Before and *after* in a nutshell

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1. Introduction and Plan

- It seems a matter of common sense that *before* and *after* are converses.
- That is, “A before B” if and only if “B after A” .
- For example, (1) is true iff (2) is:

(1) Cleo left Europe before David did.

(2) David left Europe after Cleo did.

The received view

- Anscombe (1964) argued that *before* and *after* are not converses.
- She said (1) quantifies universally over times when David left Europe, but (2) is purely existential.
- Her arguments have never been countered.
- Until now. We will show that *before* and *after* really are just converse orderings over times.

Plan

1. Introduction and Plan
2. Arguments against converseness
3. Anscombe's position
4. The Proposal
5. Conclusions
6. Non-veridicality of *before*

2. Arguments against converseness

   1. Inference based arguments

   2. Differences in polarity item licensing

   3. Differences in veridicality requirements

Inferential arguments against converseness

- Anscombe (1964) argues that while *before* is antisymmetric and transitive, *after* is neither.

(Anti-)symmetry

(3) a. There were ammonites after there were dinosaurs.

b. There were dinosaurs after there were ammonites.

(4) There were violent upheavals after there were animals.

www.bvalphaserver.com/postp218906.html

Counterexample to transitivity

(5) After the safe was open, Downey was pushed to the floor and was then beaten with the butt of a shotgun. (4-9-03, Court of Appeal 2nd Circuit, St. of Louisiana No. 36,929-KA)

(6) The safe was open after the robbers left.

(7) Therefore, Downey was beaten after the robbers left.

NPI licensing

- NPIs are not licensed in main clauses regardless of the temporal connective.
- NPIs are licensed in *before*-clauses but usually not in *after*-clauses.

NPI licensing cont.

(8) Cleo leapt into action before David moved a muscle/could say a word.

(9) * Cleo leapt into action after David moved a muscle/could say a word.

(10) * David moved a muscle/could say a word before Cleo leapt into action.

(11) * David moved a muscle/could say a word after Cleo leapt into action.

Web data on NPI licensing

- *Google* turned up 30 instances of *moved a muscle*, 27 instances of *had the faintest idea*, and 10,200 instances of *could say a word* licensed by *before*.
- *Google* found no instances of *moved a muscle*, *had the faintest idea* or *could say a word* licensed by *after*.

Web examples

(12) Bridge produced no reaction from Liverpool's back line, and Marsden chased after the ball and got himself a couple of yards clear before anyone moved a muscle.

(13) I once spent 10 minutes staring at Trevor Lock before I had the faintest idea who he was.

Web examples cont.

(14) [Sometime back in 1965 …] Before Jones could say a word, Lennon looked at him and with a smirk began singing Tom's hit as he walked by. Problem was Lennon changed the words from, "It's Not Unusual" to, "It's Not A Unicorn, It's An Elephant" and kept walking.

Discussion of NPI licensing data

- There is an asymmetry in NPI licensing between *before* and *after*, although, as we will see, the difference is not categorical.
- Ladusaw (1979) and others have argued that the main licensing condition for NPIs is semantic: they are licensed by operators producing a downward monotone context.
- If so, the NPI distribution data we have seen so far suggests *before* and *after* are not converses, since we would expect the same NPI distribution in an *after* main clause as a *before* sub-clause.

A further NPI licensing puzzle

- Linebarger (1987) claimed that *after* may license NPIs when combined with an appropriate measure phrase.

(15) She persisted long after she had any hope of succeeding. [ML]

(16) She persisted for years after she had any hope at all of succeeding. [ML]

NPI licensing puzzle (cont.)

(17) He kept writing novels long after he had any reason to believe they would sell. [ML]

(18) * He kept writing novels long after he retired to any Carribean island. [ML]

NPI licensing puzzle (cont.)

- Linebarger uses these examples to argue against semantic accounts of NPI licensing.
- She claims NPIs are licensed in the presence of a Negative Implicature (NI), e.g. for (15):
  NI = She persisted when there was no hope anymore
- Her claim is that *long after* tends to "close down" the situation described in the subordinate clause, and that this results in the relevant NI.
- The details of Linebarger's proposal remain unclear, but later the data is explained within a semantic account.

3. Anscombe's position

- Anscombe proposed (essentially) the following definitions, in which A and B are predicates true of times when A and B hold, respectively, and $<$ is temporal precedence:

$$\text{X before Y} \quad \text{iff} \quad \exists t X(t) \wedge \forall t' Y(t') \rightarrow t < t'$$

$$\text{X after Y} \quad \text{iff} \quad \exists t, t' X(t) \wedge Y(t') \wedge t' < t$$

- These definitions do not appear to make *before* and *after* into converse relations.

Inference patterns explained

- Non-overlapping events are as expected.

X ——————— Y ———————

True: “X before Y”, “Y after X”

False: “Y before X”, “X after Y”

Inference patterns explained cont.

- But in cases of overlap, *after* is weak:

$$\frac{X \qquad ____ \quad ____}{Y}$$

True: “X before/after Y”, “Y after X”

False: “Y before X”

Basic NPI licensing explained

- The logic of universal quantifiers means that *before* licenses NPIs.
- *After* has only existentials, so does not license NPIs.

Problem 1: A lack of compositionality

- Anscombe did not give an account of the meaning of the connectives themselves but rather of the meaning of the sentences containing the connectives.
- The different quantification force at the sentential level can of course be built into the lexical meaning of the connectives.
- But this begs the question of why the two connectives should differ in their meaning so substantially.

Problem 2: NPI Licensing

- If NPI licensing is semantic, as most supporters of Anscombe's position have maintained, there is no obvious way of explaining Linebarger's data.

Problem 3: Odd truth conditions

- The truth conditions predicted are strange. Even if David never won a gold medal at anything in his whole life, provided he ate lots of ketchup at some point, (19) is predicted true.

(19) David ate lots of ketchup before he made a clean sweep of all the gold medals in the Sydney Olympics.

Problem 4: Measure phrases

- Anscombe did not discuss measure phrases.
- If extended in the most obvious way, her account would make incorrect predictions for *before*, e.g., that in (20) Cleo left exactly 5 seconds before every time point at which David was singing.

(20) Cleo left exactly 5 seconds before David sang.

- Indeed, since leaving events are not extended, and given that Cleo did leave at some point, (20) is predicted true iff David did not sing.

Problem 5: NP complements

- For *after* but not *before*, NP complements behave differently to sentential complements, but Anscombe's theory does not provide any hint as to why this might be.

(21) a. Mike left after the talk was in progress. $\not\rightarrow$

b. Mike left after the talk.

(22) a. Mike left before the talk was in progress. $\leftrightarrow$

b. Mike left before the talk.

NP complements cont.

(23) a. Mike felt sick after the car was in motion (between Stanford and UCSC). $\not\rightarrow$

b. Mike felt sick after the drive (between Stanford and UCSC).

(24) a. Mike felt sick before the car was in motion (between Stanford and UCSC). $\leftrightarrow$

b. Mike felt sick before the drive (between Stanford and UCSC).

Relation of Anscombe's to other proposals

- Anscombe's proposals are adopted by e.g. Landman (1991), Ogihara (1995) and Valencia, van der Wouden and Zwarts (1992).
- Pratt and Francez (2001) treat sentential complements like definite NP complements. (Incorrect predictions for states, activities, most accomplishments.)
- The best known alternative account is Heinämäki's (1974), which appearsquite different to Anscombe's.

Heinämäki's position

- Heinämäki's proposal still suffers from at least 3 of the above 5 problems. (Her account does not deal with measure phrases but could, and her truth conditions for factual 'before', as for 'after', require that the temporal clause be true at some interval, thus predicting falsity for the ketchup example.)
- Despite superficial differences between the accounts, we can show formally that for veridical state, activity and achievement predicates, Heinämäki's proposal yields identical truth conditions to Anscombe's — see Beaver and Condoravdi (2003).

4. The Proposal: Strategy

- We will take the case of (singular) event-denoting NP complements as basic, and then extend the analysis to sentential complements.
- This will motivate maximally dull interpretations for *before* and *after*.
- Note that Higginbotham (1988) and von Stechow (2002) have independently proposed dull analyses of *before* and *after*, but do not explain the data under discussion here.

Foundational assumptions

- Assumption 1: Time consists of intervals, down to some (pragmatically set) minimal granularity.
- Assumption 2: (a) Time is partially ordered by an antireflexive, antisymmetric, transitive relation $<$, and its converse $>$. (b) For any non-overlapping intervals, $I_1 < I_2$ or $I_1 > I_2$, while overlapping intervals are not ordered.
- Assumption 3: Event denoting definite NPs (*the ceremony*, *the flight*, *WWII*) pick out a single interval.

Foundational assumptions (cont.)

- Assumption 4: Untensed sentential clauses pick out sets of intervals, state and activity denoting clauses closed under sub-intervals.
- Assumption 5: Modifiers combine with main clauses intersectively.
- Assumption 6: If the untensed meaning of a sentence S is the set of times S', then the tensed meaning is $\exists t\ S'.t$. (The actual tense used adds further constraints on both clauses, which we ignore.)

The theory of *before* and *after*

before $\mapsto$ $<$

after $\mapsto$ $>$

Basic properties of analysis

- The analysis is uniform: the same principles of interpretation apply to *yesterday* etc. as for temporal clauses.
- A quite uncontroversial assumption gives the wide scope existential interpretation of main clauses stipulated by other authors as part of the theory of *before* and *after*.
- The properties of NP complements drop out from the meaning of singular event-denoting NPs and our assumptions about time

Sample analysis: NP complement

X	$=$	"We'll be at the Rosie McCann's"
Y	$=$	"the colloquium"
after	$\mapsto$	$>$
Y	$\mapsto$	[3:30-5:00]
after Y	$\mapsto$	$>$ [3:30-5:00]
X	$\mapsto$	$\lambda t' \; @(us, P\&S, t')$
X after Y	$\mapsto$	$\lambda t' \; @(us, P\&S, t') \wedge t' >$ [3:30-5:00]
tense(X after Y)	$\mapsto$	$\exists t' \; @(us, P\&S, t') \wedge t' >$ [3:30-5:00]
	$\equiv$	$\exists t' \; @(us, P\&S, t') \wedge t' >$ [5:00]

Clausal complements

- For clausal complements, we have a connective α (*before* or *after*) looking for a time and a clause Y providing a set of times. How do we combine them?
- We propose that a coercion operation C maps a set of times to a single time, and is applied to the meaning of Y prior to combination with the connective.
- C is undefined when applied to an empty set. Hence, temporal clauses have a semantic value only if their sub-clause denotes a non-empty set of times.

The early coercion gets the facts

Let C be the function *earliest*, mapping a set of intervals to the first interval to end, if defined.

- Consider sentences "A before/after B" containing only veridical sentential clauses A, B of aspectual class state, activity or achievement.
- For Anscombe's analysis use only the time points (minimal intervals) in the clausal denotations.
- Proposition: Our analysis yields identical truth conditions to Anscombe's.

Anscombe regained

- Given the above assumptions:
  X before Y $\mapsto \exists t\, X'.t \wedge t < \mathit{earliest}.Y'$, with presupposition $\exists t\, Y'.t$
- Intuition: t is prior to every time point in C iff it is prior to the first time point in C.
- X after Y $\mapsto \exists t\, X'.t \wedge t > \mathit{earliest}.Y'$, with presupposition $\exists t\, Y'.t$
- Intuition: t follows some time in C iff it follows the first time point in C.

Sample analysis: clausal complement

$$
\begin{array}{rcl}
\text{X} & = & \text{“Cleo was in America”} \\
\text{Y} & = & \text{“David was in America”} \\
\text{before} & \mapsto & < \\
\text{Y} & \mapsto & \lambda t\ \mathit{in}(d,a,t) \\
\text{before Y} & \mapsto & < \mathit{earliest}.\lambda t\ \mathit{in}(d,a,t) \\
\text{X} & \mapsto & \lambda t'\ \mathit{in}(c,a,t') \\
\text{X before Y} & \mapsto & \lambda t'\ [\mathit{in}(c,a,t') \wedge \\
 & & t' < \mathit{earliest}.\lambda t\ \mathit{in}(d,a,t)] \\
\text{tense(X before Y)} & \mapsto & \exists t'\ [\mathit{in}(c,a,t') \wedge \\
 & & t' < \mathit{earliest}.\lambda t\ \mathit{in}(d,a,t)]
\end{array}
$$

Explaining the data

- However, the sentential meanings we derive in these cases are truth-conditionally identical to those Anscombe derives, so the original inference data follows automatically.
- The definedness condition on *earliest* takes care of (19) (the ketchup example)

Basic NPI licensing

- We follow von Fintel (1999), who argues that NPIs are licensed if strengthening inferences are valid in contexts where all presuppositions hold.
- NPIs are licensed in *before* clauses because of the validity of arguments like that in (25), which is analyzed as in (26).

Sample monotonicity inference

(25)
a. At some time David sang loudly.
b. Everybody left before David sang.
c. So, everybody left before David sang loudly.

(26)
a. At some time David sang loudly.
b. Everybody left earlier than the first time David sang.
c. So everybody left earlier than the first time David sang loudly.

Simple measure phrases are unproblematic

3 years $\mapsto$ $\lambda t \lambda t' \; |t' - t| = \textit{3 years}$

3 years before $\mapsto$ $\lambda t \lambda t' t' < t \wedge |t' - t| = \textit{3 years}$

tense(X 3 years before Y)

$\mapsto$ $\exists t' \; \textit{in}(c, a, t') \wedge$

$t' < \textit{earliest}.\lambda t \; \textit{in}(d, a, t) \wedge$

$|t' - \textit{earliest}.\lambda t \; \textit{in}(d, a, t)| = \textit{3 years}$

Where does coercion happen?

- In the above analyses, *earliest* is introduced in the compositional analysis.
- However, nothing I have said precludes *earliest* from being part of the lexical meaning of the temporal connectives.
- If *earliest* is not the only possible coercion operator, that might provide an argument for keeping it out of the lexicon.
- In fact, it is possible to find cases where a state is coerced into an endpoint or complete interval.

Web data: non-startpoint coercion

(27) It also included cleaning the viewing room after you had a cat or bunny in there.

(28) You know how hard I work for what I get, and I think you know that I never had money help from any human creature after I was a child.

(29) Once the white blood cells are there, they continue to fight long after there is an enemy to conquer.

Web data cont.

(30) During those difficult years after I was a child and before I became a man, sports served to bridge the gap between us.

(31) Biszantz said more and more owners should be concerned with the welfare of horses, even long after they owned them. ”An owner’s responsibility is greater than just using the product and then throwing it away when we’re done with it,” he said.

Endpoints or total intervals?

- We have not found any evidence of *before* having endpoint readings.
- For *before*, startpoint readings are truth conditionally identical to complete interval readings.
- This provides an argument for treating the above as examples of complete interval coercion.
- Note: other factors may be relevant, e.g. the cognitive salience of the startpoint, and a general preference for stronger readings.

Linebarger's data explained

- If A happens later than the complete interval (or final point) when B holds, then it must happen later than the complete interval (or final point) when any stronger predicate than B holds.
- So selecting the complete interval (or endpoint) creates a downward monotone environment.
- We therefore explain Linebarger's data: NPIs are predicted to arise with (and only with) complete interval (endpoint) readings.

Linebarger's data

(15) She persisted long after she had any hope of succeeding. [ML]

(16) She persisted for years after she had any hope at all of succeeding. [ML]

- In both cases, she persisted after the last time she had hope.

Linebarger's data (cont.)

(17) He kept writing novels long after he had any reason to believe they would sell. [ML]

- I.e. he kept writing novels after the last time he had reason to think they would sell.

(18) * He kept writing novels long after he retired to any Carribean island. [ML]

- The act of retirement is punctual. We do not get subset inferences because we are dealing with a singleton set, so the NPI is unlicensed.

Web data: *after* licensing NPIs

- It is easy to find naturally occuring examples like Linebarger's.

(32) Depending on how parameters are set, once a node is heard, it can stay in the nodes list long after there is any chance of successful connection.

(33) The office was ten by twelve, with no floor and a mud roof. It used to rain inside that office for days after there was any indication of rain out of doors.

Web data cont.

- However, Linebarger misleadingly indicates that NPI licensing is dependent on there being an appropriate measure phrase. This is not the case:

(34) Unfortunately I found this all out after there was any possibility of seeing it.

(35) Some say the cuts were made after there was any real use for them.

Rah! Rah! Go flexible coercion!

- No other theory predicts the truth conditions associated with total interval readings, and no other theory fully accounts for the NPI licensing facts.
- Note that the flexibility of having alternative coercion operators is also needed to deal with accomplishments, for which all previous theories also have problems.

More comparative or less?

- *Before* and *after* are temporal comparatives.
- Many of the same issues come up in the regular comparatives literature.

(36) I can eat slower than you (can eat).
= I can eat slower than the slowest you can eat.

- Here a set of rates you can eat is somehow mapped onto a single minimal rate.
- Should a coercion operation be used here? Should the minimality mapping be incorporated into the meaning of the *-er* morpheme?

Comparatives cont.

- It is instructive to consider morphologically comparative temporal connectives: *earlier than*, *later than*, *sooner than*.
- These behave differently to *before* and *after*: they do not like durative complements.
- Does this perhaps suggest that the comparative analogy is misleading?
- Or could these be comparatives over time points rather than intervals?

5. Conclusions

- Despite appearances, *before* and *after* have their natural converse interpretations.
- In the light of the analysis, it is no longer reasonable to ask whether there could have been some language in which *before* was existential and *after* universal.
- We could ask: is there some language where the endpoint of a state/activity is more salient than the startpoint?
- I guess *not*!

And a moral

- Compositionality is not just a ‘straitjacket’: sometimes the only way to see the wood is to look at the trees.

6. Veridicality

- *Before* clauses can be non-veridical.
- *After* clauses and main clauses are veridical.
- Analysis so far makes them both veridical.

Web examples: non-veridicality

(37) On Dec. 9, the U.S. Supreme Court stopped the hand count before it was completed. *USA Today, 5-15-2001*.
(Uncounted votes.)

(38) Another booby-trapped bicycle and a bomb hidden in a supermarket cart were discovered and defused by police before they exploded.
(No explosion.)

Web examples cont.: non-veridicality

(39) Mozart died before he finished the Requiem and it was completed by his student, Franz Xavier [Süssmayr].
(Unfinished Requiem.)

Web examples cont.: non-veridicality

(40) I left Trafalgar Square about half an hour ago and it started to look scary. The happy crowd that had made its way towards the square for some reason got cut off by the police and the Trade Union Congress march was prevented from getting in for their planned meeting. I gather that McDonalds has been trashed. Tourists seemed to be mingling curiously with the demonstrators in the square, but there was no violence at that time. Yet the police seem to be blocking off all the exits. I decided to leave before there was any trouble.
(Trouble was likely and may have come about)

Veridical and non-veridical readings

- Though allowing for non-veridical construals, *before* sentences are not just neutral as to whether the temporal clause is instantiated
  - contrast between veridical and ketchup-type examples
  - contrast between non-veridical and ketchup-type examples
  - non-veridical uses of *before* carry additional implications

Non-Veridical readings

- Counterfactual reading
  - temporal clause is implied to be false
  - a corresponding counterfactual conditional
    If A had not been the case, B might/would have been the case is implied to be true
- Non-committal reading
  - temporal clause is implied to be/have been likely, with the eventual outcome unknown to the speaker
    (temporal clause may or may not be true)

Previous analyses

Heinämäki (1972), Ogihara (1995):

- important insight about role of pragmatic presuppositions
  - different readings of *before* are tied to information in the context in which the *before* sentence is uttered
- Anscombe-type truth conditions
- associate a lexical presupposition with *before*
  - *A after B* entails *B*
  - *A before B* presupposes *B* (on the veridical reading)

Previous analyses cont.

Heinämäki (1972):

- semantic presupposition that temporal clause is instantiated
- truth conditions have a special provision for cases when the context updated with the main clause entails that the temporal clause is uninstantiated
- analysis cannot be extended to non-committal reading
- counterfactual implication independent of truth conditional or presuppositional content

Previous analyses cont.

Ogihara(1995):

- pragmatic modal presupposition: 'A before B' pragmatically presupposes (roughly) that B is instantiated in the inertial course of events
- modal presupposition even for veridical reading
- non-committal reading predicted to be the default (i.e. arises in contexts with no further information other than what is necessary to satisfy the presupposition)
- veridical reading requires further information in the context (e.g. that the temporal clause is true, or that whatever was the inertial course of events turned out to be the actual course of events)

Extending the analysis

- preserve uniformity on the semantics of *before* and *after*
  - mechanism responsible for producing non-veridical readings for *before* produces only veridical readings for *after*
- tie the modality of *before* to the need to satisfy definedness condition of *earliest*
- characterize different readings of *before*

Basic idea

- We need to assume a right-branching model of world histories and consider parts of world histories with the branch point just before the time the main clause becomes true in the world of evaluation
- It is easily seen that that while the semantics of *before* clauses allows them to be false in the world of evaluation (fig.1), *after* clauses must be true (fig.2).

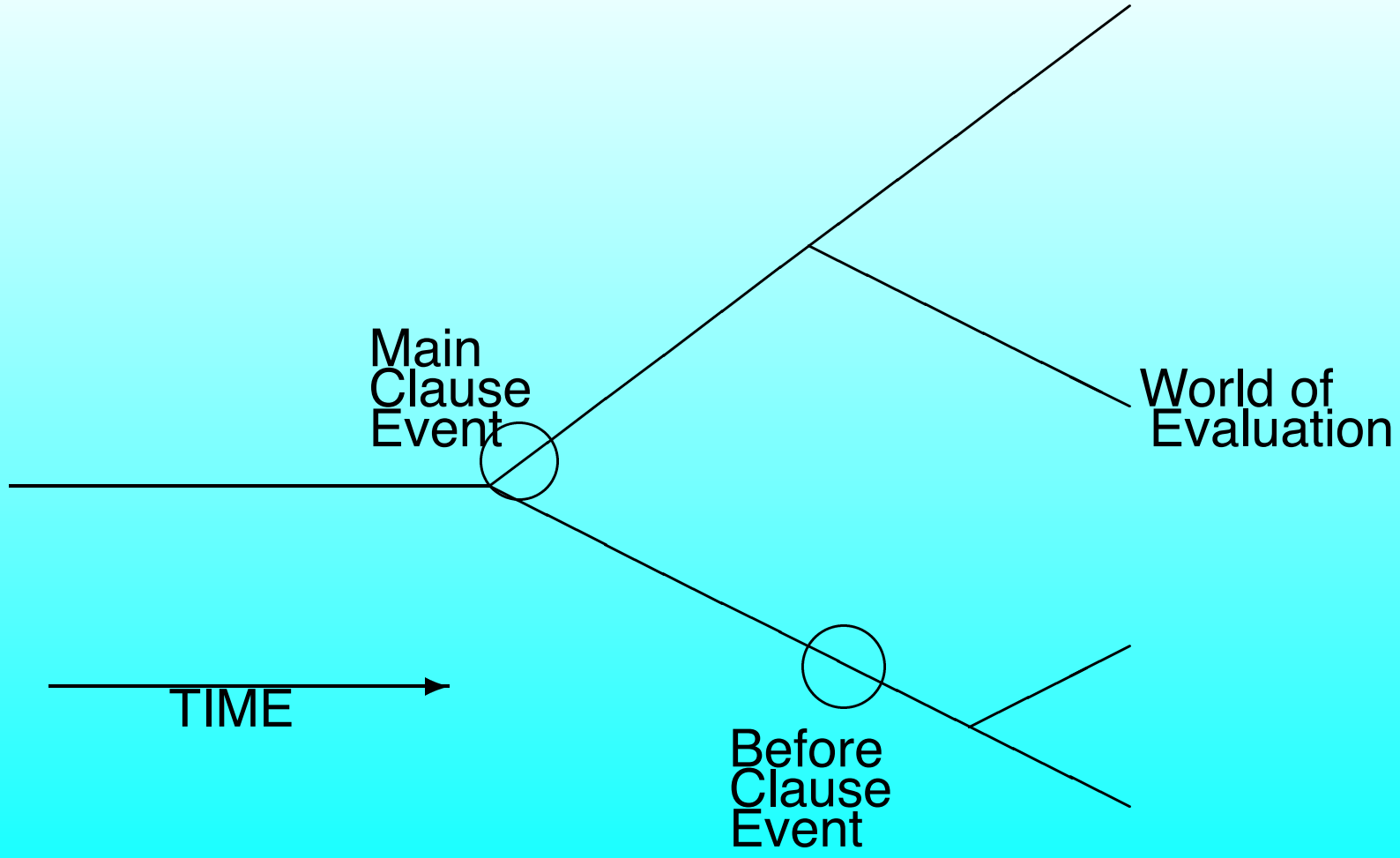

Figure 1: “Mozart died before he finished the requiem.”

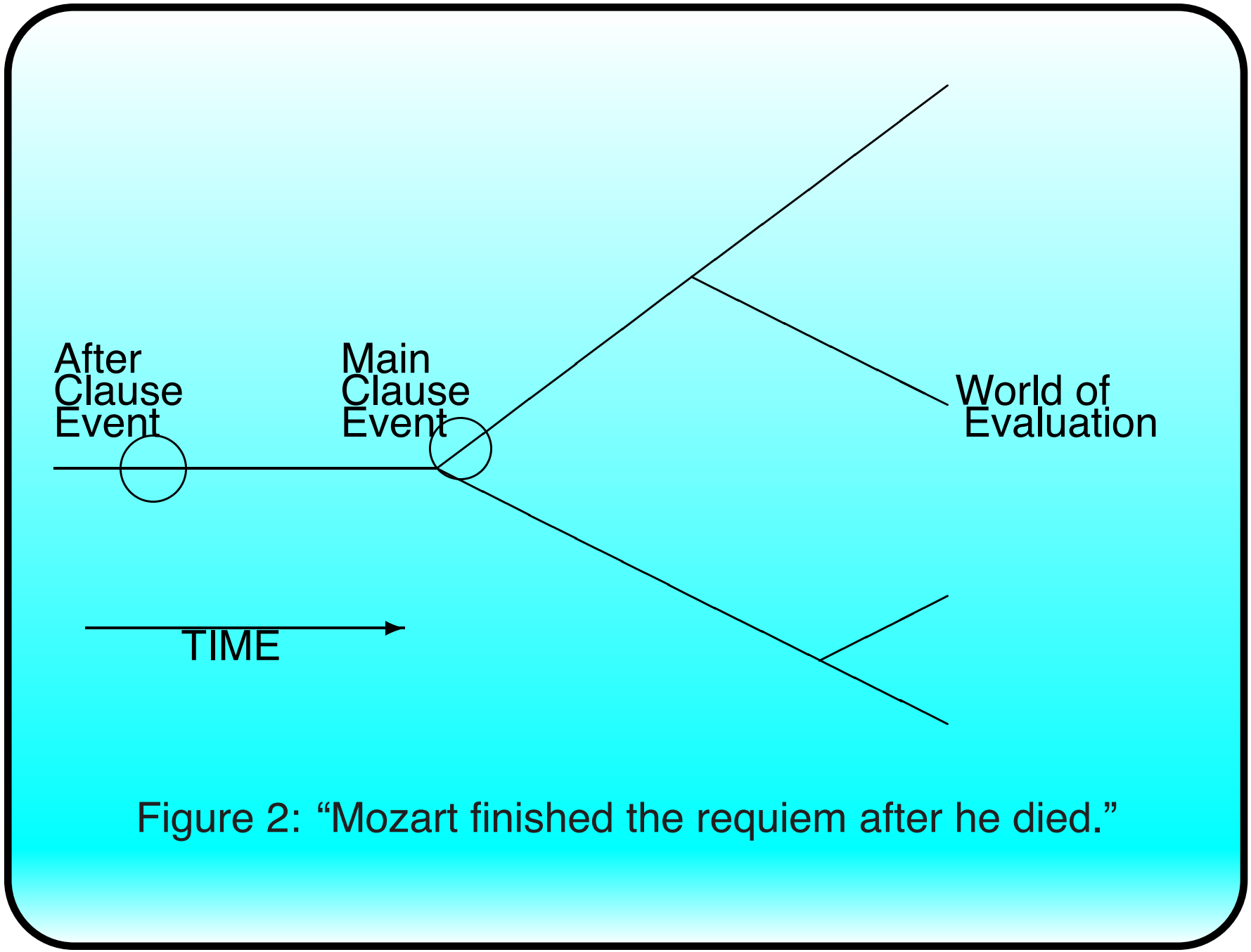

Figure 2: “Mozart finished the requiem after he died.”

Basic idea cont.

- If the temporal clause is not instantiated in the world of evaluation, *earliest* is relativized to an expanded domain of worlds.
  - If *earliest* is not defined relative to expanded domain, we get semantic undefinedness (no truth value).
  - If *earliest* is defined, truth conditional content reflects domain expansion.

Intensionalizing the system

- Untensed sentential clauses denote sets of world-time pairs
- B is instantiated in w, $\mathit{Inst}_w(B')$, if for some t, $B'.\langle w,t\rangle$
- Taking $\mathit{earliest}_w$ to be defined (i.e. assuming $\mathit{Inst}_w(B')$):
  - 'A before B' is true relative to w iff
    $\exists t\ A'.\langle w,t\rangle \wedge t < \mathit{earliest}_w.B'$
  - 'A after B' is true relative to w iff
    $\exists t\ A'.\langle w,t\rangle \wedge t > \mathit{earliest}_w.B'$
- $\mathit{earliest}_w.X = \mathit{earliest}.\lambda t\ X.\langle w,t\rangle$

Allowing for Non-veridicality

- Allow *earliest* to be defined relative to alternative worlds to the world of evaluation (which could be just the world of evaluation)
- Taking $\mathit{earliest}_{\mathit{alt}(w,t)}$ to be defined (i.e. assuming $\exists w' \in \mathit{alt}(w,t)\, \mathit{Inst}_{w'}(B')$):
  - 'A before B' is true relative to w iff $(\exists t : \langle w,t\rangle \in A')\ t < \mathit{earliest}_{\mathit{alt}(w,t)}.B'$
  - 'A after B' is true relative to w iff $(\exists t : \langle w,t\rangle \in A')\ t > \mathit{earliest}_{\mathit{alt}(w,t)}.B'$
- $\mathit{earliest}_W.X = \mathit{earliest}.\lambda t.(\exists w \in W)\ X.\langle w,t\rangle$

Conditions on *alt*

- If $\mathit{Inst}_w(B)$, $\mathit{alt}(w,t) = \{w\}$
- Otherwise,
  - $\mathit{alt}(w,t)$ consists of worlds indistinguishable from w for as long in their history as possible and still allowing for t to be a non-*A* time (initial branch point condition)
  - that are, moreover, reasonably probable given the course of events up to t (normality condition)

Asymmetry between *before* and *after*

- A and B have to be on the same branch in the case of *after* (initial branch point condition crucial)
- A and B can be on different branches in the case of *before*
- Trivial modality of *after* connected to the impossibility of plain backtracking counterfactuals (Lewis (1979), Frank (1997))

Contextual update and entailments

- In updating a context with a sentence, the truth conditions are checked pointwise for each world in the context
  - worlds in which the sentence is true are retained
  - worlds in which it is false or has no truth value are discarded
- The semantic definedness condition of *earliest* is not a pragmatic presupposition of the connectives
  - *Before/After* clauses can be informative and not necessarily pragmatically presupposed
- Characterize veridical and non-veridical readings in terms of entailments of particular types of contexts when updated with a *before/after* sentence

(Non-)Veridical readings and contextual entailments

- Any context consistently updated with 'A after B' will entail that B is instantiated
- Consistently updating a context c with 'A before B' will result in a context c' which has one of these three kinds of mutually exclusive properties:

  Veridical $(\forall w \in c')\ \mathit{Inst}_w(B')$

  Counterfactual $(\forall w \in c')\ \neg \mathit{Inst}_w(B')$

  Non-committal

  $$((\exists w \in c')\ \mathit{Inst}_w(B')) \wedge ((\exists w \in c')\ \neg \mathit{Inst}_w(B'))$$

- The role of pragmatic presuppositions: what c' entails regarding B's instantiation depends on the information in the input context c

(Non-)Veridical readings and contextual entailments cont.

- c' will also always satisfy (41) (trivially in the case of the veridical reading)

(41) $$(\forall w \in c')\ \neg \mathit{Inst}_w(B') \rightarrow (\exists t : A'.\langle w,t\rangle)(\exists w' \in \mathit{alt}(w,t))\ \mathit{Inst}_{w'}(B')$$

- Whenever c' entails that B is uninstantiated (counterfactual reading), (41) amounts to the counterfactual implication.
- Whenever c' is compatible with both B being instantiated or uninstantiated (non-committal reading), this is because the reasonably probably alternatives are also epistemic alternatives of what the actual course of events may have been.

Counterfactual reading and pragmatic presuppositions

- For the counterfactual reading to arise, the input context has to entail that
  - A's occurrence makes B's later occurrence impossible
  - prior to A's occurrence there was a process that made B's occurrence at least reasonably probable
- depending on any additional information the input context contains, a *before* sentence can be informative in different ways

Non-Committal reading and pragmatic presuppositions

- The non-committal reading will arise
  - if A and B are independent
  - and in the presence of a pragmatic presupposition that at some point B's occurrence was likely
  - such a pragmatic presupposition will guarantee that worlds in the input context in which B is uninstantiated will remain in the updated context (since B is instantiated in some of their reasonably probable alternatives)

Veridical reading as the default

- The veridical reading will arise when the input context is simply consistent with A being instantiated before the earliest time at which B is

(Non-)Veridical readings vs. odd cases

- Ketchup-type examples are odd because they cannot lead to a consistent update in any context with common sense assumptions about what is reasonably probable.

Conclusions

- The asymmetry in veridicality between *before* and *after* is now derived rather than stipulated
- Veridical and non-veridical readings of *before* have been precisely characterized in terms of contextual entailments
- By distinguishing semantic from pragmatic presuppositions, the proposal allows for temporal clauses to contribute new information
- The obligatory veridicality of *after* can be connected to the absence of backtracking counterfactuals and the counterfactual reading of *before* can be connected to the semantics of the progressive

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