

Workshop *Correlating possibilities* (satellite workshop of OASIS 2)

University of Nantes, October 14-15 2019

Partiality, situations and branching time

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Overview

1. I want to talk about a notion of **partiality** and show its relevance to a number of phenomena from the domain of **modality**.
2. A Kratzerian view on **situations** as **parts of possible worlds**.
3. An Austinian view on situations as the stuff we talk about (**topic situations**). Time is an abstraction and need not be assumed as a separate ontological category.
4. A view of situations as **branching to the future**.

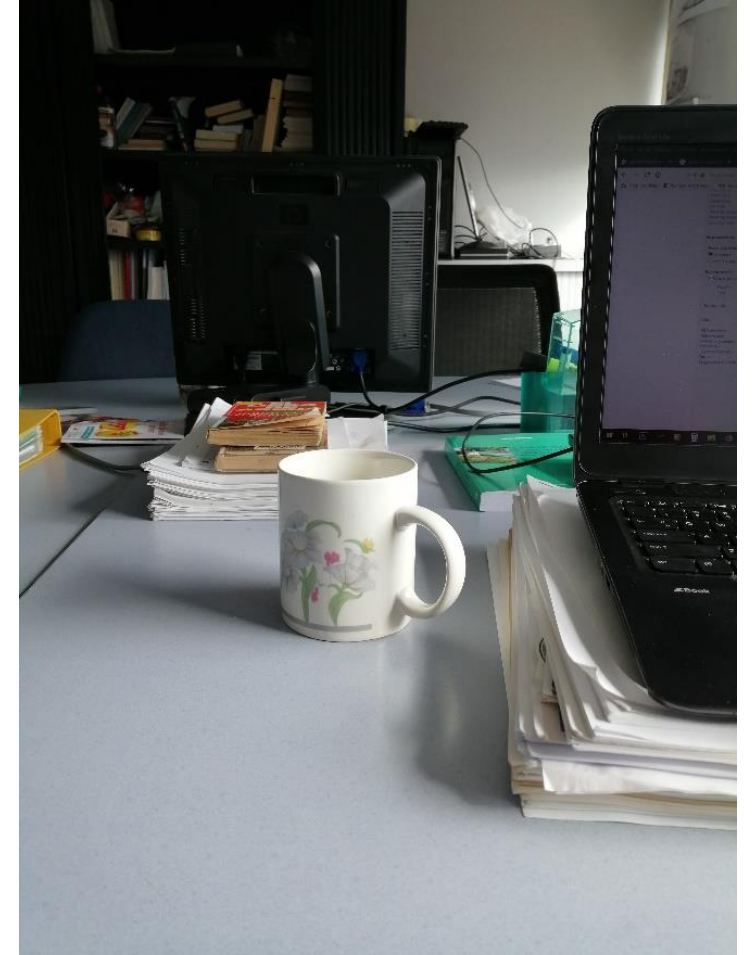
1. Tarski, States of Affairs, Possible Worlds

(α) The mug is on the desk.
[Uttered in actual context c_1 .]

□ **Tarski (in context):**

(T) Sentence (α) (as uttered in c_1) is true
if and only if
**the mug (referred to by the speaker of c_1) is
on the desk (referred to by the speaker of c_1).**

The condition in boldface in (T) stands in for a particular (possible) *state of affairs*—call it ‘MoD’.



Picture 1. The state of affairs M(ug)o(n)D(esk).

(α) The mug is on the desk.

□ **Standard Truth Conditions in formal semantics:**

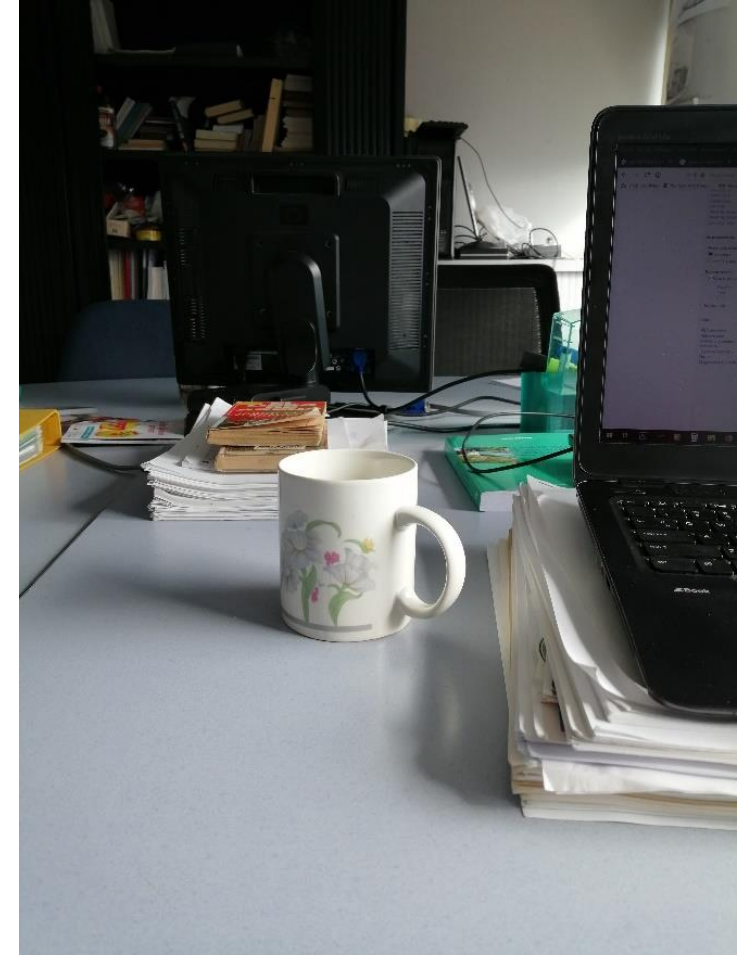
(TC) $[[(\alpha)]]^c, g, @ = 1$ iff $@ \in [[(\alpha)]]^c, g$.
iff $@ \in \{w: [[\text{the mug}]]^c, g, w \text{ is on } [[\text{the desk}]]^c, g, w \text{ in } w\}$.

- How does the Tarski story fit with (TC)?
 - (TC) makes explicit reference to an *evaluation index* @ (a possible world), thus relativizing truth to such an index.
 - I prefer however to understand (TC) as introducing *a world as subject of a predication*: the subject @ is a world w such that the mug is on the desk in w.

- In formal semantics, states of affairs like MoD are modelled as *a possible world being member of a set of possible worlds / having a certain property (of possible worlds)*;
- MoD is modelled as the world @ being member of the set of those possible worlds in which the mug in question is on the desk in question—call this set ' X_{MoD} '.

□ Tarski (Possible Worlds jargon):

(T_{PW}) Sentence (α) (as uttered in c_1) is true *iff* the actual world is a member of X_{MoD} .



Picture 1. The state of affairs MoD.

- **A problem.** This approach does not distinguish between (α) and (β) - (γ) :

(α) (At this moment) The mug is on the desk.

(β) (#At this moment) The mug is made of ceramics.

(γ) (#At this moment) Water is H_2O .

- (α) concerns a “temporally small” situation;
- (β) and (γ) cannot possibly concern a small situation: (β) concerns a situation (containing the mug and the property of being made of ceramics) co-extensive with the mug’s life span, and (γ) concerns the maximal actual situation, i.e. the actual world @. (Maybe not the whole actual world but only a temporally maximal situation that includes all the water there is and nothing else. I will put this issue aside.)

- Only generics such as (γ) involve properties of whole worlds (and so, only generics make the classical formal semantics representation of truth conditions fully appropriate).
- **A historical note.** Lewis (1979) made a close point in his article on *De Se* attitudes: attitudes such as belief, traditionally conceived as *propositional* (i.e., their objects would be classical *propositions*—sets of possible worlds), sometimes take *properties* as their objects, where properties need not be homogeneously true (or false) throughout a whole world and are rather instantiated “locally”.
- Here we think of Lewis’ properties as nothing more and nothing less than propositions in the generalized sense of properties of possible situations.

2. Kratzerian Situations, Austinian Topic Situations, Fully Specific Propositions

- Kratzerian **situations** are **partial worlds** (i.e., parts of possible worlds).

(α) The mug is on the desk.

- **M(inimal)-truth (Kratzer 2019)**

The proposition (of the c_1 -utterance of) (α) is M(inimally)-true in a situation s_1 that *only* contains:

- i. the mug,
 - ii. the desk,
 - iii. information regarding the spatial relation between the desk and the mug.
- We will also say that s_1 is the “*minimal* situation” in which (α) is true and that s_1 is the situation that (α) **concerns**.

- Kratzer (1989) assumes a principle of Persistence:

Persistence

If (α) is true in a situation s and s is a part of a situation s' ($s \subseteq s'$), then (α) is true in s' .

- Kratzer abstracts away from time: in her statement of Persistence, $s \subseteq s'$ means that s' is an extension of s *that is synchronous with* s .
- By Persistence, since (α) (as uttered in c_1) is true in the (actual) situation s_1 depicted in Picture 1, it is also true in the maximal situation $@$ that is our world (since $s_1 \subseteq @$).

Given what we said about the difference between (α) (*The mug is on the desk*) and (γ) (*Water is H_2O*), what would it mean that (α) (as uttered in c_1) is true in @?

Aren't we falling back onto the problem raised by the classical possible worlds picture of propositions?

- **Persistence (time added).** If (α) is true in a situation s and s is a part of a situation s' that extends s in time/space, then (α) is true in s' .
 - **M-truth** corresponds to the concept of a **proposition concerning a situation** and does not satisfy Persistence.
(Except possibly for generics: if generics are M-true in worlds, then M-truth of generics satisfies Persistence in a trivial way.)
 - The notion of truth that does satisfy Persistence (call it **P-truth**) corresponds to a concept of ***a-temporal / a-locational truth***: since the proposition of (α) 's utterance in c_1 is M-true somewhere (i.e., in s_1), it is P-true in every situation that has s_1 as a part (in particular, it is P-true in the possible world @).
- “P-true in a situation s ” means “M-true somewhere within s ”.

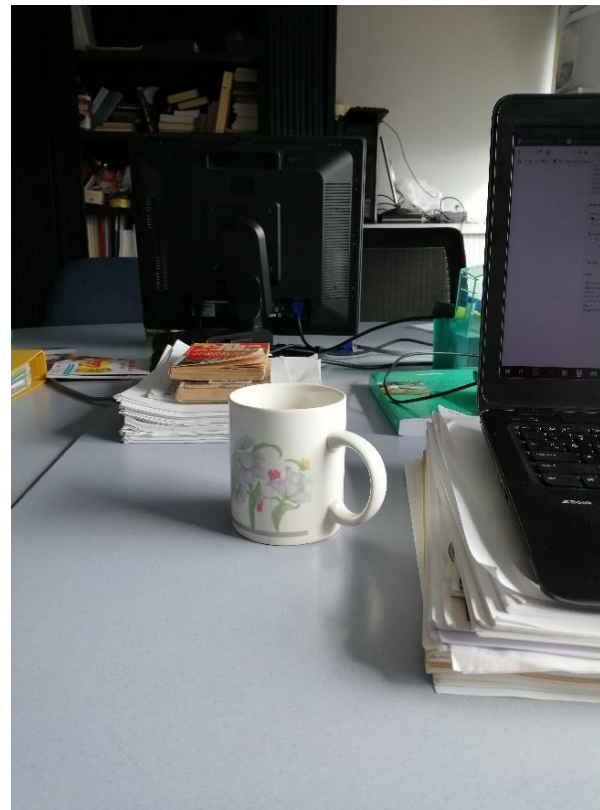
- Persistence only works *upward* (not downward!) on the part-of structure. So, from the fact that (α) (as uttered in c_1) is P-true in our world $@$, it does not follow that it is P-true in the situation $s_2 \leq @$ depicted in Picture 2.
- Notice that in s_2 (α) (as uttered in a context $c_2 \neq c_1$) is true. But in this case we have a different proposition!
 - In c_1 (α) was addressed to my office-mate to instruct her on the whereabouts of the mug I had borrowed from her.
 - In c_2 (α) was addressed to my daughter to let her know where in our apartment I saw her favourite mug.



Picture 2. MoD2

Different mugs,
different desks,
different moments in
the temporal flow ...

Different situations!



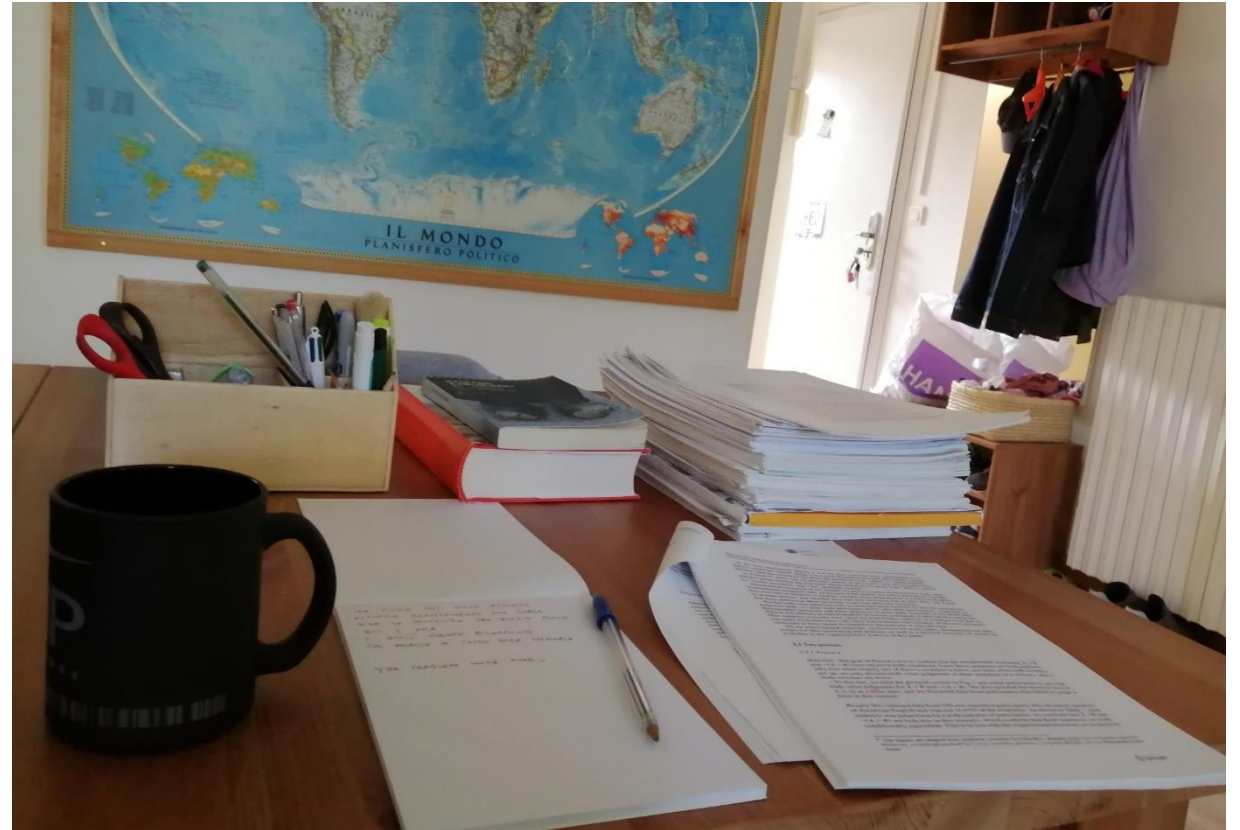
Picture 1. “The mug is on the desk” in c_1 .

Picture 2. “The mug is on the desk” in c_2 .



- I am in a context c_3 , one year after c_2 . I tell my daughter “*the mug is on the desk*”, referring to the same mug and to the same desk as in c_2 .
- Is the proposition expressed by my c_3 -utterance true in the old situation s_2 ?
- This time the identity of the mug and the desk does not pose a problem—the mug and the desk I am referring to in c_3 are the same mug and the same desk contained in s_2 .
- However, while s_2 was in 2018, the minimal situation s_3 in which (α) (as uttered in c_3) is true is a situation in 2019.

- Minimal situation s_3 in 2019 verifying the proposition of my c_3 -utterance of (α)
- Situations are particulars:
a situation in which the mug is on the desk one year ago is not the same as a situation in which the mug is on the desk today.



Picture 3. “The mug is on the desk” in c_3 .

- **A triviality.** In the new context c_3 , to say something true of the old situation s_2 I should use a different sentence:

(α') The mug is on the desk and **it was on the desk *that time too***.

The boldfaced part of (α') (as uttered in c_3) expresses the same proposition as (α) (as was uttered in c_2).

(The parts “that time” and “too” do not contribute anything to this proposition and their only role is to contribute to discourse coherence.)

- **A question/objection.** Why are you going so *particular*? **Propositions** (like concepts) are ***general***: they typically apply to different situations. Your situations s_2 , s_3 are *both* correctly described by the proposition *that the mug is on the desk*.
- **Reply.** Propositions are M-true in situations and those situations in which they are M-true are what they concern—those situations are *constituents* of the propositions, if you like.
(To say that (α) as-uttered-in- c_2 and (α) as-uttered-in- c_3 express the same proposition would be like saying that *John is tall* and *Bill is tall* express the same proposition because they involve the ascription of the same property to an individual.)
- (α) as-uttered-in- c_2 and (α) as-uttered-in- c_3 concern different situations and so they are different propositions.

- **In conclusion:** the propositions are different since they encompass different (though resembling) situations:

s_2 is such that the mug is on the desk = p

s_3 is such that the mug is on the desk = p'

- I give an example of propositional identity from Amaral & Del Prete (2016) study on Portuguese *afinal* and Italian *alla fine* ('in the end') as markers of "**truth unperistence**":

(A) [Uttered on Friday:] *I will go to the theatre on Sunday.*

(B) [Uttered on the following Monday:] *In the end I did not go to the theatre.*

- Operators like "in the end" mark the **unperistence of the truth** of a backgrounded proposition:

"This notion [*of truth unperistence*] captures a basic fact concerning felicitous and truthful utterances of [sentences as in (B)]: they require that the truth of a proposition p^* fail to persist through a temporal succession of epistemic states, where p^* is incompatible with the proposition modified by [*in the end*] (hereafter, the "prejacent")."
[Amaral & Del Prete (2016)]

(A) [Uttered on Friday] *I will go to the theatre on Sunday.*

(B) [Uttered on the following Monday] *In the end I did not go to the theatre.*

- For the utterance in (B) to make sense, the prejacent of “in the end” must be factually incompatible with the same proposition that was previously entertained—the proposition of the utterance in (A).
- In spite of (A) being future tensed and (B) past tensed, the proposition in (A) and the proposition with which the prejacent of “in the end” in (B) is factually incompatible are *the same proposition*.

(F) $[[\text{will}(p)]]^c, g, s = 1$ iff $(c < s)$ and p is M-true in s
iff $(c < s)$ and $s \in [[p]]^c, g$

(P) $[[\text{past}(p)]]^c, g, s = 1$ iff $(s < c)$ and p is M-true in s
iff $(s < c)$ and $s \in [[p]]^c, g$

- The underlined conditions in (F) and (P) (i.e., the temporal relations between topic situation and utterance situation marked by the tense) do not contribute to the pure **propositions** expressed by an utterance of “will(p)” / “past(p)”.
- As far as their propositional content is concerned, “will(p)” and “past(p)” do not differ from one another (provided that they concern the same situation).
- “will(p)” and “past(p)” only differ in their **use-conditions** (the place of the speaker with respect to the topic situation has changed in passing from one context to the other).

(NOTE. If you are not happy with this “flat” analysis of past vs. future, I’ll be back to the future later on.)

- **Question.** What sort of semantic object is the one obtained via abstraction over the situation?

$\lambda s. s$ is such that the mug is on the desk

- It is the sort of compositional object we need to compute the meaning of sentences like (δ) and (ε) :

(δ) The mug is **always** on the desk

(you always forget to put it back in the kitchen!)

(ε) The mug **must** be on the desk

(1. I saw it there this morning. / 2. The house rules dictate so.)

3. Open Propositions, Intra-World vs. Cross-World

Relations Between Situations

- We must distinguish between:
 - i. propositions as the semantic objects that get transmitted in communication and are built and identified in concrete utterances,
 - ii. “proposition-like” entities (*propositional functions*, if you like) that are needed for compositional semantics purposes (see Rabern 2012).

(δ) The mug is always on the desk

(you always forget to put it back in the kitchen!)

- The intuition about (δ): it concerns a temporally large situation s_{big} .
- “Always” quantifies over situations (from a context set C) that are parts of the situation s_{big} :

$$[[\text{Always}_C]]^c, g, s_{\text{big}} = \lambda p_{\langle s, t \rangle}. \forall s' \in C (s' \subseteq s_{\text{big}} \rightarrow p(s') = 1)$$

$$[[\wedge [\text{the mug is on the desk}]]]^c, g, s_{\text{big}} = \lambda s_s. (s \text{ is such that mug is on desk})$$

$$[[[\text{Always}_C \wedge [\text{the mug is on the desk}]]]]^c, g, s_{\text{big}} = 1 \text{ iff } \forall s' \in C (s' \subseteq s_{\text{big}} \rightarrow s' \text{ is such that mug is on desk})$$

(ε) The mug must be on the desk

(Context 1. I saw it there this morning. / Context 2. The house rules dictate so.)

- The intuition about (ε): in Context 1 it concerns a small situation but in Context 2 it concerns a large situation.
- “Must” quantifies over situations that are related to the concerned (topic) situation via some intra- or cross-world relation f :

$$[[\text{must}]]^{c, g, s} = \lambda p_{\langle s, t \rangle}. \forall s' (s' \in f(s) \rightarrow p(s') = 1)$$

$$[[\wedge [\text{the mug is on the desk}]]]^{c, g, s} = \lambda s_s. (s \text{ is such that the mug is on the desk})$$

$$[[[\text{Must} \wedge [\text{the mug is on the desk}]]]]^{c, g, s} = 1 \text{ iff } \forall s' (s' \in f(s) \rightarrow s' \text{ is such that the mug is on the desk})$$

(ε_1) The mug must be on the desk. (I saw it there this morning.)

The situation concerned is a small evidential situation s_0 containing the speaker and relevant information accessible to her from which she infers that the mug is on the desk.

In (ε_1)'s truth condition:

$\forall s' (s' \in f(s_0) \rightarrow s' \text{ is such that the mug is on the desk})$

$f(s_0)$ is a set of situations that, in light of the evidence in s_0 , might be the actual situation; **f is not a cross-world relation because the situations in $f(s_0)$ are candidates for an actual situation in @.** (See Santorio 2012.)

(ε_2) The mug must be on the desk. (The house rules dictate so.)

The situation concerned is a large normative situation s_0 consisting of certain rules that provide that the mug be on the desk.

In (ε_2) 's truth condition:

$\forall s' (s' \in f(s_0) \rightarrow s' \text{ is such that the mug is on the desk})$

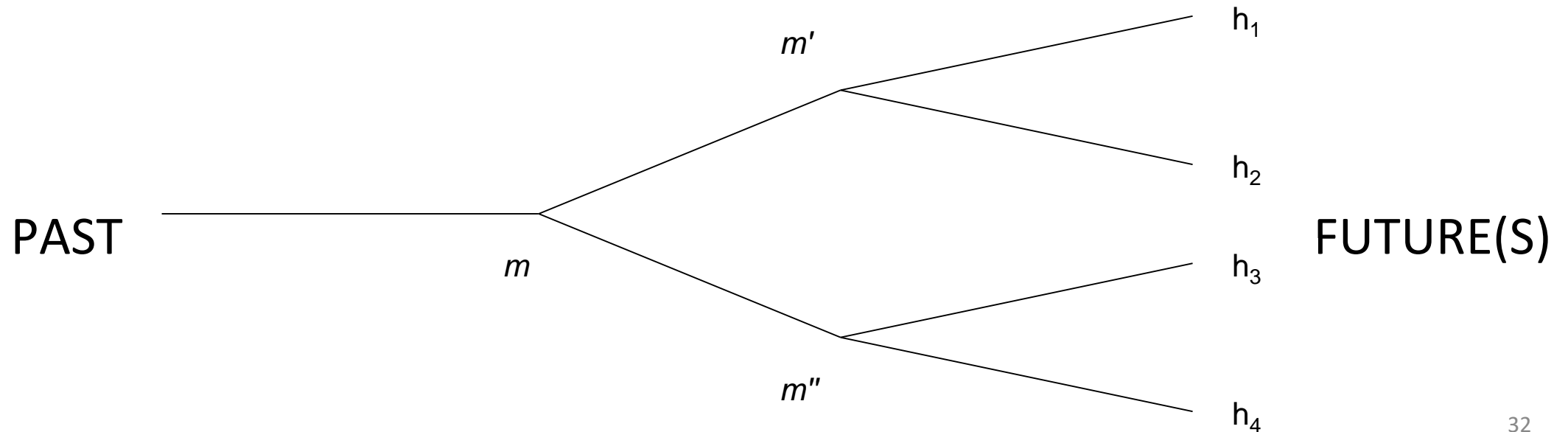
$f(s_0)$ is a set of situations that comply with the relevant rules; **f is a cross-world relation because the situations in $f(s_0)$ are (also) situations from non-actual worlds** (cf. “The mug must be on the desk, but you never put it back there!”).

4. SITUATIONS IN BRANCHING TIME

Branching Time (BT): many futures, one past (Prior 1967, Thomason 1984, Belnap et al. 2001)

- Our world, considered at any moment m , has a unique fixed past and present (the past and the present at m) and many open futures (the possible futures at m).

A suitable representation of our world, as it is at a moment m , depicts it as the cluster of all histories passing through m .

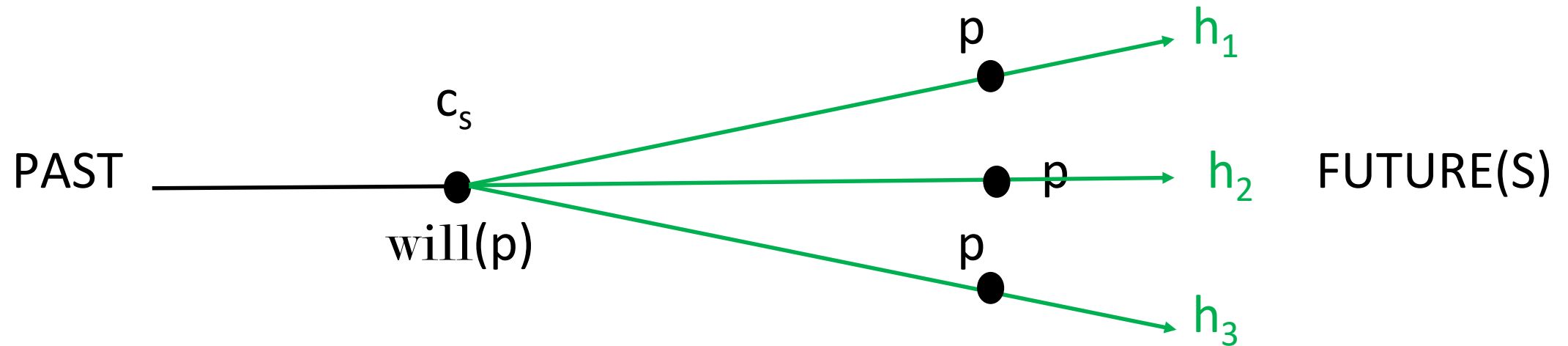


Branching Situations (Partial BT)

- A variant of Branching Time based on situations (called *Partial Branching Time* in Del Prete 2012): every situation comes with a unique past history but may evolve into a number of alternative situations.
- For any situations s_1, s_2 , the formula ' $s_1 \varepsilon_s s_2$ ' means that s_1 *did* occur from the perspective of s_2 , while s_2 *might* occur from the perspective of s_1 (Belnap 1992), the occurrence of s_2 being expected given some relevant facts in s_1 and its past.
- Histories are maximal chains of causally connected situations.
- A **world** is always a **world at a particular situation**: the world at s , $\text{world}(s)$, is **the set of all histories passing through s** .

Future tense in PBT: “Peircean” approach (Prior 1967)

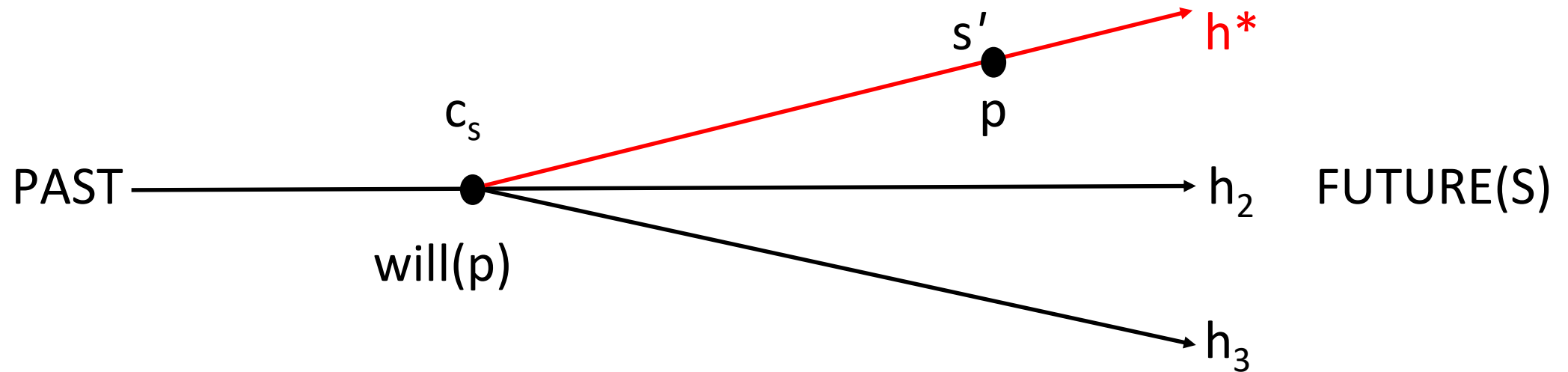
- $[[\text{will}(p)]]^c, g, c_s = 1$ iff $\forall h (c_s \in h \rightarrow \exists s' \in h (s' > c_s \ \& \ [[p]]^c, g, s' = 1))$



- On this approach, future tensed sentences are essentially **necessity modal sentences** $\Box p$ (Condoravdi 2003): they make a claim about the present and require to check the truth of their open prejacent p relative to a number of alternative world-histories accessible from the present situation.

Future tense in PBT: “Ockhamist” approach (Prior 1967)

- $[[\text{will}(p)]]$ ^{c, g, c_s} = 1 iff $\exists s' \in \text{TRL}(c_s)$ ($s' > c_s$ & $[[p]]$ ^{c, g, s'} = 1))
 ($[[\text{will}(p)]]$ ^{c, g} is true in c_s if and only if p is true at an s' following c_s **on the history h^* that will be actual after c_s** – the **Thin Red Line** of c_s)



- Although there are many possible futures, only one will be actual. A future tensed statement concerns **this only future**.

- The Peircean approach makes justice to the modal uses of the future (Condoravdi 2003), but it faces some problems with negation and indefinites:

(in the following I will make use of parameterized choice functions ε to analyse indefinites; a choice-function term “ $\varepsilon(N, w)$ ” picks out an individual that is N in w)

Modals/Future and indefinites (Stalnaker's asymmetry)

(ϕ) President Carter has to appoint a woman to the Supreme Court, but he doesn't have to appoint any particular woman; he just has to appoint some woman or other. [from Stalnaker 1981]

(ϕ') $(\forall s_1 \in f(s_0)) (s_1 \text{ is such that Carter appoints } \varepsilon(\text{woman, world}(s_1)))$
BUT $\neg \exists \varepsilon' (\forall s_1 \in f(s_0)) (s_1 \text{ is such that Carter appoints } \varepsilon'(\text{woman, world}(s_0)))$

(γ) President Carter will appoint a woman to the Supreme Court, #but he won't appoint any particular woman; he just will appoint some woman or other. [from Stalnaker 1981]

(γ') $(\forall h_1 s_0 \in h_1) (\exists s_1 > s_0 \ \& \ s_1 \in h_1) (s_1 \text{ is such that Carter appoints } \varepsilon(\text{woman, world}(s_1)))$
BUT $(\forall h_1 s_0 \in h_1) \neg \exists \varepsilon' (\exists s_1 > s_0 \ \& \ s_1 \in h_1) (s_1 \text{ is such that Carter appoints } \varepsilon'(\text{woman, world}(s_0)))$

Modals/Future and negation

- The \forall lexically introduced by *must* can scopally interact with negation, as in (σ -b), (σ -c):

- (σ)
- a. He must not come to the party.
 - b. $(\forall s_1 \in f(s_0)) (s_1 \text{ is such that } \neg(\text{he comes to the party}))$
 - c. $\neg(\forall s_1 \in f(s_0)) (s_1 \text{ is such that he comes to the party})$

- On the other hand, the \forall over histories in the “Peircean” interpretation of *will(p)* cannot scopally interact with negation (see the unavailability of narrow scope in (τ -c)):

- (τ)
- a. He will not come to the party.
 - b. $(\forall h s_0 \in h) \neg(\exists s_1 > s_0 \ \& \ s_1 \in h) (s_1 \text{ is such that he comes to the party})$
 - c. ~~$\neg(\forall h s_0 \in h) (\exists s_1 > s_0 \ \& \ s_1 \in h) (s_1 \text{ is such that he comes to the party})$~~

- Universal quantification underlying the “will” future does not seem to be able to enter scope relations with other scope bearing elements.
- In the past, I took this behaviour as evidence that this quantification is not contributed by any element overtly realized in the sentence and is due to a pragmatic strategy: a supervaluation to overcome the plurality of possible future histories that are relevant to evaluate the utterance (Del Prete 2014).

- “**Modal Forcing**” – not just with future tensed sentences! (Spolaore & Del Prete 2019):
 - (a) Now Yohan Blake will win. [Uttered after Usain Bolt has been disqualified.]
 - (b) Now you committed a crime last year. [Uttered after the new *ex post facto* law.]
 - (c) Now Pluto is not a planet anymore. [Uttered after the relevant conceptual shift has occurred.]
 - (d) Now it was an asteroid and not climate change that killed dinosaurs. [Uttered after the relevant theory-change has occurred.]
- Modal interpretations of *will* as a particular case of Modal Forcing? (Context-situation forces the topic situation.)
- Narrative contexts in the “historical present”:
 - (e) 1941 - Richard Cheney is born in Lincoln, Nebraska, on January 30th. He will grow up in Casper, Wyoming, and earn his bachelor's and master's of arts degrees from the University of Wyoming.
- The purely temporal (“Ockhamist”) *will* appears from examples like (e), where the narrated events are located in the past (in spite of being reported in the present tense) and the narrator has complete information about the relevant sequence of events. (Transposition in the past tense of (e) would show a parallel purely temporal *would*.)

Conclusion

- A partial semantics based on situations and a relation of minimal truth between propositions and situations capturing the intuition that a proposition concerns a situation (its topic situation).
- Propositions in actual communication are completely specific (they are not open propositions that are evaluated relative to times or worlds).
- Open propositions are needed for compositional semantics purposes – we need them in order to compute the meaning of sentences containing modals and other quantificational operators.
- Situation semantics allows a simple take on propositional contents of our utterances (ultimately there might be no semantic difference between the past tense “I went to the theatre on Sunday” and the future tense “I will go to the theatre on Sunday”, when the two utterances refer to the same situation).

[[Thank you!]] here, now



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