

# Scientific realism

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## A statement of scientific realism

### Characterization (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, 1066)*

### Characterization (Common sense realism naturalized)

*“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 thoughts, theories, and other symbols, and except insofar as reality is dependent on thoughts, theories, and other symbols in ways that might be uncovered by science.” (Godfrey-Smith, 176)*



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

# The no-miracles argument (NMA) for scientific realism

(Reconstruction courtesy of Greg Frost, [obscureandconfused.blogspot.com](http://obscureandconfused.blogspot.com))

Proponents: Smart, Putnam, Boyd

Abductive inference schema:

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

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$\therefore q$

No-miracles argument for scientific realism:

- (1) *Mature scientific theories are predictively successful.*
- (2) *The (approximate) truth of mature scientific theories best explains their predictive success.*

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$\therefore$  *Mature scientific theories are (approximately) true.*

## Antirealist strategy in the face of NMA

- empirical adequacy or *instrumental* success are sufficient to account for the success of science
- reason: sci thys are *constructed* to be empirically adequate/instrumentally successful
- by having to deal with anomalies of predecessor thy, later thys must be more empirically adequate/instrumentally successful
- “Darwinian” selection guarantees that later thys are “fitter” than their predecessors in exactly these respects
- no need to invoke “truth” of thys

# Bas van Fraassen: constructive empiricism



- *The Scientific Image* (1980)
- instrumentalist in sense of Godfrey-Smith: sci thys are devices to deal with experience
- **not** instrumentalist in van Fraassen's own sense that sci statements are not capable of being true/false, language of sci is not be construed literally

## Characterization (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, 1069)*

## Characterization (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.)*

## Characterization (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.” (1072)*

# The theory/observation dichotomy

Two questions:

- 1 “Can we divide our language into a theoretical and non-theoretical part?” (van Fraassen, 1071)  
⇒ No, bc language is thoroughly theory-infected.
- 2 “[C]an we classify objects and events into observable and unobservable ones?” (ibid.)
  - Maxwell: no, bc there’s continuum of cases that lie bw direct observation and inference
  - van Fraassen: yes, bc although ‘observable’ is vague predicate is still useful as it has clear cases and counter-cases

# Observability according to van Fraassen

## Clear cases (observable entities)

- tables and chairs
- moons of Jupiter
- winged horses

## Clear counter-cases (unobservable entities)

- elementary particles
- forces
- the big bang

# The pessimistic meta-induction (PMI) for antirealism

(Reconstruction courtesy of Juha Saatsi (2005))

Proponents: (Poincaré), Laudan

*(1) Assume that success of thy reliably indicates truth.*

*(2) So most current successful thys are true.*

*(3) Then most past sci thys are false, since they differ significantly from current thys.*

*(4) Many of these past thys were also successful.*

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*∴ So success of a thy is not a reliable indicator of its truth.*

⇒ defuses NMA, but does not by itself establish antirealism

## Stronger version of PMI

(Reconstruction courtesy of Juha Saatsi (2005))

*(1) Most successful thys (current and past) are taken to be false by current lights.*

*(2) Current successful thys are not essentially different from past successful thys wrt their observable content.*

*(3) (By argument on previous slide) success of a thy is not a reliable indicator of its truth, and there is no other reliable indicator of truth.*

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*∴ Current successful thys are probably false by statistical reasoning.*

⇒ if sound, establishes antirealism

## Realist strategy in the face of strong NMI

- ⇒ **Structural realism** (Poincaré, Worrall, Ladyman, French)
- $\exists$  cumulative continuity through revolutions captured by underlying (mathematical) structure of thys
  - non-cumulative aspects (stark shifts in ontology) responsible for falsity of thys as viewed later
  - more than carrying over successful empirical content
  - less than carrying over full theoretical content
  - continuity of structure, not content of thys
- ⇒ only be realist wrt “structure” of thy
- claim: avoid PMI, accounts for NMA
  - problem: notion of “structure” insufficiently developed and applied

# Underdetermination of theory by evidence argument

- antirealists:  $\exists$  always range of thys compatible with actual evidence, and maybe always a range of thys compatible with all possible evidence
- ⇒ we have never good grounds on which to choose one thy over its empirically equivalent competitors

Challenge:

Find episode in history of sci where we have truly been confronted with two or more empirically equivalent, but otherwise inequivalent thys

## Base rate fallacy and realist ennui

(Magnus and Callender (2004))

- suppose  $\exists$  disease with inevitable, unique, identifiable symptoms taking some time to show
- reliable test for disease identifying people who do not yet show symptoms
- $Dx$ :  $x$  has disease;  $Px$ :  $x$  tests positive
- assume  $P(Px|Dx) = 1$
- assume  $\exists$  small chance if someone is healthy, they nevertheless test positive (“false positive”), e.g.  $P(Px|\neg Dx) = 0.05$
- now suppose patient  $a$  tests positive: what is the probability that she actually has disease, i.e.  $P(Da|Pa) = ?$
- it is tempting to argue as follows...

- $P(Pa) = 1, P(Pa|Da) = 1, P(Px|\neg Da) = 0.05 \Rightarrow P(Da|Pa) \gg 0$
- Problem: is disease is rare in population, e.g. if only 1 in 1000 people has the disease, then given the assumptions, we should expect about 51 in 1000 to test positive; of these, only 1 has disease; thus, chance that  $a$  has disease is 1 in 51 or roughly  $P(Da|Pa) = 0.02$
- ⇒ assumption that  $P(Pa) = 1$  not true given this population
- Magnus and Callender: both NMA and PMI commit this fallacy
- ⇒ bc we don't know the base rate (= probability that a random thy among all present candidate thys is true), we cannot make any inference about whether success is reliable indicator for truth
- just as: if we don't know the relative frequency of disease in population, we don't know whether a positive test is a reliable indicator for presence of disease
- ⇒ bc it boils down to our incompatible intuitions about base rate,  $\exists$  "ennui" in the realism debate

So perhaps the logical empiricists were right in claiming that the debate is meaningless...?