# Empirical analysis and the metaphysics of causation

— Chapter 1 handout —

## The method of empirical analysis

> To conduct the empirical analysis of some topic X, overly broadly speaking, is to identify scientifically improved concepts of X. Empirical analysis is a form of conceptual analysis in the broad sense that it provides a link between our ordinary conception of X and things in the world, but it is a non-standard form of conceptual analysis by forging the linkage in a manner especially responsive to scientific theorizing and experimental results. (p.3)
>
> The empirical analysis of X is the engineering of a conceptual framework optimized in the service of the scientific explanation of whatever empirical phenomena motivate our possession of a concept of X, especially insofar as they are characterized in terms of experiments. (p.10)

NOT IMPORTANT: "Evaluate our mutually shared folk concept X from the armchair"

IMPORTANT: "to take what data science provides and to organize that data from the armchair to arrive at superior surrogates for X" (while accommodating paradigm cases of the folk concept)

Must be
- wide enough so that new empirical results don't invalidate it (e.g. classical concept of energy still applies in the context of thermodynamics etc.)
- narrow enough so that outlandish possibilities are ignored (e.g. the metaphysics of magic) — we stay in close possible worlds

**Example 1**. Food science introduces the general concept of nutrient, defined as any type of ingested substance. In folk parlance, dirt isn't typically food, but as far as food science is concerned, it can be a nutrient (although not a very effective one for humans).

**Example 2**: Mathematics generalizes our concept of rotation into the following function (in 2D, assuming rotation of θ degrees anti-clockwise):

$$\begin{pmatrix} x \\ y \end{pmatrix} \rightarrow \begin{pmatrix} x\cos\theta - y\sin\theta \\ y\cos\theta + x\sin\theta \end{pmatrix}$$

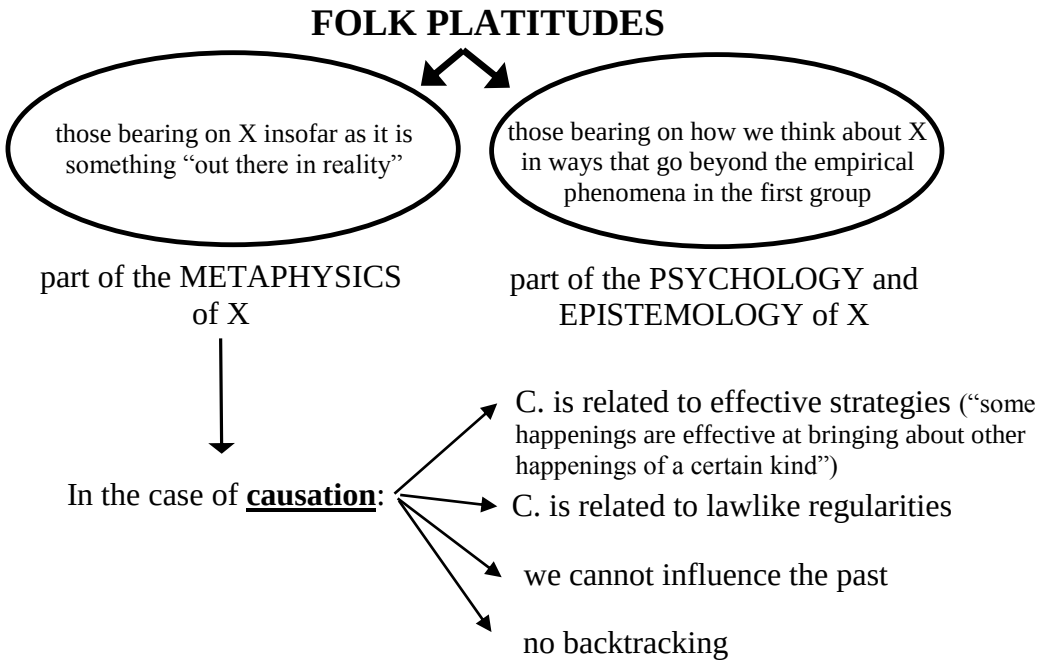
A consequence of this definition is that the case of $\theta = 0$ ("null rotation") also qualifies as a rotation.

In contrast, in **(orthodox) conceptual analyses** of X, the goal is to systematize the platitudes that constitute our implicit concept of X. "There is no further systematic method (beyond custom, personal preference, and appeasing journal referees) for adjudicating between competing analyses".

**The method of empirical analysis**

(1) Take the platitudes concerning X as a starting point

(2) Formulate explicit experiments whose results clarify why X has some conceptual utility (e.g. [later in the book] the promotion experiment, the backtracking experiment, and the asymmetry experiment).




"If an optimal, or at least adequate, set of concepts can be developed that help to explain [all these components of our intuitive concept], then the metaphysics of causation will be largely solved." p.17

**The empirical analysis of causation has 3 layers:**

| | | | |
|---|---|---|---|
| TOP LAYER<br>non-metaphysical | "culpable causation" | token causation | RELAXED standards |
| MIDDLE LAYER<br>metaphysical | causation in derivative reality (difference-making) | type causation | STRICT standards |
| BOTTOM LAYER<br>metaphysical | causation in fundamental reality (probability-fixing) | token causation | STRICT standards |

Goal:
"Optimize metaphysical concepts in accord with the demands of fundamental reality and non-metaphysical concepts in accord with the demands of folk psychology or epistemology."

## Preview of the analysis

> The objective structure behind all causation is located in how the fundamental laws link the fundamental material stuff at different times and places. Specifically, some fundamental happenings determine the existence of other fundamental happenings or fix an objective probability for their existence, and that is what ultimately grounds all causal relations. (p.23)

Problem: Fundamental reality includes much more stuff than our typical causal claims (ordinary or scientific) acknowledge.

>> we switch from probability-fixing to probability-raising and from token causation to type causation in the middle layer

> "Imagine a magnetic compass lying undisturbed. By moving a lodestone near the compass [C], one can reliably make the compass needle move [E]. [...] Our belief that C caused E is in part a belief that the lodestone part of the world was somehow a more important part of the vast C* [= all the microphysical facts at the time when C occurred] than all the far flung events that seemingly have nothing to do with the motion of the compass needle. What makes C the important part of C*, I claim, is that the probability that C* fixes for the effect is significantly greater than the probability that would be fixed for the effect by events that are just like C* except that the physics instantiating the movement of the lodestone is hypothetically altered to make the lodestone remain at rest." (p.23)

> The metaphysical picture, boiled down to its essence, is that there is some sort of fundamental reality instantiating relations of determination or probability-fixing among microscopically detailed events and a more abstract or fuzzy construal of reality where events of type C raise the probability of events of type E. (p.24)

## The concept of fundamental reality

(1) Fundamentality is reality. "The way things are fundamentally is the way things really are."

(2) The fundamental is the basis. "Fundamental reality is the only real basis for how things stand derivatively."

(3) The fundamental is determinate. "Fundamental reality is as determinate as reality ever gets."

(4) The fundamental is consistent.

Note: No talk of "levels" of reality, not assuming microreduction.

Working hypothesis:
"Fundamental reality resembles models of paradigm theories of fundamental physics" (p.31)

**Example**: Classical picture: Point particles with position, mass, and charge.
Fundamental reality: These + laws.
Derivative reality: Poetry, patience, financial assets... (=everything else)

**Derivative entities**

Derivative entities "do not appear as components or parts of the model nor do the laws of the [fundamental] theory make special use of them. [...] Once we have supposed that some model completely and accurately represents fundamental reality, we can think of derivative entities and properties as existents that are not substructures of the model."

**Status of ordinary mesoscale objects**:

(i) Part of fundamental reality (FR) if they are mere sums of particles.
(ii) Not part of FR if they can change parts.
(iii) Not part of FR if the fundamental entities are strings or other exotic structures.

**Derivative quantitites**

"A quantity is derivative if its magnitude requires some specification beyond the totality of fundamental reality (and beyond any specification required to locate the quantity in fundamental reality)." E.g. in the classical picture, mass is fundamental, kinetic energy is derivative.

**Fundamentally arbitrary quantities:** e.g. states of rest.

**Definition of derivative quantitites**

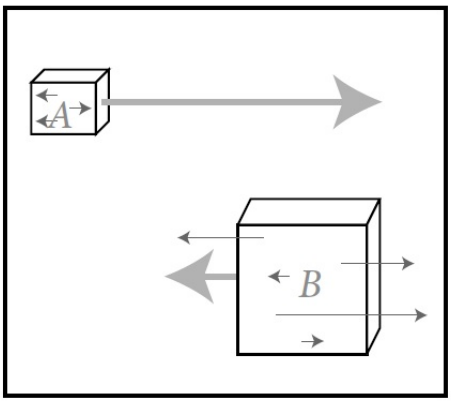
A quantity $Q^D$ is derivative iff

(i) There is a function $Q^D = \varphi(A, F_1, F_2...)$ such that $F_1$, $F_2$... are fundamental quantities and A is a fundamentally arbitrary parameter, and

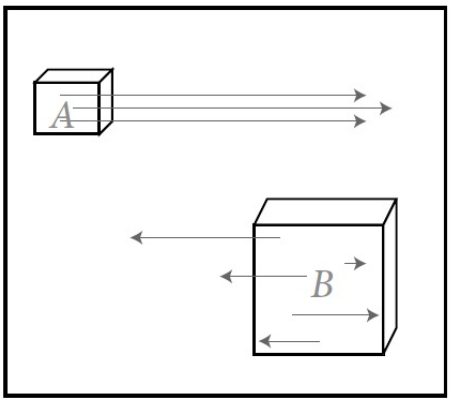
(ii) $Q^D$ is "demonstrably useful for explaining empirical phenomena."

(Kutach says that $Q^D$ abstreduces to fundamental reality in this case.)

**Example**: the thermal energy of particles is a function of their fundamental properties plus a fundamentally arbitrary parameter that fixes macroscopic objects that the particles are assumed to compose.




thermal energy of the particles relative to the net motion of *A* and *B*, respectively (plus the mechanical energy of the blocks)




thermal energy of the particles relative to the total system (the "sum" of *A* and *B*)

**Strict vs relaxed standards**

A theory obeys strict standards iff its principles make contrary predictions about realistic possibilities. A theory obeys relaxed standards otherwise.

Strict standards: bottom and middle layer of causation. (I.e. strict standards prevail in the metaphysics of causation. "The motivation for adhering to strict standards in metaphysics makes sense given that the foundational role of metaphysics does not permit it to delegate conflicts to other disciplines." p.43)

Relaxed standards: top layer of causation

**Example 1:** Two ecological principles: (1) If there are more islands nearby, there are more species. (2) If cataclysms occur, there will be fewer species.

What happens if cataclysms create more islands?

Not a problem because a theory in the special sciences is "a theory of derivative reality that is only approximate and relies on additional resources of fundamental reality to adjudicate what is fundamentally going on."

**Example 2**:
On our intuitive conception, (i) causation is transitive and (ii) causes raise the probability of their effects. But these two principles contradict each other.

"By the relaxed standards appropriate to most special sciences, including the kind of psychology concerned with modeling people's responses to questions about what caused what, it is acceptable for a theory to claim that people employ both [principles] as rough-and-ready heuristics for assessing the existence of a cause-effect relation." (47)

## A critique of the orthodox analysis of causation

"A culpable cause of some event E is an event that counts as "one of the causes of E" in the sense employed by [orthodox] metaphysicians who study causation" (p.46)
e.g. The burglar made the dog bark. Heat caused the traffic jam.

(Culpable causes are so called because they are "blameworthy for their effects".)

Orthodox analyses of culpable causation
• connect causation with laws, chance, and time through candidate necessary and sufficient conditions
• are supposed to obey strict standards (counterexamples must be neutralized).

But culpable causation, in fact, obeys relaxed standards. Hence the wildly conflicting intuitions about the correct metaphysics of causation.