The scope of alternatives

Simon Charlow

Rutgers, The State University of New Jersey

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Goals for today

- Sketch a new kind of **alternative semantics**, where alternatives interact with their semantic context by **taking scope**.
- Show why we should prefer this kind of approach to standard varieties of alternative semantics:
  - More compositional
  - Better predictions when multiple sources of alternatives
  - A more robust treatment of binding
  - Super modular, extensible (e.g., if we have time, to dynamics)
- I'll focus on **English indefinites**, but much of what follows is applicable in other domains where alternatives have been argued to offered insight (e.g. questions, focus, indeterminate pronouns).

Where we are

- Standard alternative semantics
  - Composing sets
  - Why alternatives?
- Proposal: alternatives take scope
  - Basic pieces
  - Deriving exceptional scope
- Why scope?
  - Compositionality
  - Selectivity
  - Binding
- Horizons
  - Dynamics (time permitting)
  - Concluding

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Alternative semantics

- Some expressions introduce alternatives into the semantics, causing us to calculate a number of meanings in parallel.
- E.g., indefinites might be taken to denote **sets of individuals**:

$$[\![\texttt{a linguist}]\!]^{i} = \{x \mid \text{linguist}\, x\}$$

- Cf. the standard generalized-quantifier semantics:

$$[\![\texttt{a linguist}]\!]^{i} = \lambda\kappa.\, \exists x.\, \text{linguist}\, x \wedge \kappa\, x$$

Composing alternatives

- **Compositional challenge:** $[\![\texttt{a linguist}]\!]^i$ is type $e \to t$, but occurs in places where something of type e standardly expected.
- The usual way to go: first, suppose that **everything** denotes a set:

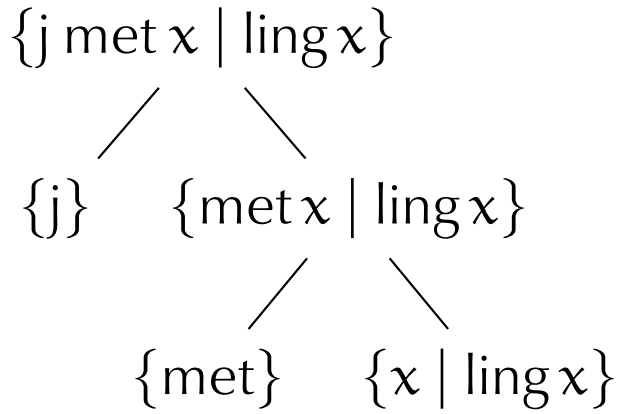
$$[\![\texttt{John}]\!]^i = \{j\} \qquad [\![\texttt{met}]\!]^i = \{\text{met}\} \qquad [\![\texttt{a ling}]\!]^i = \{x \mid \text{ling}\, x\}$$

- Then, to compose these sets, use *point-wise* functional application (**PWFA**) (e.g. Hamblin 1973; Rooth 1985):

$$[\![A\ B]\!]^i = \{f\, x \mid f \in [\![A]\!]^i \wedge x \in [\![B]\!]^i\}$$

An example

- A basic example, *John met a linguist*:



- As we climb the tree, the alternatives **expand**, eventually yielding a set of propositions, **one per linguist**.

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Why alternatives? Why PWFA?

- A standard motivation since Rooth 1985: *insensitivity to islands*.
- Each of the following can be interpreted in a way that gives the **bolded** thing apparent scope outside a syntactic ⟨island⟩.

(1) If ⟨**a rich relative of mine** dies⟩, I'll inherit a house. (∃ > if)

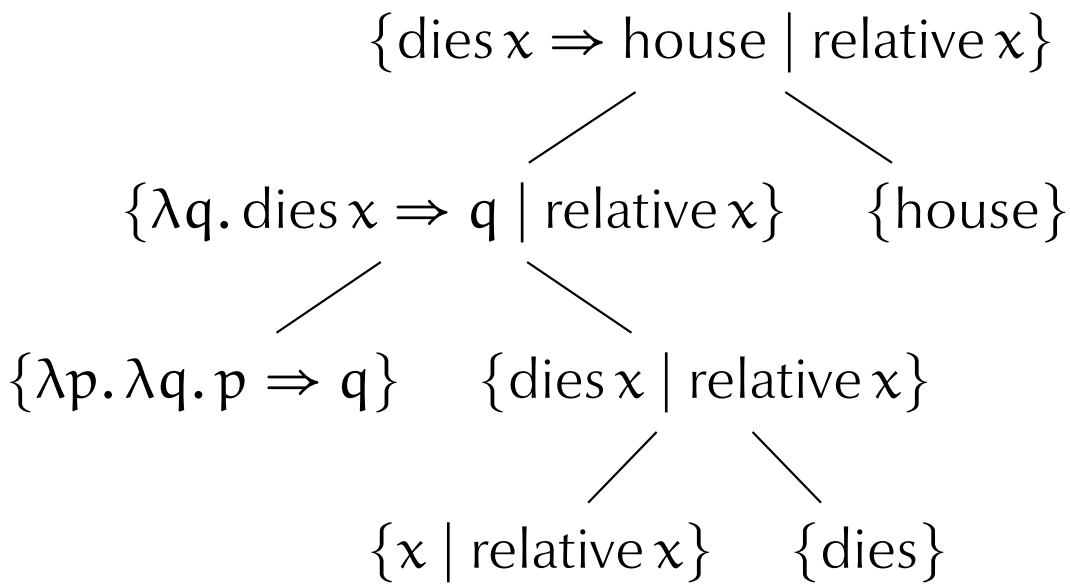
(2) I only complain when ⟨**BILL** leaves the lights on⟩.

(3) Taro-wa ⟨**dare**-ga katta mochi-o⟩ tabemasita ka?
Taro-TOP who-NOM bought rice cake-ACC ate Q
'Who is the x such that Taro ate rice cakes that x bought?'

[Examples after Reinhart 1997; Rooth 1996; Kratzer & Shimoyama 2002]

Getting traction on island-insensitivity

- Island-insensitivity is a **consequence of PWFA**. Here's an alternatives-based derivation of the *relative-of-mine* conditional:



- The indefinite acquires a kind of "scope" over the conditional, yielding various conditional propositions "about" various relatives.

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Proposal summarized

- My proposal: **no** PWFA, **no** ubiquitous lexical sets.
- Instead, resolve the type mismatch introduced by a set of alternatives by **scoping it** (cf. quantifiers in object position)!
- Allows us to reframe (and *generalize*) the compositional issue to a problem of integrating **fancy** things (e.g., things that denote sets) with **boring** things (e.g., things that do not).

Greasing the skids

- All this requires is **two type-shifters**. And they're already familiar!
- First: $\boxed{\cdot}$ is Karttunen 1977's C_o, aka Partee 1986's IDENT. It turns a boring thing into a fancy thing (though still fairly boring).

$$\boxed{x} = \{x\}$$

- Second: $\cdot^{\Uparrow}$ turns a set $\mathfrak{m}$ into a scope-taker by feeding each member of $\mathfrak{m}$ to a scope κ and unioning the resulting sets.

$$\mathfrak{m}^{\Uparrow} = \lambda\kappa.\bigcup_{x \in \mathfrak{m}} \kappa\, x$$

- E.g., $\{x \mid \text{linguist}\, x\}^{\Uparrow} = \lambda\kappa.\bigcup_{\text{linguist}\, x} \kappa\, x$.[1]

[1] $\{x \mid \text{linguist}\, x\}^{\Uparrow}$ is actually equivalent to the meaning Cresti 1995 assigns to *which linguist*, and also crops up in Heim 2000; Ciardelli & Roelofsen to appear.

Fancy, boring types

- Typing judgments, where $\mathsf{F}\alpha$ should be read as "a fancy α". In this case, a fancy α is simply a set of α's, so $\mathsf{F}\alpha ::= \{\alpha\} ::= \alpha \to \mathsf{t}$:

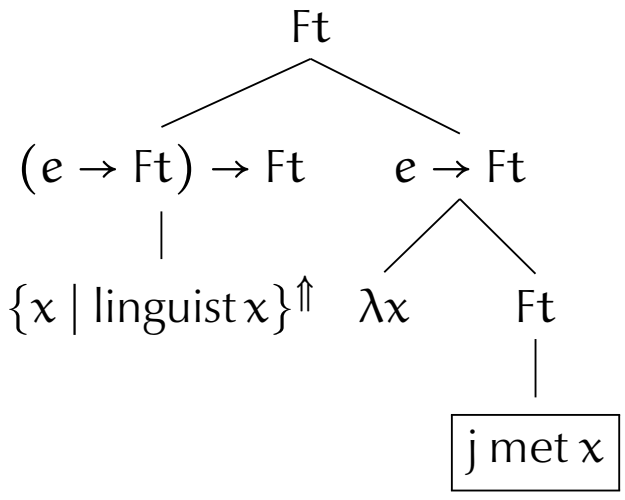
$$\boxed{\cdot} :: \alpha \to \mathsf{F}\alpha \qquad \cdot^{\Uparrow} :: \mathsf{F}\alpha \to (\alpha \to \mathsf{F}\beta) \to \mathsf{F}\beta$$

- $\boxed{\cdot}$ and $\cdot^{\Uparrow}$ build a bridge between fancy things (sets of alternatives) and boring things (familiar denotations). Schematically:

$$\underbrace{m^{\Uparrow}}_{(\alpha\to\mathsf{F}\beta)\to\mathsf{F}\beta} \overbrace{\left(\lambda x.\, \boxed{\ldots x \ldots}\right)}^{\alpha\to\mathsf{F}\beta}$$

An example

- An example of how this works to derive the same result as PWFA for *John met a linguist*:



- Gives the expected set of propositions, about different linguists:

$$\{\text{j met x} \mid \text{linguist x}\}$$

- This pattern will be repeated time and again. The alternative generator takes scope via $\cdot^{\Uparrow}$, and $\boxed{\cdot}$ applies to its remnant.

Multiple alternative generators

- Cases with multiple sources of alternatives such as *a linguist met a philosopher* require two applications of $\cdot^{\Uparrow}$, and two scopings:

$$\textbf{a.linguist}^{\Uparrow}\,(\lambda x.\,\textbf{a.philosopher}^{\Uparrow}\,(\lambda y.\,\boxed{x\ \text{met}\ y}\,))$$

$$= \{x\ \text{met}\ y \mid \text{linguist}\,x \wedge \text{philosopher}\,y\}$$

- This is the same result PWFA would give.

Getting closure

- We can define a categorematic **closure** operation to extract a truth-condition from a set of propositions:

$$!\mathfrak{m} = \exists \mathfrak{p} \in \mathfrak{m}.\, \mathfrak{p}$$

- For example, applying ! to what we obtained for *a linguist met a philosopher* yields:

$$\exists \mathfrak{x}.\, \text{linguist}\, \mathfrak{x} \wedge \exists \mathfrak{y}.\, \text{philosopher}\, \mathfrak{y} \wedge \mathfrak{x}\ \text{met}\ \mathfrak{y}$$

The Monad Slide

- $\boxed{\cdot}$ and $\cdot^{\Uparrow}$ are decompositions of LIFT (e.g. Partee 1986):

$$\boxed{x}^{\Uparrow} = \text{LIFT}\, x = \lambda\kappa.\, \kappa\, x$$

- They also form something known in category theory & computer science as a **monad** (e.g. Moggi 1989; Wadler 1992, 1995).
  - In general, monads are *really* good at allowing (arbitrarily) fancy things to interact with boring things.
  - See Shan 2002; Giorgolo & Asudeh 2012; Unger 2012; Charlow 2014 for discussions of monads in natural language semantics.

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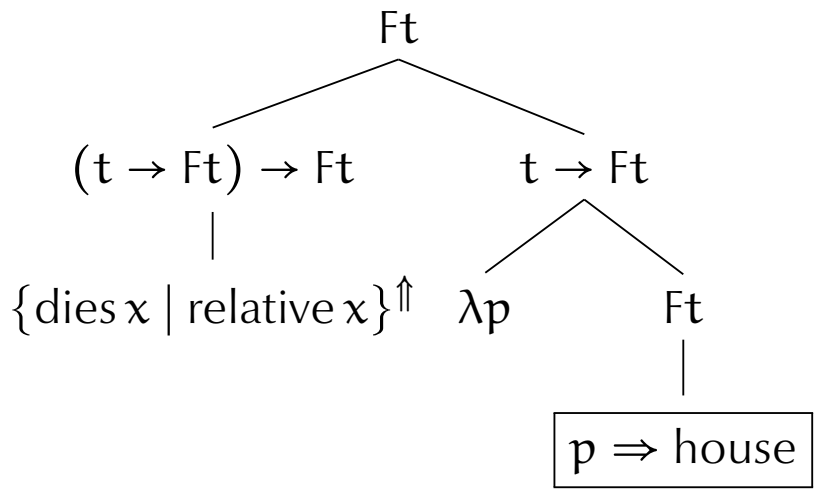
Exceptional scope?

- Since we manage alternatives via scope, it may appear as if we have given up an account of exceptional scope-taking:

  (4) If ⟨**a rich relative of mine** dies⟩, I'll inherit a house.

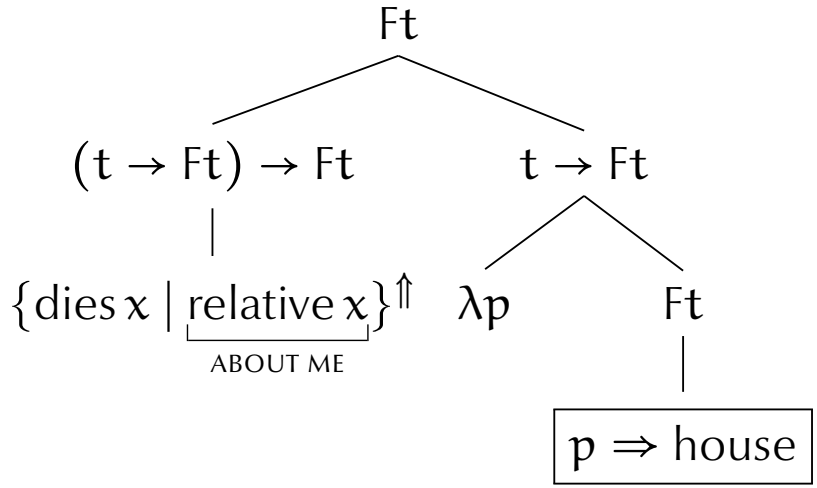
- In fact, this is not so! The grammar generates an exceptional scope reading for this case by *scoping the island*:



- The result is the same set of alternatives derived by PWFA:

$$\{\text{dies}\,x \Rightarrow \text{house} \mid \text{relative}\,x\}$$

Why does this work?



- The alternativeness induced by the indefinite is inherited by the island, and then transmitted to the conditional via $\cdot^{\Uparrow}$.
- In other words, the island is "about" relatives in **the same way** as the indefinite! $\cdot^{\Uparrow}$ simply passes this aboutness to the conditional.
- So we explain exceptional scope as the result of **LF pied-piping** (Nishigauchi 1990; von Stechow 1996): movement of the island gives the appearance of exceptional scope for things on the island.

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Compositionality (YMMV)

- The semantics is more compositional than PWFA-based grammars, which rely on syncategorematic rules for (e.g.) closure operations (see e.g. Rooth 1992; Kratzer & Shimoyama 2002):

$$[\![!X]\!]^g_{\text{PWFA}} = \{\exists p \in [\![X]\!]^g . p\}$$

- The reason: PWFA-style grammars are simply *built to point-wise compose sets*. If ever you want to do anything else (like quantify over a set), you need a new composition rule.

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Selective exceptional scope

- Datum: indefinites can take *selective* scope outside islands. E.g., the following allows an any-old-lawyer, one-rich-relative reading:

  (5) If ⟨**a good lawyer** visits **a relative of mine**⟩, I'll get a house!

- PWFA doesn't do selective scope-taking, since it only generates **flat** alternative sets:

$$[\![\langle \cdots \rangle]\!]^{i}_{\text{PWFA}} = \{x \text{ visits } y \mid \text{lawyer } x \wedge \text{relative } y\}$$

- Using this set, there's no way to give one indefinite scope over the conditional without bringing the other along for the ride.

More evidence for selectivity

- A closely related case in the domain of focus interpretation (cf. examples in Rooth 1996; Wold 1996; Beck 2006; Krifka 2006):

  (6) $[\text{John only gripes when MARY leaves the lights on}]_C$, and $[\text{JEN only gripes when } \langle \text{SUE leaves the lights on} \rangle]_{\sim C}$.

- Considering examples like these, Rooth concludes:

  > [Their] theoretical imact is quite dramatic: the recursive definition of alternatives [SC: i.e. PWFA-based semantics] has no advantage over the scoping approach to the logical form of focus. (Rooth 1996)

- It might seem that we're similarly out of luck. Won't scoping *a persuasive lawyer visits a relative of mine* (type Ft) give **both** indefinites scope over the conditional?

$$\{x \text{ visits } y \mid \text{lawyer } x \wedge \text{relative } y\}^{\Uparrow} (\lambda p. \dots)$$

Selectivity lurks

- Truu. However! An alternative derivation for the island lurks.

$$\textbf{a.relative}^{\Uparrow}\left(\lambda y.\ \boxed{\textbf{a.lawyer}^{\Uparrow}\ (\lambda x.\ \boxed{x \text{ visits } y})}\right)$$

- The key bit is the extra $\boxed{\cdot}$. This gives rise to a *higher-order* alternative set, type FFt (cf. e.g. Dayal 1996, 2002; Fox 2012):

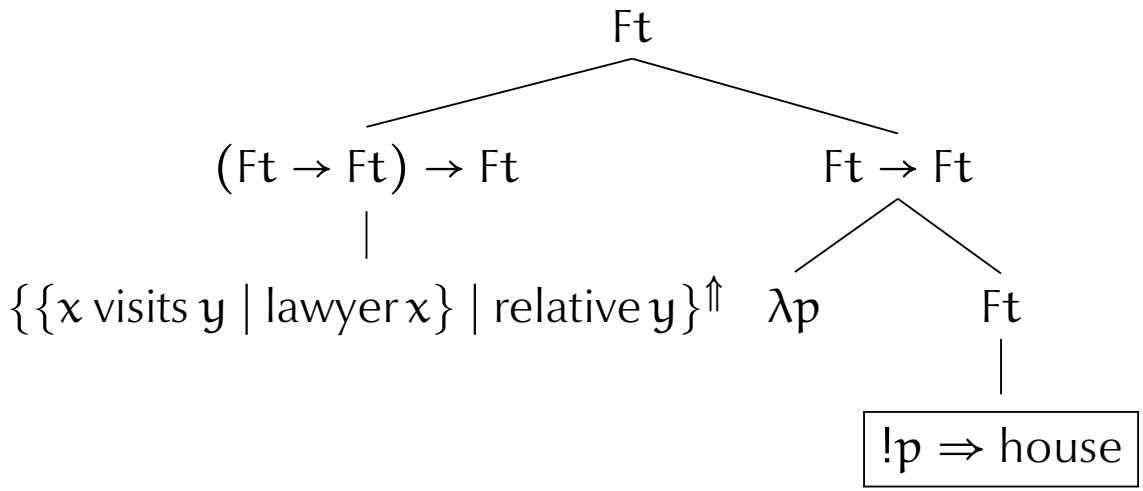
$$\{\{x \text{ visits } y \mid \text{lawyer } x\} \mid \text{relative } y\}$$

- I.e., if the lawyers are L_1 and L_2, and my relatives are R_1 and R_2:

$$\{\{L_1 \text{ visits } R_1, L_2 \text{ visits } R_1\},\ \{L_1 \text{ visits } R_2, L_2 \text{ visits } R_2\}\}$$

How it works

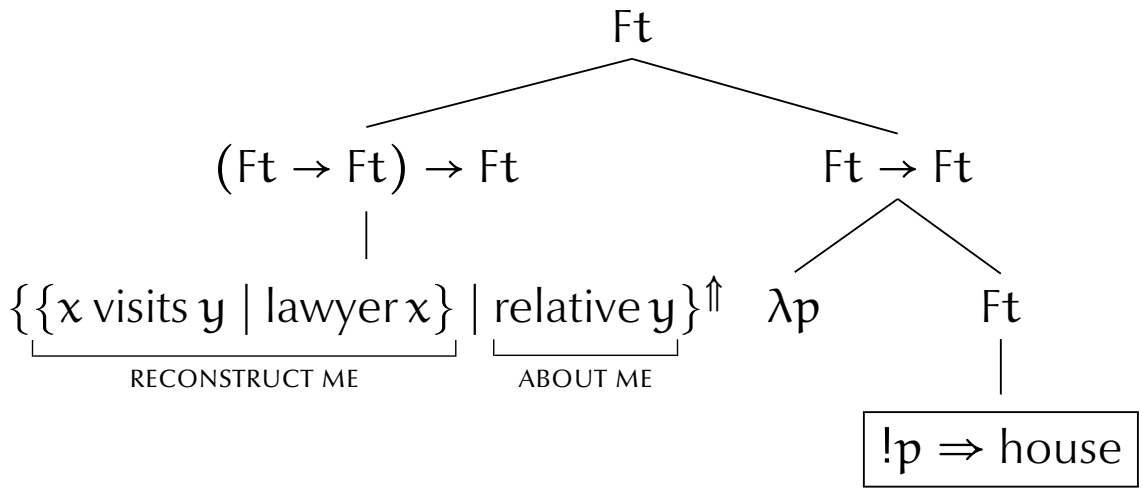
- LF pied-piping the higher-order alternative set derives the selective exceptional scope reading:



- The result is exactly what we're looking for (any-old-lawyer, one-rich-relative):

$$\{(\exists x.\, \text{lawyer}\, x \wedge x\ \text{visits}\ y) \Rightarrow \text{house} \mid \text{relative}\, y\}$$

Why it works



- The finely-articulated higher-order alternative set lets us separate the relative-alternatives from the lawyer-alternatives.
- The island, when derived in this way, **is "about" relatives in a way it *isn't* about lawyers**. $\cdot^{\Uparrow}$ spreads this aboutness to the conditional.
- The "inner" layer of alternatives **semantically reconstructs** (Cresti 1995) — i.e., gets sent back down the tree to meet !.

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Abstraction

- Binding creates headaches for PWFA (e.g. Shan 2004; Romero & Novel 2013; Charlow 2014; Ciardelli & Roelofsen to appear).
- E.g., Kratzer & Shimoyama 2002's abstraction definition, below, over-generates alternative functions. $[\![\mathfrak{n}\ X]\!]^i$ is no longer guaranteed to be "about" the same things as $[\![X]\!]^i$.

$$[\![\mathfrak{n}\ X]\!]^i = \{f \mid \forall x.\, f\, x \in [\![X]\!]^{i[\mathfrak{n} \mapsto x]}\}$$

- Problematic prediction: *nobody met a linguist* can mean that nobody met *every* linguist. See Charlow 2014 (§5.5) for details.
- Jettisoning PWFA in favor of standard FA (with $\boxed{\cdot}$ and $\cdot^{\Uparrow}$ greasing the skids) gives us access to a standard abstraction operation.

Glass houses, etc.

- Yet it may appear that we have binding issues of our own.
- Ex. (7) has a reading giving the island-bound indefinite widest scope, even as the pronoun on the island is bound by the subject.

  (7) Every linguist$_i$ is overjoyed whenever ⟨**a famous expert on indefinites** cites her$_i$⟩.

- How is this consistent with our theory? Shouldn't scoping the island over the quantifier unbind the pronoun?

Binding reconstruction

- It's true: we can't handle data like this if binding requires LF c-command (as in e.g. Heim & Kratzer 1998). Given the situation with two indefinites on an island, this comes as a surprise.
- What we require is a (minimal) shift in perspective, to a semantics that allows **binding reconstruction** à la Sternefeld 1998, 2001.
- The key to binding reconstruction is allowing things to denote *functions from assignments* into values.
- An example of how this goes for *her*$_i$ *mother, Polly*$_i$ *likes*:

$$\underbrace{(\lambda F.\, \lambda i.\, \mathrm{p}\ \text{likes}\ (F\, i^{[0 \mapsto \mathrm{p}]}))}_{\text{Polly likes \_}}\ \underbrace{(\lambda i.\, i_0\text{'s mom})}_{\text{her mom}}$$

$$= \lambda i.\, \mathrm{p}\ \text{likes p's mom}$$

Generalized fanciness

- Implementing this perspective simply means tweaking our notion of what a "fancy" meaning is.
- Echoing the theory of binding reconstruction, we'll now take fancy α's to be **functions from assignments** into sets of α's.

$$F\alpha = s \to \{\alpha\}$$

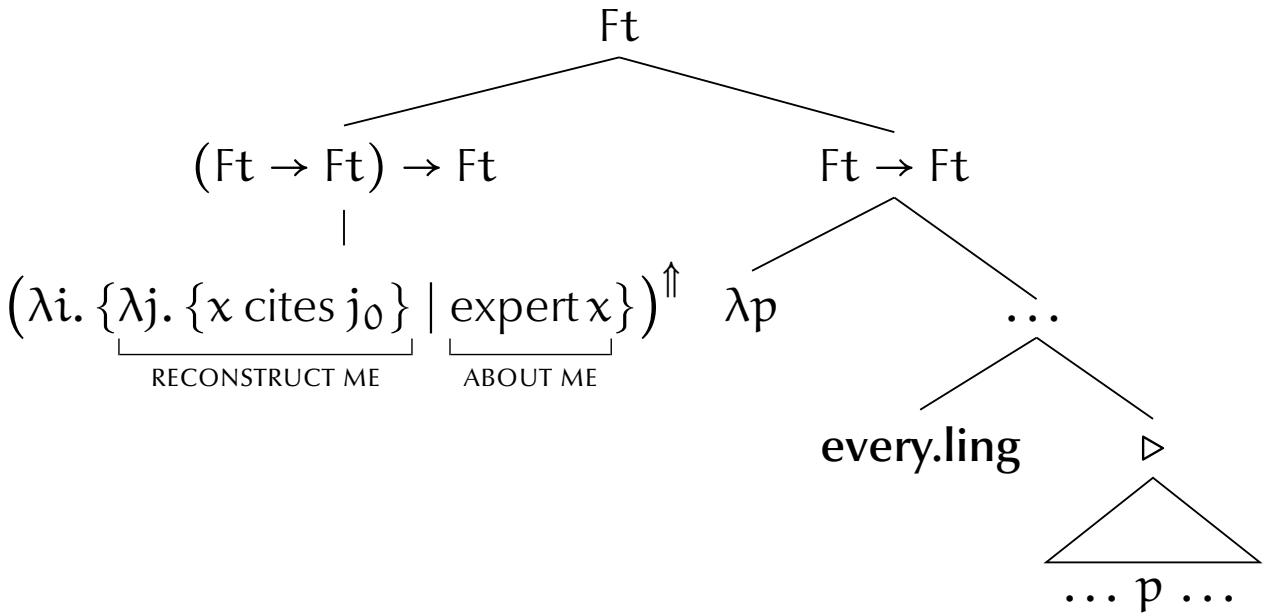
- This in turn implies minimally tweaked versions of $\boxed{\cdot}$ and $\cdot^{\Uparrow}$:[2]

$$\boxed{x} = \lambda i.\, \{x\} \qquad\qquad m^{\Uparrow} = \lambda \kappa.\, \lambda i.\, \bigcup_{x \in mi} \kappa\, x\, i$$

[2] Still a monad, still decompositions of LIFT!

How this works

- The derivation of (7) is **entirely parallel** to the two-indefinites case. We build a higher-order FFt and reconstruct the inner layer:



- The tree invokes ▷, a placeholder for your fave way to do binding (e.g. Partee 1973's Derived VP Rule, Büring 2005's β-binding).

Roofing

- We shouldn't be able to wide-scope the indefinite in **roofing** configurations (e.g. Schwarz 2001; Brasoveanu & Farkas 2011):

  (8) No candidate$_i$ submitted a paper he$_i$ wrote.

- We make the correct prediction. Here's how we'd go about trying to give this indefinite scope over the subject:

$$\overbrace{(\lambda \mathbf{i}.\,\{\mathbf{y} \mid \underbrace{\mathbf{i}_0 \text{ wrote } \mathbf{y}}_{\text{ABOUT ME}}\})}^{[\![\text{a paper he}_0\ \text{wrote}]\!]}{}^{\Uparrow}\ (\lambda \mathbf{y}.\,\textbf{no.cand}\ (\lambda \mathbf{x}.\,\boxed{\mathbf{x} \text{ submit } \mathbf{y}}\,)^{\triangleright})$$

- The resulting set of propositions are "about" things that $\mathbf{i}_0$ wrote (given an assignment $\mathbf{i}$). Binding fails!

Roofing (cont.)

- This improves on choice-functional accounts of exceptional scope (e.g. Reinhart 1997), which can assign roofed indefinites a kind of wide scope (Schwarz 2001; see also Geurts 2000):

$$\exists f.\ \textbf{no.candidate}\ (\lambda x.\ x \text{ submitted } (f\ \{y \mid x \text{ wrote } y\}))$$
$$\approx \text{no candidate submitted } \textit{every} \text{ paper he wrote}$$

- About which Heim 2011 remarks:

> We may have to concede what Fodor and Sag and most subsequent authors wanted to avoid: indefinites are existential quantifiers that enjoy a greater degree of scopal mobility.... (Heim 2011: 1022)

- I hope to have shown that we *don't* have to concede this.

Where we are

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Basic data

- A familiar data point: Indefinites behave more like names than quantifiers with respect to anaphoric phenomena.

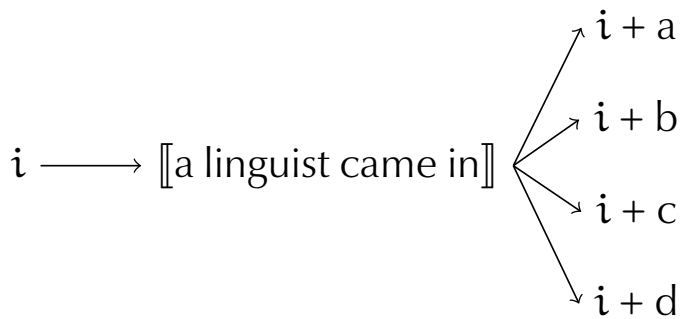
  (9) $\{\text{Polly}_i, \text{a linguist}_i, \text{*every linguist}_i\}$ came in. She_i sat.

Discourse referents

- Dynamic semantics: sentences add discourse referents to the "conversational scoreboard" (e.g. Groenendijk & Stokhof 1991):

$$\mathfrak{i} \longrightarrow [\![\text{Polly came in}]\!] \longrightarrow \mathfrak{i} + \mathfrak{p}$$

- Indefinites (but not quantifiers) also set up discourse referents. In case four linguists came in — a, b, c, and d — we'll have:



- Formally captured by modeling meanings as relations on states. For example, here is a candidate meaning for *a linguist came in*:

$$\lambda \mathfrak{i}.\, \{\mathfrak{i} + \mathfrak{x} \mid \text{linguist}\, \mathfrak{x} \wedge \text{came}\, \mathfrak{x}\}$$

Extending

- It's straightforward to fold dynamics into the present perspective!
- Dynamics relies on the ability to output modified assignments (indeed, given indefinites, to output *alternative* assignments).
- One way to think of this is in terms of a new "fancy" type:

$$\mathsf{F}\,a ::= s \to \{\langle a, s\rangle\}$$

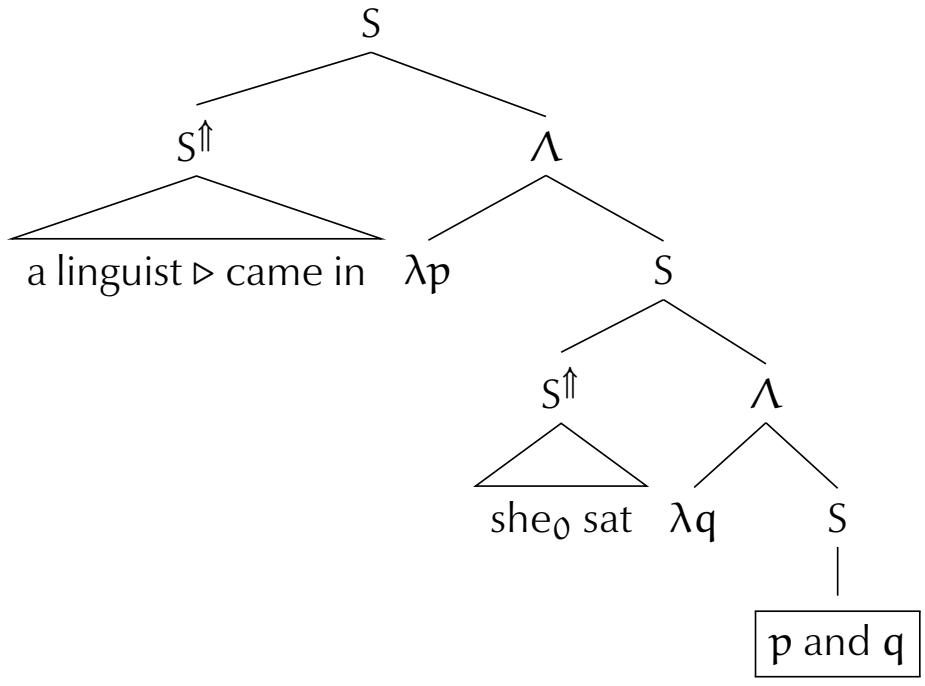
- An upgrade from the previous semantics, where $\mathsf{F}\,a ::= s \to \{a\}$.
- The relevant $\boxed{\cdot}$ and $\cdot^{\Uparrow}$ again essentially follow from the types:[3]

$$\boxed{x} = \lambda i.\, \{\langle x, i\rangle\} \qquad\qquad m^{\Uparrow} = \lambda \kappa.\, \lambda i.\, \bigcup_{\langle x,j\rangle \in m\,i} \kappa\, x\, j$$

[3] *Still* a monad, *still* decompositions of LIFT!

Dynamic binding via LF pied-piping

- Remarkably, rejiggering the semantics in this way predicts that dynamic binding *also* arises via a kind of LF pied-piping:



- Unlike standard dynamic approaches, this derivation doesn't require a notion of dynamic conjunction.
  - In keeping with the approach I've been advocating, conjunction is boring and interacts with fancy things via $\boxed{\cdot}$ and $\cdot^{\Uparrow}$.

Summing up

$F a$	$\boxed{x}$	$m^{\Uparrow}$	$[\![\texttt{a linguist}]\!]^{Fe}$	$[\![\texttt{she}_0]\!]^{Fe}$
a	x	$\lambda\kappa.\,\kappa\, m$	N/A	i_0
$\{a\}$	$\{x\}$	$\lambda\kappa.\,\bigcup_{x \in m} \kappa\, x$	$\{x \mid \mathrm{ling}\, x\}$	$\{i_0\}$
$s \to \{a\}$	$\lambda i.\,\{x\}$	$\lambda\kappa.\,\bigcup_{x \in mi} \kappa\, x\, i$	$\lambda i.\,\{x \mid \mathrm{ling}\, x\}$	$\lambda i.\,\{i_0\}$
$s \to \{\langle a, s\rangle\}$	$\lambda i.\,\{\langle x, i\rangle\}$	$\lambda\kappa.\,\bigcup_{\langle x,j\rangle \in mi} \kappa\, x\, j$	$\lambda i.\,\{\langle x, i\rangle \mid \mathrm{ling}\, x\}$	$\lambda i.\,\{\langle i_0, i\rangle\}$

Progressively enriching a grammar to handle alternatives, alternatives with assignment-sensitivity, and alternatives with assignment modification.

Where we are

Concluding

- My bottom line: if you want alternatives, let them take scope.[4]
- $\boxed{\cdot}$ and $\cdot^{\Uparrow}$ allow a robust account of alternatives, avoiding many of the pitfalls of PWFA (and other theories of exceptional scope).
- The approach is **really** flexible:
  - Folding in dynamics is a piece of cake.
  - Suggests that dynamic and alternative semantics have all along been palping different parts of the indefiniteness elephant.

[4]The centrality of scope-taking to natural language semantics has likewise been emphasized in work on *continuations* (e.g. Barker & Shan 2014).

Last words

- I focused on English indefinites, but the same strategy allows us to give parallel, empirically robust accounts of focus and in situ *wh*:

> The group of island-escaping operators does not appear to be an arbitrary one.... [Their] semantic similarity, together with the common insensitivity to scope islands, suggest that we should not be satisfied with a theory which treats focus as sui generis. We would like to replace the focus-specific definition with a theory in which focus is one of a family of island-insensitive operators which, roughly, use restricted variables to name families of propositions, open propositions, and/or their existential closures. It is not at all clear to me how this should be done. (Rooth 1996)

- I hope to have shed some light on this. Thanks!

References

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