realist response

- But are successful scientific theories really analogous to well-adapted organisms?
- Moreover, the analogy seems incapable of explaining the success of a particular theory: such an explanation seems to have to refer to the specific characteristics of the theory, such as its description of unobservable objects.

Bas van Fraassen: constructive empiricism

- major book: *The Scientific Image* (1980)

Characterisation (Constructive empiricism)

"Science aims to give us theories which are empirically adequate; and acceptance of a theory involves as belief only that it is empirically adequate." **(van Fraassen 1980, 12)**

Characterisation (Empirical adequacy)

"[A] theory is empirically adequate exactly if what it says about the observable things and events in this world, is true—exactly if it 'saves the phenomena'." **(ibid.)**

Characterisation (Observability)

"X is observable if there are circumstances which are such that, if X is present to us under those circumstances, then we observe it.» **(p. 16)**

The theory/observation dichotomy

Two questions:

1. "Can we divide our language into a theoretical and non-theoretical part?" **(van Fraassen 1980, 14)**

   $\Rightarrow$ No, because language is deeply imbued with theory.

2. "[C]an we classify objects and events into observable and unobservable ones?" **(ibid.)**

   - Nicholas Maxwell: no, because there is a continuum of cases between direct observation and inference
   - van Fraassen: yes, because although 'observable' is vague, it is still useful because it has clear cases and clear counter-cases

Observability according to van Fraassen

Clear cases
(observable entities)

- tables and chairs
- moons of Jupiter
- unicorns

Clear counter-cases
(unobservable entities)

- elementary particles
- forces
- the big bang

Constructive empiricism: discussion

- One of the major points against constructive empiricism is that many entities are found in the 'grey zone' between clear cases and clear counter-cases. Does constructive empiricism recommend that we believe in the existence of entities in the 'grey zone'?
- Is the explanation of the predictive success of scientific theories provided by constructive empiricism really sufficient?

The pessimistic meta-induction (PMI) for antirealism

Juha Saatsi. On the pessimistic induction and two fallacies. *Philosophy of Science* 72 (2005): 1088-1098..

- advocates: (Poincaré), Laudan

(1) Assume that the predictive success of a theory reliably indicates its truth.
(2) So most current predictively successful theories are true.
(3) Then most past scientific theories are false, since they differ significantly from current theories.
(4) Many of these past theories were also predictively successful.

∴ So the predictive success of a theory is not a reliable indicator of its truth.

⇒ defuses NMA, but does not by itself establish antirealism

Stronger version of PMI

(1) Most successful theories (current and past) are taken to be false by current lights.
(2) Current successful theories are not essentially different from past successful theories with respect to their observable content.
(3) (By argument on previous slide) success of a theory is not a reliable indicator of its truth, and there is no other reliable indicator of truth.

∴ Current successful theories are probably false by statistical reasoning.

⇒ If sound, this argument establishes antirealism.

Structural realism (SR)

Realist strategy in the face of strong NMI

- advocates: Poincaré, Worrall, Ladyman, French
- There exists a cumulative continuity through revolutions captured by the underlying (mathematical) structure of theories (example: Hamiltonian in successive theories of the electron).
- Non-cumulative aspects (stark shifts in ontology) are responsible for the falsity of theories as viewed later (example: phlogiston)
- SR is realist because accepted theories do more than simply carry over successful empirical content.
- But less than carrying over full theoretical content; so SR is antirealist regarding the non-cumulative aspects.
- continuity of structure, not in content of theories

$\Rightarrow$ only be realist with respect to the 'structure' of theory

- claim: avoid PMI, accounts for NMA
- problem: notion of 'structure' insufficiently developed and applied

NMA vs PMI: like Ulysses between Scylla and Charybdis

Underdetermination of theory by evidence argument

- antirealists: there is always a range of theories compatible with actual evidence, and maybe always a range of theories compatible with all possible evidence

$\Rightarrow$ We have never good grounds on which to choose one theory over its empirically equivalent competitors.

Challenge:

Find an episode in the history of science where we have truly been confronted with two or more empirically equivalent, but otherwise inequivalent theories; in other words, a case of strong MUD.

The problem of unconceived alternatives

P Kyle Stanford (2006). *Exceeding Our Grasp: Science, History, and the Problem of Unconceived Alternatives*. New York: Oxford University Press.

- Stanford: a common situation in history of science is that the evidence people had at a moment was not only what led them to make their theory choice, but was also consistent with another theory that they had not ruled out, because they had not thought of that theory.
- Although "unconceived" at the time, we now believe these theories. And given that this has happened repeatedly, why should we think that our present theories will not be replaced in the future?

$\Rightarrow$ "recurrent transient underdetermination"

- The underdetermination is transient: once both theories are on the table, we develop empirical tests to enable theory choice.
- This transient underdetermination is a problem because it is recurrent: we have reason to think that whenever faced with a decision whether the believe a given theory at a given time, there is probably at least one unconceived alternative to it available.
- Note: strict empirical equivalence not necessary for the problem to arise, equally good confirmation at a moment sufficient

Base rate fallacy and realist ennui

P D Magnus et Craig Callender. Realist ennui and the base rate fallacy. *Philosophy of Science* 71 (2004): 320-338.

- Suppose there is a disease with inevitable, unique, identifiable symptoms taking some time to show,
- and a (more or less) reliable test for the disease, identifying people who do not yet show symptoms
- Dx: x has disease; Px: x tests positive
- Assume $P(Px|Dx) = 1$ (no 'false negatives').
- Assume that there is a small chance that if someone is healthy, they nevertheless test positive ('false positive'), e.g. $P(Px|\neg Dx) = 0.01$
- Now suppose patient a tests positive: what is the probability that she actually has the disease, i.e. $P(Da|Pa) =?$
- it is tempting to argue as follows...

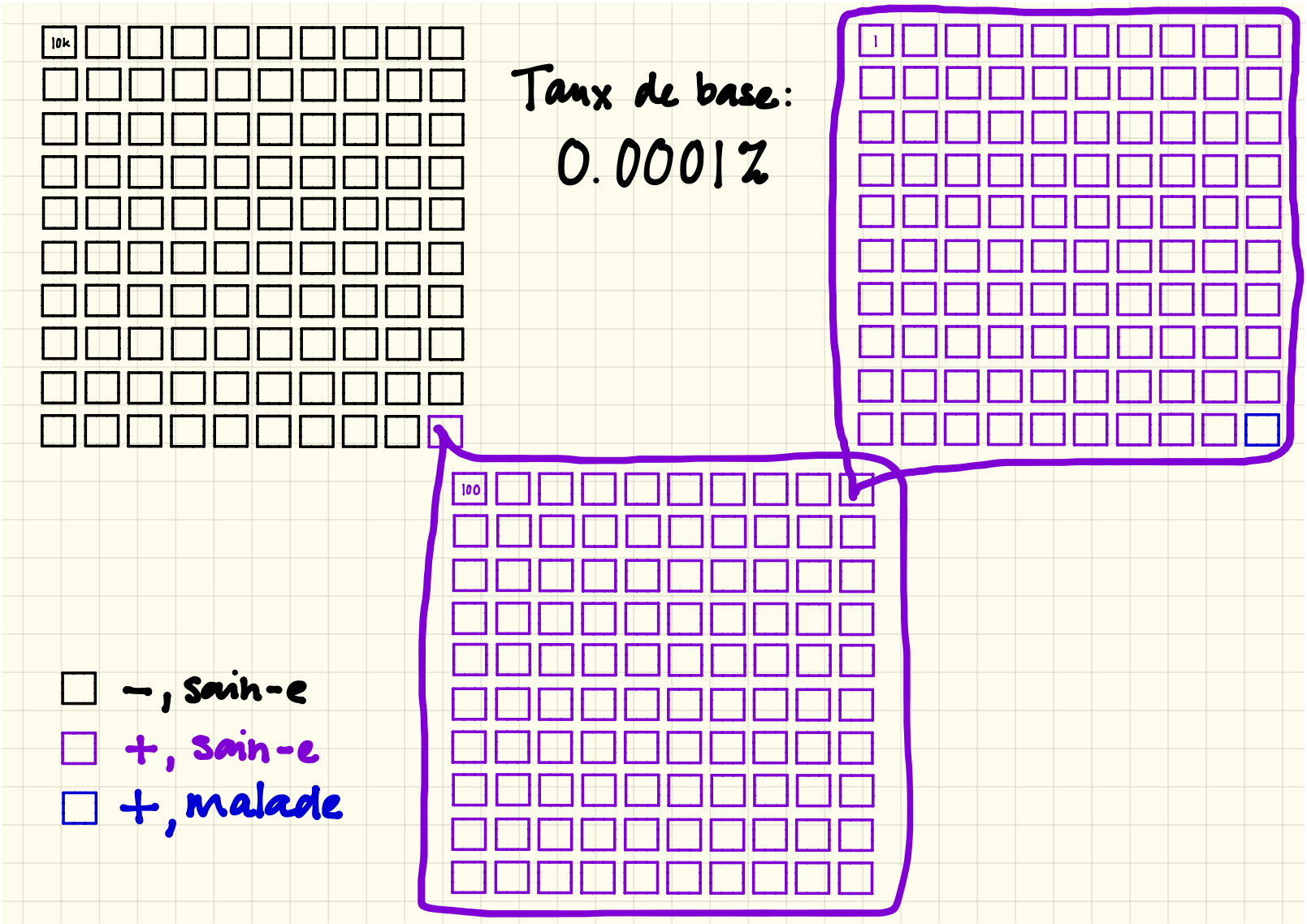
- $P(Pa) = 1, P(Pa|Da) = 1, P(Pa|\neg Da) = 0.01 \Rightarrow P(Da|Pa) \gg 0$
- Problem: if the disease is rare in the population, e.g. if only 1 in 1,000,000 people has the disease, then given the assumptions, we should expect about 10,001 in 1,000,000 to test positive;of these, only 1 has the disease;thus, the chance that a has disease is 1 in 10.001 or roughly $P(Da|Pa) = 0.0001$.

$\Rightarrow$ The suggestion that $P(Da|Pa) \gg 0$ is not true in this population.

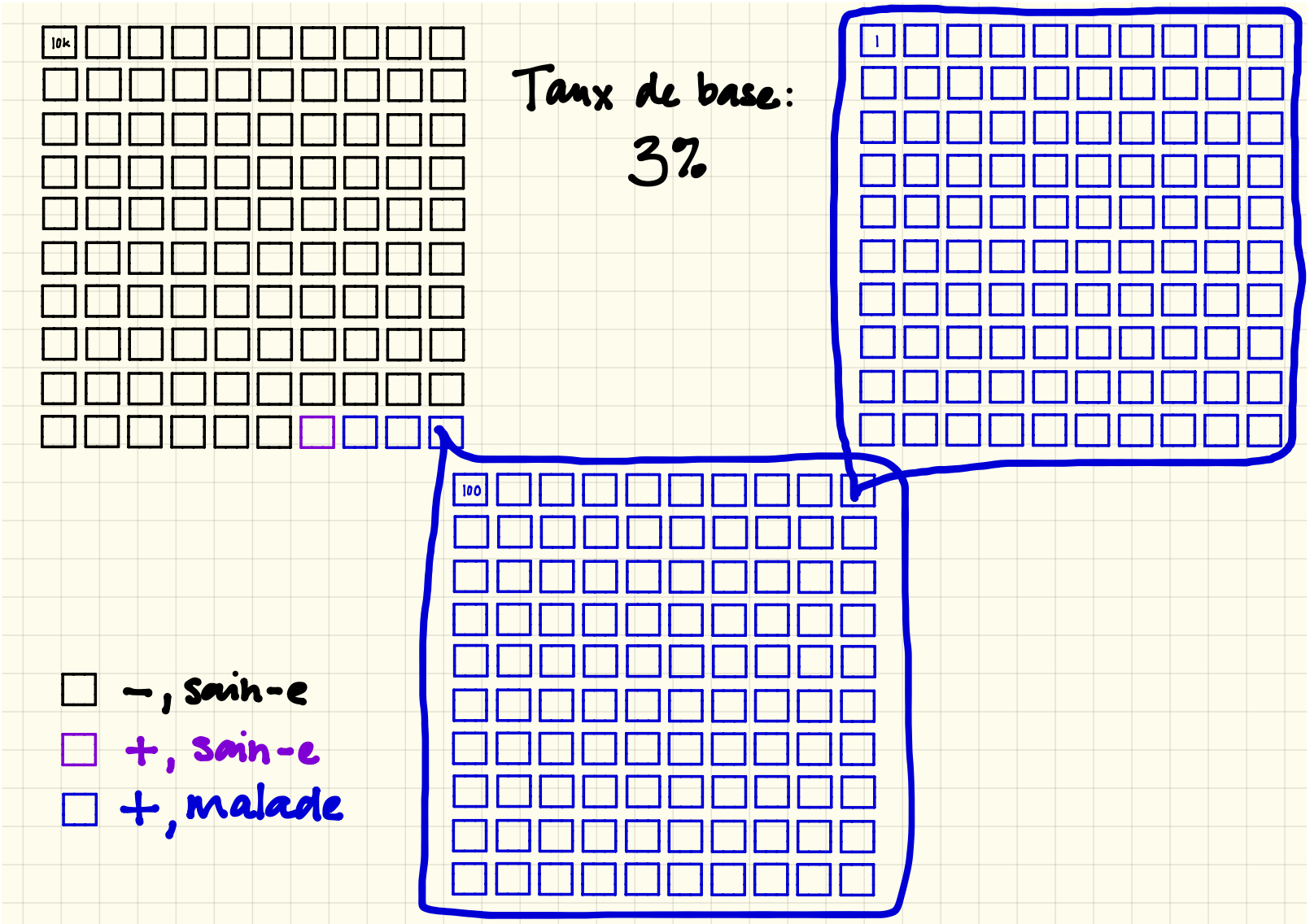
Problème général:

If $P(Pa|Da) = 1, P(Pa|\neg Da) = 0.01$, what can we infer regarding $P(Da|Pa)$?

Base rate fallacy: low base rate



Base rate fallacy: high base rate



Correspondence to the debate on scientific realism

'Translation' manual:

	Disease	Realism
Dx	x has the disease.	The theory is true.
Px	x has tested positive.	The theory is successful.

- By a similar argument, we could conclude that if we find a theory that is successful, it is true.
- But as in the case of the disease, the validity of this inference depends on the 'base rate', i.e., on the proportion of sick people in the total population or of true theories in the set of all relevant scientific theories (and thus on the corresponding probabilities).

- Magnus and Callender: the NMA and the PMI both commit this fallacy (though in opposite directions).

$\Rightarrow$ Because we don't know the base rate (= probability that a random theory among all present candidate theories is true), we cannot make any inference about whether success is a reliable indicator for truth.

- Just as: if we don't know the relative frequency of a disease in a population, we don't know whether a positive test is a reliable indicator for the presence of disease

$\Rightarrow$ Because it boils down to our incompatible intuitions about the base rate, there's 'ennui' in the realism debate.

So perhaps the logical empiricists were right in claiming that the debate is meaningless...? Or does it make sense without being clear-cut in this way?