Foundations of Mechanistic Reasoning
PhDs in the Humanities PhD project

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Informal Philosophy PhD Symposium
28 February 2019
Glyphosate
European Chemicals Agency

- Only statistical evidence is valid
  - Epidemiological data
  - Studies on animals
  - Mostly conducted by industry itself

World Health Organisation

- “The mechanistic data provide strong evidence” that glyphosate causes cancer
- But what is mechanistic evidence?
Bayes net

The rooster’s crow does not cause sunrise

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Foundations of Mechanistic Reasoning
Is causality all just probability?

Given binary variables $X$ and $Y$, say $X$ raises the probability of $Y$ just in case $P(y | x) > P(y)$.

Fact. Probability-raising is symmetric

$X$ raises the probability of $Y$ iff $Y$ raises the probability of $X$.

Proof.

$$P(y | x) > P(y)$$
$$\frac{P(x | y)P(y)}{P(x)} > P(y) \quad \text{Bayes rule}$$
$$P(x | y) > P(x) \times \frac{P(x)}{P(y)}$$

$\therefore$ Probability-raising does not represent causal asymmetry

Example

Seeing someone smoke raising the probability that they cough is equivalent to

Seeing someone cough raising the probability that they smoke
Asymmetry by intervention

Observation

Seeing someone cough raises one’s credence that they smoke

\[ P(c | s) \]

Intervention

Making someone cough does not raise one’s credence that they smoke

\[ P(c) \]
What does it mean for this model to describe the actual world?

- Probability raising?
- Intervention?
- Temporal modality
Is causality all just intervention?

- There are causal relations at the big bang
- But what would it mean to *intervene* in the big bang?
- Intervention is too anthropocentric
Temporal modality

Switch down, light off \[\rightarrow\] \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow\] Switch down, light on

Switch up, light off \[\leftarrow\] \leftarrow \leftarrow \leftarrow \leftarrow \leftarrow \leftarrow \leftarrow \leftarrow\] Switch up, light on
There's no causality without change,
But there is change without causality
Hume on causation

[...] we are ignorant of those powers and forces, on which [the] regular course and succession of objects totally depends.

Hume, *Enquiry 4*