

**GENEVA
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ÉTUDES INTERNATIONALES
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GRADUATE INSTITUTE
OF INTERNATIONAL AND
DEVELOPMENT STUDIES

Causality, Causation, and Causes

Practicing Research

James Hollway

Let's get metaphysical



Causality cuts across ontology, epistemology, and methodology

- Cause comes from Aristotle's αἰτία: an answer to a 'why' question
- Consists of *explanans* (that which explains) and *explanandum* (that which is explained)

Why causality?

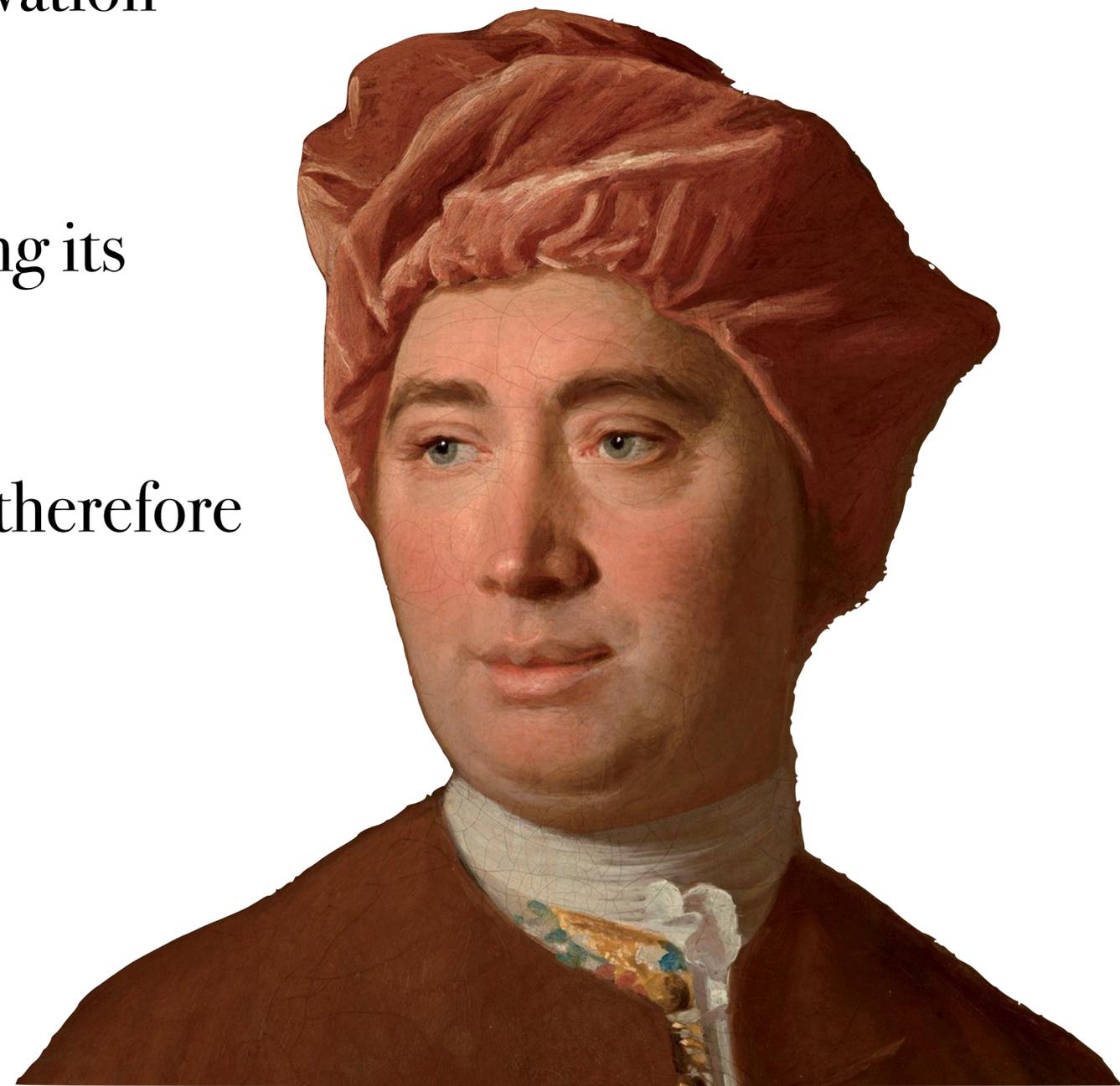
- We use causal language all the time (see Kurki 2008: 197):
 - “because”, “affects”, “leads to”, “produces”, “enables”, “constrains”, “why”, etc...
- Causation holds privileged position in our societies:
 - To make (more) sense of the world
 - To act in the world as effectively as possible
 - To make claims (e.g. authorship, liability, remedy)
 - To advise and change others’ classifications, opinions, actions, and behavior
- So safe to say nobody understands causation (Feynman), but cannot seem to do without it...

I'm talking
just because
I need to say
something.

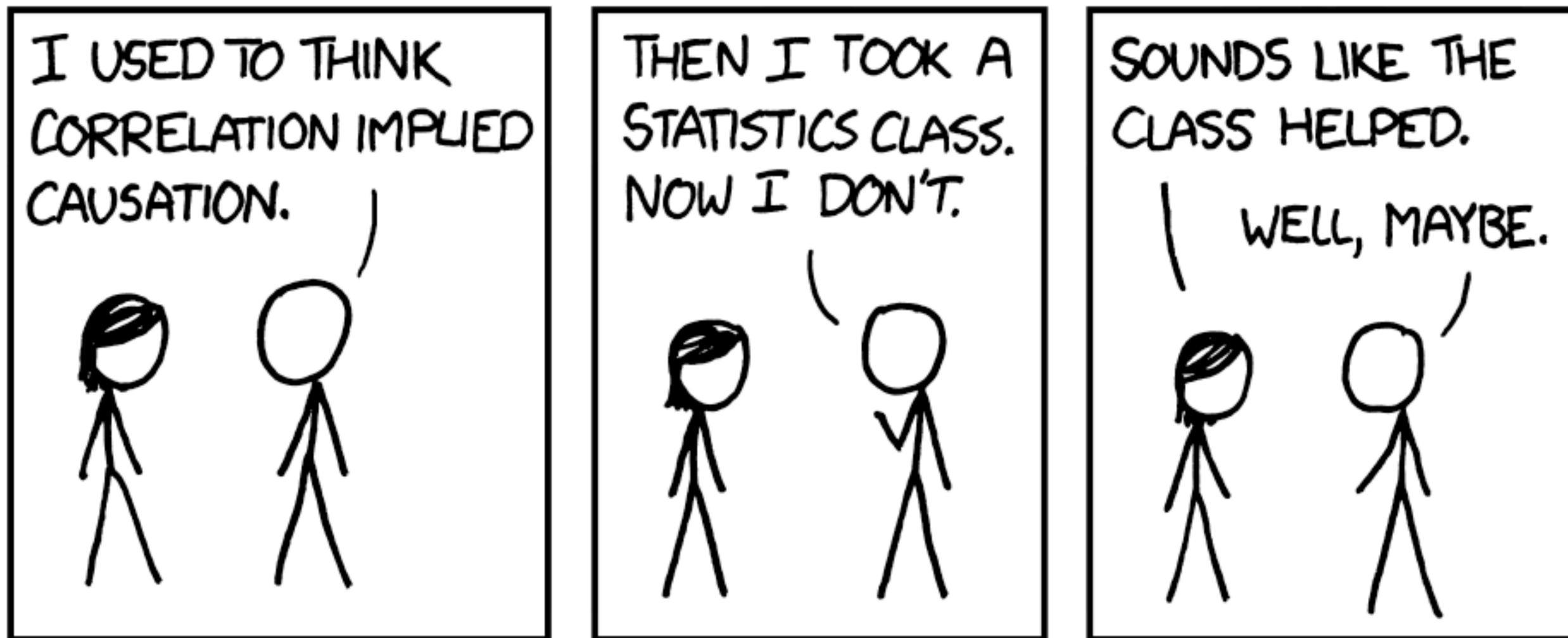


Hume's conception

- Cannot understand cause prior to experience and observation (e.g. baby learning)
- Causation isn't sensory (like colors) but our mind reading its habits based on regularities onto the world
- No reason in nature to expect regularities in the future, therefore be careful with 'prove' or 'confirming' ;)



Correlation \neq causation

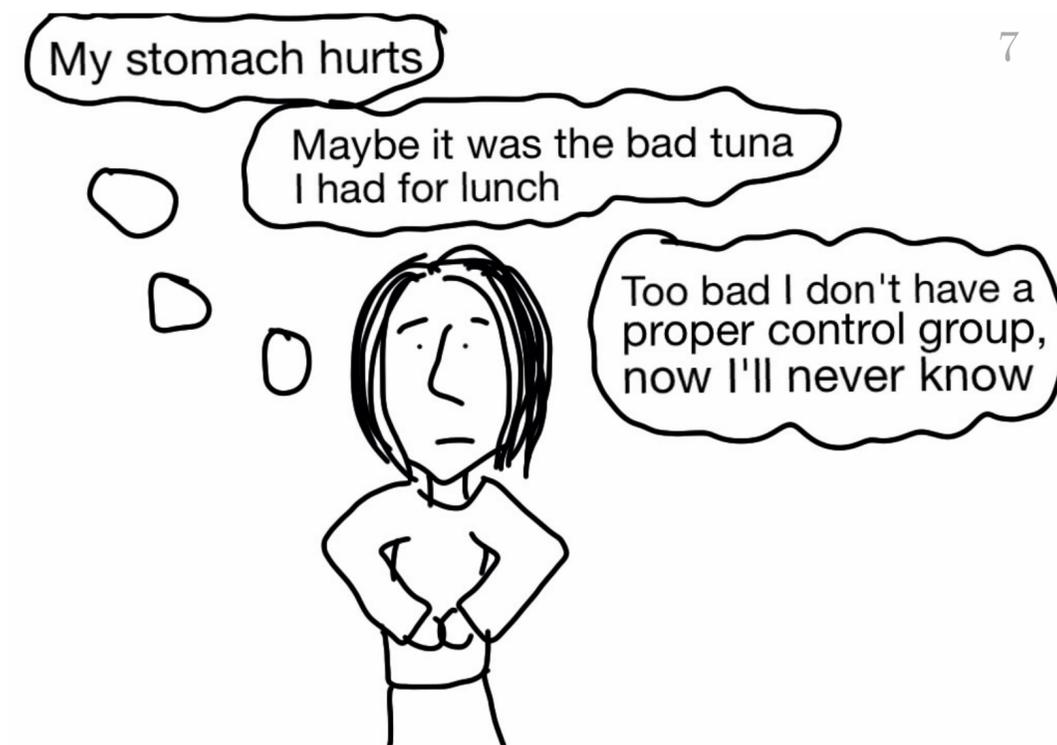


“forget causality, all we have is correlation”... **but are we satisfied with that?**

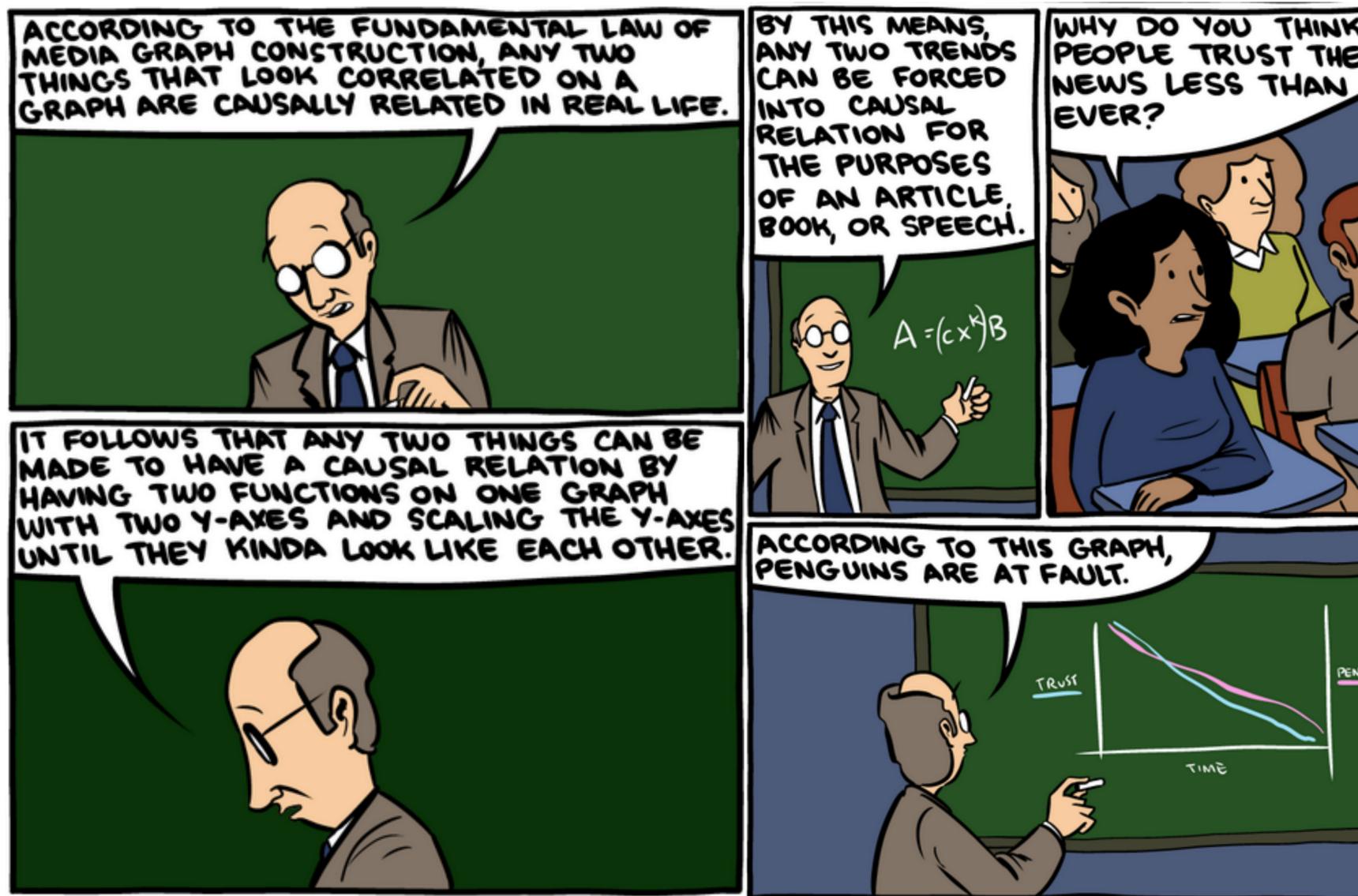
Rubins Causal Model

- Causality defined as $Y_t(u) - Y_c(u)$:
 - difference in outcome for unit when exposed to treatment and control...
- But impossible to see both *potential outcomes* at once since one is *counterfactual*: “fundamental problem of causal inference”
 - Statistical solution to replace impossible causal effect with estimable *average causal effect* over sample:

$$T = E(Y_t) - E(Y_c)$$
 - Reichenbach’s *common cause principle*: if two things (X and Y) are dependent, then either X causes Y, Y causes X, or something else causes X and Y
 - Typically extended as probabilistic to account for indeterminate causes (e.g. war→deaths) and uncertainty
- Assumes unit homogeneity, conditional independence, etc



Covering law account



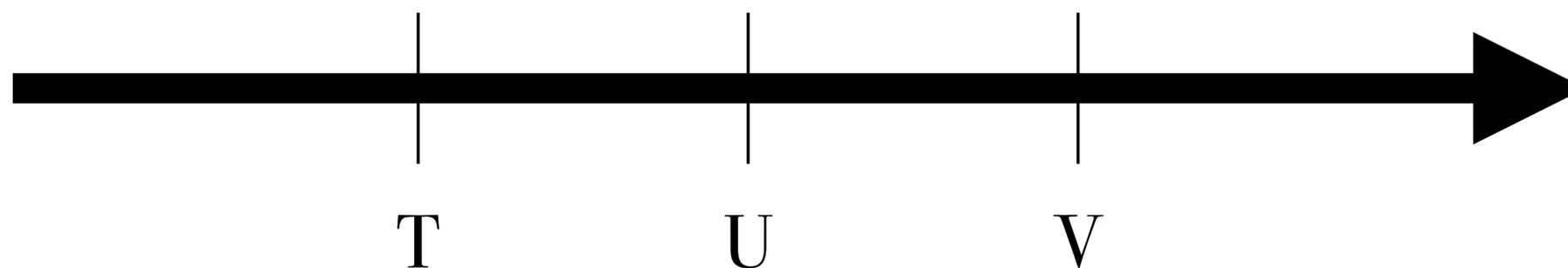
- Explanations:
 - deductive or nomological (statistical) arguments
 - comprise statement about an outcome as a conjunction of particular facts/initial conditions and some (combination of) general laws as the premise
 - make the explanandum expected, such that explanation \approx prediction
- Issues:
 - Notion of law unclear and unsubstantiated
 - Asymmetry of explanatory relations: flagpole \Leftrightarrow shadow
 - What about time?

What is time?

- Is time special dimension (Newton) or just ordering of successions (Leibniz)?
 - Or perhaps time is explained by cause (i.e. a primitive concept to reality)... that it happened earlier means that it *is* causal (Le Poidevin)
- Is time ordered (Whitehead) or reversible (Newton, Einstein)?
 - Space-time integrates time as malleable, relative, yet asymmetric 4D
 - In quantum mechanics, time universal, absolute, and could be symmetric
 - Entropy (2nd law thermodynamics: order to disorder) suggests asymmetric, at least at macroscopic scales
- Why can we move through space anywhere but time in only one direction?
 - Vividly recognised in consciousness and in reasoning: we can remember the past, but cannot remember or record the future (but see *Minority Report*)
 - Joan Robinson: “*arrow of time*”, irrevocable past to uncertain future



McTaggart's A- and B-series'

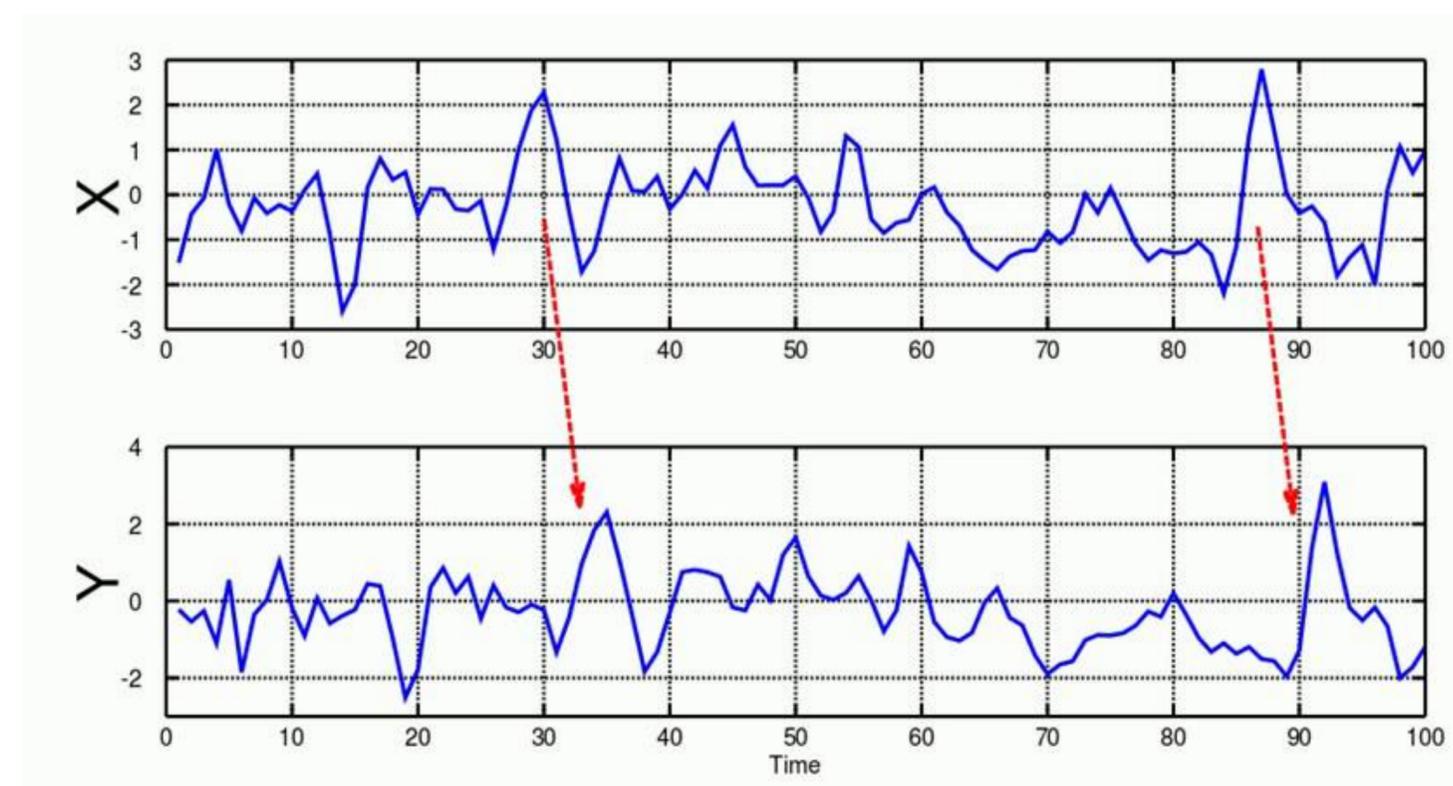


- *A-series*: past-in-present-in-future
 - Past incorporated in the present which also embodies expectations about the future
 - Events in constant transformation: first they are in the future, then they are in the present (briefly), and then the past
 - Tensed: it rained today
- *B-series*: before and after
 - Events strung out along the arrow of time, with some before and after one another
 - Events are asymmetric, irreflexive, and transitive
 - Tenseless: it rained 7 March 2023

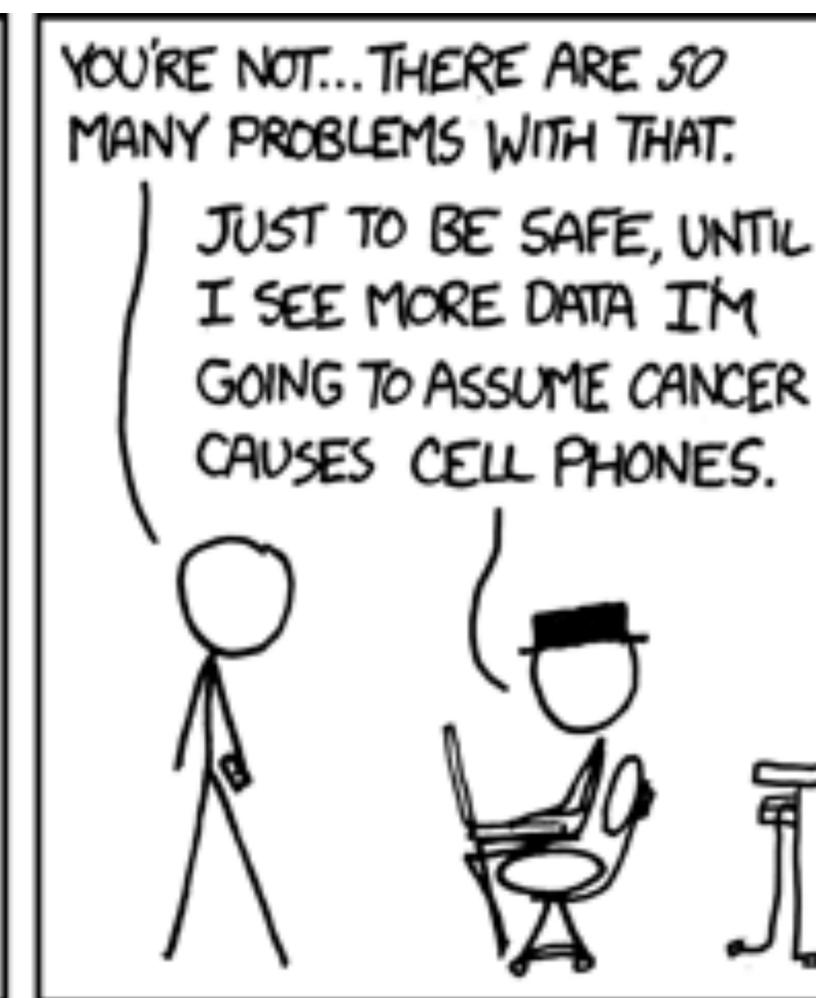
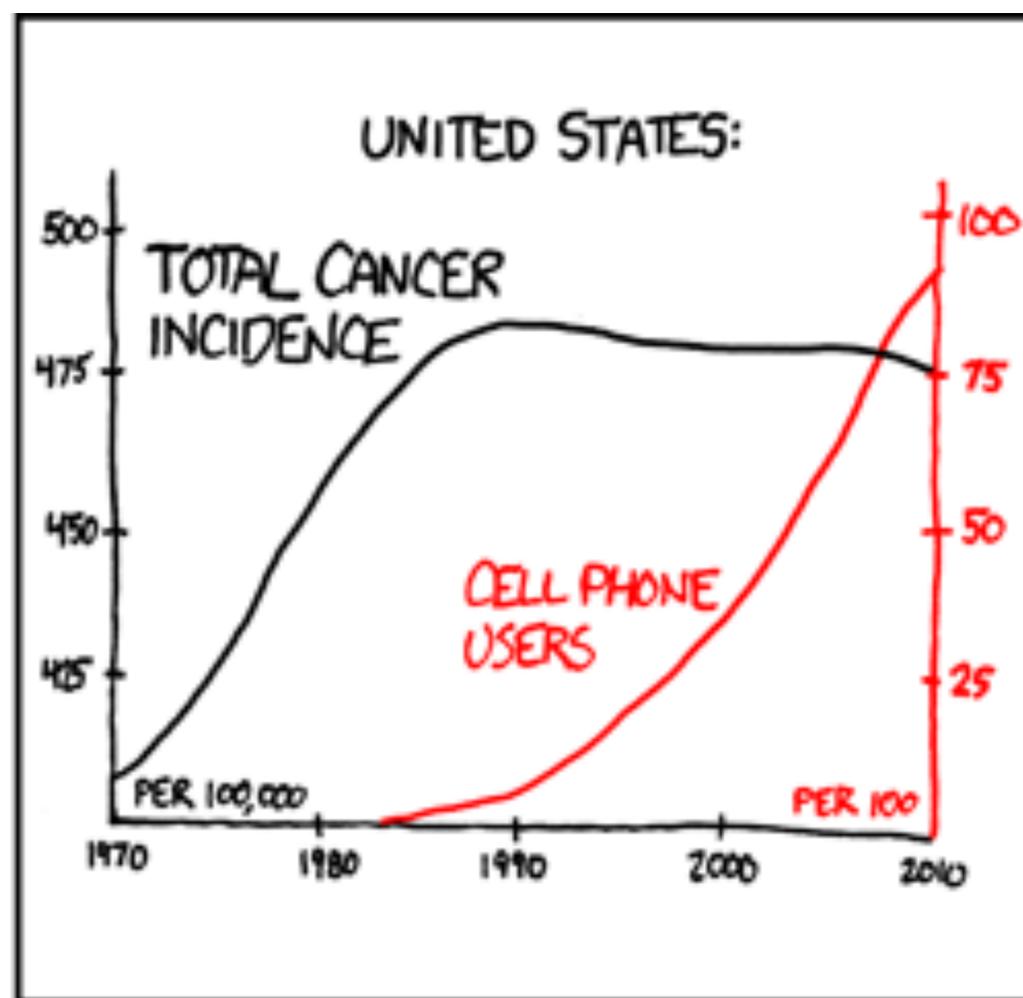
Granger causality, aka predictive causality

x “Granger-causes” y if:

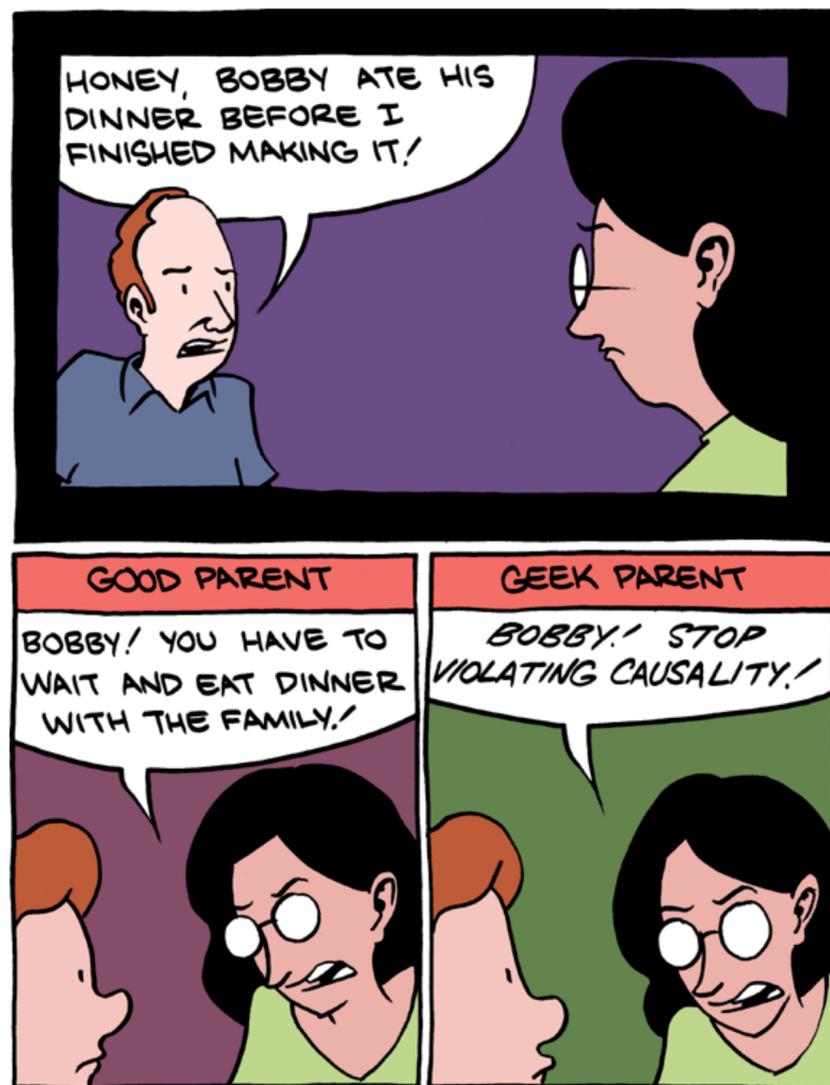
- x provides statistically significant information on future values of y
- x has unique information on y (alternative hypothesis)
- x causally prior to y (i.e. y lagged)



But post hoc ergo propter hoc...

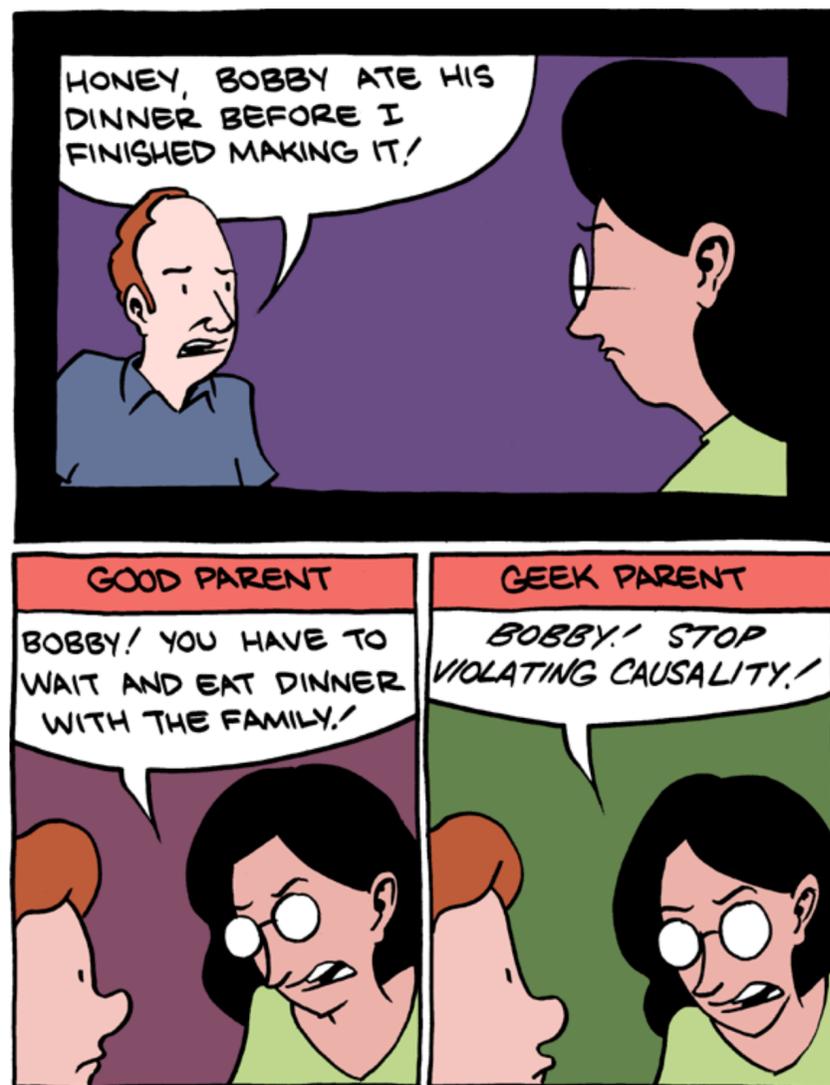


John Stuart Mill's 3 Criteria of Causation



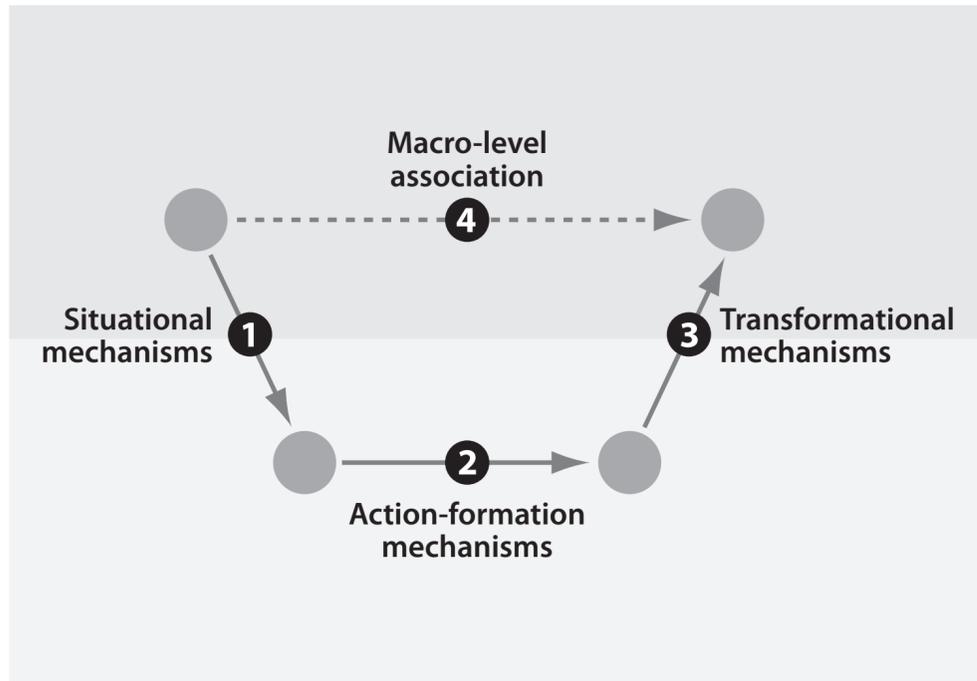
1. Association
2. Time order
3. ?

John Stuart Mill's 3 Criteria of Causation

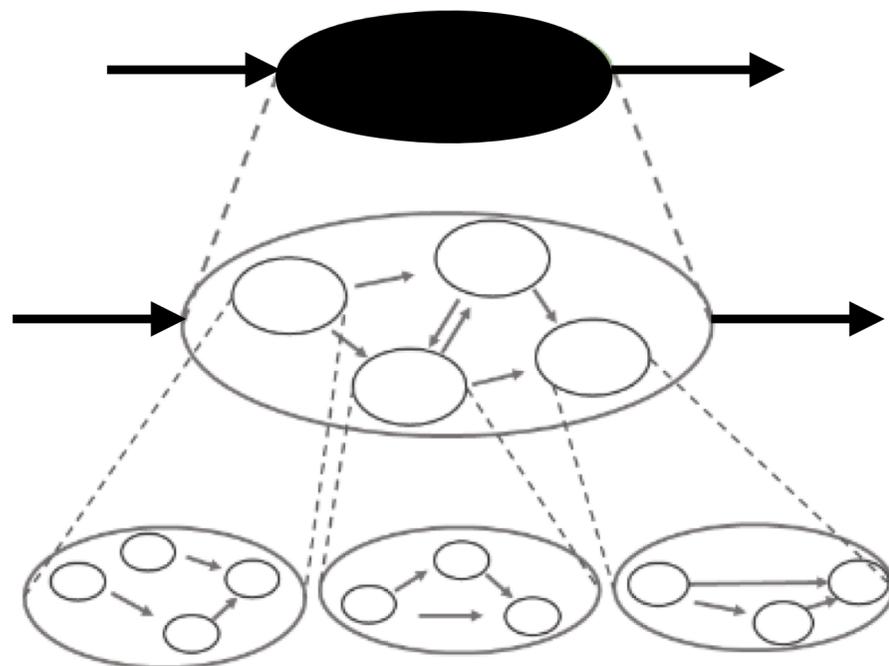


1. Association
2. Time order
3. Non-spuriousness

(Social) Causal mechanisms



- Are always for something (though same mechanisms can cause multiple outcomes)
 - Mechs combine to explain particular facts (e.g. Tilly 2001) or stylized facts (e.g. Watts & Strogatz 1998)
 - Mechs, not regs, generalise (typical/macro patterns or distributions of actions, beliefs, norms can be explananda)
 - Identifying a mechanism supports inference; absence of mechanism gives reason for suspicion
- Are an irreducibly causal notion (not necessarily unobservable or sufficient)
 - Mechanisms sometimes process, sometimes components in process
 - Influence directed, though can be feedbacks/reciprocity
 - Explanation \neq prediction: causal complexity means explanation easier than prediction (see Block et al 2018)
- Have a structure (breaking open black box into smaller causal questions)
 - “commitment to the locality of causal processes” (p53), connecting x to y not (nec) $P(Y = y | x) > P(Y = y | x^c)$
 - Mid-range, theory of action (e.g. RCT, prag), but not necessarily deductive or methodologically individualist
- Form a hierarchy (holism of science, but complete not required)
 - Finding *a* mechanism easy, *the* mechanism(s) hard: so research always conditional and subject to critique
 - Explanatory qualities of a generalisation are counterfactual consequences of possible interventions



Getting at mechanisms

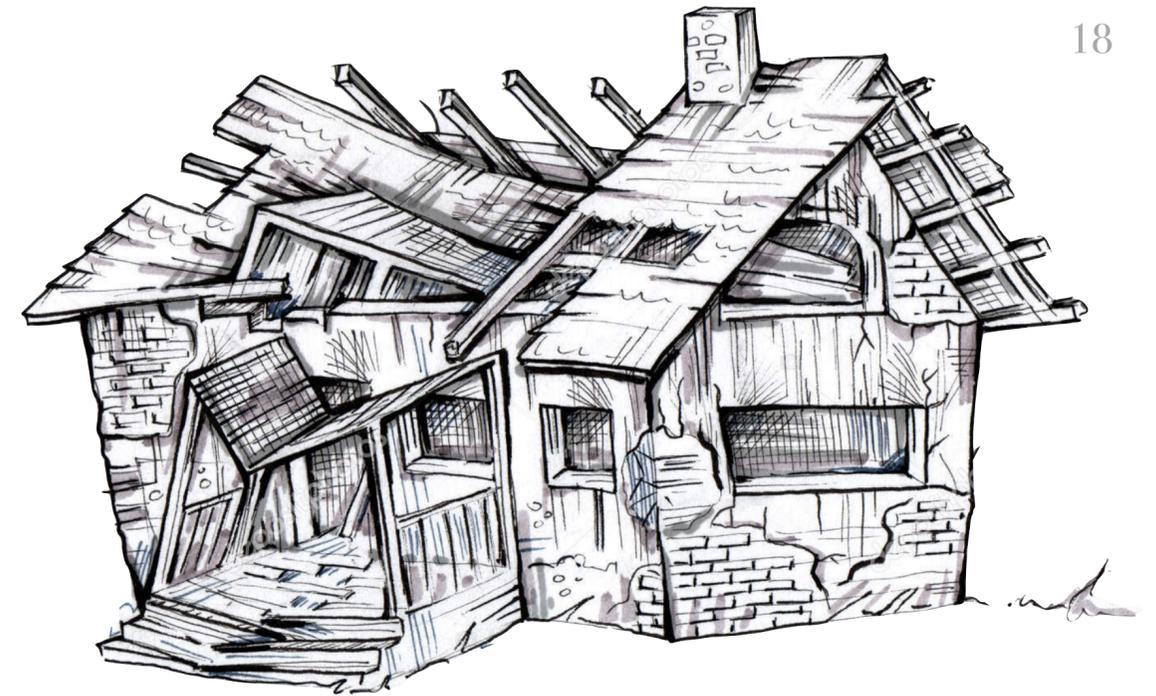
- *Process tracing* (e.g. George and Bennett 2005; Norman 2021) puts emphasis on temporality, sequence, and self-reinforcing dynamics
- *Agent-based modelling* (e.g. Schelling 1978) for theoretical exploration, methodological decisions or, if empirically calibrated, inference
- *Network modelling* (e.g. Bearman et al. 2004, but see Stadtfeld et al. 2017) relates the micro and macro explicitly, is all about context
- “Longitudinal data with relational information are essential” (Hedström and Ylikoski 2010: 64)
- **Others?**



What kind of causes can
you think of for your field?

N, S, INUS

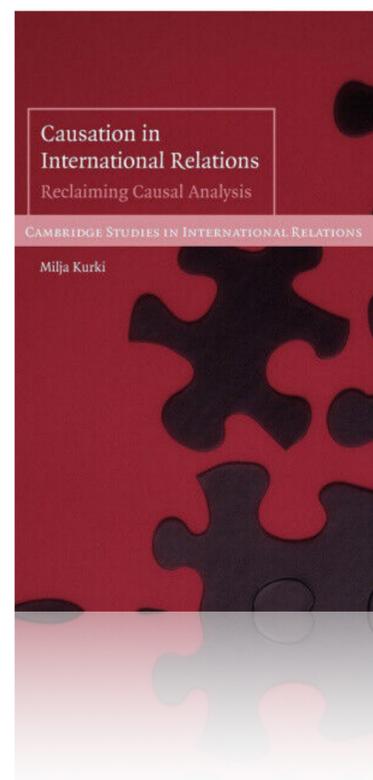
- *Necessary condition*: $X \Leftarrow Y$ or “no Y without X” (but X could be without Y)
 - e.g. US senator must be at least 30 years old *or* lightning necessary for thunder
- *Sufficient condition*: $X \Rightarrow Y$ or “X adequate for Y” (but no X insufficient for no Y)
 - e.g. president signing a bill sufficient to make it law *or* thunder sufficient for lightning
- Conditions can be both necessary and sufficient, $X \Leftrightarrow Y = X \Rightarrow Y \wedge Y \Rightarrow X$ or “Y if and only if X”
 - Note that conditions \neq causes, for thunder, while necessary and sufficient, does not ‘cause’ lightning... simultaneity possible
- Causes often *INUS conditions*: “Insufficient but Necessary parts of a condition that is itself Unnecessary but Sufficient”
 - **Insufficient**: not on their own, but in conjunction with other factors such as flammable material, oxygen, absence of firefighters etc
 - **Necessary**: the other parts are not sufficient to cause fire though without the short circuit
 - Together **Unnecessary**: other collections of events could have led to the house burning down, e.g. flamethrower, etc.
 - But **Sufficient**: they caused the fire – note the equifinality



Short circuits cause house fires

Aristotelian causes

- Kurki wants a...
 - *deeper* notion of cause
 - *broader* notion of cause
- e.g. a chair breaks because...
 - It is made out of plastic
 - Its design distributes load to weak element
 - A large weight was placed upon it
 - Someone wanted to destroy it



**Active or extrinsic
causes**

**Constitutive or
intrinsic causes**

Material

Efficient causes:
actor/action
'by which'

Material causes:
material condition
'out of'

Ideational

Final causes:
reason/purpose
'for the sake of'

Formal causes:
structure or idea
'according to'

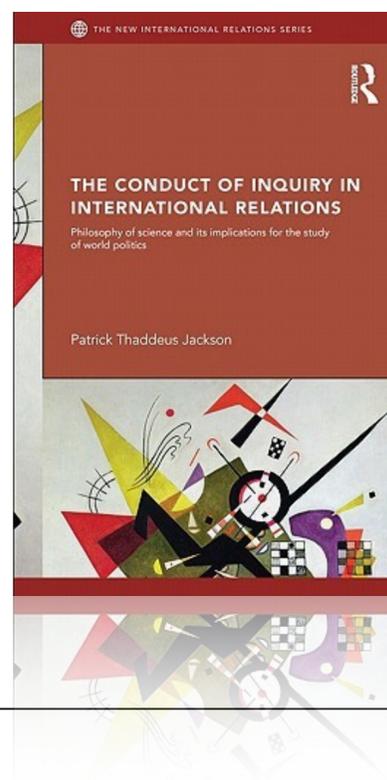
Should causal & constitutive be separate?

Should causal & constitutive be separate?

- Integrating constitution into causation (e.g. Kurki 2006)
 - interpretivists and reflectivists abide by (narrow) Humean notion of causality too quickly
 - reasons and intentionality are a type of cause (final), rules, norms, and discursive structures are a type of cause (formal)
 - practices, discourses, frames and dispositions do not trigger processes, but processes happen upon them and still a component important to a why explanation
 - context, meaning, (post)structure etc typically involve ‘implicit’ causal claims
 - e.g. Campbell (1998): representations matter because they produce certain consequences
 - study of ‘non-causal relations’ never really an end in itself (Wendt 1999: 86)
- Pairing constitution with causation (e.g. Norman 2021)
 - they each have their contributions
 - interpretive approaches better at capturing reproduction than change (p939)
 - they are compatible
 - both rely on counterfactuals: “what-if-things-would-have-been-different?” (Woodward 1984)
 - “ c rather than c^* causes e rather than e^* ” (p945) - so four different things, not just two (downward causation)
 - causation fundamentally asymmetric and temporal; constitution symmetric and synchronous

Conduct of Inquiry

- Meta-theory to undermine methodological hegemony, identify claims, and explore their impact on inquiry
- ‘Philosophical ontological wagers’
 - Whether mind and world conceived as separable
 - Whether knowledge should be limited to the (in principle) observable
- Offers epistemological and methodological ideal types



Mind-world dualism

Phenomenalism

Neopositivism

Unfalsified conjecture
Hypothesis testing
Empirical generalisation
Subsume under general law

Transfactualism

Critical realism

Best approximation to reality
Building transcendental argument
Dispositional
INUS-complexes

Mind-world monism

Analyticism

Useful account
Analytical narrative
Ideal-typical and configurational
Counterfactuals

Reflexivity

Self-awareness device
Theorize own social conditions
Dialectical
Disclose unresolved tensions

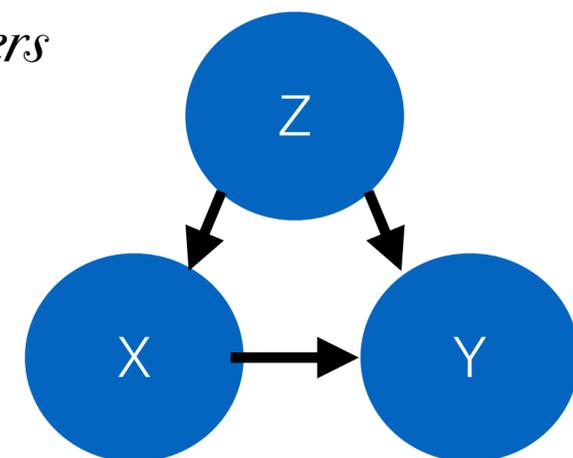
Ladder of causation



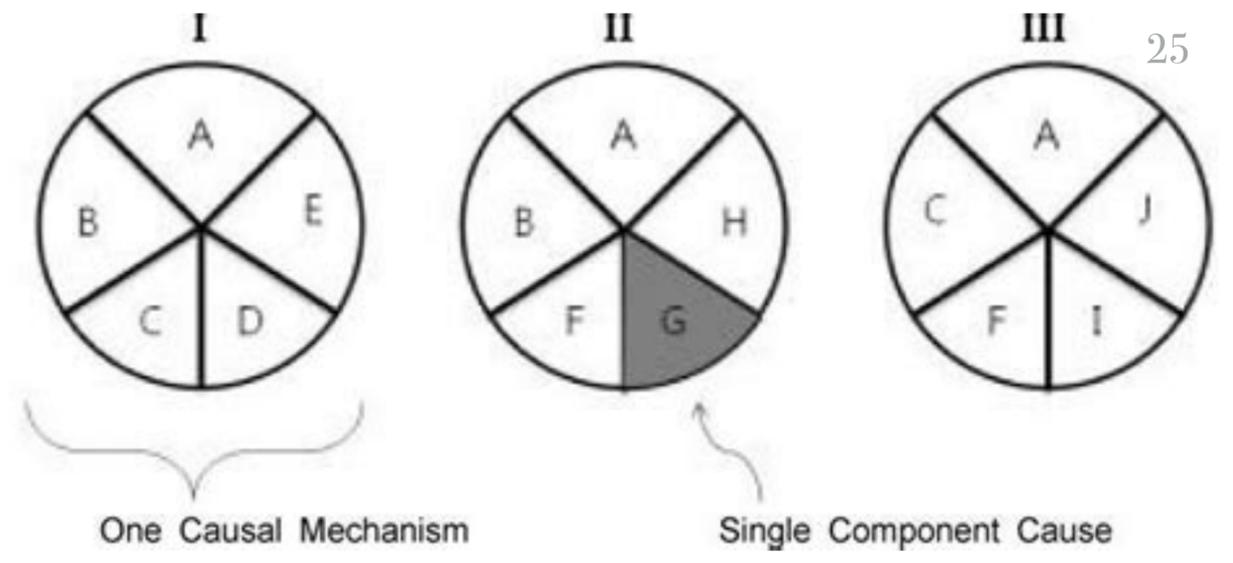
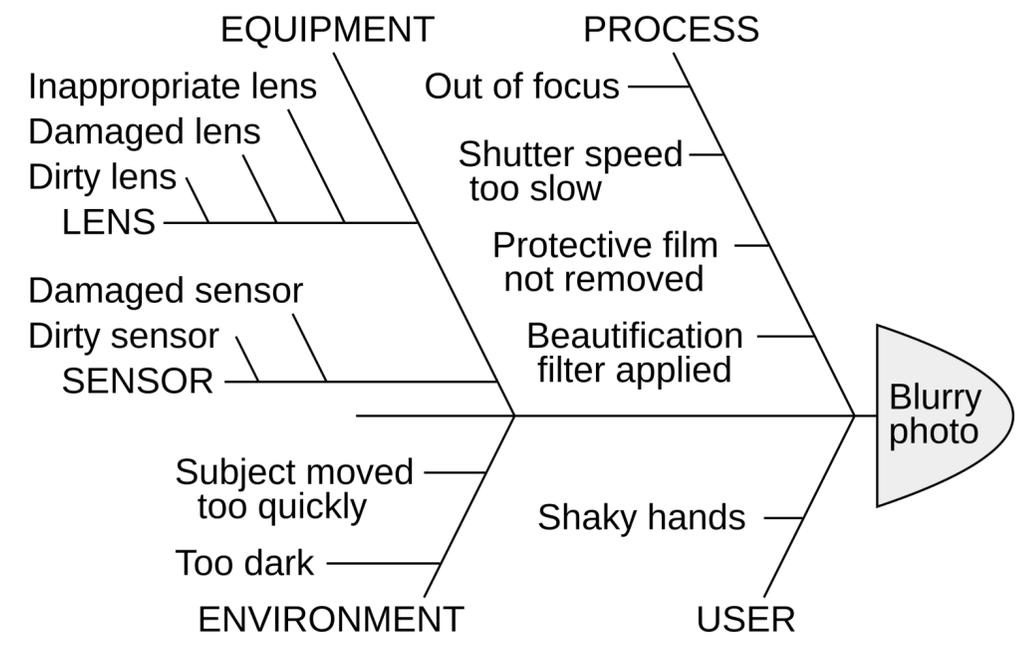
- *Association* (seeing/observing): sensing of regularities or patterns in the input data e.g. correlations, i.e. *description*
 - e.g. $P(\text{floss} \mid \text{toothpaste})$
- *Intervention* (doing): predicting the effects of deliberate actions, expressed as causal relationships, i.e. *prediction* and “no causation without manipulation”, e.g. causal effect of height on weight
 - $P(\text{floss} \mid \text{do}(\text{toothpaste_price}))$
- *Counterfactuals* (imagining): involves constructing a theory of (part of) the world that explains why specific actions have specific effects and what happens in the absence of such actions, i.e. *inference*
 - $P(\text{floss} \mid \text{toothpaste_price} \times 2)$

Causal models

- aka *path analysis, structural equation modelling, structural causal models, causal diagrams, causal loop diagrams, directed acyclic graphs, Bayesian causal networks, ...*
- A conceptual model that describes (and increasingly often visualises) the causal mechanisms of a system
 - Consists of a tuple (U, V, E) of exogenous (U) and endogenous ($V = \{X, Y, Z, \dots\}$) variables and a set of structural equations (E) expressing value of each V from U and V
 - e.g. E: $Y = f_Y(X, Z, U_Y)$, $X = f_X(Z, U_X)$, $Z = f_Z(U_Z)$
 - Nodes can be *mediators, confounders, and instrumental variables*, in patterns of *chains, forks, and colliders*
- Purposes:
 - Can merge findings/data from multiple studies
 - Improving study designs, e.g. identifying questions, confounding variables, and what can be ignored
 - Allow some questions to be answered from observational data without RCT

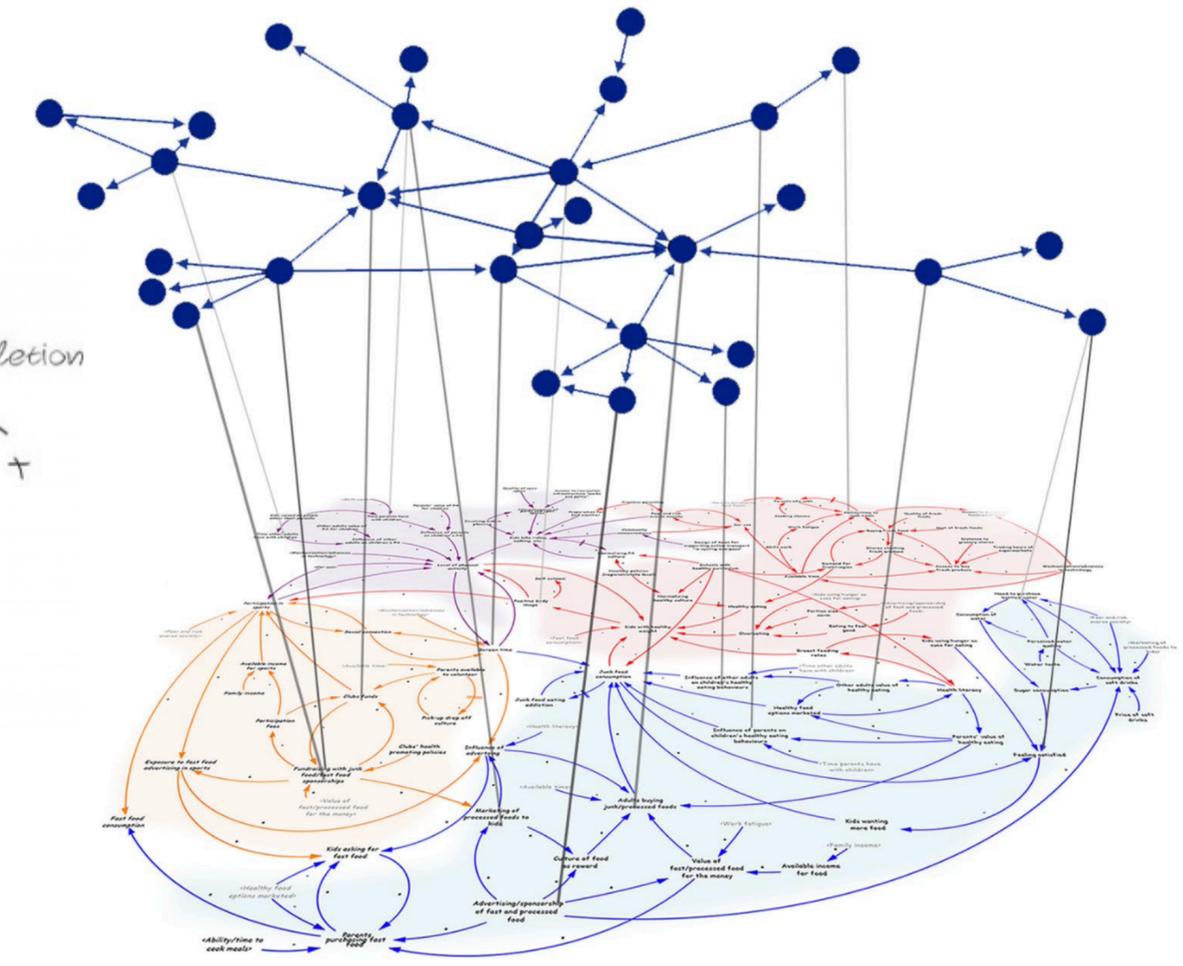
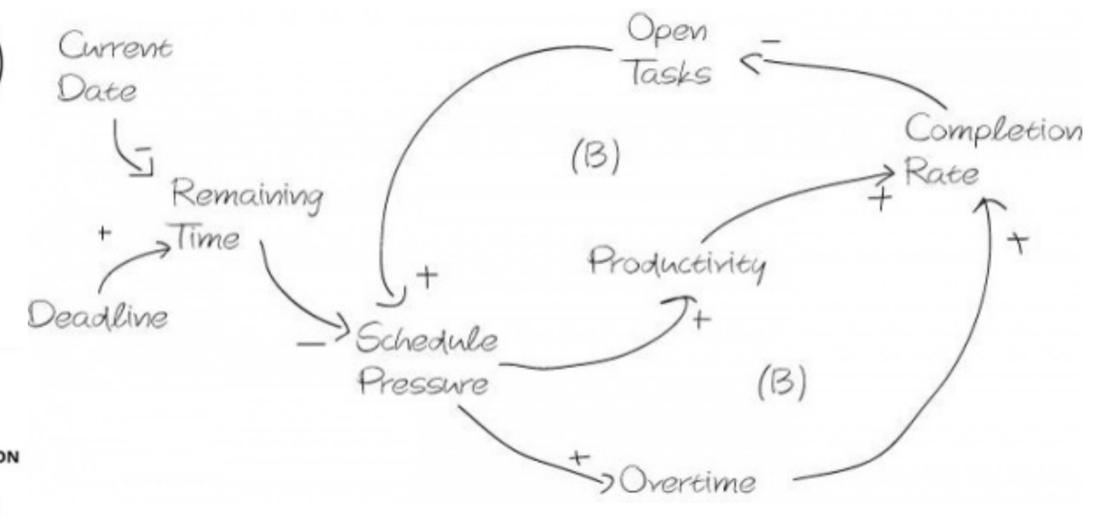
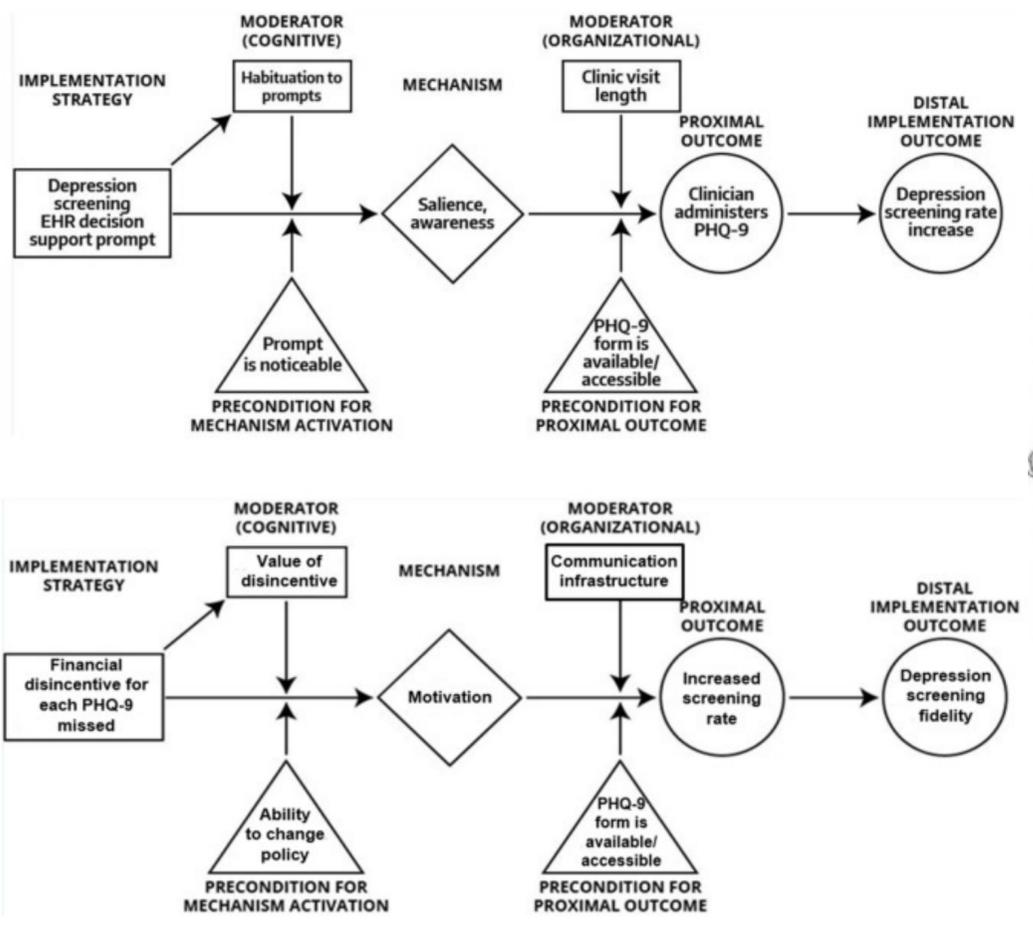


Some options



Rothman (1976)

Ishikawa (1968)





Create a causal diagram for your topic...
[See here](#)

Completion: 1p graph + 1p description
Credit: 1p graph + ≤ 3 p description

Some big thoughts for next time



- “there is too much that is avoidably false”
- ‘causal inference’ vs ‘mere description’ (KKV)?
- probabilities leaves space for uncertainty
- ask various why questions (Kurki 209 and explanatory pragmatism)
- how complex should an explanation be (Norman 950)?
- draw it out.
- interrogate typologies: dichotomies, spectra, even 2x2s ;)