Seminar on ‘Because’

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Plan

1. Analysing sufficiency
2. Independent motivation for sufficiency from conditionals
   - Strengthening with a possibility
3. Structural causal models
   - Expressive limits of structural causal models

The need for sufficiency

(1) a. Ali has an Irish passport because he was born in Ireland.
    b. Ali has an Irish passport because he was born in Europe.

The need for sufficiency

(1) a. Ali has an Irish passport because he was born in Ireland.
b. Ali has an Irish passport because he was born in Europe.

(2) a. Being born in Ireland caused Ali to get an Irish passport.
b. Being born in Europe caused Ali to get an Irish passport.

The need for sufficiency

(3) a. Sue was allowed into the bar because she's over 21.
    b. Sue was allowed into the bar because she's over 16.

(4) a. The fact that Sue is over 21 caused the bouncer to let her in.
    b. The fact that Sue is over 16 caused the bouncer to let her in.

The need for sufficiency

(5) *The radio spontaneously starts playing music.*

A: Why did the radio turn on?
B: I have no idea. I didn't touch it.
A: I see it's plugged in, and it needs to be plugged in to turn on.
B: Right, but I still have no idea why it started playing.

The need for sufficiency with reasons

Sami and Jan are fun on their own, but always fight when together. A heard that they are both attending a party and therefore decids to skip it.

(6) a. I'm skipping the party for two reasons: because Sami is going and because Jan is going.
  b. I'm skipping the party for one reason: because Sami and Jan are going.

(7) a. The reasons why I'm skipping the party are that Sami is going and that Jan is going.
  b. The reason why I'm skipping the party is that Sami and Jan are going.

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My intuitive judgement: the (a)-sentences are odd, the (b)-sentences are fine.

The need for sufficiency with reasons

Sami and Jan are each miserable people. Even one of them going to a party is enough to make it a dull event.

(8) a. I'm skipping the party for two reasons: because Sami is going and because Jan is going.
b. I'm skipping the party for one reason: because Sami and Jan are going.

(9) a. The reasons I'm skipping the party are that Sami is going and that Jan is going.
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The need for sufficiency with reasons

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My intuitive judgement: the (a)- and (b)-sentences are both fine.

The sufficiency requirement

- *E because C* $\Rightarrow$ C is sufficient for E.
- *C cause E* $\Rightarrow$ C is sufficient for E.

What does it mean for C to be sufficient for E?

Sufficiency is not logical entailment

(10) a. My laptop turned on because I pushed the power button.
b. Pushing the power button caused the laptop to turn on.

$\not\Rightarrow$ In every logically possible world where I push the power button, the laptop turns on.

These are assertable even though there is a logically possible world where the laptop's battery is empty.

Is C sufficient for E just in case *if C would E* is true?

Problem

Many existing semantics of conditionals validate conjunctive sufficiency, predicting that C and E together entail *if C would E*.

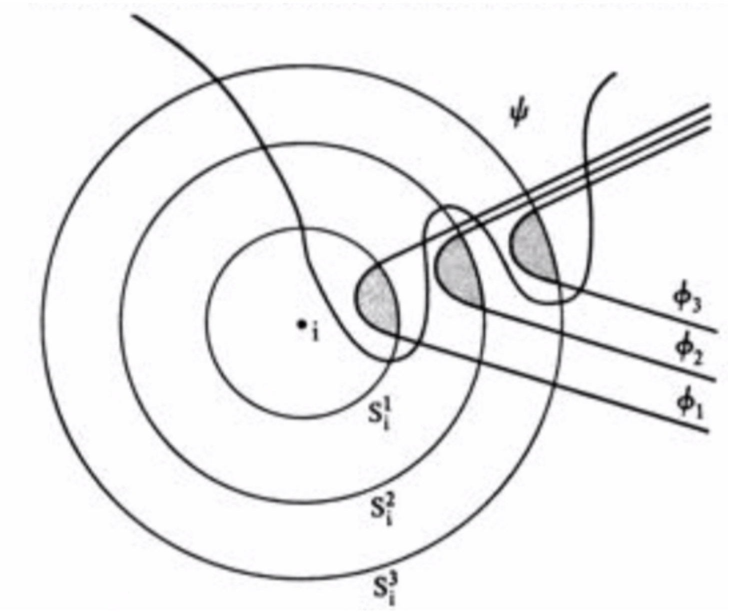
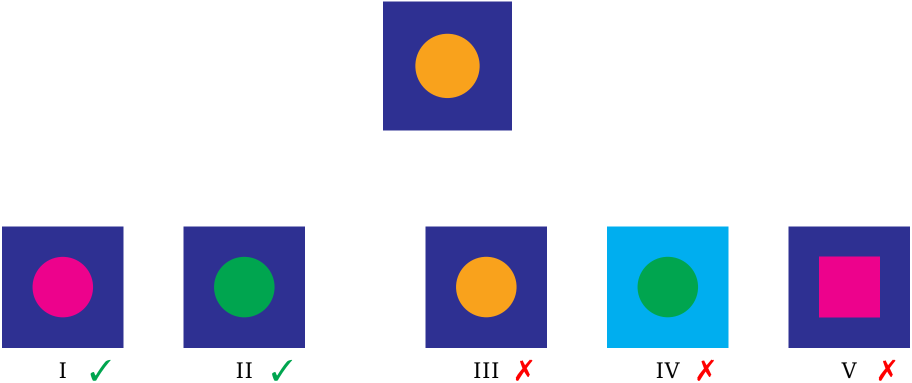


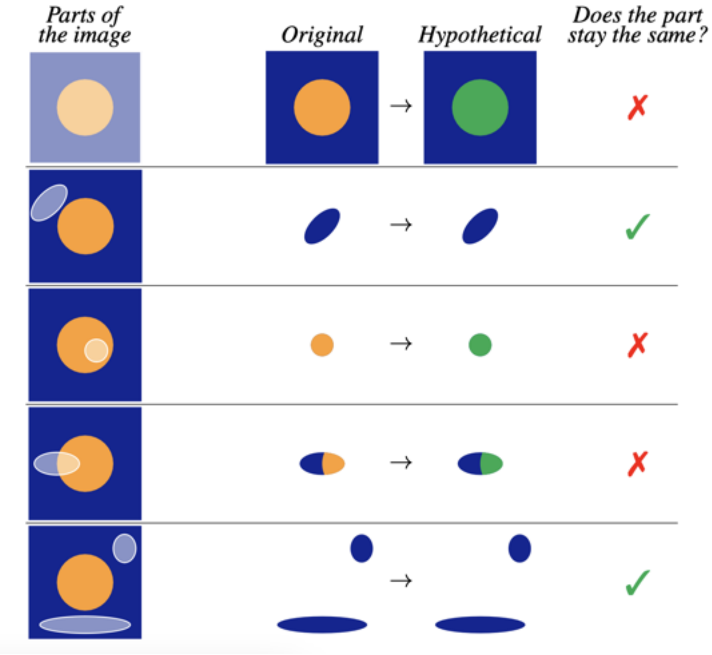
Figure: Lewis (1973) assumes strong centering: every world is more similar to itself than any other world is to it.

There is an intuitive and appealing way of thinking about the truthconditions for counterfactuals. It is an analysis that, in my heart of hearts, I have always believed to be correct...

A "would"-counterfactual is true in a world w iff every way of adding propositions that are true in w to the antecedent while preserving consistency reaches a point where the resulting set of propositions logically implies the consequent.

— Kratzer (2012, p. 127)


I ✓
II ✓
III ✗
IV ✗
V ✗


Parts of the image
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Does the part stay the same?
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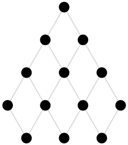
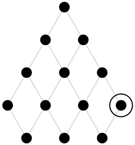
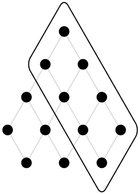


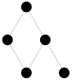
A world w
at a moment in time t



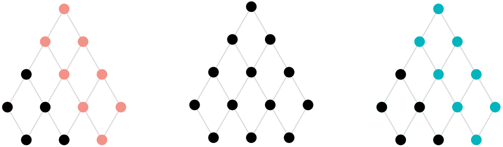
States A is about



Parts of w at t overlapping
a state A is about

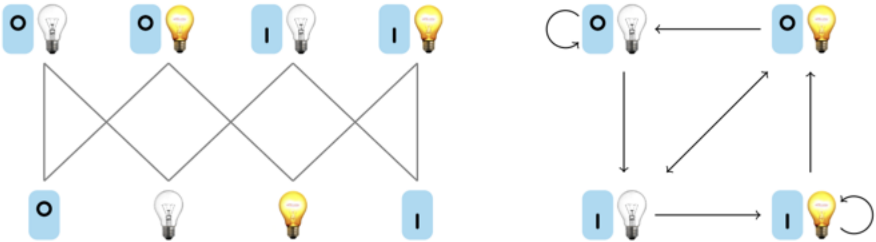


Background of A



A-variants of w at t

Figure: Steps to construct the A-variants of a world at a moment in time.



(a) Mereological structure. (b) Nomic possibilities.

Figure: Light switch example. Nomically possible worlds correspond to directed paths in (b).

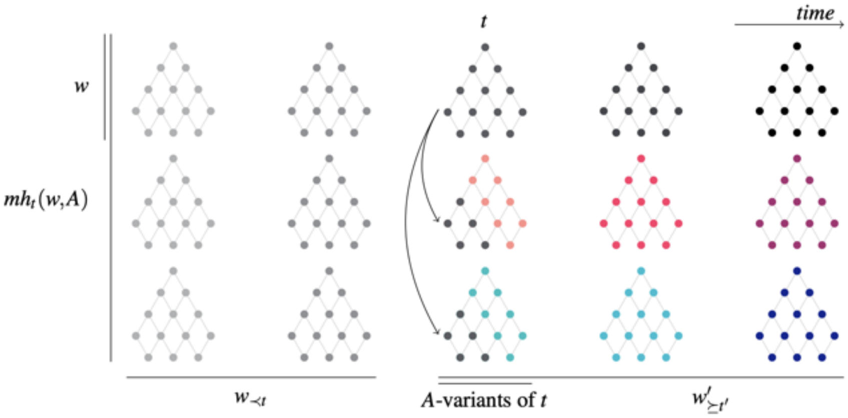


Figure: Constructing the modal horizon.

Definition (Nomic aboutness model)

Where S is a set and $\leq$ a binary relation on S, define

$$\begin{aligned} Sit &:= S \times I, \text{ where } I \text{ is an arbitrary label set,} \\ M &:= \{t_i \in Sit : t \leq u \textit{ implies } t = u \textit{ for all } u \in S\}, \\ W &:= \{(M', \preceq) : M' \subseteq M, \ \preceq \text{ is a linear order}\}. \end{aligned}$$

Definition (The modal horizon)

For any sentence A, moment $t \in M$ and world $w \in W$, define

$$mh_t(w, A) := \{w_{\prec t} \frown w'_{\succeq t'} : t' \textit{ is an A-variant of } t, t' \in w' \text{ and } w' \in P\}.$$

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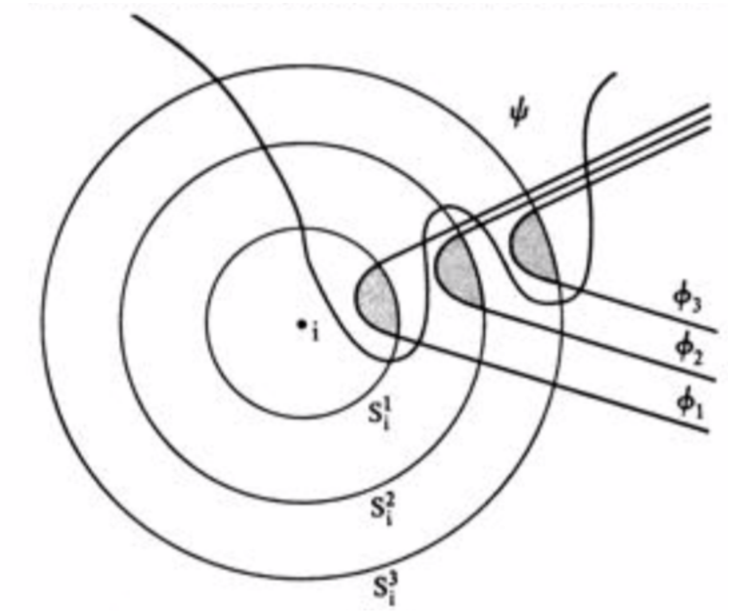


Figure: Lewis (1973)

Strengthening with a Possibility (aka rational monotonicity):

$$\frac{A > C \qquad A \mathbin{\Diamond\!\!\rightarrow} B}{(A \wedge B) > C}$$

This is valid in Lewis' (1973) sphere semantics for counterfactuals.

Counterexample

Boylan and Schultheis (2017, 2021)
Alice, Billy, and Carol are playing a simple game of dice. Anyone who gets an odd number wins $10; anyone who gets even loses $10. The die rolls are, of course, independent. What Alice rolls has no effect on what Billy rolls and vice versa. Likewise for Alice and Carol as well as for Billy and Carol.
Each player throws their dice. Alice gets odd; Billy gets even; Carol gets odd.

(11)
a. If Alice and Billy had thrown the same type of number, then at least one person would still have won $10.
b. If Alice and Billy had thrown the same type of number, then Alice, Billy, and Carol could have all thrown the same type of number.
c. If Alice, Billy, and Carol had all thrown the same type of number, then at least one person would still have won $10.

Ordering semantics

For every world w, let $<_w$ be a strict partial order over worlds.

$<_w$ is *almost connected* iff for all worlds w, x, y, z,
if $x <_w z$ then $x <_w y$ or $y <_w z$.

Strengthening with a Possibility is valid iff $<_w$ is almost connected (Veltman 1985, p. 103).

Our intuitive concept of closeness is total, and hence almost connected.

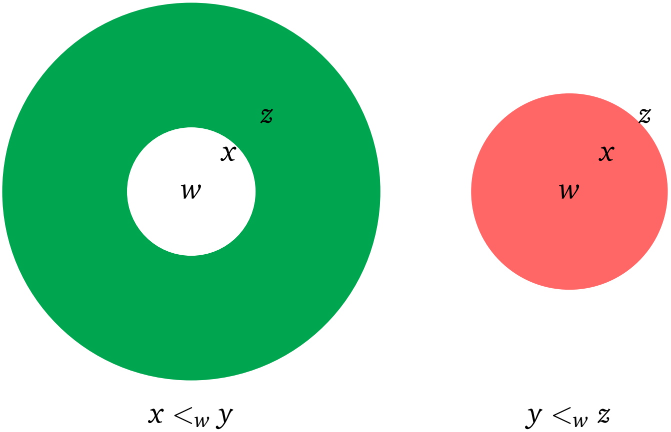
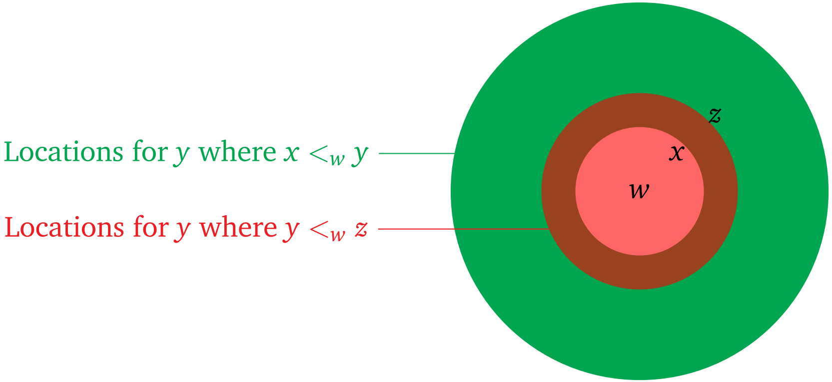


Figure: y must be in either the green or red region.



$x <_w y$ or $y <_w z$

Figure: The green and red regions exhaust the domain: y must be in either the green or red region.

Our concept of closeness is almost connected.

If the semantics of counterfactuals is given by an order over worlds, it is an order that is not almost connected.

And therefore one that cannot be described in terms of ‘closer’ or ‘closest’ worlds.

Upshot: when we speak of the semantics of counterfactuals in terms of ‘closer’ or ‘closest’ worlds, we are strictly speaking making a mistake.

“Alice and Billy threw the same type of number” is about the state of Alice’s throw and Billy’s throw.
“Alice and Billy and Carol” threw the same type of number” is about the state of all three throws.

Structural causal models

Definition (Structural causal model)

A structural causal model is a triple $M = (V, E, F)$ where

- V is a set of variables
- (V, E) is a directed acyclic graph
- F is a set of functions of the form

$$F_X : \mathcal{R}(pa_X) \to \mathcal{R}(X),$$

one for each endogenous (i.e. with a parent) variable $X \in V$.

Structural causal models

The value of an endogenous variable X is determined by the values of its parents, according to F_X

- Since F_X are functions, the dependence is deterministic
- Where $U = u$ is an assignment of values to the exogenous variables in V, we call u a *setting* or *context* for M
  - i.e. the values of the exogenous variables determine the values of all the variables

Interventions in structural causal models

Let $M = (V, E, F)$ be a structural causal model

Definition (Interventions as model surgery)

$M_{X=x}$ is the model $(V, E, F_{X=x})$ which results from replacing the equation for X in M with $X = x$ (that is, $F_{X=x} := (F \setminus \{F_X\}) \cup \{F'_X\}$ where $F'_X(y_1, y_2, \dots) = x$ for any values $y_1, y_2, \dots$ of X's parents).

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Definition (Truth conditions for interventions)

Let M be a structural causal model and u a setting of the exogenous variables.

$$M, u \models [X \leftarrow x]Y = y \quad \text{iff} \quad M_{X=x}, u \models Y = y$$

Plan

Figure 3.11

Asked about what happened, we could reply:

(34) If object A had been blue, it would have been accepted.

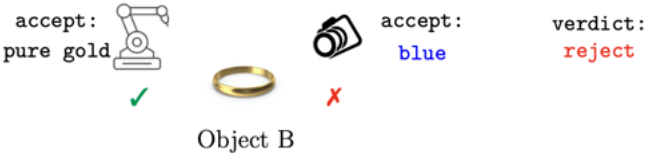
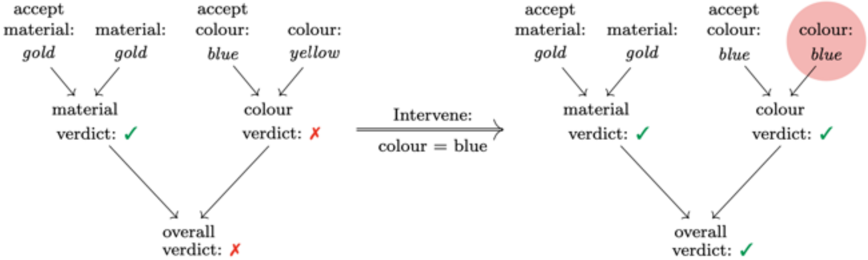


Figure 3.12

Consider (35) in this context.

(35) If object B had been blue, it would have been accepted.


accept material: *gold*
material: *gold*
accept colour: *blue*
colour: *yellow*
material verdict: ✓
colour verdict: ✗
overall verdict: ✗
Intervene:
colour = blue
accept material: *gold*
material: *gold*
accept colour: *blue*
colour: *blue*
material verdict: ✓
colour verdict: ✓
overall verdict: ✓

References I

Boylan, David and Ginger Schultheis (2017). Strengthening principles and counterfactual semantics. *Proceedings of the 21st Amsterdam Colloquium*. Ed. by Floris Roelofsen Alexandre Cremers Thom van Gessel, pp. 155–164. URL: https://semanticsarchive.net/Archive/jZiM2FhZ/AC2017-Proceedings.pdf.

— (2021). How strong is a counterfactual? *The Journal of Philosophy* 118.7, pp. 373–404. DOI: 10.5840/jphil2021118728.

Kratzer, Angelika (2012). *Modals and conditionals*. Oxford University Press. DOI: 10.1093/acprof:oso/9780199234684.001.0001.

Lewis, David (1973). *Counterfactuals*. Wiley-Blackwell.

References II

Veltman, Frank (1985). Logics for conditionals. PhD thesis. University of Amsterdam. URL: https://eprints.illc.uva.nl/id/eprint/1834/3/HDS-02-Frank-Veltman.text.pdf.