Modals in event semantics

Semantics II

February 26

Overview

There are systematic relationships between a modal's height and its flavor, as well as between its height and which individuals/times the modal is relative to.

Hacquard (2010) argues that modals quantify over a set of worlds that's determined from a base *event*, rather than a base *world*.

Different kinds of events are available at different positions in a structure, explaining the relationship between modal height and interpretation.

Three positions for modals

1. John had to have taken out the trash.
   Modal keyed to what's **epistemically** necessary to **me**, **now**.

2. John had to take out the trash.
   Modal keyed to what's **deontically** necessary to **John**, **then**.

3. Mary thought that John had to have taken out the trash.
   Modal keyed to what's **epistemically** necessary to **Mary**, **then**.

Rounding out the picture

Whose beliefs are relevant for the interpretation of this modal?

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It seems it has to be John's beliefs (and cannot be Mary's or the speaker's). Bolsters the general picture: epistemics are keyed to the "closest" epistemic state.

Recall also the case of modals under attitude verbs:

5. Fido thinks it might be raining.

This sentence simply seems to mean that there is a rain-world among Uni's belief-worlds. But the standard semantics derives a higher-order belief instead:

$$\forall v \in \mathbf{Bel_f}\, w : \exists u \in R v : \mathbf{rain}_u$$

Event-relativity

Why is there such a systematic correlation between modal height and modal flavor/time-individual-relativity? And how do epistemics under attitudes work?

Hacquard (2010) argues that both problems are solved by relativizing modals to *events*, rather than worlds.
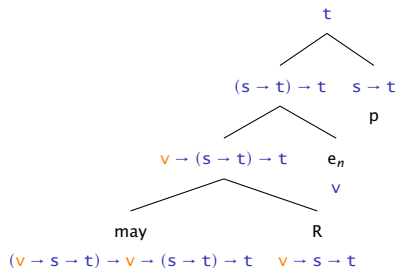
Modals

Our baseline proposal for modals, tweaked a bit (i.e., with an extensional $[\![\cdot]\!]$):

$$[\![\text{may}]\!]^g = \underbrace{\lambda R.\lambda w.\lambda p.\exists v \in R\,w : p\,v}_{(s\to s\to t)\to s\to(s\to t)\to t}$$

Hacquard's proposal: the quantificational domain of the modal is fixed by an *event*:

$$[\![\text{may}]\!]^g = \underbrace{\lambda R.\lambda e.\lambda p.\exists v \in R\,e : p\,v}_{(v\to s\to t)\to v\to(s\to t)\to t}$$

Modal structures, modal bases

$$t$$

```
                              t
                             / \
                (s → t) → t      s → t
                   / \              p
   v → (s → t) → t     e_n
        / \              v
     may     R
(v → s → t) → v → (s → t) → t    v → s → t
```

Epistemic modal bases access the *content* of their event argument. Thinkings, sayings, and assertings have content. Runnings and screamings won't.

$$\mathbf{R}_{\text{epis}} = \underbrace{\lambda e.\, \{w \mid w \in \mathbf{Content}\, e\}}_{v \to s \to t}$$

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Tense and aspect

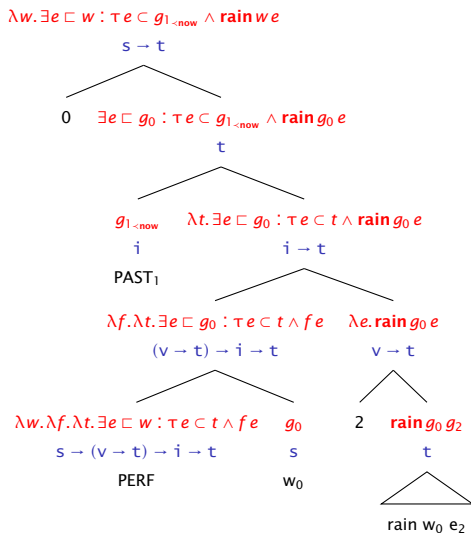Hacquard adopts a basic pronominal treatment of tense:

$$\llbracket \text{PAST}_i \rrbracket^g = \underbrace{\begin{cases} g_i \text{ if } g_i \prec \textbf{now} \\ \text{otherwise undefined} \end{cases}}_{\text{i (the type of intervals of time)}}$$

Along with a quantificational treatment of aspect following Kratzer (1998):

$$\llbracket \text{PERF} \rrbracket^g = \underbrace{\lambda w. \lambda f. \lambda t. \exists e \sqsubset w : \tau e \subset t \wedge f e}_{\text{s} \rightarrow (\text{v} \rightarrow \text{t}) \rightarrow \text{i} \rightarrow \text{t}}$$

$\approx$ There's an event in w whose runtime is contained in t, and where f is true.

Basic derivation: *it rained-PERF*

$\lambda w. \exists e \sqsubseteq w : \tau e \subset g_{1_{<now}} \wedge \mathbf{rain}\, w\, e$
s → t

0    $\exists e \sqsubseteq g_0 : \tau e \subset g_{1_{<now}} \wedge \mathbf{rain}\, g_0\, e$
t

$g_{1_{<now}}$ $\lambda t. \exists e \sqsubseteq g_0 : \tau e \subset t \wedge \mathbf{rain}\, g_0\, e$
i   i → t
PAST$_1$

$\lambda f. \lambda t. \exists e \sqsubseteq g_0 : \tau e \subset t \wedge f\, e$ $\lambda e. \mathbf{rain}\, g_0\, e$
(v → t) → i → t   v → t

$\lambda w. \lambda f. \lambda t. \exists e \sqsubseteq w : \tau e \subset t \wedge f\, e$ g_0 2 $\mathbf{rain}\, g_0\, g_2$
s → (v → t) → i → t   s   t
PERF w_0

rain w_0 e_2

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World (and event) variables in the syntax

We are working with an interpretation function $[\![\cdot]\!]^g$ that is only relative to assignments, not worlds. Correspondingly, intensional lexical entries mention world-dependence in their actual semantics. E.g., from the last slide:

$$[\![\text{PERF}]\!]^g = \underbrace{\lambda w.\lambda f.\lambda t.\exists e \sqsubset w : \tau e \subset t \wedge f e}_{s\rightarrow(v\rightarrow t)\rightarrow i\rightarrow t}$$

In this kind of setup, things like PERF meet their world arguments *directly in the syntax.* Thus, we have variables over worlds, which we can bind with Predicate Abstraction (e.g., Percus 2000).

Motivating world variables

The motivation for world variables is cases like these:

6. Mary thinks my brother is Canadian.
7. Mary wants to buy an expensive designer coat.

Sentence (6) can mean Mary thinks "Simon's brother is Canadian" or that she thinks "that guy (who happens to be my brother) is Canadian".

Sentence (7) can mean Mary thinks "I want an expensive designer coat" or that she thinks "I want one of those coats (which happen to be expensive designer coats)".

The ambiguity of (6) is easy to account for, but the ambiguity of (7) is not. Why?

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The ambiguity of (6) is easy to account for, but the ambiguity of (7) is not. Why? We cannot simply scope *an expensive designer coat* above *wants*, because we will predict that Mary's desires will have to be about a *particular* coat.

World variables and restrictions on them

Data like this has led theorists to introduce world variables in the syntax, such that possible logical forms for cases like (6) and (7) include the following:

8. [0 Mary [thinks w_0] [1 [my brother w_0] [is Canadian w_1]]]
9. [0 Mary [wants w_0] [1 PRO [buy w_1] [an [inexpensive coat w_0]]]]

However, while DPs are flexible about their world variable, VPs aren't:

10. *[0 Mary [thinks w_0] [1 [my brother w_1] [is Canadian w_0]]]
11. *[0 Mary [thinks w_0] [1 [John [thinks w_1] [2 [Bob [is Canadian w_1]]]]]]

That is, Canadian-ness is fixed by the closest world-binder: (10) should be about Mary's notion of Canadian-ness, and (11) about John's notion of Canadian-ness.

Locality of world binding

Percus (2000) suggests that world variables won't over-generate if we require certain of them to be bound by the closest available world binder.

12. [0 Mary [thinks w_0] [1 [my brother w_0] [is Canadian w_1]]]

13. *[0 Mary [thinks w_0] [1 [my brother w_1] [is Canadian w_0]]]

Verbal world variables are subject to this, but nominal world variables aren't.

Back to modals

Hacquard suggests that the event variable relative to which modals are construed is likewise subject to a locality constraint: it has to be bound by the nearest event binder. This derives the correlation between height and flavor:

- ▶ When highest, the nearest event binder is ASSERT (the speaking event).
- ▶ When under ASP, but in the matrix, the nearest event binder is ASP.
- ▶ When under an attitude verb, higher than the embedded ASP, the nearest event binder will be the matrix ASP (the attitude eventuality).
- ▶ With multiple attitude verbs, the nearest one will trump the others.

The meaning derived for *Fido thinks it might be raining*:

$$\exists e \sqsubset w : \mathbf{Subj}(e, \mathbf{f}) \wedge \mathbf{belief}(e, w) \wedge \forall v \in \mathbf{Content}\, e : \exists u \in \mathbf{Content}\, e : \mathbf{rain}\, u$$

The $\forall v$ ends up vacuous: it doesn't bind any variables.

Hacquard, Valentine. 2010. On the event relativity of modal auxiliaries. *Natural Language Semantics* 18(1). 79–114. https://doi.org/10.1007/s11050-010-9056-4.

Kratzer, Angelika. 1998. More structural analogies between pronouns and tenses. In Devon Strolovitch & Aaron Lawson (eds.), *Proceedings of Semantics and Linguistic Theory 8*, 92–110. Ithaca, NY: Cornell University. https://doi.org/10.3765/salt.v8i0.2808.

Percus, Orin. 2000. Constraints on some other variables in syntax. *Natural Language Semantics* 8(3). 173–229. https://doi.org/10.1023/A:1011298526791.