



# Evidence, causation, and scientific disagreement

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# Overview

## Intersecting parallel literatures

- Evidential pluralism, or the search for consensus

- Inconsistencies in science, or the search for a logic of inconsistency

- An HPS and PSP approach

## The 'cholesterol wars'

- Hypotheses and main developments

## Scientific disagreement

- Loci & Reasons

- (Some) disagreement in the cholesterol wars

## Beyond the 'cholesterol wars'

- 'Loci & Reasons' in contemporary controversies

Two parallel literatures

# **EVIDENTIAL PLURALISM, OR THE SEARCH FOR CONSENSUS**

# Evidential pluralism

To establish a causal claim, we need multiple sources of evidence

**that** causes make a difference to the effect

**how** causes produce the effect

(Russo & Williamson 2007, Gillies 2011, Illari 2011, Clarke et al 2014)

An epistemological and methodological thesis

In medicine, but also elsewhere

Partly descriptive, partly normative

## Establishing causal claims

What if we disagree?

The debate on the Semmelweis case

Was the community right in rejecting the claim?

‘Being right’ needs unpacking, or replacement

See later Loci & Reasons

Two parallel literatures

# **INCONSISTENCIES IN SCIENCE, OR THE SEARCH FOR A LOGIC**

# Inconsistent *theories*

Theories in physics

(sometimes cosmology, or chemistry)

A set-theoretic approach

If hypotheses are inconsistent, what can we derive from the theory?

To save the theory, we **change the logic**

Paraconsistent logic for inconsistent theories

(Brown 1990, Norton 2002, Meheus 2002(eds) and 2003)

What if we **changed the problem?**

# Nuancing inconsistencies

A better understanding of how science works

Resolving inconsistencies not just to 'reconcile' global theories, but also experimental practices (Smith 1988)

The perspective of history of scientific development

Investigating heuristic role of inconsistencies in process of conceptual change (Nersessian 2002)



# **PARALLEL LITERATURES INTERSECT**

From inconsistent theories to disagreement in  
**modelling practices**

Modelling practices have modellers

Besides establishing a causal claim, what **hinders its  
establishment**

Who hinders such establishment, at what level of the  
modelling practice

# Philosophical methodology

## Approaches

Philosophy of science in practice

History and philosophy of science

But also: Causality in the Science, Philosophy of Information

## Theories >> Modelling practices, Modellers

Modelling practices: data, inferences, evidence, ...

Modellers: assumptions, beliefs, values, conflicts, ...

# THE 'CHOLESTEROL WARS'

# What causes heart disease?

Received view in the early 1900s

A side effect of aging

New hypothesis

High-fat diet / blood cholesterol causes heart disease

# The received view, as of today

Mechanism explaining how high cholesterol causes heart disease

Two types of lesions in the artery wall

## Fatty streak

Deposits of free cholesterol and cholesterol taken up by macrophages turned into cholesterol scavenging foam cells

Inflammation > more macrophages recruited > more cholesterol accumulation + further inflammation

Appears early, clinically silent

## Advanced lesion with fibrous plaque

Develops on top of the early fatty streak lesion

Involves proliferation of smooth muscle cells, connective tissue, small amounts of lipids, calcification and necrosis

Characteristic of mature atherosclerosis

Causes clinical events by blocking blood flow locally, or by (partly) rupturing from the artery wall and getting stuck in narrow vessels elsewhere

# A super brief history of hypercholesterolemia

1910s: First animal studies

Nikolai Anitschkow's rabbit experiments

1930s: Heart disease in xanthomatosis patients

Inheritance studied by Müller (1939), familial hypercholesterolemia

1949: Discovery of lipoproteins (Gofman)

1957-1961: Seven Countries Study, and Framingham Heart Study

1950-1970: Diet intervention trials

# A super brief history of hypercholesterolemia – cont'ed

1961: American Heart Association recommends low-fat diet

1970s: First statin, independently isolated by two groups in Japan and Britain

1974: LDL receptor discovered

1984: National Institutes of Health consensus conference declares cholesterol hypothesis 'beyond reasonable doubt'

1994: Scandinavian Simvastatin Survival Study, aggressive cholesterol lowering with statins lowers all-cause mortality

...



# **SCIENTIFIC DISAGREEMENT: FOCI & REASONS**

# Two questions about disagreement

**Where** – in the stages of scientific process – do scientists disagree?

Reconstruct scientific process as a step-wise problem solving process

Highly general, widely applicable

**Why** do scientists disagree?

Recur to epistemic, psychological, sociological factors

Several perspectives are possible

# Loci of disagreement

1. Define the problem

Different perspectives or viewpoints; different concepts, different operationalizations of the concepts

2. Collect data

Issues about data collection, missing or poor data, different clues to collect data

3. Analyse data and generate evidence

What to infer from data, what evidence, different views on evidence hierarchies

4. Draw conclusion from evidence

Relevance of the evidence for the problem, different background theories, evidence amalgamation

# Reasons for disagreement

Epistemic

Concepts of causation,  
mechanism, etc; disciplinary  
differences (methodology,  
etc)  
Competences and expertise

Non-epistemic

Fact-value confusion

Sociological

Psychological

Public interest, conflict  
of interest; social  
dynamic of science;  
different mental models,  
bias

Extra-scientific

Different  
metaphysical,  
religious, political  
ideas

# **EPISTEMIC DISAGREEMENT IN THE CHOLESTEROL WARS**

# Problem definitions

Is high cholesterol a cause of hearth disease?

Would lowering cholesterol reducing CHD mortality? To what extent?

In which sub-populations would lowering cholesterol reduce CHD mortality?

Does an appropriate diet effectively lower cholesterol?

# Addressing different problems definitions

How much evidence is needed?

What type of study / data analysis is most appropriate?

Do questions about intervention directly follow from  
questions about causation?

# Concepts and methods – Cause

What concept of cause / causation underpins different problems definitions?

Interventionist vs epidemiological (variational) concepts of cause

Mono-causal vs multi-causal models; deterministic cause vs probabilistic cause



# Concepts and methods – Mechanism

What mechanism(s) support causal claims about cholesterol and heart disease?

Remember problem definitions in ‘cholesterol wars’

Different questions about causation, different questions about intervention

The-One-Mechanism?

Evidence of mechanisms is multi-faceted

In fact, many mechanisms are at work to explain a same causal relation

# Evidence and inference

Drawing different conclusions from current, available evidence

Is one piece of evidence sufficient to establish a given claim?  
(But see different problems definitions)

Evidence amalgamation

Concluding remarks

# **BEYOND THE CHOLESTEROL WARS**

# Contemporary controversies

Why an HPS / PSP study on cholesterol wars helps

- Identify critical points for disagreement

- Help medical practice in current controversies

An example: Zika outbreak

- New causal questions

- Multiple sources evidence, not always convergent

- Need of public health interventions

# Intellectual synergies

Well researched cases in **history** of medicine and epidemiology contribute and complement existing **philosophical** approaches  
Evidential pluralism, Inconsistencies, ...

Well researched cases in HPS / PSPS help discussions about **current medical methodology**  
Evidence of mechanisms, Evidence amalgamation, Qualitative studies, ...

Much is ongoing, a lot more needs to be done

Join us!

