

Interpreting causality in the health sciences

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Causality and probability *in* the sciences

An ongoing project at Kent

www.kent.ac.uk/secl/philosophy/jw/2006/CausalityProbability.htm

In the sciences

About probability
We defend an
ObjectiveBayesian-cum-Frequency
interpretation

About causality
We defend an epistemic interpretation

Overview

Two types of evidence

Probabilistic

Mechanistic

Against causal monism

Against causal pluralism

The case for epistemic causality

Probabilistic evidence

Observed dependencies
in a range of similar studies

Coherent results

Tests for stability
in structural models

...

Mechanistic evidence

Biomedical mechanisms

Chemical reactions, electric signals,
alterations at the cellular level, ...

A plausible (physiological) link
from the cause to the effect

We need both types of evidence

Semmelweis and puerperal fever

He had statistics but the link wasn't accepted till backed with the mechanism

Helicobacter pylory

The causal relation was hypothesised based on probabilistic evidence and accepted when backed with the mechanism

A classic: Bradford Hill's criteria

- 1. Strength of association
- 2. Temporality
- 3. Consistency
- 4. Theoretical plausibility
- 5. Coherence
- 6. Specificity in the causes
- 7. Dose response relationship
- 8. Experimental evidence
- 9. Analogy

Contemporary medicine: IARC

IARC reviews published studies

Assessment of causality depends on:

- Presence of a plausible mechanism
- Probabilistic evidence
 - (e.g. frequencies, risks)

Monistic accounts won't do

Mechanistic accounts

Causal processes intersect with each other
in interactive forks

Probabilistic accounts

Causes make a difference
in the probability of the effect
(ceteris paribus)

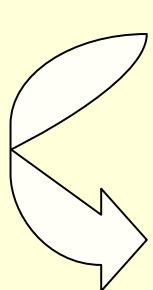
Problem:

Neither can handle the dual aspect
of causal epistemology

Pluralistic accounts won't do ... either

Uniformity of causal language:
A *single* notion of cause is used

The pluralist rebuts:



A *mechanistic* cause₁

A *probabilistic* cause₂

Different meanings of *cause*

But *each* refers to a single concept!

Therefore, the pluralist has
twice as the problems of the monist!

The way out: epistemic causality

Rational causal beliefs:

The agent's evidence determines
which beliefs to adopt

A causal relation is the set of causal beliefs
that an agent with total evidence
should adopt

Constraints on causal beliefs

The agent's causal beliefs should account
for all known dependencies
that are not already accounted for
by non-causal dependencies

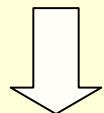
The agent's causal beliefs should be
compatible with other knowledge

The agent should not have causal beliefs
that are not warranted by her evidence

An application: epistemic causality in cancer science

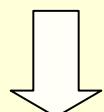
Dataset of clinical observations of past patients

Dataset of observations at molecular level



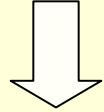
Probabilistic evidence

Knowledge of biological mechanisms



Mechanistic evidence

Knowledge of semantic relations between variables



Pro/contra mechanistic evidence

To sum up

- ✓ The health sciences need and employ two types of evidence
- ✓ Monistic accounts won't do
- ✓ Pluralistic accounts won't do either
- ✓ The epistemic account succeeds

To conclude ... and to research ahead

There is a key distinction between
Evidence from which we draw causal
conclusions
and the *concept* of cause

A single epistemic concept suits
the case of the health sciences

... and possibly the social and natural
sciences too