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Who's afraid of mechanisms?

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Outline

1. Evidence in medicine project
2. Who's afraid of mechanisms?
3. Heuristics of mechanism discovery

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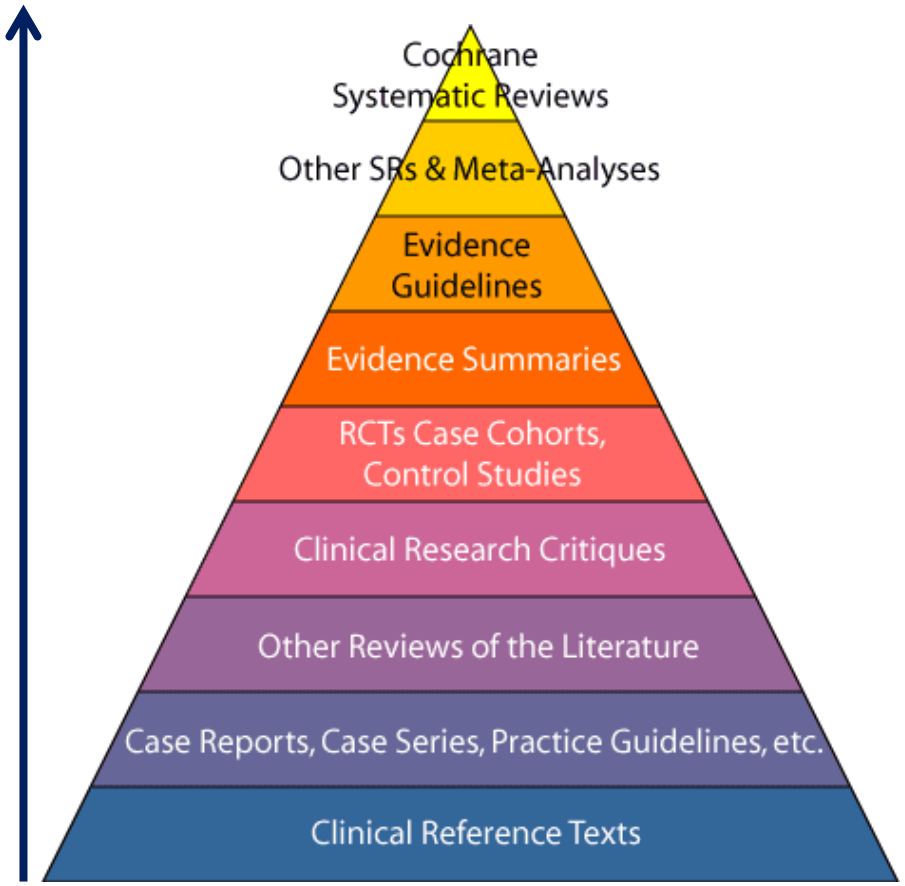
How do we get evidence in medicine?

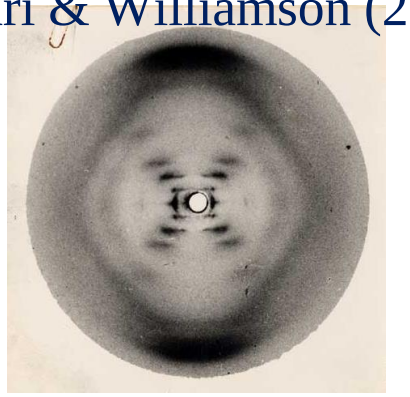
Evidence hierarchy



Where are mechanisms?

'A mechanism for a phenomenon consists of entities and activities organized in such a way that they are responsible for the phenomenon.'

Illari & Williamson (2012)



What is evidence of mechanism?

Evidence of ENTITIES

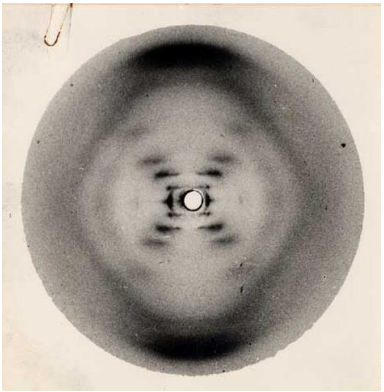
Evidence of ETIOLOGY?

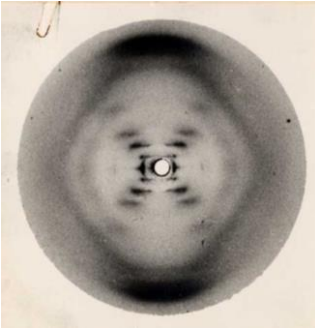
‘A mechanism for a phenomenon consists of **entities** and **activities organized** in such a way that they are responsible for the phenomenon.’

Illari & Williamson (2012)

Evidence of ACTIVITIES

Evidence of ORGANISATION





Example: protein synthesis

Entities: ‘cell membrane, vesicles, microtubules, molecules, and ions,’

Activities: ‘biosynthesis, transport, depolarization, insertion, storage, recycling, priming, diffusion, and modulation.’

(Machamer, Darden & Craver p8.)

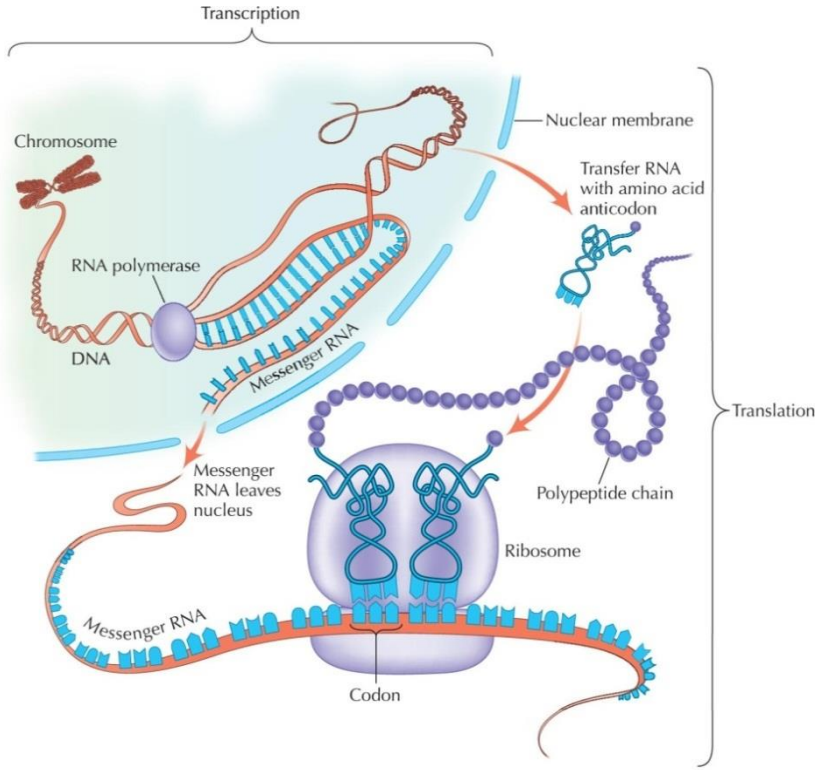


FIGURE 2.27. General mechanism of eukaryotic protein synthesis. The major steps include transcription of the DNA gene sequence into the messenger RNA template in the nucleus of the cell, translation of the DNA codons of that gene into amino acids, and their assembly into polypeptides in the cytoplasm. Important mediators of this process include transfer RNAs, splicing elements, and ribosomes.

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EBM+ @EBMplus · 31 Mar 2016

@PhyllisIllari on "Who´s Afraid of Mechanisms?" for @EBMplus, this afternoon in #MuST2016 conference in Munich. must2016.philosophie.uni-muenchen.de/program/index.…

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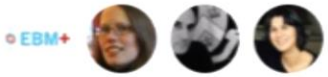

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Who's afraid of mechanisms?

History of Evidence Based Medicine

EBM defined itself as in opposition to uncritical deference to authority

Still very suspicious of mechanism

Pluralist philosophers of the life sciences

John Dupré and Sandra Mitchell suspicious of general claims

Seem to have particular worries about mechanisms

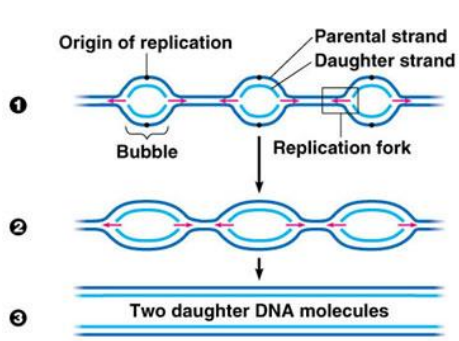
2 ‘evidence of mechanism’ mistakes from history of EBM

We want much more than a ‘just-so-story’.

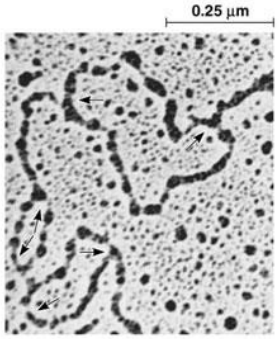
Evidence.

We cannot achieve ‘complete-in-detail’.

This is tempting, but misleading.



(a) In eukaryotes, DNA replication begins at many sites along the giant DNA molecule of each chromosome.



(b) In this micrograph, three replication bubbles are visible along the DNA of cultured Chinese hamster cells. The arrows indicate the direction of DNA replication at the two ends of each bubble (TEM).

Indeed, there is a complex relationship between evidence of mechanism and causal claims.

2 ‘evidence of mechanism’ mistakes from history of EBM

Interpreting ‘evidence of mechanism’ as:

1. A story about a mechanism – this is just a hypothesis.
2. Full knowledge of a complete mechanism – we rarely, if ever, have this.

In practice, we always have ***partial knowledge.*** This really matters for methodological and ethical decisions.

Dupré 1: ‘Mechanism’ is vacuous

> ‘Indeed there is a serious danger of vacuity in some treatments of the topic, in which it seems that mechanisms just are whatever explains whatever happens. If the concept of a mechanism is to do any work, we must surely have some sense of what isn’t a mechanism, or at least what might constitute an explanation that wasn’t a mechanism.’ (Dupré, 2013, p. 28.)

Dupré objects to constraints on what counts as a mechanism being continually relaxed so that anything counts.

- Glennan account of causation
- Illari and Williamson account of explanation across the sciences
- Here: we seek an account of an evidential role.

Dupré 2: Mechanisms are ‘too rigid’

‘It seems to me that there are good reasons to think that biological systems—organism, cells, pathways, etc.—are in many ways quite misleadingly thought of as mechanisms. Paradigmatic machines—cars, dishwashers, computers—consist of a number of parts, typically more or less rigidly connected. The constituent parts gradually wear out, and the machine lasts as long as they are replaced piecemeal.’ (Dupré 2013 p28.)

Dupré worried about rigidity in entities.

What is one mechanism; what several?

What are the mechanism boundaries?

Nonlinearity and other complexities, such as feedback

Failures of modularity (or modularities)

The importance of context e.g. redundancy

4 ‘evidence of mechanism’ mistakes from EBM and philosophy

Interpreting ‘evidence of mechanism’ as:

1. A story about a mechanism – this is just a hypothesis.
2. Full knowledge of a complete mechanism – we rarely, if ever, have this.

From Dupré (and Mitchell)

3. Vacuous – anything can count, care needed with the shift between general and particular interpretations.
4. Far too rigid – not interpreted according to Machine Metaphor (especially on the particular interpretation).

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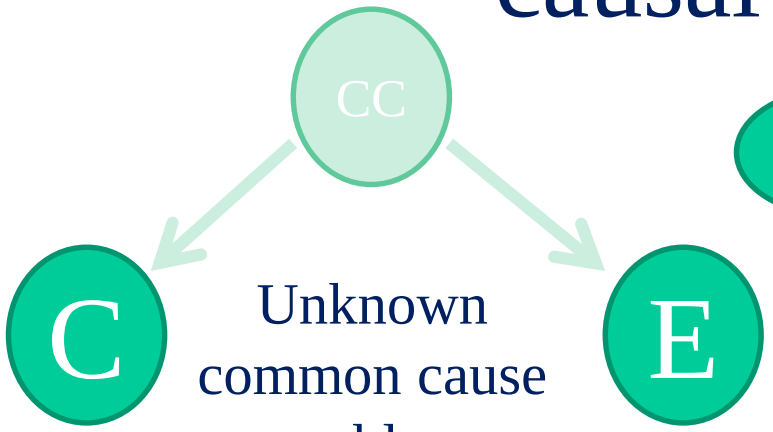
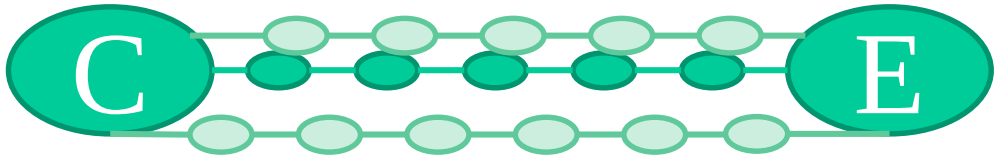
General role for mechanisms in causal inference



Unknown common cause problem



Unknown masking mechanisms problem

Finding a linking mechanism helps you to be sure that the correlation is not the result of a common cause.

Finding a correlation helps you to be sure that your mechanism is not masked by unknown mechanisms.

So evidence of mechanisms and evidence of difference-making integrate in a special way:
Each addresses the major weakness of the other.

‘Just-so’ story

Vacuous — Rigid

‘Complete-in-detail’

Evidential pluralism

- Evidence in the case of partial knowledge.
- Gives positive guidance without rigidity.

Craver (the usual interpretation)

Craver is usually interpreted as calling for completeness:

> ‘The regulative ideal is that constitutive explanations must describe all and only the component entities, activities, properties, and organizational features that are relevant to the multifaceted phenomenon to be explained.’ (Craver, 2007, p. 111.)
>
> ‘Good explanatory texts describe all of the relevant components and their interactions, and they include none of the irrelevant components and interactions.’ (Craver, 2007, p. 140.)

Powerful rhetorical appeal:

- But my arguments so far indicate we should set this aside.
- And note that he is giving an account of what we know of mechanisms – not a just-so-story.

Heuristics

Gigerenzer, Kahneman & Tversky: ‘fast thinking’ heuristics used to make quick decisions; subject to systematic errors.

But mechanists have been strongly influenced by Herbert Simon, who cites Polya.

- Polya’s *How to Solve It* gives a variety of heuristics which use what you know to help you figure out what you don’t know.

In common: heuristics are what you use when you cannot search comprehensively or optimally.

- Different fields have different *reasons* for why you can’t search comprehensively or optimally.

Discovery stories: Bechtel *et al.*

(1993, 2008, and continuing…)

Following Simon, we use *fallible heuristics* to guide search. The mark of mechanistic explanation

- Decomposition: following Simon, you find an approximation of parts you try to make work
- Localization: you try to identify a 'locus of control' of the phenomenon of interest, discover that it's insufficient, and extend work.

Mutually constraining: the localization convinces you that you have the right sub-parts and tasks.

Also need to recompose and situate mechanisms

Decomposition *as heuristic*

‘Decomposition allows the subdivision of the explanatory task so that the task becomes manageable and the system intelligible. Decomposition assumes that one activity of a whole system is the product of a set of subordinate functions performed in the system. It assumes that there are but a small number of such functions that together result in the behavior we are studying, and that they are minimally interactive. We start with the assumption that interaction can be handled additively or perhaps linearly. … The failure of decomposition is often more enlightening than its success: it leads to the discovery of additional important influences on behavior.’ (1993, 23-4)

All discovery accounts as heuristics

Craver

- top-down and bottom-up experiments
- mosaic unity (multiple disciplines constraining space of possible mechanisms)

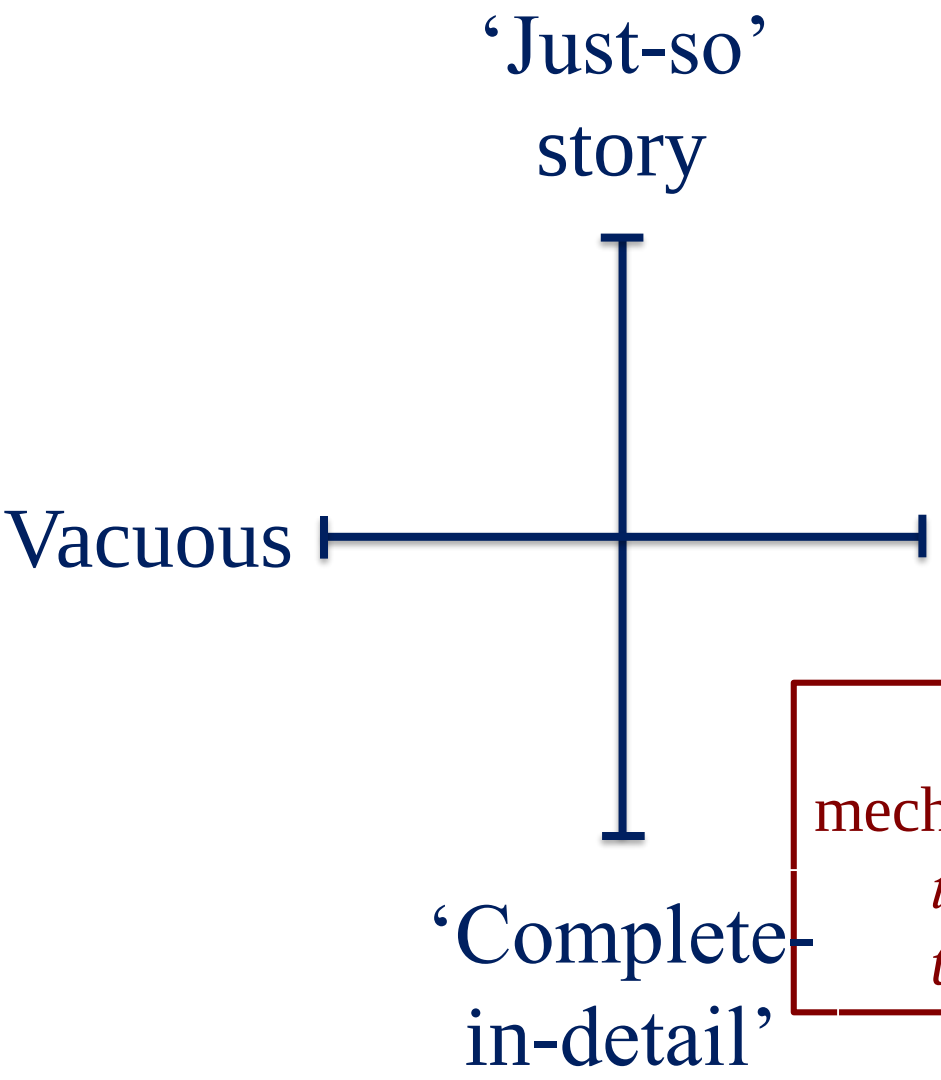
Darden

- schema instantiation (with Craver)
- forward/backward chaining (e.g. matching energy and information in protein synthesis)

Social Sciences

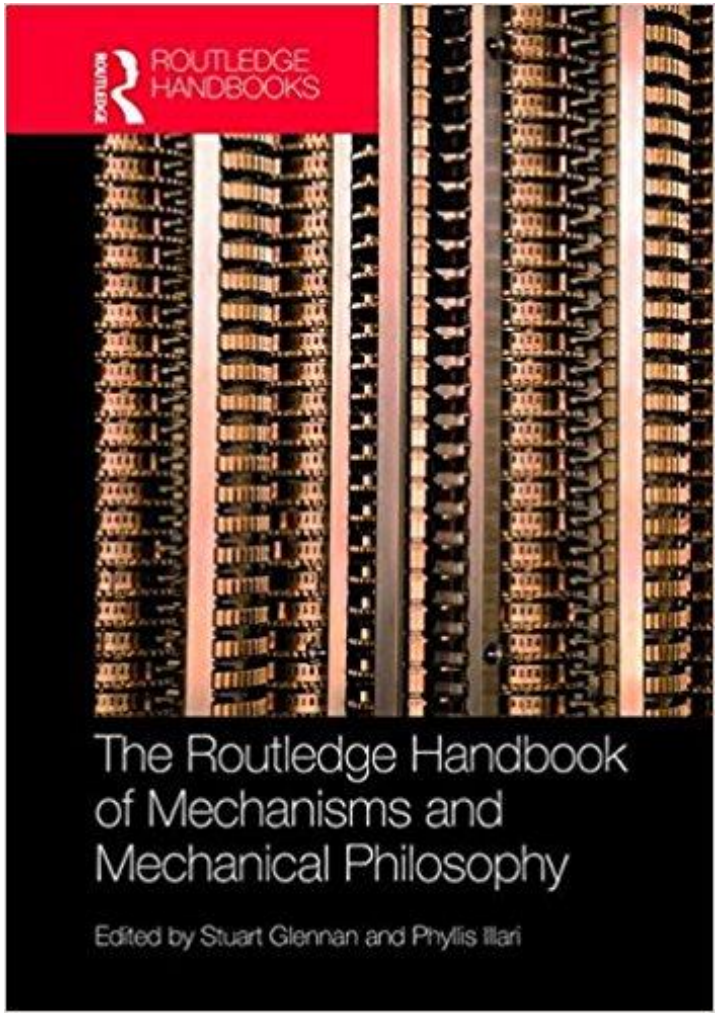
- process tracing (Steel)
- recursive decomposition (Russo et al.)
- intervening variables (Hedstrom and Ylikoski, Kincaid)

Lots about putting parts of the picture together.



‘Discovery cannot be relegated to woolly flights of imagination, unconstrained conjecture, or single ‘a-ha’ moments. Rather, there are more or less reliable, yet inherently fallible, strategies for discovery. Discovery is construed broadly to include construction, evaluation and anomaly resolution.’ (Darden & Craver, 2002, p19.)

Note that eliminating gaps in a mechanism schema can be good, *without that being because it’s a step on the way to complete knowledge*.



Glennan and Illari (eds) (2017)

The Routledge Handbook of Mechanisms and the Mechanical Philosophy

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