

# Modal interpretation of temporal expressions\*

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## Goals of this talk:

- Take a close look at the relationship between non-veridical (esp. “counterfactual”) uses of *'before'*-sentences and counterfactual conditionals
- Characterize and compare the notions of “likelihood” involved in the interpretation of non-veridical *'before'*-sentences and counterfactuals
- Explore some cross-linguistic data to get an idea of the range of variability in the interpretation of expressions of temporal precedence

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\*Some parts of this material are my own, others joint work with Cleo Condoravdi, still others joint work with Yukinori Takubo. All errors and misrepresentations are my own.



► The truth of  $B$  (jointly with  $A$ ) is not necessary for the truth of ' $A$  before  $B$ '.  
**BUT** nor is the falsehood of  $B$  (jointly with the truth of  $A$ ) sufficient for the truth of ' $A$  before  $B$ ', even when the temporal relationship is right:

(11)  $A, \neg B \Rightarrow 'A \text{ before } B'$

The following are adapted from Beaver and Condoravdi (2003):

- (12) David never won a gold medal at anything, but he once ate lots of ketchup.  
 $\Rightarrow$  David ate lots of ketchup before he won all the gold medals in the Sydney Olympics.  
 $\Rightarrow$  Squares had four sides long before David won all the gold medals in the Sydney Olympics.

► Under what circumstances is ' $A$  before  $B$ ' true when  $B$  is false?

## 1.2 (Non-)veridical uses of '*before*' and their modal implications

' $A$  before  $B$ ' has three possible interpretations<sup>3</sup> depending on the *context*: *veridical*, *non-committal*, and *counterfactual*

**Veridical:**  $B$  is implied to be true.

' $A$  before  $B$ ' has no relevant modal implications.

- (13) The police evacuated the airport before the bomb exploded.  
 $\leadsto$  *The bomb exploded.*

**Non-committal:**  $B$  is neither implied to be true nor implied to be false.

►  $B$  may be false, but if it is, it was at least *reasonably probable*.<sup>4</sup>

- (14) Having seen several suspicious pieces of luggage, I left the airport before any of them exploded.  
 $\leadsto$  *An explosion seemed likely and may or may not have occurred.*

**Counterfactual:**  $B$  is implied to be false.

►  $B$  was reasonably probable.

- (15) The police defused the bomb before it exploded. And a good thing too, because they saved the lives of a trainful of commuters.  
 $\leadsto$  *There was no explosion.*

► The modal implications we are interested in are most clearly observable in contexts which give rise to the “counterfactual” reading of '*before*'.

<sup>3</sup>See also Heinämäki (1972); Ogihara (1995); Beaver and Condoravdi (2003). Beaver and Condoravdi show that this context dependence can be accounted for with a uniform analysis of '*before*' that does not postulate an ambiguity, hence it is misleading to treat the three interpretations as different *readings* of '*before*'.

<sup>4</sup>The term “reasonably probable” was first used by Beaver and Condoravdi (2003).

### Analysis of non-veridical readings

In the analysis of Beaver and Condoravdi (2003), the time contributed by the temporal clause is specified in terms of an *earliest* operator applied to the denotation of the temporal clause. When *earliest* is undefined at the world  $w$  of evaluation, it is relativized to a set of alternative worlds:

- Trace  $w$  back to the reference time  $t_A$  of 'A' (when 'not A' was still possible)
- Look at those courses of events that were *reasonably probable* at  $w, t_A$
- Check whether 'B' is consistent with those courses of events
- If consistent, then *earliest* is defined at  $w$   
(as the earliest occurrence of 'B' among the courses of events that were reasonably probable at  $w, t_A$ )

### (Non-)veridical implications as contextual entailments

- The definedness of *earliest* is not a pragmatic presupposition, but checked point-wise at all worlds in the context set; those where *earliest* is undefined are discarded.
- 'before/after'-clauses can be informative.
- Let  $rph_c(w, t)$  designate the reasonably probable (given the contextual assumptions in  $c$ ) among world  $w$ 's historical alternatives at time  $t$ .
- In order for 'A before B' sentence to be felicitous in context  $c$ , it has to lead to a consistent update. The update will be consistent only if
  - there is some  $w \in c$  such that the 'B' is true in  $w$ , OR
  - there is some  $w \in c$  such that  $rph_c(w, t)$  is compatible with 'B'
- veridical and non-veridical readings are *contextual entailments*, i.e., entailments of particular types of contexts when updated with a 'before/after' sentence.

### Most important for our purposes:

- “For the counterfactual reading, the input context has to entail that A’s occurrence makes B’s later occurrence impossible and that prior to A’s occurrence there was a process that made B’s occurrence at least reasonably probable.” (Beaver & Condoravdi 2003:51)
  - Facts at times later than the reference time of 'A' are given up in the process of “rerunning history.”
  - An intuitively plausible and often observed parallelism links the truth of “counterfactual” 'A before B' with that of the corresponding counterfactual conditional 'If had not been A, would have been B'.
- (16) a. The police defused the bomb before it exploded.  
 b. If the police had not defused the bomb, it would have exploded.

### Questions:

- What does “reasonably probable” mean?
- What is the relationship between (16a) and (16b)?
- Are posterior facts (later than the reference time of A) ignored in both?

## 2 Counterfactual conditionals

A first hypothesis based on the preceding section:

- Counterfactual 'A before B' and the counterfactual conditional ' $\text{not-}A \square \rightarrow B$ ' go hand in hand. I.e., whatever makes one true (false) also makes the other true (false).
- Likelihood at the relevant past time is crucially involved in both.

### 2.1 'Before'-sentences and counterfactuals

**Problem for the first hypothesis:** While 'A before B' on its counterfactual reading implies that B was/is likely, counterfactual conditionals *do not* generally imply this.

(17) 'A before B'  $\rightsquigarrow$  'If had been  $\neg A$ , would have been B'

(18) 'If had been  $\neg A$ , would have been B'  $\not\rightsquigarrow$  'A before B'

#### Scenario 1

You are on the bus from Kyoto to Tokyo. You get off at Nagoya; the bus travels on. The next day you hear that the bus had an accident and everyone on board was injured or killed. Consider now the following sentences:

(19) *If I hadn't gotten off the bus, I would have been injured.* [true]

(20) *I got off the bus before I got injured.* [false]

- Intuitively, (20) is false because the accident was *not foreseeable* at the time I got off – i.e., likelihood.
- But (19) is true even though the accident was unlikely!

Main difference: The truth of the counterfactual depends on “posterior” developments (i.e., ones after the reference time of 'A' whereas the 'before'-sentence does not.

### 2.2 Posterior counterfactuals and prior indicatives

The difference between counterfactuals and 'before'-sentences is reminiscent of their relation to their indicative counterparts. Counterfactuals are not generally associated with likelihood, whereas indicatives are.

#### Pro equivalence

(21a) is false (unlikely) *now* because (21b) was false (unlikely) *then*.

- (21) a. If Oswald had not killed Kennedy, someone else would have. [now]  
 b. If Oswald does not kill Kennedy, someone else will. [Nov 22, 1963]

Examples like (21a,b) have led many authors to believe that counterfactuals are basically past-tense indicatives.

### Contra equivalence

In the above scenario, (22a) is true, but (22b) is false.

- (22) a. If I hadn't gotten off the bus, I would have been injured. [is true now]  
 b. If I get off the bus, I will get injured. [was false then]

### Scenario 2

*I was on my way to the airport this morning when my car broke down.<sup>5</sup> Now I am back home, upset because I believe:*

(23) *If I had not missed my plane, I would be on my way to Vancouver now.*

*The next morning, however, it turns out that the plane crashed and everyone on board was killed. So I was lucky, for*

(24) *If I had not missed my plane, I would be dead now.*

Q: But maybe what matters is that the plane crash was likely, not from the speaker's subjective perspective, but somehow "objectively," i.e., with respect to facts that held at the time unbeknownst to the speaker?

A: Not likely. Very similar effects are observed with posterior facts that happen purely by chance, and therefore *cannot* have been predictable. Here's another example from the philosophical literature on the counterfactuals:

### Scenario 3

*Time 1: A fair coin is about to be tossed, and you are asked to make a bet. Since the coin is fair, (25) is false.<sup>6</sup>*

(25) *If I bet on tails, I will lose.* [was false then]

*Time 2: You bet on heads. The coin is tossed and comes up heads. You win. Now (26) is true:*

(26) *If I had bet on tails, I would have lost.* [is true now]

*The counterfactual (26) is now true. But there was no earlier time at which the indicative (25) was true.*

► Examples like these suggest that the 'before'-sentence is more closely related to the past indicative than to the present counterfactual.

- 'A before B':  
*B* was predictable/likely at the time of *A*;  
*'If not-A then B'* was true at the time.
- 'If had been not-A, would have been B':  
*B* may have been very unlikely at the time of *A*;  
 Does not imply that *'if not-A then B'* was true at the time.

<sup>5</sup>This scenario is due to Dorothy Edgington (p.c.; also Edgington 2003)

<sup>6</sup>This example was attributed to Sidney Morgenbesser by Slote (1978) and was also discussed by Bennett (1984, 2003); Edgington (1995); Barker (1998); Kaufmann (2005) and others.

## 2.3 Consequences for the analysis of counterfactuals: Holding on to the facts

### Naïve strategy

To evaluate a counterfactual '*If had been A, would have been B*', where 'A' is false and the reference time of 'A' precedes that of 'B':<sup>7</sup>

- Hypothetically “rerun history” from a past time at which 'A' was still a “live possibility”
- Restrict this hypothetical exploration to those courses of events in which 'A' does occur.
- The counterfactual is true iff all of those courses of events lead to 'B'.
- Modify the preceding clause if some weaker notion of necessity is called for (e.g., Kratzer’s “human necessity” relative to an ordering source).
- Facts at times later than the reference time of 'A' are given up in the process of “rerunning history.” But that’s what we said above for '*before*'! Something else is called for to account for the differences.

### Proper strategy

Make reference to a relation of *causal (in)dependence*. Hold on to facts that are causally independent of the antecedent.

- *Bus example*: Whether the accident occurs does not causally depend on my presence or absence on the bus.
- The accident was unlikely, but it did occur. This fact is held constant.
- *Coin example*: Whether the coin lands heads or tails does not causally depend on the bet.
- The coin’s coming up heads was not predictable, but it did occur. This fact is held constant.

#### Counterfactuals vs. '*before*':

- Posterior facts that are causally independent of 'A' are held constant in the interpretation of the counterfactual '*if had been  $\neg A$ , would have been B*'.
- Such posterior facts are given up in the interpretation of '*A before B*'.

## 3 '*Before*' again

**A second hypothesis** in contrast to the findings on counterfactuals:

- What matters for the question whether 'A' happened “before B” or not is whether 'B' was likely at the time.
- ignore everything that came after 'A';
- consider *all and only* the facts of the world at the reference time of 'A'.

But this is still not enough: Certain facts about the state of the world at the reference time of 'A' must be given up as well.

<sup>7</sup>Variants of this idea have informed many approaches in philosophy and linguistics (Downing, 1959; Adams, 1975; Ellis, 1978; Thomason and Gupta, 1981; Tedeschi, 1981; Dudman, 1994; Strawson, 1986; Bennett, 1988; Mellor, 1993; Edgington, 1995; Dahl, 1997, among others).

### 3.1 Likelihood and 'before'

**Problem for the second hypothesis:** Counterfactual '*A before B*' does not always imply that '*B*' is (was) probable at the time in question.

In (27) the use of *before* is felicitous even though the meteor was unlikely to reach the ground.

- (27) a. [*As meteors usually do / As scientists expected,*]  
the meteor burned up before it hit the ground.  
b. If the meteor had not burned up, it would have hit the ground.

- The context given in (27) explicitly denies that the meteor was likely to hit the ground. Still, there is no problem with (27a).
- Notice that the counterfactual (27b) is true as well. This is for a somewhat different reason, though (see below).

Likewise, (28a) is felicitous even though Bill's books were never likely to become overdue.

- (28) a. [*As he always does / as people around here always do,*]  
Bill returned his books to the library before they became overdue.  
b. If Bill hadn't returned his books to the library, they would have become overdue.

#### A still better strategy for interpreting 'before'-sentences

- Causally independent facts are not just “given up” in the interpretation of 'before'-sentences
  - Giving up facts means “opening up” the question of whether those facts were likely to hold.
  - The answer may well be affirmative.
  - That's not what we want in cases like (27a), (28a).
- Rather, the very question of whether they occur or not is *disregarded*.
  - Intuitively, focus on a part of the world: the process that is/was (at the relevant time) bound to bring about the truth of the 'before'-clause.
  - Don't even think about things external to that process.

#### A potential objection

Q: But the counterfactuals in (27b) and (28b) are also true! Doesn't that (somehow) explain the truth of the 'before'-sentences?

- A:
- The counterfactuals are true because their antecedents are causally (though not logically) inconsistent with the events that interfered with the truth of *B* (the friction in the atmosphere; the books' becoming overdue).
  - Conditional antecedents “win” over unmentioned conflicting facts (see Hiddleston, 2005, for a theory which takes this into account)
  - In 'before'-sentences, on the other hand, we want to know whether the reference time of *A* was “before *B*,” regardless of what *A* is.
  - In a fully compositional account, the interpretation of '*before B*' should not even have access to *A*.
  - Our interpretation of '*before B*' cannot make reference to (the negation of) *A*.

## 4 Outline of a formal analysis

### Goals of this section:

- Start with an off-the-shelf semantic framework for the interpretation of counterfactuals (in our case, Kratzer’s (1981) premise semantics)
- Add a principled (and also off-the-shelf) way to deal with (many) counterfactual conditionals
- Against this background, propose a principled way to deal with ‘before’-clauses which highlights the contrast.

### 4.1 Premise semantics, similarity, and human necessity

#### Main points (accepted here largely without argument):

- Counterfactuals and ‘before’-sentences alike call for a modal interpretation in terms of what’s likely, necessary, etc.
- The standard interpretation of necessity as truth at *all* *A*-worlds is too strong for our purposes. For instance, if ‘*B*’ was likely but did not happen, its likelihood cannot have been truth at all possible courses of events. Similar arguments abound for conditionals.
- “Human necessity” is a weaker notion of (roughly speaking) truth at all “relevant” worlds, e.g., all worlds following the “normal” course of events.
- Goal: Encode the difference between counterfactuals and ‘before’-clauses in terms of different conditions on the “relevant” worlds to consider.

#### Some formal background

Let us adopt the formal tool of an *ordering source* imposing a relation of *relative likelihood* on the possible worlds (or states of affairs). For details, see Kratzer (1981).

- A *proposition* is a set of possible worlds.
- A *modal base* is a function  $f$  from worlds to sets of propositions. For concreteness, let  $f(w)$  be the set of those propositions that are contextually taken for granted. Their intersection,  $\bigcap f(w)$ , is the set of those worlds which, are compatible with everything that is taken for granted.
- An *ordering source* is a function  $o$  from worlds to sets of propositions. Intuitively, in our case,  $o(w)$  is the set of those propositions that are “normally” true (or more likely to be true than not) given the facts at  $w$ .
- At each world  $w$  of evaluation,  $o(w)$  induces a relation of *relative likelihood* between worlds:

$$(29) \quad u \leq_{o(w)} v \iff \{p \mid p \in o(w) \wedge v \in p\} \subseteq \{p \mid p \in o(w) \wedge u \in p\}$$

- This offers a new notion of “human” necessity that is weaker than “simple” necessity. Simplifying,  $p$  is a human necessity at  $w$  relative to  $f$  and  $g$  iff those worlds in the modal base that are most likely under  $g(w)$  are  $p$ -worlds.

$$(30) \quad \forall u \in \bigcap f(w) \exists v \in \bigcap f(w) [v \leq_{o(w)} u \wedge \forall z \in \bigcap f(w) [z \leq_{o(w)} v \rightarrow z \in p]]$$

## 4.2 Counterfactuals

### Main idea:

- In the evaluation of 'If had been  $\neg A$ , would have been  $B$ ' at world  $w$ , the “relevant” worlds are those which satisfy two conditions:
  - $A$  is true at them; and
  - they are at least as similar to  $w$  as any other  $A$ -worlds.
- Roughly: The counterfactual is true at  $w$  iff among all  $A$ -worlds, those that are most similar to  $w$  are  $C$ -worlds (Stalnaker, 1968; Lewis, 1973).<sup>8</sup>

- $f(w) = \emptyset$  for all  $w$ . Thus  $\bigcap f(w) = W$ , the set of all worlds.
- Since the relevant ranking is based on *relative similarity to  $w$* ,  $o(w)$  contains propositions that are true at  $w$ .

Q: Which true propositions?

### How similarity is determined

Much recent work in philosophy, psychology and artificial intelligence has explored the role of *causal (in)dependencies* in the interpretation of counterfactuals (Spirtes et al., 1993; Pearl, 2000; Hiddleston, 2005; Schulz, 2007, among many others)

(31) [I bet on heads, the coin came up heads, I won]  
If I had bet on tails, I would have lost.

- True if the speaker’s bet has no (causal) influence on the outcome of the toss.
- False if it does (e.g., if a different fair coin is used depending on the bet).

(32) [I got off the bus, the bus had an accident, I was uninjured]  
If I hadn’t gotten off the bus, I would have been injured.

- True if the speaker’s presence or absence on the bus has no (causal) influence on the accident.
- False if it does.

► If a relation of *causal dependence* (or causal influence) is given as basic, then the interpretation of counterfactuals can be explained in terms of it.

Lots of people nowadays think that this is a more fruitful approach than Lewis’s attempt to go the other way and reduce causality to counterfactual (in)dependence.

<sup>8</sup>The above presupposes that there is a set of most similar  $A$ -worlds. In fact, neither Stalnaker nor Lewis make exactly that assumption. Stalnaker: iff *the* most similar  $A$ -world (to  $w$ ) is a  $C$ -world. Lewis: iff any sequence of  $A$ -worlds whose similarity to  $w$  grows monotonically, ends in a sequence of  $C$ -worlds.

**Some formal background**

- Causal dependence is a relation between *variables* (in the statistical sense).
- The relation is transitive and asymmetric (often given as a *directed acyclic graph*).
- In our framework, a “variable” is a *partition* of the set of all worlds (like a question denotation).
- For simplicity, assume that these variables are binary (i.e., yes-no questions): Each corresponds to a proposition and its negation.
- At each world, all relevant variables take some value or other.

(33) Let  $X_w$  be the cell in partition  $X$  that contains world  $w$ .

- Impose the following constraint on ordering sources for counterfactuals:

(34) For all  $X, Y$  such that  $X \rightarrow Y$  (i.e.,  $X$  causally influences  $Y$ ), and all  $w$ ,  $o_{cf}(w)$  contains only  $Y_w \cap X_w$  (not  $Y_w$ ).

Intuitively, the partition  $Y$  does not really play a role in the interpretation; only its refinement by  $X$  does.

**Upshot:**

- Suppose  $X, Y$  are both true at  $w$ .
- Without causal dependence: Among the worlds at which  $X$  is false, those at which  $Y$  is true are more similar to  $w$  than those at which  $Y$  is false.
- With causal dependence  $X \rightarrow Y$ : Among the worlds at which  $X$  is false,  $Y$  does not count towards similarity to  $w$ .
- We derive the following asymmetry:
  - (35) a. If  $Y$  were false,  $X$  would (still) be true.
  - b. If  $X$  were false,  $Y$  might not be true.

**Back to our examples**

(36) If I had stayed on the bus, I would have been injured.

- Suppose my presence or absence on the bus had no causal bearing on whether there would be an accident.
- At worlds  $w$  at which the accident happened,  $o(w)$  contains the proposition that the accident happened. This proposition is consistent with the antecedent of (36), hence (36) is true.
- Suppose my whereabouts did have an influence on the accident.
- At worlds  $w$  at which the accident happened,  $o(w)$  does not contain the proposition that the accident happened, but only the proposition that I got off and the accident happened. This proposition is not consistent with the antecedent of (36), hence (36) is false.

### 4.3 'Before'-clauses

(37) If I had stayed on the bus, I would have been injured.

(38) The meteor burned up before it hit the ground.

#### Main idea:

- What mattered for counterfactuals was *similarity to w*.  
Since the accident happened, accident-worlds are more likely than others.
- What matters for 'before'-clauses is not similarity.
- *Nor* is it (overall) likelihood, however!  
(38) may be true even if the meteor never had a chance to hit the ground.
- · Not only do we not hold on to the fact that the meteor burned up;  
· We even disregard the question of whether it would burn up nor not.

#### Implementation

- Assume again that we are given information on causal independence.
- Consider some relevant fact, such as the fact that the meteor was falling (along a certain trajectory, with a certain velocity) at time  $t$ .
- Worlds at which it burns up in the atmosphere are *more likely* than worlds at which it doesn't.
- This follows from a “stereotypical” ordering source of the usual kind:

(39) For all  $X, Y$  such that  $X \rightarrow Y$ , and all  $w$ ,  $o_l(w)$  contains  $Y_w$  or its negation, whichever is more “normal” at  $w$ .

- BUT the atmosphere presents an external intervention on the meteor's fall.
- Impose the following constraint on ordering sources for 'before':

(40) For all  $X, Y$  such that  $X \rightarrow Y$ , and all  $w$ ,  $o_b(w)$  contains neither  $Y_w$  nor its negation.

### 4.4 Conclusions on 'before' and counterfactuals

- Causal (in)dependence is at work in both 'before' and counterfactuals.
- Given a set of relevant variables, the two are interpreted rather differently: Hold independent facts constant for counterfactuals, give them up for 'before'.
- But the set of relevant variables is generally small (and likely subject to contextual and general cognitive factors), and variables that are not included are ignored.
- This idea, as well as its implementation in terms of disregarding partitions, sounds a lot like *awareness*, though we should probably prefer to call it *attention* (Franke and de Jager, 2008).

## 5 Some Japanese facts

Two expressions corresponding (roughly) to 'A before B':

- |         |  |                             |
|---------|--|-----------------------------|
| (41) a. | [ <i>B mae ni</i> ] <i>A</i><br>before-LOC         | [lit. 'before B, A']        |
| b.      | [ <i>B-nai uti-ni</i> ] <i>A</i><br>not within-LOC | [lit. 'while not yet B, A'] |

### 5.1 'Mae' and counterfactuals

Recall that in Scenario 1, the accident is not foreseeable (in any sense) at the time the speaker gets off the bus.

#### Veridical use<sup>9</sup>

- (42) [Boku-wa] ziko-ga        {okoru mae-ni / okora-nai uti-ni        } basu-o orita  
 I-TOP        accident-SUBJ occur before-LOC occur-NEG within-LOC bus-ACC exit-PAST  
 I got off the bus before there was an accident.

#### Non-veridical use

(Notice that in the given context, the reading is counterfactual.)

- |         |   |         |
|---------|---|---------|
| (43) a. | [Ziko-de] kega suru mae-ni basu-o orita<br>accident-CAUS get injured before-LOC bus-ACC exit-PAST       | [true]  |
| b.      | [Ziko-de] kega si-nai uti-ni basu-o orita<br>accident-CAUS get injured-NEG within-LOC bus-ACC exit-PAST | [false] |

'*B mae-ni A*' in (43a)

- does not imply that the accident was likely at the time of *A*
- thus differs from English '*A before B*' (cf. 20 below)
- patterns with the counterfactual (44a) below<sup>10</sup>

'*B-nai uti ni A*' in (43b)

- requires that the accident was likely at the time of *A*
- thus similar to English '*A before B*' (cf. 20 below)
- patterns with the (past) indicative (44b) below

<sup>9</sup>The felicity of (42) is unexpected under Ogihara's (1995) theory, which wrongly attributes the likelihood implicature to the veridical use as well (see also Beaver and Condoravdi, 2003).

<sup>10</sup>Recall that the relevant reading of the English example (20) is called "counterfactual." In light of the differences observed here, this label should be taken with caution.

### Recall the English examples

(19) If I hadn't gotten off the bus, I would have been injured. [true]

(20) I got off the bus before I got injured [in the accident] [false]

(44) a. Basu-o ori-tei-nakat-tara kega si-tei-ta [is true now]  
*bus-ACC get off-PERF-NEG-COND get injured-PERF-PAST*  
 If I hadn't gotten off the bus, I would have been injured.

b. Basu-o ori-nakere-ba kega suru [was false then]  
*bus-ACC get off-NEG-COND get injured*  
 If I don't get off the bus, I will get injured.

### 5.2 'Mae' and 'before'

On the other hand, as in the case with 'before', (45) is true even if the meteor never had a chance to hit a ground.

(45) Insei-wa otiru mae-ni kieta .  
*meteor-TOP fall-NPST before-LOC burn up-PST*  
 The meteor burned up before it fell down.

- The first observation suggests that unlike with English 'before', and similarly to counterfactuals, the interpretation of Japanese 'mae'-sentences does take posterior facts into account.
- Its behavior in cases like (45), on the other hand, suggests that it is similar to 'before' in calling for the dismissal of causally independent facts, even ones which are responsible for the falsehood of the temporal clause.

### 5.3 Tentative conclusions on Japanese

How can we make sense of this?

Two contravening tendencies:

- Given a set of relevant variables, interpret 'mae'-sentences like counterfactuals (and unlike 'before'-sentences) by holding on to causally independent facts.
  - However, the set of relevant variables is not fixed by the semantics. Rather, it is determined by contextual and general cognitive factors, but generally rather small.
- Pay attention to a small part of the world and interpret 'mae' like a counterfactual relative to that small part.

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