Event semantics

Semantics II

February 12 & 15

Events in semantics

Quantifying over events

Parsons (1990) follows Davidson (1967) in arguing that natural language has ubiquitous, generally implicit quantification over **eventualities**:

1. Mary drank coffee.
   $\rightsquigarrow \exists e : \mathbf{Subj}(e, \mathbf{m}) \wedge \mathbf{Drank}\, e \wedge \mathbf{Obj}(e, \mathbf{coffee})$
2. Mary drank coffee in the garden.
   $\rightsquigarrow \exists e : \mathbf{Subj}(e, \mathbf{m}) \wedge \mathbf{Drank}\, e \wedge \mathbf{Obj}(e, \mathbf{coffee}) \wedge \mathbf{loc}(e, \iota\, \mathbf{garden})$

Eventualities include events (things we intuitively think of as *happening*), as well as states (things we think of as *holding*):

3. Mary knows French.
   $\rightsquigarrow \exists s : \mathbf{Subj}(s, \mathbf{m}) \wedge \mathbf{Knows}\, s \wedge \mathbf{Obj}(s, \mathbf{french})$

Subatomic semantics

Think of this as a further development of the approach we've been using. Thus far, we have regarded formulas like $\mathbf{saw}\,x\,y$ as standing in for truth iff y saw x.

If we were to really unpack atomic sentences, we'd observe further structure:

$$\mathbf{saw}\,x\,y \iff \exists e : \mathbf{Subj}(e, y) \wedge \mathbf{Saw}\,e \wedge \mathbf{Obj}(e, x)$$

$$\text{i.e., } \mathbf{saw} = \lambda x.\lambda y.\exists e : \mathbf{Subj}\,(e, y) \wedge \mathbf{Saw}\,e \wedge \mathbf{Obj}\,(e, x).$$

In general, unpacking atomic sentences in this way puts the existential eventuality quantifier "as narrow as possible". We'll come back to this important point.

$$\forall x \in \mathbf{ling} : \mathbf{saw}\,x\,\mathbf{m} \iff \forall x \in \mathbf{ling} : \exists e : \mathbf{Subj}(e, \mathbf{m}) \wedge \mathbf{Saw}\,e \wedge \mathbf{Obj}\,(e, x)$$

Diamond entailments

Adverbial modification gives rise to consistent entailment patterns. Every sentence in (4)–(7) entails every sentence below it, and (4) asymmetrically entails (5) $\wedge$ (6).

4. Brutus stabbed Caesar in the back with a knife.
5. Brutus stabbed Caesar in the back.
6. Brutus stabbed Caesar with a knife.
7. Brutus stabbed Caesar.

The pattern here exactly mirrors the pattern observed with adjectival modification:

8. I've got a big black car.
9. I've got a big car.
10. I've got a black car.
11. I've got a car.

Scope entailments

The following seem equivalent:

12. Brutus stabbed Caesar in the back with a knife.
13. Brutus stabbed Caesar with a knife in the back.

Again, this exactly mirrors the pattern you find with nominal modification:

14. The guy who left who Mary likes. . .
15. The guy who Mary likes who left. . .

(I've switched to relative clauses here because, as we saw on Friday, adjectives can be picky syntactically about which order they come in.)

Modification

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Nominal modifiers are treated with *semantic modification*. Predicate Modification means they're interpreted as further specifying properties of some entity:

$$[\![\text{big black car}]\!] = \lambda x.\, \mathbf{big}\, x \wedge \mathbf{black}\, x \wedge \mathbf{car}\, x$$
$$[\![\text{guy who left who Mary likes}]\!] = \lambda x.\, \mathbf{guy}\, x \wedge \mathbf{left}\, x \wedge \mathbf{likes}\, x\, \mathbf{m}$$

Then the logical properties of $\wedge$ secure diamond and scope entailments:

$$p \wedge q \wedge r \implies p, q, r, p \wedge q, q \wedge r, p \wedge r$$
$$p \wedge q \iff q \wedge p$$

Adverbial modification

Diamond and scope entailments are a powerful argument that adverbial modification should be handled in the same way as adjectival modification.

This is precisely what events make possible. For modification to happen, we need to have a hook on which we can hang the properties that adverbial phrases denote.

- Individual?

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- Individual? No. (*Mary ran slowly* doesn't mean Mary's slow simpliciter.)
- World? No. (*Mary ran slowly* doesn't mean our world's a slow one.)
- Time? No. (*Mary is French* doesn't mean the present is Frenchy.)
- Something else? Yas. That something else is an eventuality.

Higher types?

You might try to push an *operator* theory of adverbials, on which they compose with verb phrases (cf. Thomason 1971, Thomason & Stalnaker 1973):

$$\textbf{slowly} :: (\mathtt{e} \to \mathtt{t}) \to \mathtt{e} \to \mathtt{t}$$

But it is challenging to ensure that this kind of treatment will secure diamond and scope entailments. We need to ensure that for all candidate adverbial functions f and g and all properties P the following two things hold:

$$f\,P \subseteq P$$
$$f\,(g\,P) = g\,(f\,P)$$

Perhaps this is possible, but it would be rather nicer not to have to do this.

Other kinds of adverbs

There exist *subsective* as well as *privative* adjectives. Sentence (16) doesn't imply that Mary is a quick typist, and (17) doesn't imply that Alex is an embezzler.

16. Mary is a quick sprinter.
17. Alex is an alleged embezzler.

Adverbs likewise aren't always simple intersective modifiers: (18) and (19) don't entail that the door became closed; and (20) is ambiguous between a repetitive reading and a restitutive reading (e.g., von Stechow 1996, Beck & Johnson 2004).

18. Mary partially closed the door.
19. Mary allegedly closed the door.
20. Mary closed the door again.

Event semantics

What are events?

We could approach the question from a metaphysical point of view, or (as we do here) a technical one. Minimally, events are or determine structured information: who their subject/object is, what kind of event they are, what their runtime is, etc.

In type theory and computer science, objects structured in this way are known as **records** (basically just a tuple with labeled fields). Here's a record representation of an event of John seeing Mary yesterday:

$$\left[\begin{array}{ll} \texttt{Subject} & : \mathbf{j} \\ \texttt{Object} & : \mathbf{m} \\ \texttt{Nature} & : \mathbf{Seeing} \\ \texttt{Runtime} & : \{t \mid t \in \mathbf{yesterday}\} \\ \ldots & \ldots \end{array}\right] :: \underbrace{\mathsf{V}}_{\text{the type of event(ualitie)s}}$$

Then $\mathbf{Subj}(e, \mathbf{j}) \iff \texttt{Subject}\, e = \mathbf{j}$.

Events and intensionality

Which events exist in a world is determined, naturally, by the character of the world. Maybe our world is such that there exists an event of John seeing Mary yesterday. But maybe not. So you should always think of formulas like the following...

$$\exists e : \mathbf{Subj}(e, \mathbf{j}) \wedge \mathbf{See}\, e \wedge \mathbf{Obj}(e, \mathbf{m})$$

...As true or false *relative to a world*. Generally, as we do in the formula above, we'll leave the world parameter(s) implicit.

Verb meanings

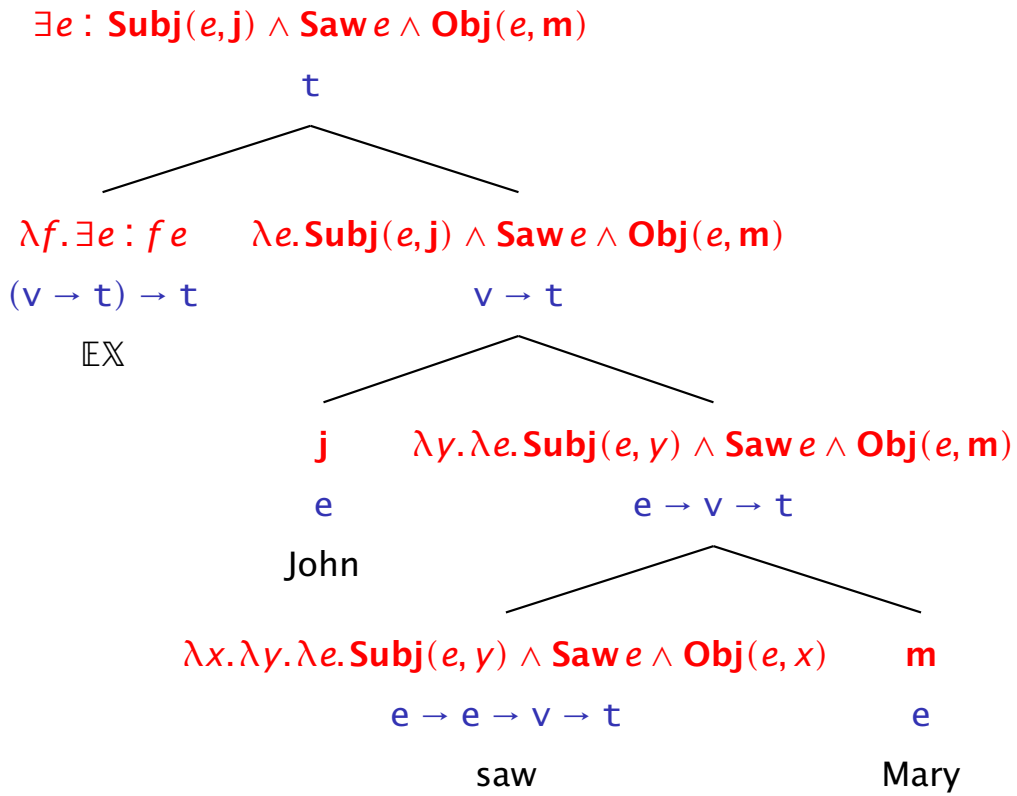
Having duly cleared our throats, let's put a theory of verb meanings on the table. Instead of denoting n-place relations between n individuals, we'll have verbs denoting $n+1$ relations between n individuals and 1 event.

$$[\![\text{saw}]\!] = \underbrace{\lambda x.\lambda y.\lambda e.\,\mathbf{Subj}(e,y) \wedge \mathbf{Saw}\,e \wedge \mathbf{Obj}(e,x)}_{\mathtt{e{\to}e{\to}v{\to}t}}$$

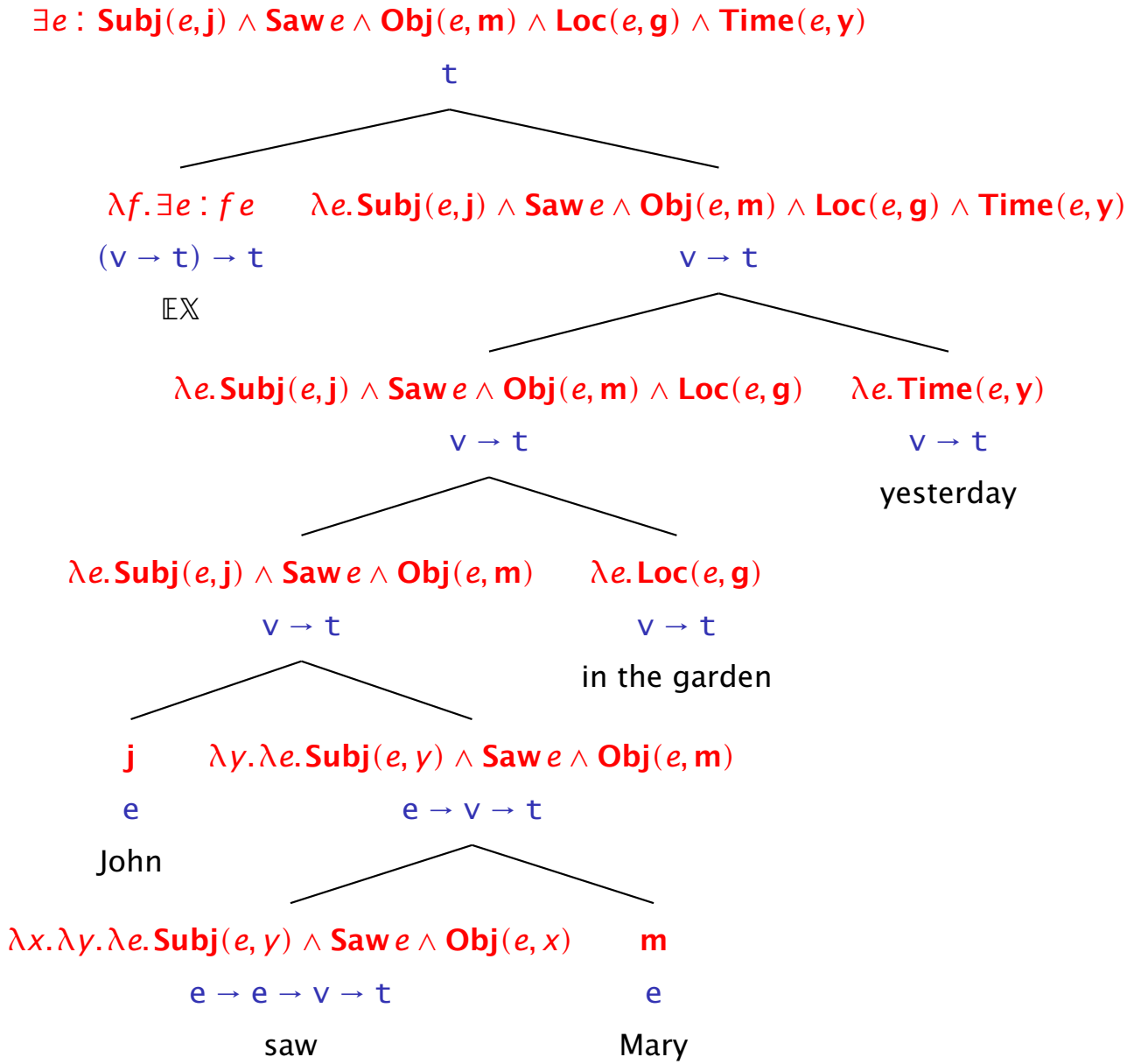
Notice that we cannot existentially close off the event in the verb's semantics: otherwise (ya might think...) it would be impossible to fold in modifiers. Thus we'll assume a silent existential closure operator:

$$[\![\mathbb{EX}]\!] = \underbrace{\lambda f.\exists e : f\,e}_{\mathtt{(v{\to}t){\to}t}}$$

Simple composition



Adverbs: entailments secured by modification



Tense

Onto this basic treatment, we could graft a simple pronominal treatment of tense:

$$[\![\text{PAST}_i]\!]^g = \lambda e.\, g_i \prec \textbf{now} \wedge \texttt{Runtime}\, e \subseteq g_i$$

Given the type we've assigned to verbs, tense is required to merge *after* all of the verb's arguments have been folded in. Then we'll have results like this:

$$[\![\mathbb{EX}\ \text{PAST}_i\ \text{John see Mary}]\!]^g = \exists e : g_i \prec \textbf{now} \wedge \texttt{Runtime}\, e \subseteq g_i \wedge \textbf{Subj}(e, \textbf{j}) \wedge \textbf{See}\, e \wedge \textbf{Obj}(e, \textbf{m})$$

Quantifiers and negation

The "subatomic" metaphor that Parsons uses to describe event semantics seems to suggest that event quantifiers should always scope as narrow as possible:

$$\forall x \in \textbf{person} : \textbf{saw}\, x\, \textbf{m} \iff \forall x \in \textbf{person} : \exists e : \textbf{Subj}(e, \textbf{m}) \wedge \textbf{Saw}\, e \wedge \textbf{Obj}(e, \textbf{m})$$

And it seems like this is *precisely* the result we're after:

21. Each person hugged Mary $\not\rightsquigarrow \exists e : \forall x \in \textbf{person} : \textbf{Subj}(e, x) \wedge \ldots$
22. John didn't see Mary $\not\rightsquigarrow \exists e : \neg(\textbf{Subj}(e, \textbf{j}) \wedge \ldots)$
23. Exactly one person cited Mary $\not\rightsquigarrow \exists e : \exists! x \in \textbf{person} : \textbf{Subj}(e, x) \wedge \ldots$

Another argument for narrowest scope

If the existential quantifier over events could take non-narrowest scope, (24) would be expected to have (25) as one of its possible meanings:

24. Brutus stabbed Caesar and Laertes stabbed Hamlet.
25. $\exists e : \mathbf{Subj}(e, \mathbf{b}) \wedge \mathbf{Stabbed}\, e \wedge \mathbf{Obj}(e, \mathbf{c}) \wedge \mathbf{Subj}(e, \mathbf{l}) \wedge \mathbf{Stabbed}\, e \wedge \mathbf{Obj}(e, \mathbf{h})$

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What's wrong with this? It entails that Brutus stabbed Hamlet!

$$\Longrightarrow \exists e : \mathbf{Subj}(e, \mathbf{b}) \wedge \mathbf{Stabbed}\, e \wedge \mathbf{Obj}(e, \mathbf{h})$$

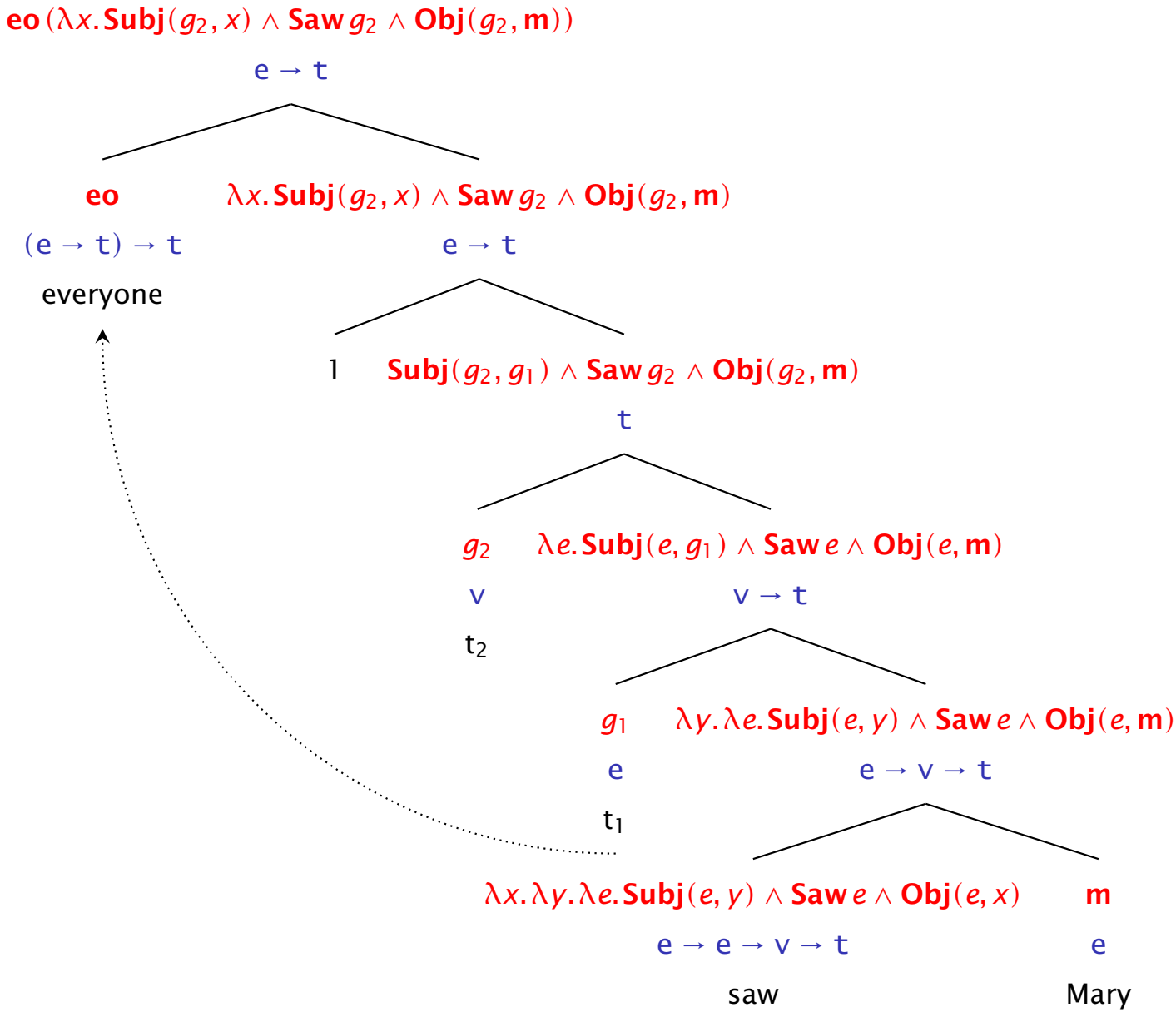
So we have strong arguments that existential quantification over events should arise at the atomic level, and *never* at non-atomic levels. Do we predict that?

Hmmm

Maybe we do make this prediction: after all, quantifiers are type $(\mathtt{e} \to \mathtt{t}) \to \mathtt{t}$, and negation is type $\mathtt{t} \to \mathtt{t}$. Neither can compose with a predicate of events. (Probably something similar could be said of conjunction as well.)

So $\mathbb{EX}$ has to be merged before quantifiers/negation are. So we are home free, yes?

Alas, scope is devilish



More and less radical separation

Verbs as predicates of events

Parsons' logical forms suggest another kind of possibility for verb meanings:

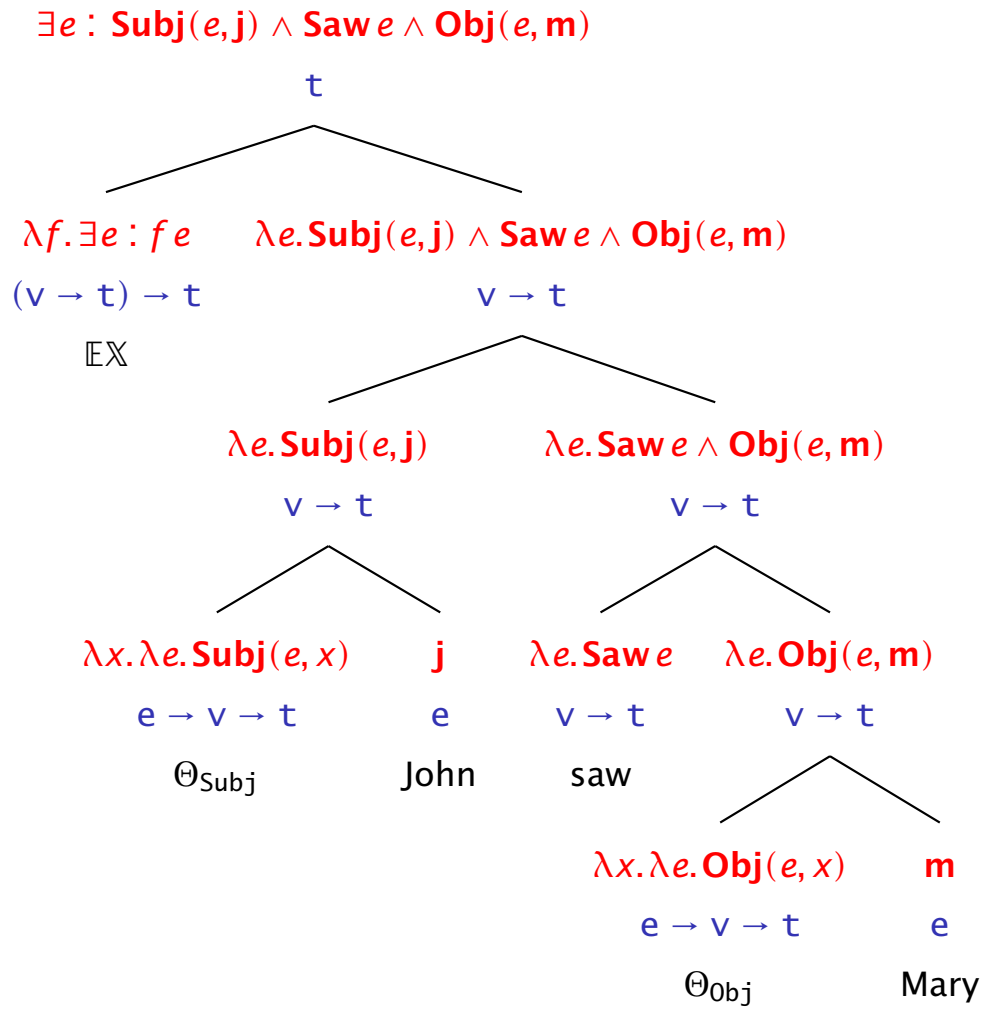
$$[\![\text{saw}]\!] = \underbrace{\lambda e.\,\textbf{Saw}\,e}_{\mathtt{v \to t}}$$

Suppose further that we introduce thematic role heads with the following semantics:

$$[\![\Theta_{\mathtt{Subj}}]\!] = \underbrace{\lambda x.\,\lambda e.\,\textbf{Subj}(e, x)}_{\mathtt{e \to v \to t}}$$

Everything else stays the same (composition rules, $\mathbb{EX}$, quantifiers, tense, adverbs).

Lots of modification



Semantics and ill-formedness

On this "radical separation" picture, the semantics has nothing to say about why it's impossible to understand *saw Mary* as a sentence — i.e., as expressing a proposition that there exist seeing events whose object is Mary.

Accordingly, the syntax must shoulder a heavier burden: transitive verbs (or something else) must *select for* ΘP's. But perhaps in our traditional, Fregean theories, something like this was happening anyway.

A Kratzerian twist

Kratzer (1996) (following Marantz) argues that facts like the following suggest a tighter relationship between verbs and objects than between verbs and subjects.

26. kill a cockroach
27. kill a conversation
28. kill an evening watching TV
29. kill a bottle
30. kill an audience

Hoping to capture this difference, she posits lexical entries like the following:

$$[\![\text{kill}]\!] = \underbrace{\lambda x.\lambda e.\mathbf{Kill}(e,x)}_{\texttt{e→v→t}}$$

Introducing external arguments

External arguments aren't mentioned in the verb's semantics, but introduced by *v*:

$$[\![v]\!] = \underbrace{\lambda x.\lambda e.\mathbf{Subj}(e,x)}_{\mathtt{e{\to}v{\to}t}}$$

But this leads to some compositional tension in basic structures:

31. [John [$_{vP}$ $\underbrace{v}_{\mathtt{e{\to}v{\to}t}}$ $\overbrace{\text{killed the cockroach}}^{\mathtt{v{\to}t}}$]]

Kratzer remedies this by introducing a composition rule, 'Event Identification':

$$[\![A\ B]\!] = \lambda x.\lambda e.[\![A]\!]\,x\,e \wedge [\![B]\!]\,e\text{, when defined}$$

Deal on Kratzer

Amy Rose Deal, in an unpublished squib, takes issue with Kratzer's arguments. Though Kratzer's verb meanings do not take subjects as arguments, events are structured enough to allow verb meanings to refer to external arguments:

$$\lambda x.\lambda e.\mathbf{Kill}\,(e, x) \wedge f\,(\mathtt{Subj}\,e) \wedge \ldots$$

Indeed, this is possible even on a radical separation view. So what, in the end, is the force of Kratzer's argument? It is true that in entries like the above, the link to the subject is "indirect" in a way, mediated by the event. Could this be leveraged?

On scope

We have seen that event semantics allows us to sever some or all of a verb's arguments in the semantics. Does this interact with our discussion of scope?

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We have seen that event semantics allows us to sever some or all of a verb's arguments in the semantics. Does this interact with our discussion of scope?

It does not. The basic move we executed above — QRing $\mathbb{EX}$ — is available in principle in any of these accounts. Nothing forces $\exists e$ to receive narrowest scope.

Building ∃ into the verb

Champollion (2011, 2015) offers yet another kind of semantics for verbs:

$$[\![\text{saw}]\!] = \underbrace{\lambda f.\exists e : \mathbf{Saw}\, e \wedge f\, e}_{(\mathtt{v}\to\mathtt{t})\to\mathtt{t}}$$

Then Θ-heads will need to be fancied up accordingly:

$$[\![\Theta_{\mathtt{Subj}}]\!] = \underbrace{\lambda x.\lambda V.\lambda f.\, V\,(\lambda e.\mathbf{Subj}(e,x) \wedge f\, e)}_{\mathtt{e}\to((\mathtt{v}\to\mathtt{t})\to\mathtt{t})\to(\mathtt{v}\to\mathtt{t})\to\mathtt{t}}$$

Champollion claims that this forces $\exists e$ to always receive narrowest scope. Does it?

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