The semantics of modality

Day 3: Modals and modal imperfectives

Andrés Pablo Salanova
kaitire@uottawa.ca

I Escuela de Lingüística de Buenos Aires

15-19 February 2016

The semantics of propositional attitude verbs

As we saw yesterday, *believe* demands that its complement be intensionalized. I.e., it demands that it be of type $< s, t >$.
Let's give the denotation a try:

(1) $[\![\text{believe}]\!]^w =$
$\lambda P_{<s,t>}.\lambda x.\forall w'.w'$ is compatible with what x believes in $w \rightarrow P(w')$

The semantics of propositional attitude verbs

As we saw yesterday, *believe* demands that its complement be intensionalized. I.e., it demands that it be of type $< s, t >$.
Let's give the denotation a try:

(2) $[\![\text{believe}]\!]^w =$
$\lambda P_{<s,t>}.\lambda x.\forall w'.w'$ is compatible with what x believes in $w \rightarrow P(w')$

There are a few features of this formula that merit attention:

We have an argument of type P.

An evaluation world remains in the formula.

The formula contains universal quantification.

The semantics of propositional attitude verbs

As we saw yesterday, *believe* demands that its complement be intensionalized. I.e., it demands that it be of type $< s, t >$.
Let's give the denotation a try:

(3) $[\![\text{believe}]\!]^w =$
$\lambda P_{<s,t>}.\lambda x.\forall w'.w'$ is compatible with what x believes in $w \rightarrow P(w')$

There are a few features of this formula that merit attention:

- We have an argument of type P.
- An evaluation world remains in the formula.
- The formula contains universal quantification.

The first is new but only somewhat surprising.

Formalizing this

The second part can be easily justified. What an individual believes is clearly relative to a specific evaluation world:

(4) Sherlock Holmes believes that the butler murdered the victim.

Which we can informally paraphrase as:

(5) That the butler murdered the victim is compatible with what Sherlock Holmes believes in the world of Sherlock Holmes.

Formalizing this

The second part can be easily justified. What an individual believes is clearly relative to a specific evaluation world:

(6) Sherlock Holmes believes that the butler murdered the victim.

Which we can informally paraphrase as:

(7) That the butler murdered the victim is compatible with what Sherlock Holmes believes in the world of Sherlock Holmes.

So a verb like *believe* relates some set of possible worlds to the present evaluation world. This is an essential feature of propositional attitude verbs and also of modals.

Formalizing this

How about the universal quantification?

Formalizing this

How about the universal quantification?
Let's imagine our own belief state. There are many things about the world that we do not know. Perhaps I don't know how many satellites Neptune has, or what the population of Lhasa is. So if I'm put in front of a world where Neptune has two satellites and Lhasa has a population of 1 million, I can say that that world corresponds to my beliefs. But a world where Neptune has three satellites and Lhasa has a population of 500.000 is also compatible with my beliefs.

Formalizing this

How about the universal quantification?
Let's imagine our own belief state. There are many things about the world that we do not know. Perhaps I don't know how many satellites Neptune has, or what the population of Lhasa is. So if I'm put in front of a world where Neptune has two satellites and Lhasa has a population of 1 million, I can say that that world corresponds to my beliefs. But a world where Neptune has three satellites and Lhasa has a population of 500.000 is also compatible with my beliefs.
That's why we speak of *worlds compatible with my belief* rather than *my belief world*. In all worlds compatible with my belief world, Argentina has a population of approximately 45 million. But some of these worlds are worlds where Lhasa has 1 million inhabitants and Neptune two satellites, while others are worlds where Lhasa has 500.000 inhabitants and Neptune three satellites.

Universal and existential force

In fact, the *universal force* in the previous example is part of the semantics of *believe*. We would be right to think that other verbs (or expressions) don't do it. For instance:

(8) John is willing to believe that Neptune has three satellites.

(9) John is agnostic as to whether Neptune has three satellites or not.

What these sentences mean could perhaps be captured by the following:

(10) $\exists w'.w'$ is compatible with John's beliefs in w
and Neptune has three satellites in w'

What our formula says is that there is at least one world (but likely many) in the intersection between John's belief worlds and worlds where Neptune has three satellites.

Modal auxiliaries

The contrast between universal and existential force is easier to see in *modal auxiliaries*.

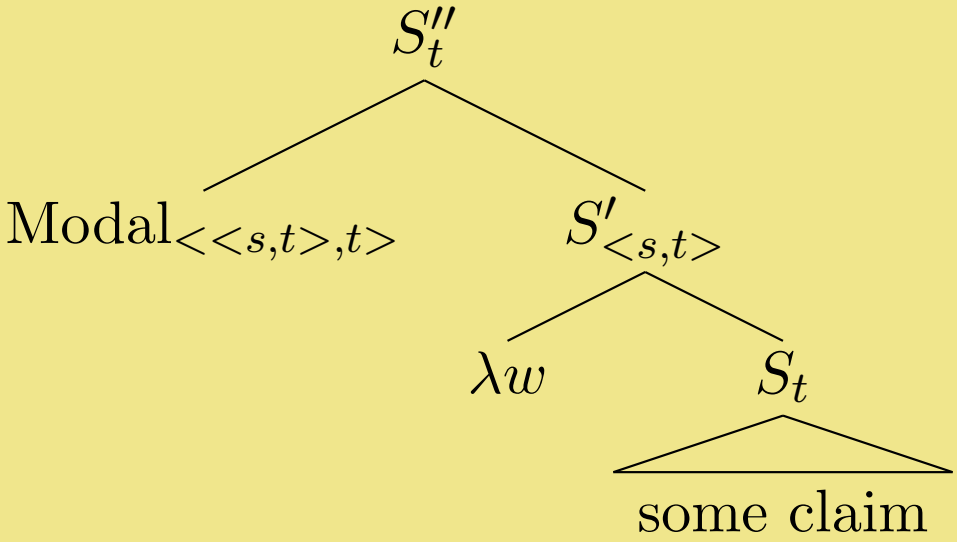
(11) The world could be flat.

(12) The world must be flat.

Modal auxiliaries are like impoverished propositional attitude verbs. They don't have an overt subject, but they still relate the evaluation world to possible worlds.
Some parts of their semantics are easy to guess:

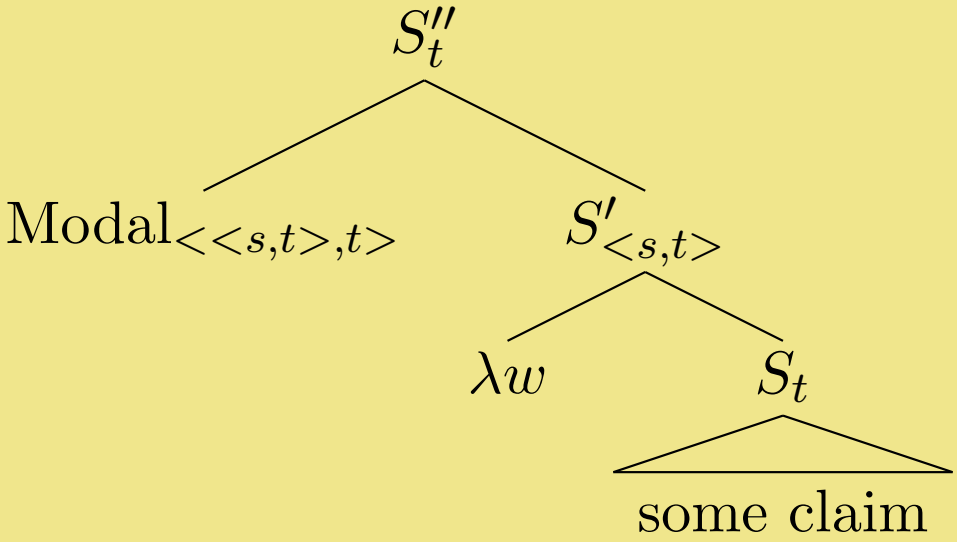
Modal auxiliaries

Their type:



Modal auxiliaries

Their type:



And the fact that some of them have existential force (*could*, *may*), while others have universal force (*should*, *must*).

Modal auxiliaries

But how exactly do they relate non-actual worlds to the evaluation world?
Modal auxiliaries in English are actually quite vague about this. This is why I spoke of various types of modality:

deontic modality: has to do with norms or expectations about the world

epistemic modality: has to do with the speaker's degree of confidence in the truth of a proposition

bouletic modality: has to do with the speaker's desires

etc.

Modal auxiliaries

Take the following:

(13) John could have travelled to Iran.

This sentence can be understood both epistemically and deontically.

(14) Deontically: there are worlds compatible with the rules in w where John travelled to Iran

(15) Epistemically: there are worlds compatible with the speaker's knowledge where John travelled to Iran

(16) Deontic context: Even after the Revolution, John could have travelled to Iran. He has a European passport.

(17) Epistemic context: John isn't in town. He could have travelled to Iran. He has family there.

Modal auxiliaries

It's harder to get the ambiguity with the modals that have universal force, but *should* does allow both readings:

(18) Deontic context: It's past the children's bedtime. They should be asleep now. Please ask them to finish up with dinner and go to bed.

(19) Epistemic context: It's 10pm. The children should be asleep now. They were quite tired.

Modality in a nutshell

To summarize our discussion about classical modality, then, there are a few points to remember:

- Modality establishes a relation between the evaluation world and a set of *accessible* possible worlds.
- Modals can be possibility modals ($\exists w'$) or necessity modals ($\forall w'$).
- The basis for relating the evaluation world to the accessible worlds is located in the *accessibility relation* or *modal base*.
- Modal bases come in various flavors: epistemic, deontic, etc.

What's this business with the ordering source?

If you read von Fintel and Heim's chapter 5, you will see that the modal base is divided into two components: an *accessibility relation* and an *ordering source*.
This is important in general, and in particular to deal with some problems that come up in examining deontic modality, but will make no difference to our particular use of modality to analyse imperfectives, so we'll leave it aside here.

Tense and aspect

We may now begin to ask ourselves how all of this machinery helps us deal with the problems with the imperfective that we introduced on the first day.

Tense and aspect

We may now begin to ask ourselves how all of this machinery helps us deal with the problems with the imperfective that we introduced on the first day.
Let's start with a purely temporal semantics for tense and aspect.
Consider the following sentence in the pluperfect:

(22) John had spoken to Mary.

There is a tradition going back to Prior (for which one of the most complete sources is Klein, 1994. *Time in language*) to deal with such sentences through successive shifts in evaluation time.

Tense and aspect

We may now begin to ask ourselves how all of this machinery helps us deal with the problems with the imperfective that we introduced on the first day.
Let's start with a purely temporal semantics for tense and aspect.
Consider the following sentence in the pluperfect:

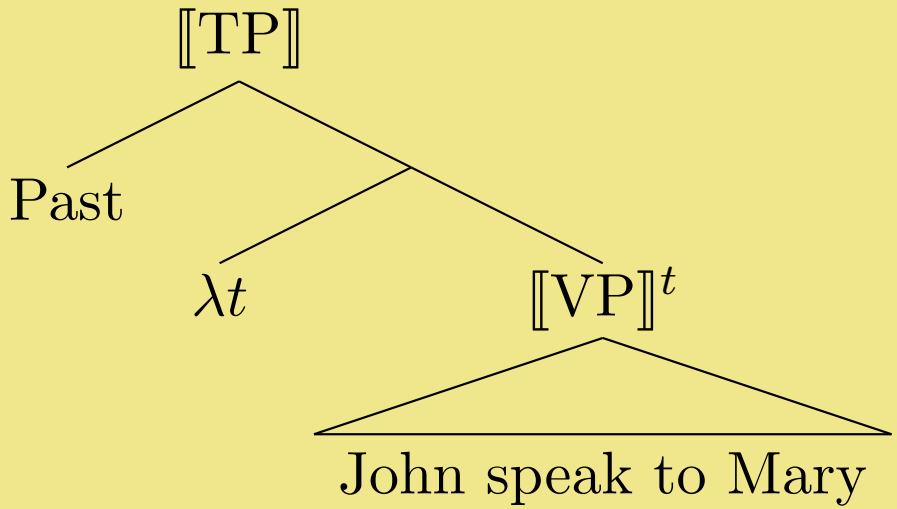
(24) John had spoken to Mary.

There is a tradition going back to Prior (for which one of the most complete sources is Klein, 1994. *Time in language*) to deal with such sentences through successive shifts in evaluation time.
The event itself is evaluated at a certain time, which in this case is clearly not the utterance time:

(25) $[\![\text{John speak to Mary}]\!]^t = \text{John speaks to Mary at } t$

Event and utterance time

Let's say:

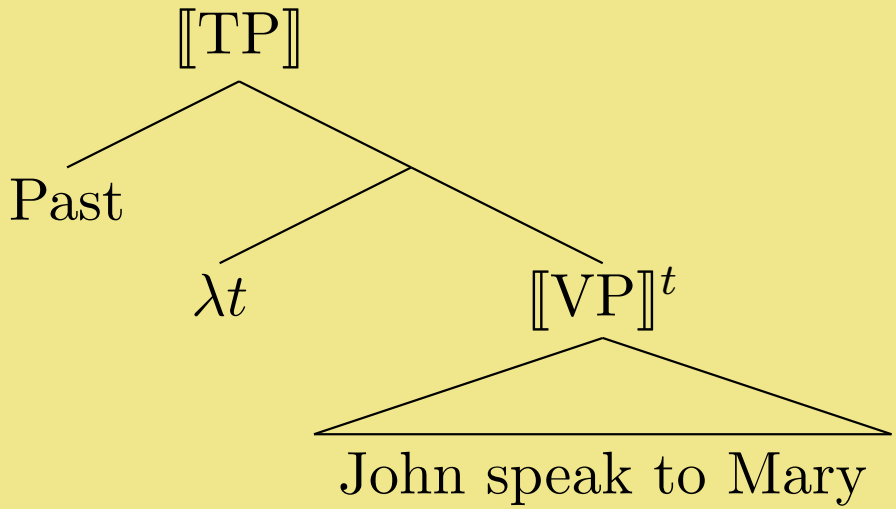


Let's say (somewhat sloppily) that past tense is:

(26) $\llbracket \text{Past} \rrbracket = \lambda P_{<l,t>}.\exists t_1 < t_0 : P(t_1)$

Event and utterance time

Let's say:



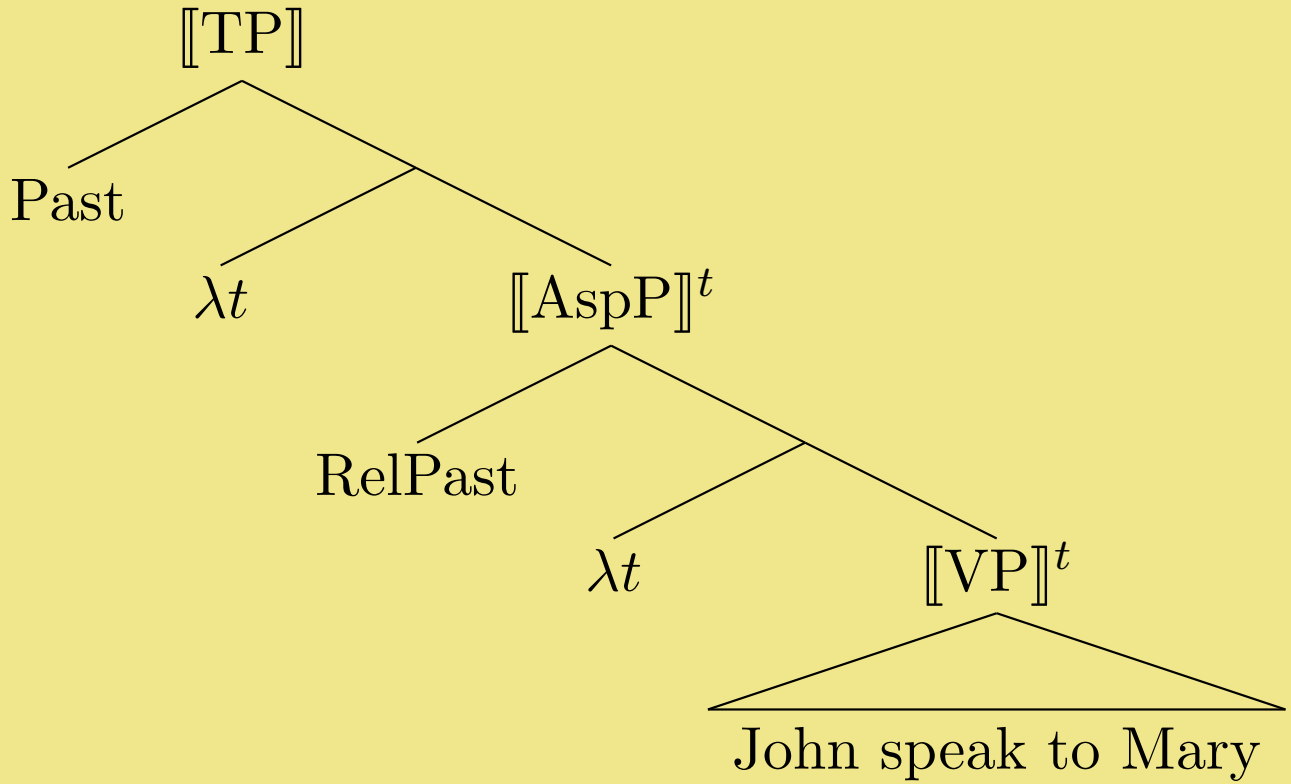
Let's say (somewhat sloppily) that past tense is:

(27) $\llbracket \text{Past} \rrbracket = \lambda P_{<l,t>}.\exists t_1 < t_0 : P(t_1)$

This is clearly not enough: it's more like the semantics of a simple past rather than of a pluperfect. In the pluperfect the event took place *before* some reference time which is itself previous to the utterance time.

Event, reference, and utterance time

So let's revise our tree:



The definition of the relative past is not unlike that of the absolute past, but evaluation can't be with respect to utterance time, but rather with respect to an evaluation time that will itself be intensionalized:

(28) $[\![\text{RelPast}]\!]^t = \lambda P_{<l,t>}.\exists t_2 < t : P(t_2)$

Pluperfect in a temporal calculus

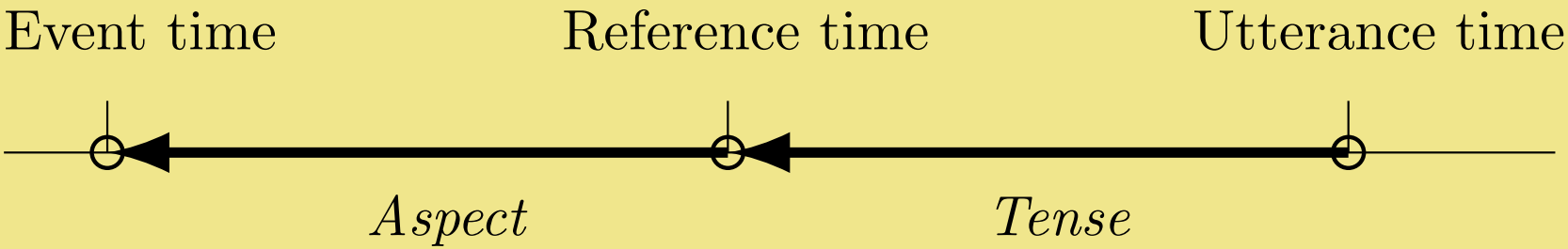
So that:

(29) When I arrived, he had left.

Pluperfect in a temporal calculus

So that:

(30) When I arrived, he had left.



Perfectives and imperfectives in a temporal calculus

This interplay of (absolute) tense and (relative) aspect may be used in the following way to deal with viewpoint aspect:

(31) $[\![\text{PFV}]\!]^t = \lambda P_{<l,t>}.\exists t^* \subseteq t : P(t^*)$

(32) $[\![\text{IMP}]\!]^t = \lambda P_{<l,t>}.\exists t^* \supseteq t : P(t^*)$

Perfectives and imperfectives in a temporal calculus

This interplay of (absolute) tense and (relative) aspect may be used in the following way to deal with viewpoint aspect:

(34) $[\![\text{PFV}]\!]^t = \lambda P_{<l,t>}.\exists t^* \subseteq t : P(t^*)$

(35) $[\![\text{IMP}]\!]^t = \lambda P_{<l,t>}.\exists t^* \supseteq t : P(t^*)$

So that, in an imperfective sentence like the following:

(36) When I entered the room, he was talking to his friend.

Perfectives and imperfectives in a temporal calculus

This interplay of (absolute) tense and (relative) aspect may be used in the following way to deal with viewpoint aspect:

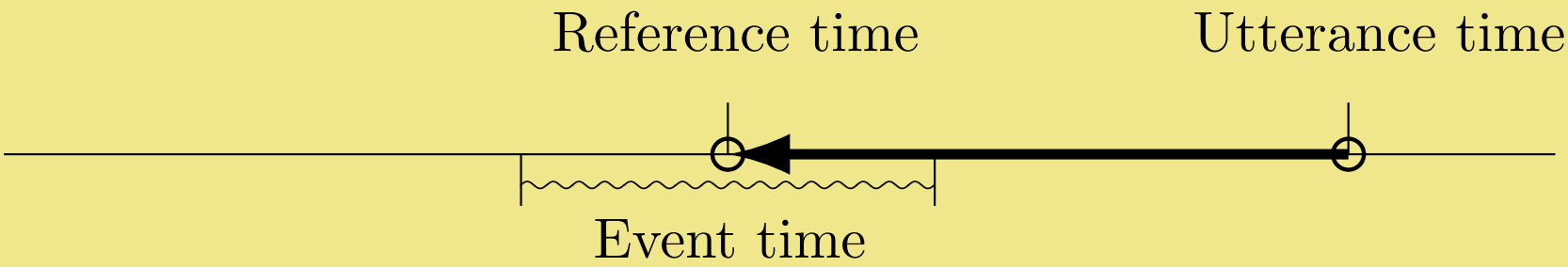
(37) $[\![\text{PFV}]\!]^t = \lambda P_{<l,t>}.\exists t^* \subseteq t : P(t^*)$

(38) $[\![\text{IMP}]\!]^t = \lambda P_{<l,t>}.\exists t^* \supseteq t : P(t^*)$

So that, in an imperfective sentence like the following:

(39) When I entered the room, he was talking to his friend.

We get:



Perfectives in a temporal calculus

In perfective sentence like the following:

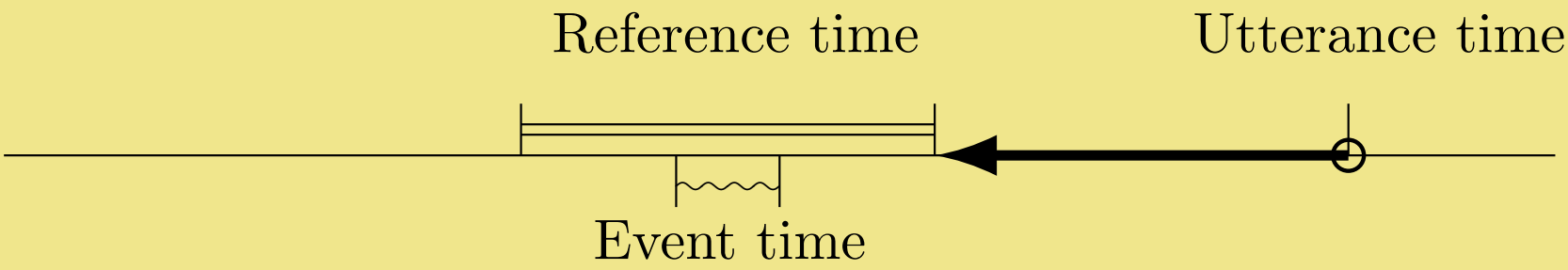
(40) While I was there he called up his friend.

Perfectives in a temporal calculus

In perfective sentence like the following:

(41) While I was there he called up his friend.

We get:



The imperfective paradox

We discussed a couple of problems with this approach.
One was what is normally called the imperfect (or progressive) paradox:

(42) He was dying but he received antimalarial treatment just in time and was saved.

(43) Mary was crossing the street but I called her back before she got to the other side.

(44) John was reading *Pride and Prejudice* but got bored and gave it up before the end.

The imperfective paradox

We discussed a couple of problems with this approach.
One was what is normally called the imperfect (or progressive) paradox:

(45) He was dying but he received antimalarial treatment just in time and was saved.

(46) Mary was crossing the street but I called her back before she got to the other side.

(47) John was reading *Pride and Prejudice* but got bored and gave it up before the end.

With telic eventualities, culmination in the actual world is not assured!

Modal readings of the imperfective

A further problem for a purely temporal tense/aspect calculus are the cross-linguistically common modal readings of imperfectives:

(48) El mes que viene nos íbamos al mar, pero cambiaron los planes.

(49) Juguemos a que yo era ladrón y vos eras policía.

Modal readings of the imperfective

A further problem for a purely temporal tense/aspect calculus are the cross-linguistically common modal readings of imperfectives:

(52) El mes que viene nos íbamos al mar, pero cambiaron los planes.

(53) Juguemos a que yo era ladrón y vos eras policía.

And also the following:

(54) ¡Eras alto!

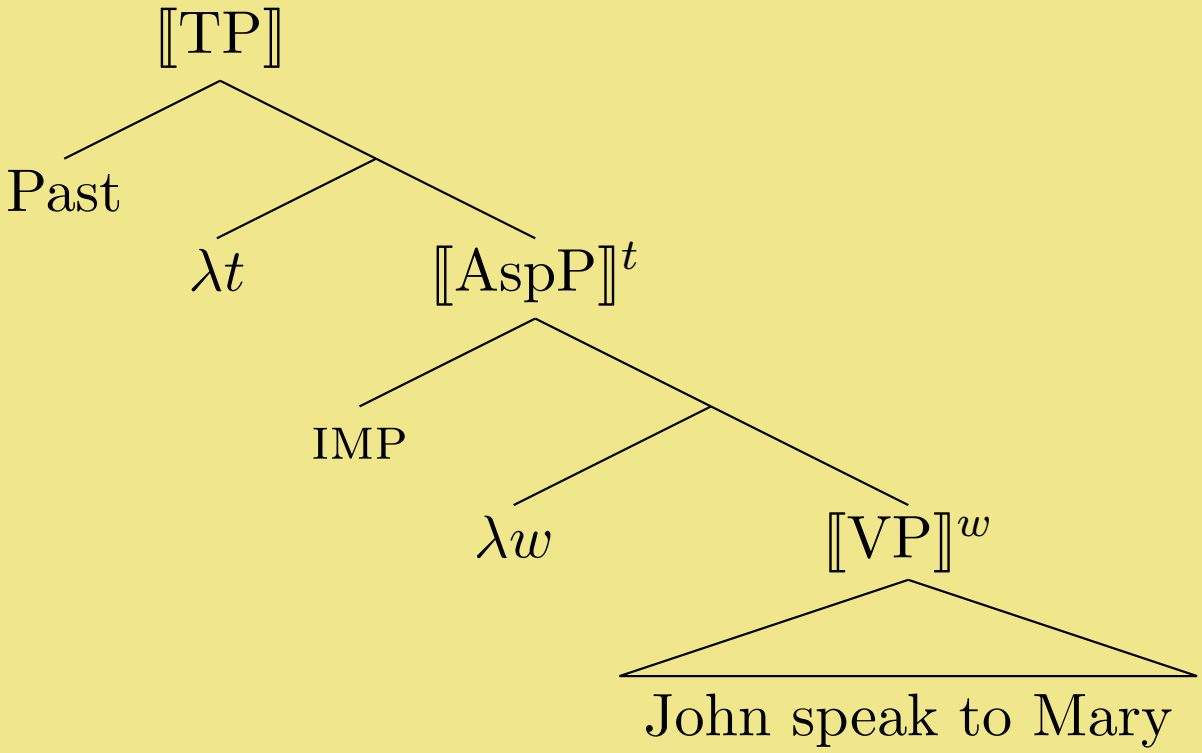
(55) ¿Cómo te llamabas?

Sketch of a solution

The solution that we propose is that one part of the displacement in sentences with imperfectives is modal.

Sketch of a solution

The solution that we propose is that one part of the displacement in sentences with imperfectives is modal.
Roughly:



Worlds versus situations

To deal with modality so far, we've followed von Fintel and Heim in speaking about possible worlds (w).

Worlds versus situations

To deal with modality so far, we've followed von Fintel and Heim in speaking about possible worlds (w).
In fact, we will not compute modal displacement with *worlds*, but with *situations*.

Worlds versus situations

To deal with modality so far, we've followed von Fintel and Heim in speaking about possible worlds (w).
In fact, we will not compute modal displacement with *worlds*, but with *situations*.
Situations are like worlds, but they are time delimited. A world may contain many situations.

Worlds versus situations

To deal with modality so far, we've followed von Fintel and Heim in speaking about possible worlds (w).
In fact, we will not compute modal displacement with *worlds*, but with *situations*.
Situations are like worlds, but they are time delimited. A world may contain many situations.
We won't create a new semantic type for situations, but rather stick to type s.

Worlds versus situations

To deal with modality so far, we've followed von Fintel and Heim in speaking about possible worlds (w).
In fact, we will not compute modal displacement with *worlds*, but with *situations*.
Situations are like worlds, but they are time delimited. A world may contain many situations.
We won't create a new semantic type for situations, but rather stick to type s.
Why do this?

It is possible to relate same-world situations

Some times we might need to relate one situation to another within the same world. The habitual imperfective is one such case:

(56) John wakes up at 5 in the morning.

A couple of recent papers by Ferreira and Deo work out the semantics of this non-modal use of the imperfective in detail. For us, suffice it to say that the situation of John habitually waking up at 5 in the morning contains many situations, *in the same world*, of John actually waking up at 5 in the morning.

It is possible to relate same-world situations

Some times we might need to relate one situation to another within the same world. The habitual imperfective is one such case:

(57) John wakes up at 5 in the morning.

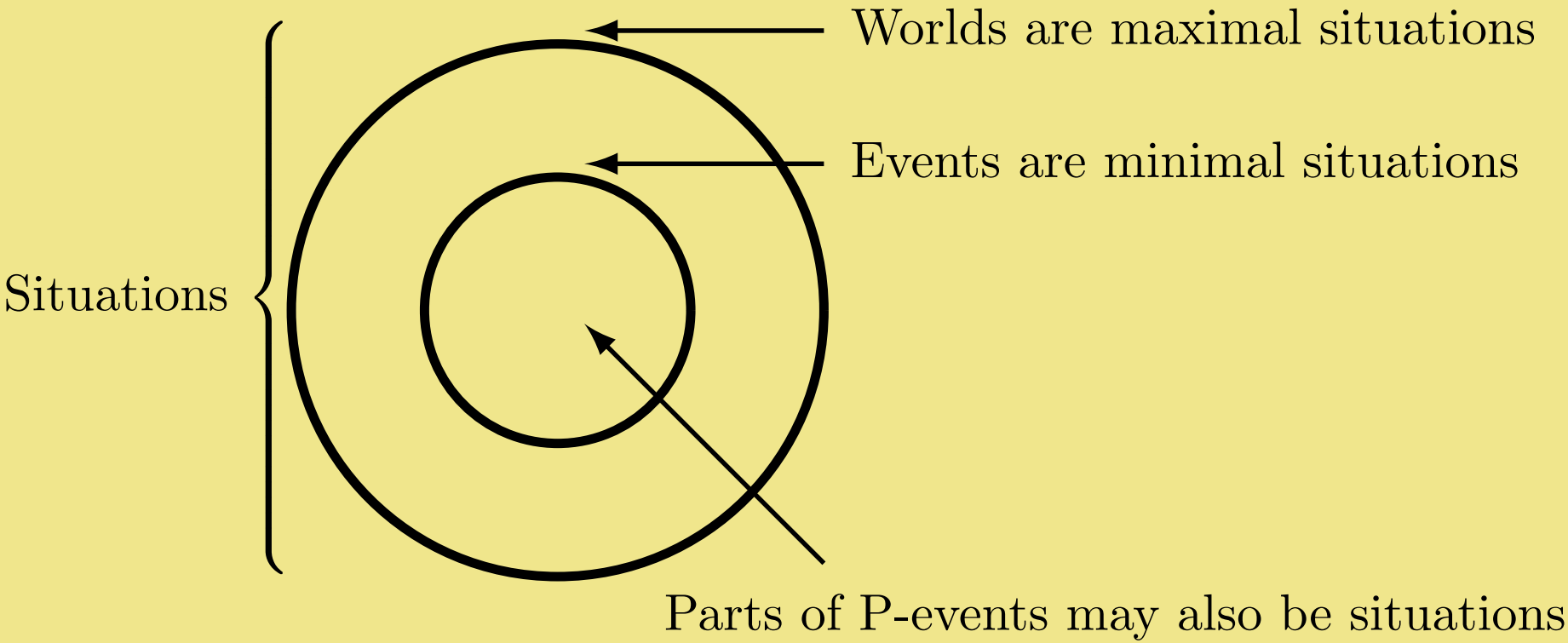
A couple of recent papers by Ferreira and Deo work out the semantics of this non-modal use of the imperfective in detail. For us, suffice it to say that the situation of John habitually waking up at 5 in the morning contains many situations, *in the same world*, of John actually waking up at 5 in the morning.
So situations allow us to express both modal and strictly temporal relations.

Worlds, situations, events

So we now have worlds and situations. You might also be familiar with the notion of events (e) introduced by Donald Davidson. Furthermore, we just spoke about times. How are all these notions related?

Worlds, situations, events

A simple answer:



Worlds, situations and events

The ontology of these notions is marred by technicalities that are not relevant for us in this course. For a very clear discussion, see Kratzer's article in the Stanford Encyclopedia of Philosophy.

Times

Both events and situations have a temporal extent, normally represented with the function τ:

(58) $\tau(s) = T$, where T is the set of time points occupied by a particular situation or event.

T may or may not be a continuous interval.

In the limiting case of worlds this notion is not useful, since their duration is maximal.

Imperfectives with ongoing interpretation

(59) María cruzaba la calle.

(60) Event Inertia

$\text{MB}_{\text{E-inertia}} = \lambda s.\lambda s'.s'$ is an Event-inertia situation for s, where for any two situations s and s', s' is an Event-inertia situation for s iff all the events that have actually started in s continue in s' as they would if there were no interruptions.

The MB in (68) is 'modal' given that an event in s can be said to continue in s' only if s' has as part an event with beginning stages that have counterparts in s.

Imperfectives with prospective interpretation

(61) Nos íbamos de vacaciones a la playa.

(62) Preparatory Inertia

$\text{MB}_{\text{P-inertia}} = \lambda s.\lambda s'.s'$ is a Preparatory-inertia situation for s, where for any two situations s and s', s' is a Preparatory-inertia situation for s iff all the events that are in preparatory stages in s continue in s' as they would if there were no interruptions.

Like in the event inertia case, in MB (69), preparations for an event in s continue in s' only if s' has as part an event with preparations that have counterparts in s.

Recapitulation: meanings of the imperfective

To recapitulate, we saw that the following meanings of imperfective cannot be reduced to an exclusively temporal calculus:

(63) María cruzaba la calle.

(64) Nos íbamos de vacaciones a la playa.

The following is indeed strictly aspectual:

(65) Hace veinte años, los niños veían menos televisión.

But note that it might have a *virtual* reading that makes it modal as well:

(66) Juan contesta la correspondencia procedente de la Antártida.

The semantics of imperfectives

The general framework for imperfective meaning relates two situations by means of a modal base:

(67) $[\![\text{IMP}]\!] = \lambda P_{<l,<s,t>>}.\lambda s.\forall s' : \text{MB}_\alpha(s)(s') = 1, \exists e : P(e)(s') = 1,$
defined only if there is a contextually or linguistically determined salient modal base (MB) of type α.

The semantics of imperfectives

The modal bases for the examples discussed above:

(68) Event Inertia

$\text{MB}_{\text{E-inertia}} = \lambda s.\lambda s'.s'$ is an Event-inertia situation for s,

where for any two situations s and s', s' is an Event-inertia situation for s iff all the events that have actually started in s continue in s' as they would if there were no interruptions.

The semantics of imperfectives

The modal bases (continued):

(69) Preparatory Inertia

$\text{MB}_{\text{P-inertia}} = \lambda s.\lambda s'.s'$ is a Preparatory-inertia situation for s, where for any two situations s and s', s' is a Preparatory-inertia situation for s iff all the events that are in preparatory stages in s continue in s' as they would if there were no interruptions.

(70) Generic

$\text{MB}_{\text{Generic}} = \lambda s.\lambda s'.s'$ is a characteristic part of s

The imperfective: beyond progressives and prospectives

Factual imperfectives in Russian:

(71) Petja uže peresekal etot kanal za polčasa
Peter already crossed.IMPF this channel in half_hour
"Peter has already crossed this channel in half an hour."

(72) Resultative

$\text{MB}_{\text{Resultative}} = \lambda s.\lambda s'.s$ results from s',

where for any two situations s and s', s *results from* s' iff s includes the consequences or results of the events in s'.

The imperfective: beyond progressives and prospectives

Narrative imperfectives:

(73) Al amanecer salió el regimiento, atravesó la montaña, y poco después **establecía** contacto con el enemigo.

(74) Ayer **moría** Borges en Ginebra.

(75) A huit heures, les voleurs **entraient** dans la banque, ils **discutaient** avec un employé, puis **se dirigeaient** vers le guichet principal.

(76) En 1492, Christophe Colomb **découvrait** l'Amérique.

The imperfective: beyond progressives and prospectives

The narrative imperfectives are distinct from Slavic factual imperfectives:

(77) ?? Wczoraj Borges umierał w Genewie.
Yesterday Borges died.IMPF in Geneva

Slavic imperfectives also don't advance the narrative time.

(78) Narrative

$\text{MB}_{\text{Narrative}} = \lambda s.\lambda s'.s'$ culminates in s',

where for any two situations s and s', s' *culminates in* s iff all events in s' have their culmination in s.

The semantics of imperfectives: synthesis

We can informally summarize the different readings of the imperfective the following way:

	Non-modal	Modal
Ongoing	Progressive of atelics	Progressive of telics
Plan	—	Prospective
Extended	Habitual	Generic (?)
Completed	Narrative	Resultative (?)

Pragmatic coercion or lexical specification?

There are important cross-linguistic differences in which modal bases can be chosen to relate situations in the imperfective:

	Polish	Bulgarian	Spanish	Mẽbengokre
Progressive	yes	yes	yes	yes (*)
Habitual	yes	yes	yes	yes (*)
Prospective	no	yes	yes	yes (*)
Resultative	yes	yes	no	no
Narrative	no	no	yes	no

(*) in Mẽbengokre, these are expressed through distinct imperfective markers. Mẽbengokre will be discussed next.
To Cipria and Roberts, the choice of modal base is given pragmatically.
The cross-linguistic differences argue for lexical codification.

Further evidence for lexical specification of modal bases

In fact, several languages have distinct markers for the various types of imperfective. Mẽbengokre is one such case:

(79) krwỳnh nẽ môp kur **onhỹ**
parrot NFUT yam eat.PL sit
"The parrot is eating yams."

(80) krwỳnh nẽ môp kur
parrot NFUT yam eat.PL
"Parrots eat yams."

(81) krwỳnh nẽ môp kur mã
parrot NFUT yam eat.PL PROSP
"The parrot is about to eat yams."