Scope and modality in event semantics

Semantics II

February 19 & 21

More and less radical separation

Verbs as predicates of events

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

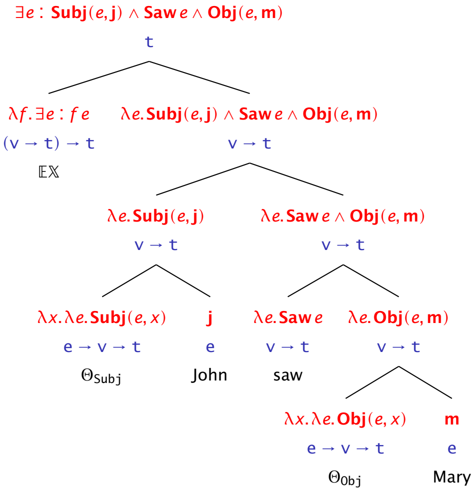
$$[\![\text{saw}]\!] = \underbrace{\lambda e.\,\mathbf{Saw}\,e}_{\mathtt{v \to t}}$$

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

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

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.

1. kill a cockroach
2. kill a conversation
3. kill an evening watching TV
4. kill a bottle
5. kill an audience

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

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

Introducing external arguments

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

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

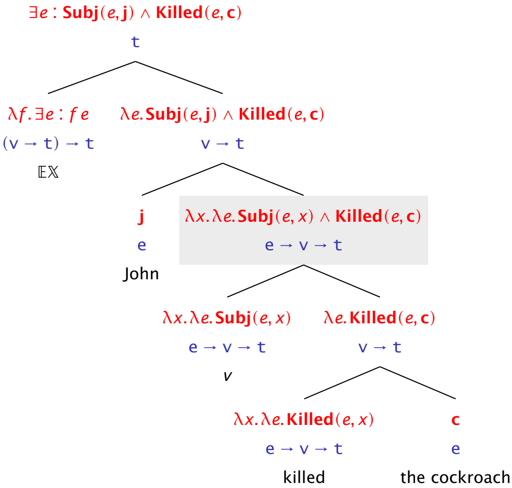
But this leads to some compositional tension in basic structures:

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

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

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

A Kratzerian derivation



Deal on Kratzer

Deal (2011), 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:

$$\lambda x.\lambda e.\mathbf{Kill}\,(e,x) \wedge \begin{cases} \text{if } \mathbf{animate}\,(\mathtt{Subj}\ e) \text{ then} \ldots \\ \text{otherwise} \ldots \end{cases}$$

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?

Scope in event semantics

On scope

There is ample evidence that existential quantification over events must always receive narrowest scope. This is a natural expectation given the “subatomic semantics” slogan, but it is surprisingly difficult to enforce.

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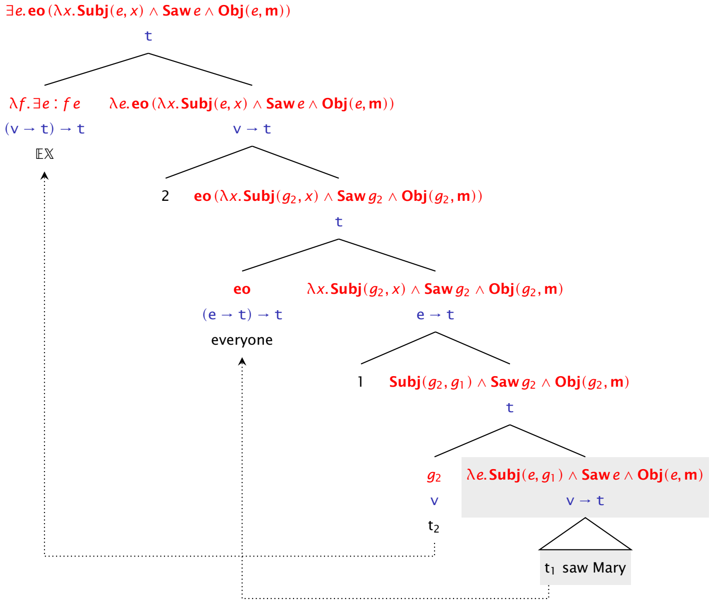
We have seen that event semantics allows us to sever some or all of a verb’s arguments in the semantics. Does this interact with our discussion of scope?

It does not. Scoping $\mathbb{EX}$ above other scope-bearing operators is an available option in principle for any of these accounts. Nothing forces $\exists e$ to receive narrowest scope.

A general schema for bad derivations



Put another way

In languages like English, we expect quantifiers to participate in non-trivial scope relationships with other scope-bearing operators (leading to ambiguity).

Event quantifiers are quantifiers. So what prevents *them* from doing so?

Building ∃ into the verb

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

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

This builds existential closure over events into the verb meaning. We do not need to rely on a silent $\mathbb{E}\mathbb{X}$ higher in the tree.

Champollion suggests that this move guarantees that $\exists e$ will always take narrowest scope. We will take issue with this later on.

Θ heads

Verbal projections in the classic neo-Davidsonian picture all have type $\mathrm{v} \to \mathtt{t}$. In the verb-as-quantifier picture, they should all have type $(\mathrm{v} \to \mathtt{t}) \to \mathtt{t}$:

$$[\![\text{see } [\Theta_{\mathtt{Obj}} \text{ Mary}]]\!] = \underbrace{\lambda f.\, \exists e : \mathbf{See}\, e \wedge \mathbf{Obj}(e, \mathbf{m}) \wedge f\, e}_{(\mathrm{v}\to\mathtt{t})\to\mathtt{t}}$$

To achieve this result, Θ-heads will need to be fancied up accordingly:

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

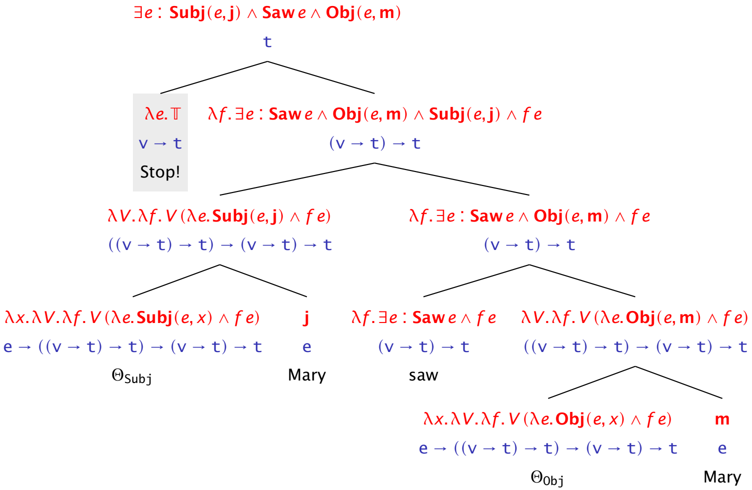
To see why this works, consider that the following expression is equivalent to V:

$$\lambda V. \lambda f.\, V\, (\lambda e.\, f\, e) \equiv_\eta \lambda V. \lambda f.\, V f \equiv_\eta \lambda V.\, V$$

A derivation

- $\exists e : \mathbf{Subj}(e, \mathbf{j}) \wedge \mathbf{Saw}\, e \wedge \mathbf{Obj}(e, \mathbf{m})$ — $\mathtt{t}$
  - ??? — ??? — Stop!
  - $\lambda f. \exists e : \mathbf{Saw}\, e \wedge \mathbf{Obj}(e, \mathbf{m}) \wedge \mathbf{Subj}(e, \mathbf{j}) \wedge f\, e$ — $(\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$
    - $\lambda V. \lambda f. V(\lambda e. \mathbf{Subj}(e, \mathbf{j}) \wedge f\, e)$ — $((\mathtt{v} \to \mathtt{t}) \to \mathtt{t}) \to (\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$
      - $\lambda x. \lambda V. \lambda f. V(\lambda e. \mathbf{Subj}(e, x) \wedge f\, e)$ — $\mathtt{e} \to ((\mathtt{v} \to \mathtt{t}) \to \mathtt{t}) \to (\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$ — $\Theta_{\mathtt{Subj}}$
      - $\mathbf{j}$ — $\mathtt{e}$ — Mary
    - $\lambda f. \exists e : \mathbf{Saw}\, e \wedge \mathbf{Obj}(e, \mathbf{m}) \wedge f\, e$ — $(\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$
      - $\lambda f. \exists e : \mathbf{Saw}\, e \wedge f\, e$ — $(\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$ — saw
      - $\lambda V. \lambda f. V(\lambda e. \mathbf{Obj}(e, \mathbf{m}) \wedge f\, e)$ — $((\mathtt{v} \to \mathtt{t}) \to \mathtt{t}) \to (\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$
        - $\lambda x. \lambda V. \lambda f. V(\lambda e. \mathbf{Obj}(e, x) \wedge f\, e)$ — $\mathtt{e} \to ((\mathtt{v} \to \mathtt{t}) \to \mathtt{t}) \to (\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$ — $\Theta_{\mathtt{Obj}}$
        - $\mathbf{m}$ — $\mathtt{e}$ — Mary

A derivation



Quantifiers

Of course, assuming that Θ-heads require their arguments to be type e predicts that they cannot combine directly with quantificational DPs, type $(e \to t) \to t$.

We have two options to deal with such cases:

- We could just QR the quantifiers out and above *Stop!*.
- We could adopt a fancier treatment of Θ-heads.

Champollion opts for the latter of these.

Θ-heads for quantifiers

Here is a semantics for Θ-heads that allows them to compose with quantifiers:

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

The strategy for turning a function of type $\mathtt{e} \to a$ into a function of type $((\mathtt{e} \to \mathtt{t}) \to \mathtt{t}) \to a$ is closely related to a technique called Argument Raising, discussed in an important dissertation by Hendriks (1993).

A quick example of how this works for a quantifier:

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

Notice that this keeps V within the scope of Q, as desired.

A (surface-scope) derivation

- $\mathbf{so}\,(\lambda y.\,\mathbf{eo}\,(\lambda x.\,\exists e : \mathbf{Saw}\,e \wedge \mathbf{Obj}(e, x) \wedge \mathbf{Subj}(e, y)))$
  $\mathtt{t}$
  - $\lambda e.\,\mathbb{T}$
    $\mathtt{v \to t}$
    Stop!
  - $\lambda f.\,\mathbf{so}\,(\lambda y.\,\mathbf{eo}\,(\lambda x.\,\exists e : \mathbf{Saw}\,e \wedge \mathbf{Obj}(e, x) \wedge \mathbf{Subj}(e, y) \wedge f\,e))$
    $\mathtt{(v \to t) \to t}$
    - $\lambda V.\lambda f.\,\mathbf{so}\,(\lambda y.\,V\,(\lambda e.\,\mathbf{Subj}(e, y) \wedge f\,e))$
      $\mathtt{((v \to t) \to t) \to (v \to t) \to t}$
      - $\lambda Q.\lambda V.\lambda f.\,Q\,(\lambda y.\,V\,(\lambda e.\,\mathbf{Subj}(e, y) \wedge f\,e))$
        $\mathtt{((e \to t) \to t) \to ((v \to t) \to t) \to (v \to t) \to t}$
        $\Theta_{\mathtt{Subj}}$
      - $\mathbf{so}$
        $\mathtt{(e \to t) \to t}$
        someone
    - $\lambda f.\,\mathbf{eo}\,(\lambda x.\,\exists e : \mathbf{Saw}\,e \wedge \mathbf{Obj}(e, \mathbf{m}) \wedge f\,e)$
      $\mathtt{(v \to t) \to t}$
      - $\lambda f.\,\exists e : \mathbf{Saw}\,e \wedge f\,e$
        $\mathtt{(v \to t) \to t}$
        saw
      - $\lambda V.\lambda f.\,\mathbf{eo}\,(\lambda x.\,V\,(\lambda e.\,\mathbf{Obj}(e, x) \wedge f\,e))$
        $\mathtt{((v \to t) \to t) \to (v \to t) \to t}$
        - $\lambda Q.\lambda V.\lambda f.\,Q\,(\lambda x.\,V\,(\lambda e.\,\mathbf{Obj}(e, x) \wedge f\,e))$
          $\mathtt{((e \to t) \to t) \to ((v \to t) \to t) \to (v \to t) \to t}$
          $\Theta_{\mathtt{Obj}}$
        - $\mathbf{eo}$
          $\mathtt{(e \to t) \to t}$
          everyone

Inverse scope

If Θ-heads compose with quantificational DPs, we can define higher-typed versions of them that are useful for inverse scope:

$$[\![\Theta_R^{inv}]\!] = \underbrace{\lambda Q.\lambda V.\lambda M.\lambda f.\,Q\,(\lambda x.\,M\,V\,(\lambda e.\,R(e,x) \wedge f\,e))}_{((e\to t)\to t)\to((v\to t)\to t)\to(((v\to t)\to t)\to(v\to t)\to t)\to(v\to t)\to t}$$

This semantics is *quite* complex. The key thing to notice is that M, the meaning of the Θ-marked subject, is caught within the scope of Q. This gives inverse scope.

In languages that do not allow inverse scope (including, perhaps, Mandarin Chinese, Hungarian, etc.), Θ^{inv}-heads might simply be unavailable. Θ-heads can be treated as a locus of parametric variation.

The basic picture, summed up

Let us take stock. Following Champollion, we've elected to treat verb meanings as existential event quantifiers. The hope is that this move can force narrowest $\exists e$.

This move in turn necessitates higher-typed entries for Θ-heads, allowing ΘP's to function as *modifiers of event quantifiers*.

Quantifiers must either be QR'd, or Θ-heads must be given even higher types.

If the latter option is taken, we can give quantifiers *even* higher types, ones that anticipate the presence of further quantifiers higher up in the tree, and assign those higher quantifiers narrower scope.

Modification?

It is worth pointing out that we have strayed rather far from the initial motivation for event semantics. The hope was for a treatment of event modification analogous to adjectival modification, in order to secure $\diamond$-entailments and commutativity.

This was accomplished in any of our basic setups: complex properties of events were derived by Predicate Modification.

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It is worth pointing out that we have strayed rather far from the initial motivation for event semantics. The hope was for a treatment of event modification analogous to adjectival modification, in order to secure $\diamond$-entailments and commutativity.

This was accomplished in any of our basic setups: complex properties of events were derived by Predicate Modification.

This pleasing feature is lost in Champollion's semantics: modifiers of events are assigned type $((\mathtt{v} \to \mathtt{t}) \to \mathtt{t}) \to (\mathtt{v} \to \mathtt{t}) \to \mathtt{t}$, and compose with verbal projections by functional application. There is **no guarantee** that $\diamond$-entailments/commutativity will follow. This will need to be built in somehow.

Another explanatory problem with higher types

Our basic Θ-heads for quantifiers assign the quantifier wide scope over V:

$$[\![\Theta_R]\!] = \underbrace{\lambda Q.\lambda V.\lambda f.\, Q\,(\lambda x.\, V\,(\lambda e.\, R(e,x) \wedge f\, e))}_{((\mathsf{e}\to\mathsf{t})\to\mathsf{t})\to((\mathsf{v}\to\mathsf{t})\to\mathsf{t})\to(\mathsf{v}\to\mathsf{t})\to\mathsf{t}}$$

But we could just as well have defined versions that reverse the scope of Q and V:

$$[\![\Theta'_R]\!] = \underbrace{\lambda Q.\lambda V.\lambda f.\, V\,(\lambda e.\, Q\,(\lambda x.\, R(e,x) \wedge f\, e))}_{((\mathsf{e}\to\mathsf{t})\to\mathsf{t})\to((\mathsf{v}\to\mathsf{t})\to\mathsf{t})\to(\mathsf{v}\to\mathsf{t})\to\mathsf{t}}$$

In other words, narrowest-$\exists e$ doesn't follow from anything deep in the setup.

Again, there are *many* possible denotations for Θ-heads, but only some of these seem to be lexicalizable. We'll need to restrict them somehow.

Factorial scope

In general, when *n* quantifiers occur in a sentence, there are *n*! available readings:

7. Two boys sent a letter to each professor.

In particular, (7) allows a $\forall \gg 2 \gg \exists$ reading (cf. Bruening 2001).

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In particular, (7) allows a $\forall \gg 2 \gg \exists$ reading (cf. Bruening 2001).

In order to derive such a reading, Champollion will need a $\Theta_{\texttt{IndObj}}$-head that anticipates the presence of the quantifiactional direct object and subject, and assigns them narrow scope (and surface scope with respect to each other).

Sentences with more quantifiers will require even more complicated Θ-heads to generate all possible readings. In principle, then, there isn't even a determinate answer to the question of how many different kinds of Θ-heads exist!

Circling back

Recall our original problem with building our semantics around $\mathbb{EX}$:

Event quantifiers are quantifiers. What prevents them from taking scope?

Champollion claims that treating verb meanings as quantifiers will force $\exists e$ to take narrowest scope. Does it?

Circling back

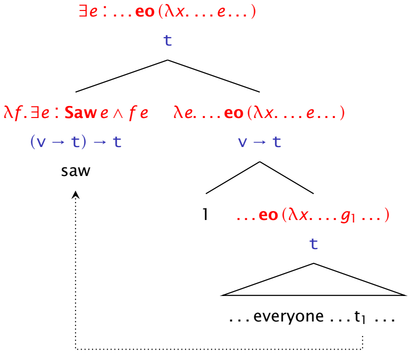
Recall our original problem with building our semantics around $\mathbb{EX}$:

Event quantifiers are quantifiers. What prevents them from taking scope?

Champollion claims that treating verb meanings as quantifiers will force $\exists e$ to take narrowest scope. Does it? Not exactly. In Champollion's setup, this is achieved, but this is ultimately due to the precise Θ-heads that are stipulated to exist.

Again, this is not a deep feature of the system: if verbs are event quantifiers, we should antecedently expect them to take scope in the way that other quantifiers do.

Back in the bad place



So what *should* we say?

At this point in the course, we simply don't have the tools to build a truly explanatory theory of event semantics. :(

But we *will*, once we start talking about compositional approaches to scope assignment later in the course. Stay tuned.

Bruening, Benjamin. 2001. QR obeys Superiority: Frozen scope and ACD. *Linguistic Inquiry* 32(2). 233–273. https://doi.org/10.1162/00243890152001762.

Champollion, Lucas. 2011. Quantification and negation in event semantics. In *Formal semantics and pragmatics: discourse, context, and models*, vol. 6 (The Baltic International Yearbook of Cognition, Logic and Communication), 1–23. New Prairie Press. https://doi.org/10.4148/biyclc.v6i0.1563.

Champollion, Lucas. 2015. The interaction of compositional semantics and event semantics. *Linguistics and Philosophy* 38(1). 31–66. https://doi.org/10.1007/s10988-014-9162-8.

Deal, Amy Rose. 2011. On the argument from idioms. Unpublished ms.

Hendriks, Herman. 1993. *Studied flexibility: Categories and types in syntax and semantics*. University of Amsterdam Ph.D. thesis.

Kratzer, Angelika. 1996. Severing the external argument from its verb. In Johan Rooryck & Laurie Zaring (eds.), *Phrase structure and the lexicon*, 109–137. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-015-8617-7_5.