# *Ellipsis, binding, & Logical Form*

*Patrick D. Elliott*

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## 1 *Focus: the semantics of alternatives*

- A PROBLEM FOR THE SAG-WILLIAMS ACCOUNT:
- Consider the following example of the familiar strict-sloppy ambiguity, from Mats Rooth (1993):

(1) John$^{1}$'s coach [$_{\text{VP}}$ thinks that he$_{1}$ has a chance], and Bill$^{2}$'s coach does Δ too.

a. $\Delta$ = *Bill's coach thinks that John has a chance*

b. $\Delta$ = *Bill's coach thinks that Bill has a chance*

- Mats Rooth (1993) observes that the sloppy reading of (21) is difficult to account for according to the Sag-Williams account, according to which only material in the antecedent VP is relevant.
- Since the subject is *John's coach*, rather than *John*, there is no candidate VP-internal $\Lambda$-binder, which could bind the pronoun.

(2) $\text{VP}_{A} = [_{\text{VP}}\ \Lambda_{2}\ t_{2}$ thinks that $pro_{1}$ has a chance]

- Intuitively, what's gone wrong here is that, according to the Sag-Williams account, sloppy-readings are contingent on ellipsis-site-internal binders.
- Mats Rooth's innovation is to develop a theory of ellipsis identity that is sensitive to both E-site internal and E-site external material.
- In order to understand Mats Rooth's theory of ellipsis, we're going to need to learn about Mats Rooth's theory of focus interpretation via *alternative semantics*.
- ALTERNATIVES IN COMPOSITIONAL SEMANTICS:
- *Alternatives* play a crucial role in a variety of different semantic phenomena. A brief selection:
  - As we learned in Yasu and Daniele's class on the *exhaustivity operator*, scalar implicature involves negating *alternatives*.

(3) Daniele is required to email Gennaro or Nino.

$$\rightsquigarrow \neg\phi : \phi \in \left\{\begin{array}{l}\text{Daniele is required to email Gennaro}\\ \text{Daniele is required to email Nino}\\ \text{Daniele is required to email Gennaro and Nino}\\ \ldots\end{array}\right\}$$

- The meaning of a *question* is a set of alternatives – the possible answers to the question (Hamblin 1973, Karttunen 1977):

(4) $[\![\text{who left?}]\!] = \left\{\begin{array}{l}\text{Homer left,}\\ \text{Bart left,}\\ \text{Lisa left,}\\ \ldots\end{array}\right\}$

- The semantics of focus-sensitive operators, such as *only* make reference to alternatives, mediated by focus.

(5) Only $\text{H}{\small\text{OMER}}_F$ left. $\Rightarrow \neg\phi : \phi \in \left\{\begin{array}{l}\text{Bart left}\\ \text{Lisa left}\\ \text{Maggie left}\\ \ldots\end{array}\right\}$

- We'll concentrate on the final case, develop a *compositional* semantics for alternatives and focus-sensitivity based on Hamblin (1973), Mats Edward Rooth (1985), etc.
- This is going to be crucial for stating the conditions under which sloppy readings are licensed.
- A THEORY OF FOCUS INTERPRETATION:
- In order to get our theory of focus interpretation off the ground, we're going to start by considering the simple case:

(6) Only $\text{H}{\small\text{OMER}}_F$ left.

- In order to state a semantics for *only*, we need to have access both to the ordinary semantic value of the prejacent, and its *alternatives*.
- The meaning of a sentence with *only* depends on the placement of *focus*.

(7) a. Homer only thinks that $\textsc{Marge}_F$ likes Lisa.
$\rightsquigarrow$ *Homer thinks that Marge likes Lisa*
*and* $\forall x \in \mathsf{alt}(\textit{Marge})$, *Homer doesn't think that x likes Lisa*

b. Homer only thinks that Marge likes $\textsc{Lisa}_F$.
$\rightsquigarrow$ *Homer thinks that Marge likes Lisa*
*and* $\forall x \in \mathsf{alt}(\textit{Lisa})$, *Homer doesn't think that Marge likes x*

- F-marking introduces *alternatives* into the semantic computation. It has the following semantics:

(8) $x_F \coloneqq (x, \{\, y \mid \mathsf{alt}_x\, y \,\})$

- A focused expression $x_F$ denotes a *pair*, the first member of which is the *ordinary semantic value* – namely, $x$ – and the second member of which is the *focus semantic value* – namely, the set of expressions $y$ that are alternatives to $x$.
- The function alt is simply a black-box to stand in for whatever theory of alternatives we end up adopting (see, e.g, Katzir 2008, Fox & Katzir 2011)
- For now, we can assume that $alt_x\, y$ iff $x$ and $y$ are of the same type, and $x \neq y$.

(9) $$\mathsf{Homer}_F = \left(\mathsf{Homer}, \left\{\begin{matrix}\mathsf{Bart,} \\ \mathsf{Lisa,} \\ \mathsf{Marge,} \\ \ldots\end{matrix}\right\}\right)$$

- Now let's define a type constructor F from a ordinary type a, to a *pair type* consisting of as, and sets of as.

(10) The focus type-constructor (def.)
$$\mathsf{F\,a} \coloneqq \begin{pmatrix}\mathsf{ord} :: \mathsf{a}, \\ \mathsf{foc} :: \{\, a \,\}\end{pmatrix}$$

(11) $\mathsf{Homer}_F \coloneqq \mathsf{F\,e}$

- Just as before, we face the problem of gluing together an alternative-sensitive expression with ordinary semantic composition.

✗

| F e | e → t |
|---|---|
| HOMER$_F$ | left |

- Now let's define a unary type-lifter $\eta$, that shifts ordinary values to inhabitants of F, and a binary operation $\circledast$ for composing inhabitants of F.[1]

(12) a. $x^{\eta} \coloneqq (x, \{\, x \,\})$

b. $(f, \mathbb{g}) \circledast (x, \mathbb{y}) \coloneqq \begin{pmatrix} f\,x, \\ \{\, g\,y \mid g \in \mathbb{g} \wedge y \in \mathbb{y} \,\} \end{pmatrix}$

- The $\eta$-shifter returns a *pair* of values – the input value $a$, and the characteristic function of the singleton set $\{\, a \,\}$.
- $\circledast$ does ordinary composition (function application) on the ord values of its arguments, and *pointwise* function application on the foc values of its arguments.
- Note that we're also going to be dealing with *intensions*, for technical reasons.
- In the current setting, we can think of predicates as inherently intensional by giving them an outermost world argument.

(13) $\mathsf{left} = \lambda w \,.\, \lambda x \,.\, \mathsf{left}_w\, x$

$\coloneqq \mathsf{s} \rightarrow \mathsf{e} \rightarrow \mathsf{t}$

- Now we simply define an $\eta$ and a $\circledast$ for dealing with worlds – the definitions turn out to be identical to our shifters for dealing with assignment-sensitivity.
- $\eta$ shifts an ordinary meaning to a trivially *intensional* meaning.
- $\circledast$ is an enriched form of function application that we use to compose intensional meanings.

(14) a. $a^{\eta} = \lambda w \,.\, a$

b. $\mathbb{f} \circledast \mathbb{x} = \lambda w \,.\, \mathbb{f}\, w\, (\mathbb{x}\, w)$

- We can easily stack our shifters via function composition. Consider for example $\mathsf{F} \circ \mathsf{S}$ (the composition of world-sensitivity with alternative-sensitivity).[2]

[1] $\langle \mathsf{F}, \eta, \circledast \rangle$ constitutes an *applicative functor*. This guarantees that is is *composable* with other applicative functors, providing us with assurance that our theory of focus will play nicely with other applicative machinery.

[2] Note that all of the enriched dimensions of meaning that we're dealing with come with accompanying $\eta$ and $\circledast$ shifters. I'll going to assume that $\eta$ and $\circledast$ have the meanings that are necessary in order for composition to proceed.

(15) a. $a^\eta = ([\lambda w\ .\ a], \{\, \lambda w\ .\ a \,\})$

b. $(\mathbb{f}, \mathbb{g}) \circledast (\mathbb{x}, \mathbb{y}) \coloneqq \begin{pmatrix} \lambda w\ .\ \mathbb{f}\ w\ (\mathbb{x}\ w), \\ \{\, \lambda w\ .\ g\ w\ (y\ w) \mid g \in \mathbb{g} \wedge y \in \mathbb{y} \,\} \end{pmatrix}$

(16)

$(\lambda w\ .\ \mathsf{left}_w\ \mathsf{Homer}, \{\, \lambda w\ .\ \mathsf{left}_w\ x \mid \mathsf{alt}_H\ x \,\})$
$(\mathsf{F} \circ \mathsf{S})\ \mathsf{t}$
$\circledast$

$(\lambda w\ .\ \mathsf{Homer}, \{\, x \mid \mathsf{alt}_H\ x \,\})$
$(\mathsf{F} \circ \mathsf{S})\ \mathsf{e}$
$\mathsf{Homer}_F$

$(\lambda w\ .\ \mathsf{left}_w, \{\, \lambda w\ .\ \mathsf{left}_w \,\})$
$(\mathsf{F} \circ \mathsf{S})\ (\mathsf{e} \to \mathsf{t})$
$\mathsf{left}^\eta$

- We can now posit a meaning for *only* that is alternative-sensitive.

(17) $\mathsf{only} = \lambda \langle p, \mathbb{p} \rangle .\ \lambda w\ .\ p\ w \wedge \forall q \in \mathbb{p} [\neg\ (q\ w)]$

(18) a. $\mathsf{only}\ (\lambda w\ .\ \mathsf{left}_w\ \mathsf{Homer}, \{\, \lambda w\ .\ \mathsf{left}_w\ x \mid \mathsf{alt}_H\ x \,\})$

b. $= \lambda w\ .\ \mathsf{left}_w\ \mathsf{Homer}\ \wedge \forall q \in \begin{Bmatrix} \lambda w\ .\ \mathsf{left}_w\ \mathsf{Bart} \\ \lambda w\ .\ \mathsf{left}_w\ \mathsf{Lisa} \\ \lambda w\ .\ \mathsf{left}_w\ \mathsf{Maggie} \\ \ldots \end{Bmatrix} [\neg q\ w]$

- ROOTH'S THEORY OF ELLIPSIS IDENTITY:
- Now that we have a way of constructing alternative-sets compositionally, we Can reconstruct Rooth's parallelism condition.

(19) For ellipsis of EC to be licensed, there must exist a *Parallelism Domain* (PD).

(20) *Parallelism Domain:*

An XP is a PD of EC iff:

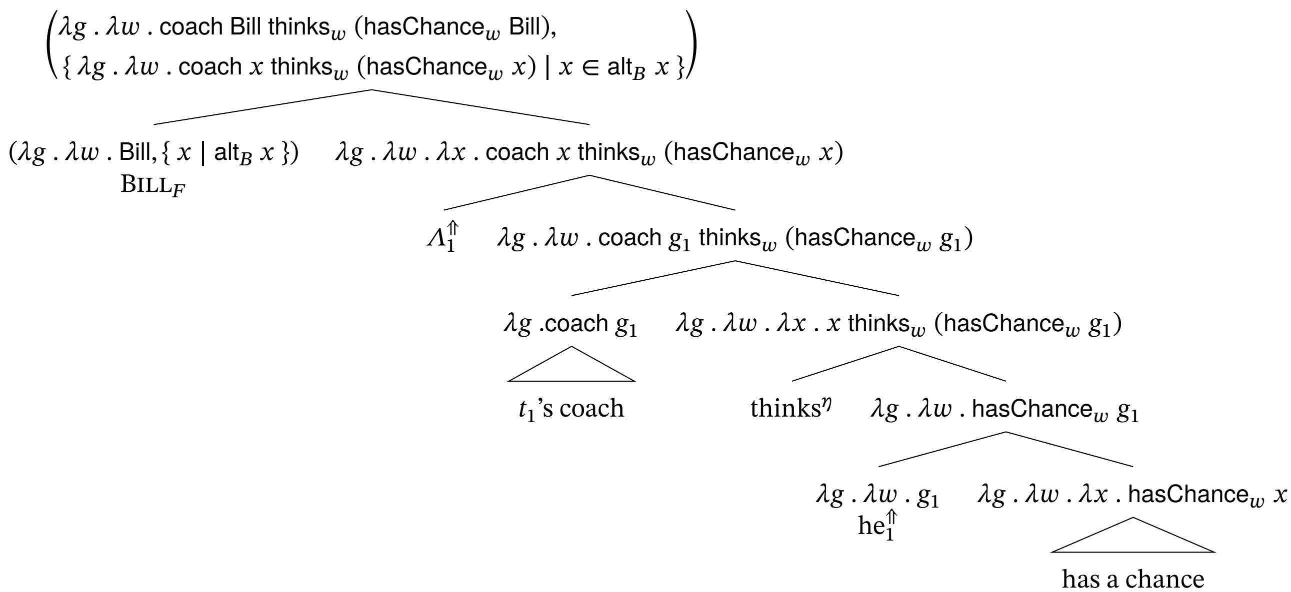
a. XP reflexively dominates EC.

b. There exists a constituent $\phi$ in the focus-semantic value of XP, s.t. $[\![\phi]\!] = [\![\mathrm{AC}]\!]$.

- Let's go back to our problematic examples:

(21) $\overbrace{\text{JOHN}^1_F\text{'s coach [}_{\text{VP}}\text{ thinks that he}_1\text{ has a chance]}}^{\text{AC}}$,
and $\underbrace{\text{BILL}^2_F\text{'s coach does think that he}_B\text{ has a chance}}_{\text{PD}}$ too.

(22)




- Under the sloppy reading then, the focus-semantic value of the PD is the following set:

(23)
$$\left\{\begin{array}{l}\lambda g\,.\,\lambda w\,.\,\text{coach Sally thinks}_w\ (\text{hasChance}_w\ \text{Sally}),\\ \lambda g\,.\,\lambda w\,.\,\text{coach John thinks}_w\ (\text{hasChance}_w\ \text{John}),\\ \ldots\end{array}\right\}$$

- A member of this set is identical to the ordinary-semantic value of the antecedent clause!

## 2 *Re-binding*

### 2.1 *Re-binding vs. internal binding*

- The Sag-Williams account of the strict-sloppy ambiguity makes a straightforward prediction *internal binding* as in (25), is allowed, but *re-binding* as in (24), is not.

(24) *Re-binding* ✗

a. [ ... $\Lambda_1$ ... [$_{AC}$ ... *pro*$_1$ ... ]]

b. [ ... $\Lambda_2$ ... [$_{EC}$ ... *pro*$_2$ ... ]]

(25) *Internal binding* ✓

a. [ ... [$_{AC}$ ... $\Lambda_1$... *pro*$_1$ ... ]]

b. [ ... [$_{EC}$ ... $\Lambda_2$ ... *pro*$_2$ ... ]]

- In other words, *sloppy identity* requires an EC-internal binder, and a corresponding AC-internal binder.

## 2.2 *Evidence for the Sag-Williams position*

- Internal binding should only be possible if the understood antecedent of the variable is the sister of the EC. *Parallelism* therefore rules out (26b).

(26) a. Jorge said that Tanya likes him$_J$,
and IVAN also did $\lambda\, x\, .\, x$ say that Tanya likes $x$.

b. *Jorge said that Tanya likes him$_J$,
and IVAN also $\lambda\, x\, .\, x$ said that she does $\lambda\, y\, .\, y$ like $x$.

- Consider also the following example from Fox & Takahashi (2005: p. 225), where wh-movement creates the re-binding configuration:[3]

(28) a. John knows which professor we invited,
but he is not allowed to reveal which one $\lambda\, x\, .\, x$ we invited $x$.

b. *John knows which professor we invited,
but he is not allowed to reveal
which one $\lambda\, x$ . we did $\lambda\, y\, .\, y$ invite $x$.

[3] Note that, because of the possibility of *successive-cycle wh-movement*, it is not immediately obvious that the parallelism condition rules out the configuration in (28).
Concretely, why can't wh-movement leave behind an intermediate trace adjacent to the EC?

(27) which one $\lambda\, x$ . we did $t_x$
$\lambda\, x\, .\, \lambda y\, .\, y$ invite $x$

## 2.3 *Evidence against the Sag-Williams position*

- Sometimes, it looks like sloppy identity is possible even where internal binding is not:

(29) Jorge insists that Tanja likes him,
but IVAN $\lambda\, x\, .\, x$ DENIES that she does $\lambda\, y\, .\, y$ like $x$

- The same point goes for rebinding configurations created by movement (Fox & Takahashi 2005: p 226):

(30) Mary doesn't know who we can invite,

but she can tell you who $\lambda x$ . we can NOT $\lambda y . y$ invite $x$

- The empirical generalization that Fox & Takahashi (2005) suggest is the following:

(31) *Intervening focus:*

when a focused-expression intervenes between the re-binder and and the re-bound variable, ellipsis is licensed.

## 3 Enter MAXELIDE

(32) MAXELIDE (alpha version)Elide the largest deletable constituent.

In all of our unacceptable cases, there was a bigger constituent that *could've* been deleted.[4]

[4] VP-ellipsis conditions the spell-out of T, which distracts from the parallel between (33a) and (33b). I've used *do*-insertion here to draw attention to the parallel, even though it sounds a little unnatural.

(33)• Jorge said that Tanya likes him$_J$

a. ...and IVAN also did $\lambda x . x$ say that she does $\lambda y . y$ like $x$.

b. *...and IVAN also did $\lambda x . x$ say that she does $\lambda y . y$ like $x$.

- In the acceptable cases, however, the presence of an intervening focus blocks deletion of the larger constituent.
- (34a) isn't a candidate deletion, since it violates the parallelism condition.

(34) Jorge insists that Tanja likes him,

a. ✗...but IVAN $\lambda x . x$ DENIES that she does $\lambda y . y$ like $x$

b.✓...but IVAN $\lambda x . x$ DENIES that she does $\lambda y . y$ like $x$

### *3.1 Circumvention of MaxElide*

- It's not hard to come up with counter-examples to MaxElide:

(35) Jorge said that Tanya likes Ivan,

   a. ...Robert also said she does like Ivan.

   b. ...Robert also did say that she likes Ivan.

(36) MaxElide (beta version)

Elide the biggest deletable constituent if EC contains a variable that is free within EC.

- The constraint in (36) is still not quite general enough. Fox & Takahashi (2005) observe that it fails to rule out *co-binding* configurations:

(37) I know which puppy $\lambda\ x$ . ...

   a. ...you said Mary would adopt
   and Fred did say she would adopt $x$ too.

   b. ...you said Mary would adopt
   and Fred said she would adopt $x$ too.

- In *co-binding*, unlike *re-binding* configurations the variables free within AC and EC are re-bound by the same re-binder.
- Fox & Takahashi (2005) suggest the following refinement of MaxElide:

(38) MaxElide 1.0

Elide the biggest deletable constituent in a re-binding configuration.

A re-binding configuration is a structure in which EC dominates a variable that is free within EC and is bound by a binder YP outside of EC, and there is no variable in AC also bound by YP.

- This seems to get the right empirical coverage, but is it plausible that such a complicated principle is codified in the grammar? Can it be reduced to more basic principles?

## 4 *Fox & Takahashi's (2005) proposal*

- Fox & Takahashi (2005) propose that, in order to understand where MAXELIDE applies, we must expand the domain in which the parallelism condition applies beyond just what is deleted.
- Instead, Fox & Takahashi adopt Rooth's parallelism condition, which we discussed in the previous section.

(39) For ellipsis of EC to be licensed, there must exist a *Parallelism Domain* (PD).

(40) *Parallelism Domain:*

An XP is a PD of EC iff:

a. XP reflexively dominates EC.

b. There exists a constituent $\phi$ in the focus-semantic value of XP, s.t. $[\![\phi]\!] = [\![\text{AC}]\!]$.

- Fox & Takahashi propose that MAXELIDE is relativized to the PD:

(41) MAXELIDE 1.1

Elide the biggest deletable constituent reflexively dominated by a PD.

- Let's see how this accounts for MAXELIDE circumvention.

(42) Jorge said that Tanya likes Ivan,

a. ...ROBERT also said she does like Ivan.

b. ...ROBERT also did say that she likes Ivan.

- In the above example, both possible ellipses are PDs, and therefore MAXELIDE is trivially satisfied.
- In re-binding configurations however, the PD must at least contain the binder, and MAXELIDE 1.1 demands deletion of the biggest constituent within the PD.

(43) Jorge said that Tanya likes $\text{him}_J$

a. ...and IVAN also did [$_{PD}$ $\lambda\, x \,.\, x$ say that she does $\lambda\, y \,.\, y$ like $x$].

b. *...and IVAN also did [$_{PD}$ $\lambda\, x \,.\, x$ say that she does $\lambda\, y \,.\, y$ like $x$].

- Just as before, intervening focus shrinks the candidates for deletion:

(44) Jorge insists that Tanja likes him,

a. ✗...but IVAN [$_{PD}$ $\lambda\, x \,.\, x$ DENIES that she does $\lambda\, y \,.\, y$ like $x$]

b.✓...but IVAN [$_{PD}$ $\lambda\, x \,.\, x$ DENIES that she does $\lambda\, y \,.\, y$ like $x$

- Things get a little more interesting with *co-binding* configurations.

(45) I know which puppy $\lambda\, x$ . ...

a. ...you said Mary would adopt $x$
and Fred did [$_{PD}$ say she would adopt $x$] too.

b. ...you said Mary would adopt $x$
and Fred said she would [$_{PD}$ adopt $x$] too.

- Fox & Takahashi's idea is that, since in (45b), the variables in AC and EC are bound by the same binder, they share the same variable name, and therefore the embedded VP is also a PD.
- This is trivially the case – $\lambda g \,.\, \textsf{adopt}\ g_x = \lambda g \,.\, \textsf{adopt}\ g_x$ for all assignments.
- In co-binding configurations, circumvention of MAXELIDE crucially depends on identity of variable names.
- This begs the question: what prevents us from *always* circumventing MaxElide by simply always picking identical variable names, even when the re-binders are distinct?, i.e.

(46) a. [ ... $\lambda\, x$ ...[$_{AC}$ ... $x$ ... ]]

b. [ ... $\lambda\, x$ ...[$_{EC}$ ... $x$ ... ]]

- To block this possibility, Fox & Takahashi make recourse to Heim's *no meaningless co-indexation* constraint (Heim 1997).

(47) *No meaningless co-indexation*

If an LF contains an occurrence of a variable $v$ that is bound by a node $\alpha$, then all occurrences of $v$ in this LF must be bound by the same node as $\alpha$.

## 5 *Re-binding and covert movement*

- It is well known that QR can create a re-binding configuration.
- First off, observe that a quantificational object can take wide scope out of the EC.

(48) A doctor treated every patient.
A NURSE did treat every patient too. $\exists > \forall; \forall > \exists$

(49) a. AC: every patient $\lambda\, x$ a doctor treated $x$

b. EC: every patient [$_{\text{PD}}$ $\lambda\, y$ A NURSE treated $y$]

- Since *a nurse* is focused, the VP is indeed the biggest deletable constituent in the PD.
- If covert movement can create a re-binding configuration, we expect that there should be circumstances under which sloppy identity is ruled out.

(50) At least one doctor tried to get me to arrest every patient,

a. ...and at least one NURSE tried to get me to arrest every patient as well. $\exists > \forall; {}^{*}\forall > \exists$

b. ...and at least one NURSE did try to get me to arrest every patient as well. $\exists > \forall; {}^{?}\forall > \exists$

## 6 *Re-binding and scope*

- question here: is re-binding about *covert movement*, or *scope*?

(51) Each brother hopes that old age will kill a certain relative of theirs soon, and each sister hopes that it will too.

(52) Each brother hopes that old age will kill a certain relative of theirs soon, and each sister does too.

(53) Every farmer who owns a donkey$^x$ asked Mary to beat it$_x$, and every LANDLORD who owns a donkey did too.

(54) Every farmer who owns a donkey$^x$ asked Mary to beat it$_x$, and every LANDLORD who owns a donkey asked her to as well.

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