Intensional independence without world variables in LFG+Glue

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1 Introduction: intensionality with an 's'

Extensional and intensional contexts

(1) Elizabeth is Queen of the UK and Harald is King of Norway ↔ Elizabeth is Queen of Australia and Harald is King of Norway .

Extensional context: substitution of coreferential expressions preserves truth value.

(2) Malcolm knows/believes/recognizes/cares that Elizabeth is Queen of the UK. $\not\leftrightarrow$ Malcolm knows/believes/recognizes/cares that Elizabeth is Queen of Australia.

Intensional context: substitution of coreferential expressions does not necessarily preserve truth value.

Examples of intensional contexts

- Propositional attitudes

  Malcolm thinks/hopes/fears/wishes that ____.

- Modals

  ____ is possible/necessary/obligatory/permitted/obvious.

- Counterfactual conditionals

  If ____, then Sarah would be better known.

Possible worlds semantics

The mainstream approach:

	Extension	Intension	
Sentence	Truth value	Function from possible worlds to truth values	(*proposition*)
Name	Entity	Function from possible worlds to entities	(*individual concept*)

We might take other parameters in addition to possible worlds, most notably times, but these have been left out for simplicity of exposition.

(Non-specific) *de re* / *de dicto*

de re vs. *de dicto* is very old terminology in philosophy, but as far as I know the distinction between specific and non-specific *de re* was first noted by Fodor (1970).

(3) Anna wants a left-handed player to win.

a. Specific *de re*:
$\Rightarrow$ $\exists x.\mathsf{LHP}' x w_@ \wedge \mathsf{want}'\mathsf{anna}'(\mathsf{win}' x) w_@$

b. Non-specific *de re*:
$\Rightarrow$ $\mathsf{want}'\mathsf{anna}'(\lambda w.\exists x.\mathsf{LHP}' x w_@ \wedge \mathsf{win}' x w) w_@$

c. *de dicto*:
$\Rightarrow$ $\mathsf{want}'\mathsf{anna}'(\lambda w.\exists x.\mathsf{LHP}' x w \wedge \mathsf{win}' x w) w_@$

(Where $w_@$ denotes the actual world)

Example of the specific *de re* reading: Anna is a massive fan of Petra Kvitová (who plays left-handed), and wants her to win (the Wimbledon tennis championship).

Example of the non-specific *de re* reading: The left-handed players in the championship are Petra Kvitová and Markéta Vondroušová. Anna wants *one of them* to win, although she may not even know they are left-handed—perhaps because they're both Czech and she wants a Czech player to win (but doesn't mind which).

Example of the *de dicto* reading: Anna is superstitious and thinks the world will be better if a left-handed player wins, although she doesn't know anything about any of the players.

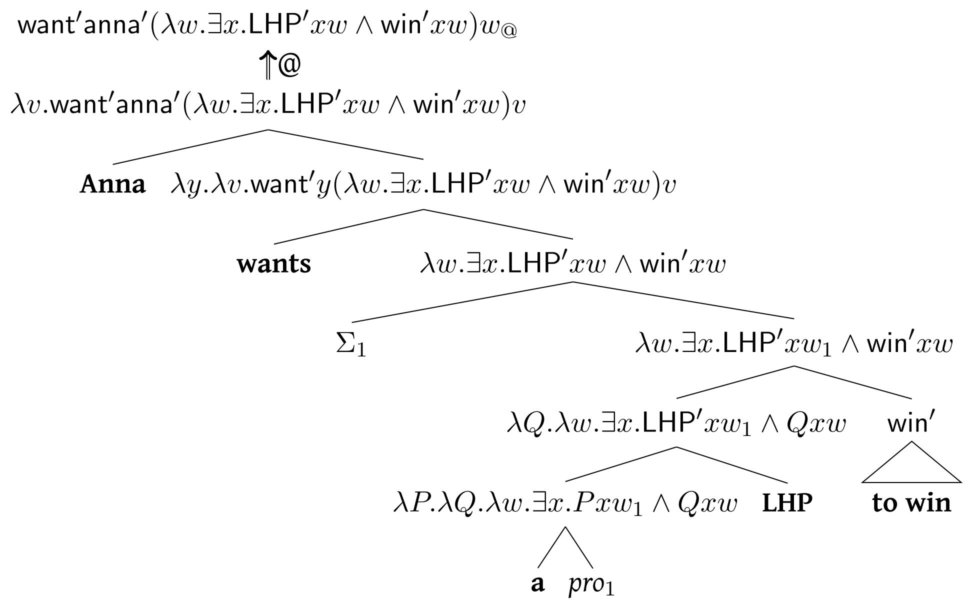
2 Background

2.1 Two theories of intensionality

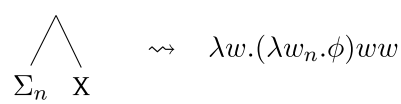
The Binding Theory of Intensionality (BTI)

- Certain lexical items combine with world (or situation) 'pronouns' in the syntax.
- Like personal pronouns, they are interpreted as variables (but over worlds not individuals).
- Intensional status is determined by the level at which these pronouns are 'bound'.

The *de dicto* reading of (3) according to Schwarz (2012)

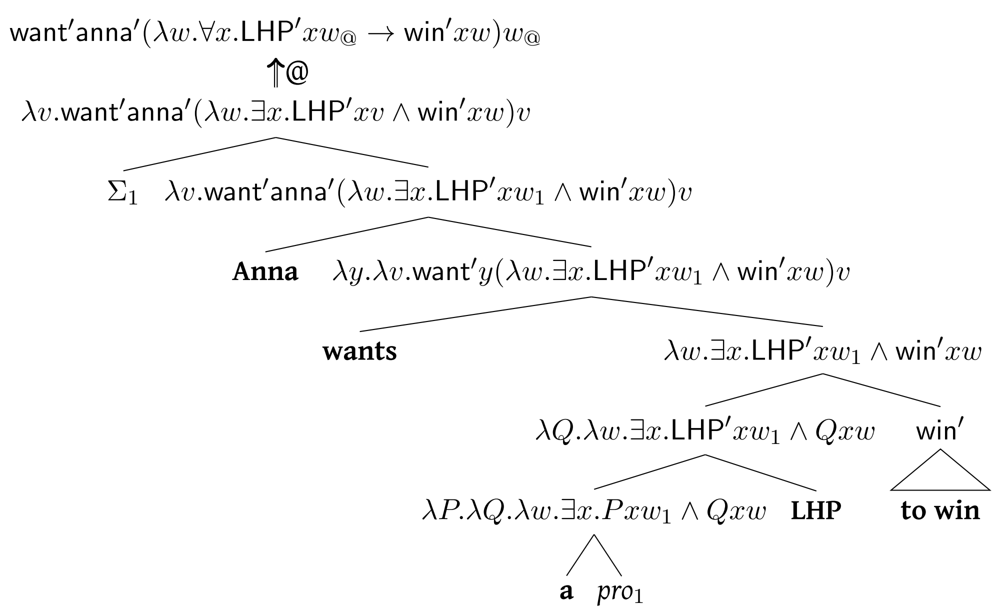


In this framework, Σ_n is an operator that binds the free world pronoun *pro*$_n$. It can be inserted as the sister to any sentential tree node. The implied translation rule for Σ_n is that if X$\rightsquigarrow \phi$, then

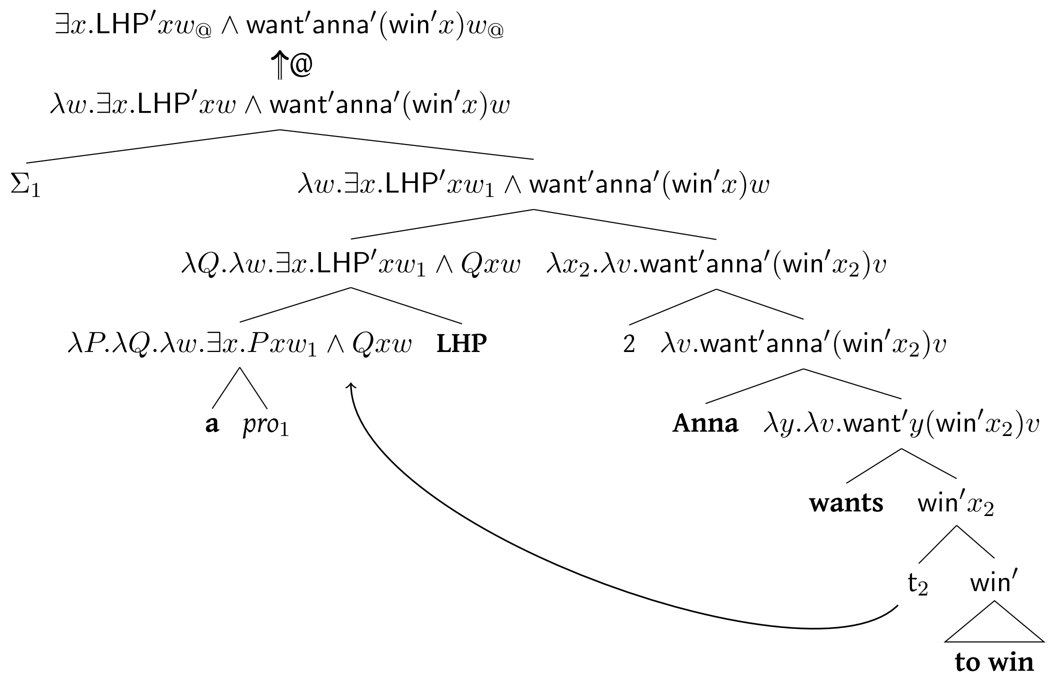


@ is notation I've adopted to indicate evaluation of a formula relative to the actual world.

The non-specific *de re* reading of (3) according to Schwarz (2012)



The specific *de re* reading of (3) according to Schwarz (2012)



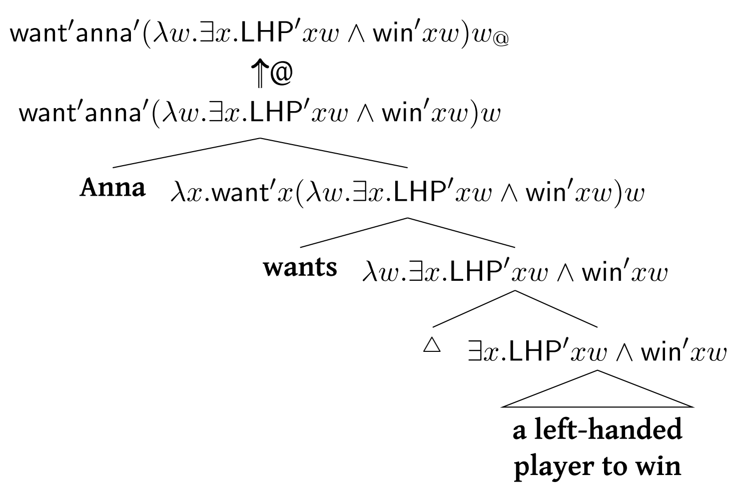
The Scope Theory of Intensionality (STI)

The intensional status of an expression is determined by its scope relative to expressions that create intensional contexts, e.g.

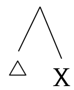
- propositional attitude verbs,
- modal predicates,
- conditionals.

The *de dicto* reading of (3) according to Keshet (2011)

In this framework, an intensional context is created by a dedicated operator $^\triangle$.

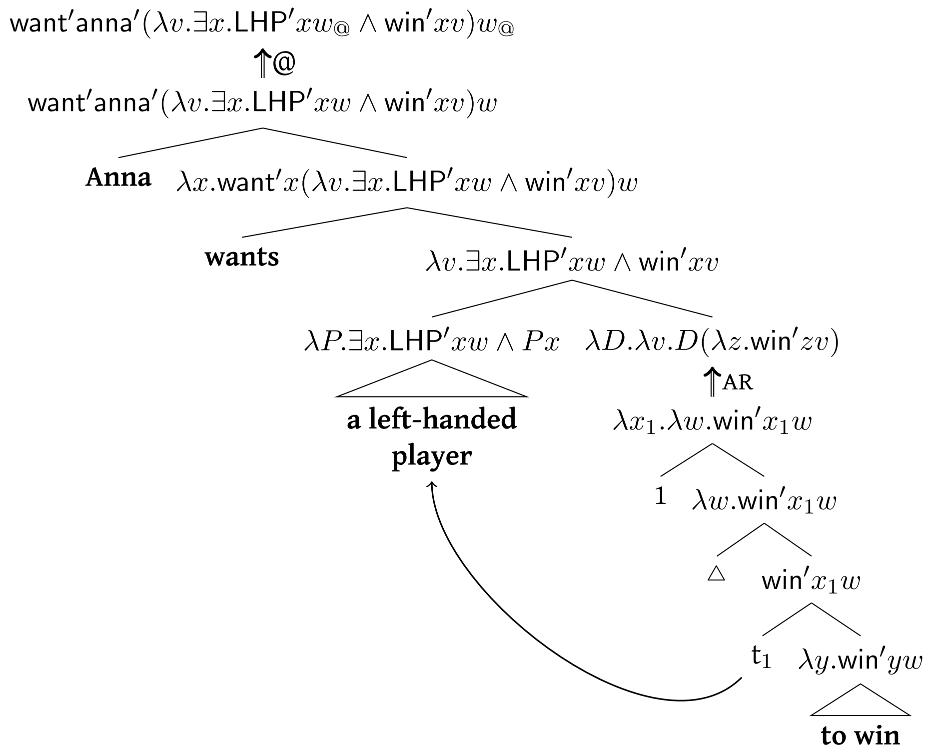


△ abstracts over a designated free world variable. The implied translation rule is that if X $\rightsquigarrow \phi$, then



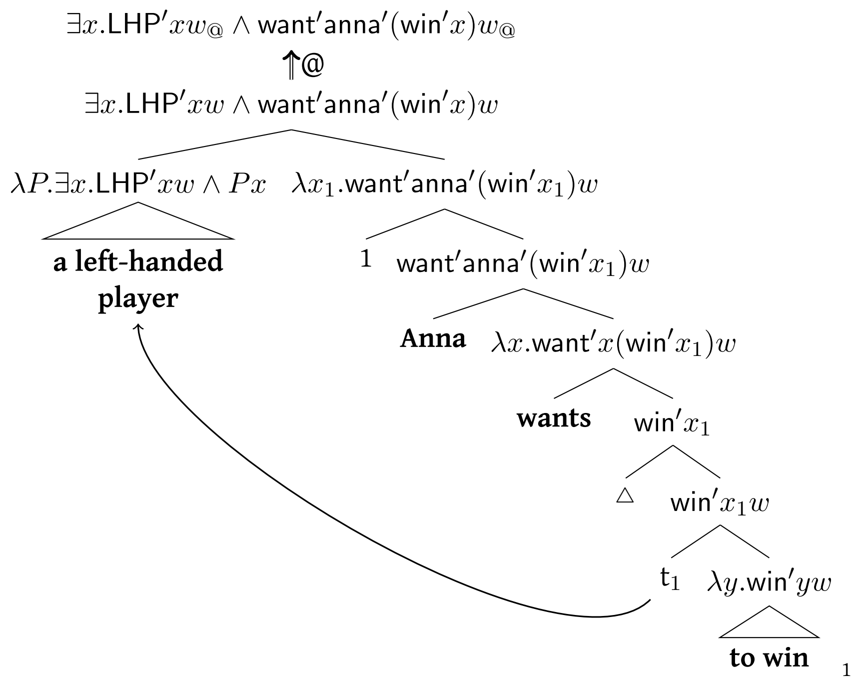
$$\rightsquigarrow \quad \lambda w.\phi$$

The non-specific *de re* reading of (3) according to Keshet (2011)



Argument Raising (AR) is a type-shift or compositional rule allowing expressions of type $(e \rightarrow t) \rightarrow t$ and $e \rightarrow s \rightarrow t$ to combine.

The specific *de re* reading of (3) according to Keshet (2011)



2.2 Desiderata for a theory of intensionality

2.2.1 Problematic for the BTI

Unavailable *de re*

(Romoli & Sudo 2009)

(4) John wants to meet the wife of the President.

$\Rightarrow$ $\mathsf{want}'\mathsf{john}'(\lambda w.\mathsf{meet}'\mathsf{john}'\imath x.\mathsf{wife\text{-}of}'(\imath y.\mathsf{president}'yw)xw)w_@$

$\Rightarrow$ $\mathsf{want}'\mathsf{john}'(\lambda w.\mathsf{meet}'\mathsf{john}'\imath x.\mathsf{wife\text{-}of}'(\imath y.\mathsf{president}'yw_@)xw_@)w_@$

$\Rightarrow$ $\mathsf{want}'\mathsf{john}'(\lambda w.\mathsf{meet}'\mathsf{john}'\imath x.\mathsf{wife\text{-}of}'(\imath y.\mathsf{president}'yw_@)xw)w_@$

$\not\Rightarrow$ $\mathsf{want}'\mathsf{john}'(\lambda w.\mathsf{meet}'\mathsf{john}'\imath x.\mathsf{wife\text{-}of}'(\imath y.\mathsf{president}'yw)xw_@)w_@$

Scenarios exemplifying the three available readings would be (in order):

- John has interviewed every First Lady since 1980 and wants to keep that record going, so he wants to meet the wife of the President, whoever that is (both *de dicto*).
- John wants to meet Melania Trump, although he knows neither that Donald Trump is President nor that she is the President' wife (both *de re*).
- John has interviewed Ivana Trump and Marla Marples and wants to keep the record going of interviewing each of Donald Trump's wives, although he doesn't realise that Trump is President ('president' *de re*, 'wife' *de dicto*).

[1] Note that $\lambda w.\mathsf{win}'x_1w \Rightarrow_\eta \mathsf{win}'x_1$.

A scenario exemplifying the unavailable reading would be this: John erroneously believes that Ron Paul is the President, and wants to meet Carolyn Wells (Paul's wife) ('president' *de dicto*, 'wife' *de re*).

Counterfactuals that aren't

(5) #If most professors were professors, the course would be better taught.

It's easy enough to explain why (5) is out: the antecedent of a counterfactual conditional has to be *counterfactual*, and whether *most professors* is interpreted *de re* or *de dicto*, that won't be the case in (5).

Another unavailable *de re*

(Keshet 2011)

However, with another level of embedding we should be able to rescue it…

(6) #Jim thinks that if most professors were professors, the course would be better taught.

$$\not\Rightarrow \mathsf{think'jim'}\big(\mathsf{if'}\big(\lambda w.\mathsf{most'}(\lambda x.\mathsf{prof'}xw_@)(\lambda x.\mathsf{prof'}xw)w\big)\mathsf{better\text{-}taught'}\big)w_@$$

…but we can't.

A scenario exemplifying the unavailable reading is as follows. The people teaching the course are Mona, Lisa, Louise, Jeremy and Sebastian. In fact, they are all professors. Jim does not believe that any of them are, though, and thinks that if most of them *were* professors, the class would be better taught. This is a coherent meaning for a sentence to have, since the antecedent to the conditional is counterfactual *relative to Jim's belief worlds*, and yet (6) is still unacceptable.

Another unavailable *de re*

(7) Mr. Smith thinks that Lucy wrote every essay that Tim wrote.

$$\Rightarrow \mathsf{think'smith'}(\lambda w.\forall z.\mathsf{ETM'}zw_@ \rightarrow \mathsf{write'lucy'}w)w_@$$

(8) Mr. Smith thinks that Tim should get detention because Lucy wrote every essay that he/Tim wrote.

$$\not\Rightarrow \mathsf{think'smith'}\big(\mathsf{because'}(\lambda w.\forall z.(\mathsf{ETM'}zw_@ \rightarrow \mathsf{write'lucy'}w)) (\mathsf{should'tim\text{-}detention'})\big)w_@$$

The scenario we are to imagine is that, in fact, Tim did his homework and wrote his own essays. However, Mr. Smith thinks that Lucy wrote them, and therefore Tim should get detention. The judgement reported is that (7) can be true in that scenario, but (8) cannot. So, *essay Tim wrote* can be interpreted *de re* from under *thinks*, but not from under both *thinks* and *because*.

2.2.2 Problematic for the STI

Depth of embedding is not the issue

(9) The Principal knows that Mr. Smith thinks that Lucy wrote every essay that Tim wrote.

$\Rightarrow \text{know}'\text{principal}'\big(\text{think}'\text{smith}'\big(\lambda w.\forall z.\text{ETM}'zw_@ \rightarrow \text{write}'\text{lucy}'w\big)\big)w_@$

A scenario exemplifying this reading is as follows. The professors are Mona, Lisa, Louise, Jeremy and Sebastian. Mary hopes that Jane believes that most *of them* are professors.

Independence from quantificational scope

(Keshet 2010, after Bäuerle 1983)

(10) George thinks every Red Sox player is staying in some five-star hotel downtown.

$\Rightarrow \text{think}'\text{george}'\big(\lambda w.\exists x.\text{hotel}'xw \wedge \forall y.\text{RSP}'yw_@ \rightarrow \text{stay-in}'xyw\big)w_@$

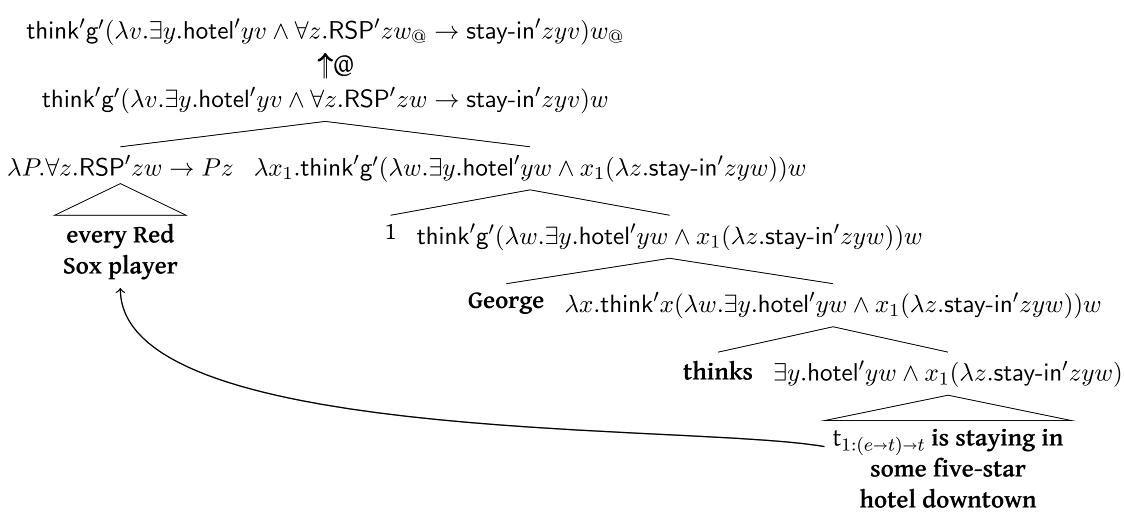
In this reading, *every Red Sox player* is in the scope of *some five-star hotel downtown*, which is intensionally dependent on *thinks*, but *every Red Sox player* is intensionally independent of *thinks*.

$\exists > \forall$
$\text{think}' > \exists$
$\forall > \text{think}'$

A scenario exemplifying this reading is as follows. The Red Sox players are Matt, Ryan, Austin, Nathan… George thinks that there is a particular hotel where *all of them* are staying, although he may not know they are Red Sox players.

2.3 The von Fintel & Heim (2011) suggestion

Higher-order traces



[2]

Reflections on the suggestion

- Use of a higher-type trace means that the QNP can move above the point of intensionalization so as to be interpreted *de re*, while its quantificational force 'reconstructs' back to its base position. So we get intensional independence.
- This general idea will form the basis of my own proposal.
- However, within the framework of transformational syntax this supposes covert movement from out of a finite clause, which is supposed to be disallowed.
- What von Fintel & Heim would have to say is that some types of movement are allowed or not depending on the type of trace left behind.
- They would also have to propose a novel constraint on covert movement to account for unavailable *de re* in the *essay*-type cases.
- In contrast, as we'll see, the LFG framework gives us the resources to state the necessary distinctions neatly.

3 An LFG+Glue approach

What 'without world variables' means

- For legibility's sake I will actually use world variables in the semantic representation—unlike in the abstract, which made use of $^\wedge$ and $^\vee$ operators (Montague 1973).
- Use of $^\wedge$ and $^\vee$ instead constrains the expressibility of the meaning representation language in certain ways.
- I will instead show that these constraints are met by using only a single world variable name: w (Zimmermann 1989).
- For legibility's sake I will show the binding patterns of occurrences of w with colours. These colours have no theoretical status.

Glue semantics crash course

(11) Jim smiles.

$$f : \begin{bmatrix} \text{PRED} & \text{'smile'} \\ \text{SUBJ} & g : [\,\text{"Jim"}\,] \end{bmatrix}$$

Jim $\rightsquigarrow \mathsf{jim}' : g$

smiles $\rightsquigarrow \mathsf{smile}' : g \multimap f$

$$\frac{\mathsf{smile}' : g \multimap f \qquad \mathsf{jim}' : g}{\mathsf{smile}'\mathsf{jim}' : f} \multimap_E$$

[2]Note that $\lambda w.\phi \Leftrightarrow_\alpha \lambda v.\psi$, where $\psi := \phi[v/w]$. This equivalence has been invoked in this derivation to avoid accidental variable capture.

Scope ambiguity

(12) A police officer guards every exit.

$\Rightarrow\ \exists x.\mathsf{officer}'x \wedge \forall y.\mathsf{exit}'y \rightarrow \mathsf{guard}'xy$ (surface scope)

$\Rightarrow\ \forall y.\mathsf{exit}'y \rightarrow \exists x.\mathsf{officer}'x \wedge \mathsf{guard}'xy$ (inverse scope)

$$f : \left[\begin{array}{ll} \text{PRED} & \text{‘guard’} \\ \text{SUBJ} & g : \left[\begin{array}{ll} \text{PRED} & \text{‘police officer’} \\ \text{SPEC} & i : \left[\begin{array}{ll} \text{PRED} & \text{‘a’} \end{array}\right] \end{array}\right] \\ \text{OBJ} & h : \left[\begin{array}{ll} \text{PRED} & \text{‘exit’} \\ \text{SPEC} & j : \left[\begin{array}{ll} \text{PRED} & \text{‘every’} \end{array}\right] \end{array}\right] \end{array}\right]$$

Multiple proofs

$$\begin{aligned}
\textit{a} &\rightsquigarrow \lambda P.\lambda Q.\exists x.Px \wedge Qx \\
&\quad : (g \multimap i) \multimap ((g \multimap f) \multimap f) \\
&\quad \%A := f \\
\textit{police officer} &\rightsquigarrow \mathsf{officer}' : g \multimap i \\
\textit{guards} &\rightsquigarrow \mathsf{guard}' : g \multimap (h \multimap f) \\
\textit{every} &\rightsquigarrow \lambda P.\lambda Q.\forall y.Py \rightarrow Qy \\
&\quad : (h \multimap j) \multimap ((h \multimap f) \multimap f) \\
&\quad \%B := f \\
\textit{exit} &\rightsquigarrow \mathsf{exit}' : h \multimap j
\end{aligned}$$

Surface scope interpretation

$$\dfrac{\dfrac{\begin{array}{c}\mathsf{a}' : \\ (g \multimap i) \multimap \\ ((g \multimap f) \multimap f)\end{array} \quad \begin{array}{c}\mathsf{officer}' : \\ g \multimap i\end{array}}{(g \multimap f) \multimap f} \qquad \dfrac{\dfrac{\dfrac{\begin{array}{c}\mathsf{every}' : \\ (h \multimap j) \multimap \\ ((h \multimap f) \multimap f)\end{array} \quad \begin{array}{c}\mathsf{exit}' : \\ h \multimap j\end{array}}{(h \multimap f) \multimap f} \quad \dfrac{\begin{array}{c}\mathsf{guard}' : \\ g \multimap (h \multimap f)\end{array} \quad [g]^1}{h \multimap f}}{f}}{g \multimap f}\multimap_{I,1}}{\begin{array}{c}\mathsf{a}'\mathsf{officer}'(\lambda x.\mathsf{every}'\mathsf{exit}'(\mathsf{guard}'x)) : f \\ \equiv \exists x.\mathsf{officer}'x \wedge \forall y.\mathsf{exit}'y \rightarrow \mathsf{guard}'xy : f\end{array}}$$

Inverse scope interpretation

$$\frac{\dfrac{\text{every}' : (h \multimap j) \multimap ((h \multimap f) \multimap f) \quad \text{exit}' : h \multimap j}{(h \multimap f) \multimap f} \quad \dfrac{\dfrac{\dfrac{\text{a}' : (g \multimap i) \multimap ((g \multimap f) \multimap f) \quad \text{officer}' : g \multimap i}{(g \multimap f) \multimap f} \quad \dfrac{\dfrac{\dfrac{\text{guard}' : g \multimap (h \multimap f) \quad [g]^1}{h \multimap f} \quad [h]^2}{f}}{g \multimap f} \multimap I, 1}{f}}{h \multimap f} \multimap I, 2}{\text{every}'\text{exit}'(\lambda y.\text{a}'\text{officer}'(\lambda x.\text{guard}'xy)) : f}$$

$$\equiv \forall y.\text{exit}'y \rightarrow \exists x.\text{officer}'x \wedge \text{guard}'xy : f$$

3.1 Upgrading for intensional independence

The type of determiners

Standard extensional type

$$(e \to t) \to (e \to t) \to t$$

Add argument positions for worlds (intensionalize)

$$(e \to s \to t) \to (e \to s \to t) \to s \to t$$

Abbreviate: let $p := s \to t$

$$(e \to p) \to (e \to p) \to p$$

Type-raise the second argument position

$$(e \to p) \to (((e \to p) \to p) \to p) \to p$$

Two layers of scope-taking

$$(e \to p) \to (((e \to p) \to p) \to p) \to p, \qquad \text{where } p := s \to t$$

determiner D

$(\uparrow \text{PRED}) = \text{‘det’}$

$\%A = (\text{QUANT\_SCOPE\_PATH} \uparrow)$

$\%B = (\text{INT\_SCOPE\_PATH} \uparrow)$

$$\lambda F.\lambda V.\lambda w^s.\exists P^{e \to t}.P = (\lambda x.Fxw) \wedge V(\lambda G.\lambda w.\text{det}' P(\lambda x.Gyw))w$$
$$: [(\text{SPEC} \uparrow) \multimap \uparrow] \multimap [((((\text{SPEC} \uparrow) \multimap \%A) \multimap \%A) \multimap \%B) \multimap \%B]$$

Where $F, G :: e \to p$ and $V :: ((e \to p) \to p) \to p$. [3]

[3] I have simplified the local names slightly: they should actually invoke something like $((\text{SCOPE\_PATH} \uparrow)(\text{SPEC}))$ to allow for scope taking within a complex nominal.

When quantificational and intensional scope are the same

Let $\uparrow := q$, ($\textsc{spec}\uparrow$) $:= e$ and $\%A := \%B := p$. Then

$$
\cfrac{
  \cfrac{
    \cfrac{
      \cfrac{\begin{array}{c}[\textit{determiner}] :\\ (e \multimap q) \multimap ((((e \multimap p) \multimap p) \multimap p) \multimap p)\end{array} \quad [F : e \multimap q]^1}{[\textit{determiner}]F : (((e \multimap p) \multimap p) \multimap p) \multimap p}
      \quad
      \cfrac{\cfrac{[V : (e \multimap p) \multimap p]^2 \quad [G : e \multimap p]^3}{VG : p}}{\lambda V.VG : ((e \multimap p) \multimap p) \multimap p}\,2
    }{[\textit{determiner}]F(\lambda V.VG) : p}
  }{\lambda G.[\textit{determiner}]F(\lambda V.VG) : (e \multimap p) \multimap p}\,3
}{\lambda F.\lambda G.[\textit{determiner}]F(\lambda V.VG) : (e \multimap q) \multimap ((e \multimap p) \multimap p)}\,1
$$

$$\equiv \lambda F.\lambda G.\lambda w.\exists P.P = (\lambda x.Fxw) \wedge \mathsf{det}'P(\lambda x.Gxw) : (e \multimap q) \multimap ((e \multimap p) \multimap p)$$

$$\equiv \lambda F.\lambda G.\lambda w.\mathsf{det}'(\lambda x.Fxw)(\lambda x.Gxw) : (e \multimap q) \multimap ((e \multimap p) \multimap p)$$

When they're not

(10) George thinks every Red Sox player is staying in some five-star hotel downtown.

$\Rightarrow \mathsf{think}'\mathsf{george}'\big(\lambda w.\exists x.\mathsf{hotel}'xw \wedge \forall y.\mathsf{RSP}'yw_{@} \rightarrow \mathsf{stay\text{-}in}'xyw\big)w_{@}$

$$
f : \left[\begin{array}{ll}
\textsc{pred} & \text{‘think’} \\
\textsc{tense} & \textsc{pres} \\
\textsc{subj} & g : [\,\text{“George”}\,] \\
\textsc{comp} & h : \left[\begin{array}{ll}
\textsc{pred} & \text{‘stay’} \\
\textsc{tense} & \textsc{pres} \\
\textsc{subj} & i : \left[\begin{array}{ll}
\textsc{pred} & \text{‘player’} \\
\textsc{spec} & j : \left[\begin{array}{ll}\textsc{pred} & \text{‘every’}\end{array}\right]
\end{array}\right] \\
\textsc{obl}_{\textsc{loc}} & k : [\,\text{“in some five-star hotel downtown”}\,]
\end{array}\right]
\end{array}\right]
$$

Meaning constructors

think $\rightsquigarrow \mathsf{think}' : g \multimap h \multimap f$

George $\rightsquigarrow \mathsf{george}' : g$

Red Sox player $\rightsquigarrow \mathsf{RSP}' : i \multimap j$

stay in $\rightsquigarrow \mathsf{stay\text{-}in}' : i \multimap k \multimap h$

in a hotel $\rightsquigarrow$

$[\textit{in a hotel}] := \lambda U.\lambda w.\exists z.\mathsf{hotel}'zw \wedge Uzw : (k \multimap h) \multimap h$

every $\rightsquigarrow$

$[\textit{every}] := \lambda F.\lambda V.\lambda w.\exists P.P = (\lambda x.Fxw) \wedge V(\lambda G.\lambda w.\forall z.Pz \rightarrow Gzw)w$

$: (i \multimap j) \multimap (((i \multimap h) \multimap h) \multimap f) \multimap f$

The intended interpretation

$$\dfrac{\dfrac{\vdots}{[\textit{every}]\mathsf{RSP}' : (((i \multimap h) \multimap h) \multimap f) \multimap f} \qquad \dfrac{\dfrac{\dfrac{\vdots}{\mathsf{think}'\mathsf{george}' : h \multimap f} \qquad \dfrac{[\textit{a hotel}] : (k \multimap h) \multimap h \qquad \dfrac{\left[\begin{array}{c} G : \\ (i \multimap h) \multimap h \end{array}\right]^1 \quad \begin{array}{c}\mathsf{stay\text{-}in}' : \\ i \multimap k \multimap h\end{array}}{\vdots \atop \lambda v.G(\lambda u.\mathsf{stay\text{-}in}'uv) : k \multimap h}}{[\textit{a hotel}](\lambda v.G(\lambda u.\mathsf{stay\text{-}in}'uv)) : h}}{\mathsf{think}'\mathsf{george}'([\textit{a hotel}](\lambda v.G(\lambda u.\mathsf{stay\text{-}in}'uv))) : f}}{\begin{array}{c}\lambda G.\mathsf{think}'\mathsf{george}'([\textit{a hotel}](\lambda v.G(\lambda u.\mathsf{stay\text{-}in}'uv))) : \\ ((i \multimap h) \multimap h) \multimap f\end{array}}\,1}{[\textit{every}]\mathsf{RSP}'(\lambda G.\mathsf{think}'\mathsf{george}'([\textit{a hotel}](\lambda v.G(\lambda u.\mathsf{stay\text{-}in}'uv)))) : f}$$

$$\begin{aligned}&\equiv \lambda w.\exists P.P = (\lambda x.\mathsf{RSP}'xw)\\ &\qquad \wedge \mathsf{think}'\mathsf{george}'(\lambda w.\exists z.\mathsf{hotel}'zw \wedge \forall y.Py \rightarrow \mathsf{stay\text{-}in}'yzw)w : f\end{aligned}$$

$$\begin{aligned}&\lambda w.\exists P.P = (\lambda x.\mathsf{RSP}'xw)\\ &\qquad \wedge \mathsf{think}'\mathsf{george}'(\lambda w.\exists z.\mathsf{hotel}'zw \wedge \forall y.Py \rightarrow \mathsf{stay\text{-}in}'yzw)w\end{aligned}$$

$$\Downarrow @$$

$$\begin{aligned}&\exists P.P = (\lambda x.\mathsf{RSP}'xw_@)\\ &\qquad \wedge \mathsf{think}'\mathsf{george}'(\lambda w.\exists z.\mathsf{hotel}'zw \wedge \forall y.Py \rightarrow \mathsf{stay\text{-}in}'yzw)w_@\\ &\equiv \mathsf{think}'\mathsf{george}'(\lambda w.\exists z.\mathsf{hotel}'zw \wedge \forall y.\mathsf{RSP}'yw_@ \rightarrow \mathsf{stay\text{-}in}'yzw)w_@\end{aligned}$$

3.2 Formalising the constraints

The nature of QUANT_SCOPE_PATH

(13) A fan thinks every left-handed player is Czech.

$\not\Rightarrow \quad \forall x.\mathsf{LHP}'xw_@ \rightarrow \exists y.\mathsf{fan}'y \wedge \mathsf{think}'y(\mathsf{czech}'x)w_@$

Generalization: an expression cannot take quantificational scope outside its minimal finite clause.

$$f : \left[\begin{array}{ll} \textsc{pred} & \text{‘think’} \\ \textsc{tense} & \textsc{pres} \\ \textsc{subj} & [\text{“a fan”}] \\ \textsc{comp} & g : \left[\begin{array}{ll} \textsc{pred} & \text{‘Czech’} \\ \textsc{tense} & \textsc{pres} \\ \textsc{subj} & \left[\begin{array}{ll} \textsc{pred} & \text{‘player’} \\ \textsc{spec} & h : \left[\begin{array}{ll}\textsc{pred} & \text{‘every’}\end{array}\right] \end{array}\right] \end{array}\right] \end{array}\right]$$

- Task: permit ($\textsc{quant\_scope\_path}\ h$) $= g$ but not f.
- Solution: $\textsc{quant\_scope\_path} := \left(\begin{array}{c} \textsc{ggf}^* \\ \neg(\rightarrow \textsc{tense}) \end{array} \quad \textsc{gf} \quad \textsc{spec} \right)$

- Result: $(f$ COMP) (i.e. g) has a tense value, hence there's no instance of QUANT_SCOPE_PATH such that (QUANT_SCOPE_PATH $h) = f$.

It may be an an open question exactly how this 'minimal finite clause' constraint should be encoded in LFG. In this paper I've gone for 'clause with a tense value at f-structure', following Dalrymple's (1993) seminal work on binding theory. Some other possible approaches in the literature are:

- clause with a FIN-valued FORM feature at f-structure (Dyvik 1999),
- clause with a $+$-valued FIN feature at m-structure (Frank & Zaenen 2002), and
- clause with a $+$-valued FIN feature at f-structure (Sells 2005).

John wants to meet the wife of the President

$$f : \left[\begin{array}{ll} \text{PRED} & \text{'want'} \\ \text{TENSE} & \text{PRES} \\ \text{SUBJ} & g : [\text{"John"}] \\ \text{XCOMP} & h : \left[\begin{array}{ll} \text{PRED} & \text{'meet'} \\ \text{SUBJ} & \\ \text{OBJ} & i : \left[\begin{array}{ll} \text{PRED} & \text{'wife'} \\ \text{SPEC} & j : \left[\text{PRED} \quad \text{'the'}\right] \\ \text{OBL}_{\text{GEN}} & k : \left[\begin{array}{ll} \text{PRED} & \text{'president'} \\ \text{SPEC} & l : \left[\text{PRED} \quad \text{'the'}\right] \end{array}\right] \end{array}\right] \end{array}\right] \end{array}\right]$$

The STI and embedding

- All scope theories, including this one, predict the unavailability of the 'wife' *de re*, 'president' *de dicto* reading.
- The reason is that *the president* is embedded within *the wife of the president*, so attempting to get the latter to scope strictly wider than the former inevitably leaves unbound variables, hence an improper derivation.

*John wants to meet [the wife of [the President]]

Proof forms of the available interpretations of (4) are shown below, along with the form of an improper derivation which is an attempt to derive the unavailable reading.

Both *de dicto*
$[\textit{want}][\textit{John}](\lambda u.[\textit{the}](\lambda x.[\textit{the}][\textit{president}](\lambda G.G(\lambda y.[\textit{wife}]xy)))(\lambda H.H(\lambda v.[\textit{meet}]uv)))$

Both *de re*
$[\textit{the}](\lambda x.[\textit{the}][\textit{president}](\lambda G.G(\lambda y.[\textit{wife}]xy)))(\lambda H.[\textit{want}][\textit{John}](\lambda u.H(\lambda v.[\textit{meet}]uv)))$

'wife' *de dicto*, 'president' *de re*
$[\textit{the}][\textit{president}](\lambda G.[\textit{want}][\textit{John}](\lambda u.[\textit{the}](\lambda x.G(\lambda u.[\textit{wife}]xy))(\lambda H.H(\lambda v.[\textit{meet}]uv))))$

'wife' *de re*, 'president' *de dicto
$[\textit{the}](\lambda x.[\textit{wife}]xy)(\lambda H.H(\lambda v.[\textit{want}][\textit{John}](\lambda u.[\textit{the}][\textit{president}](\lambda G.G(\lambda y.[\textit{meet}]uv)))))$

The nature of INT_SCOPE_PATH

(8) Mr. Smith thinks that Tim should get detention because Lucy wrote every essay that he/Tim wrote.

$$\not\Rightarrow \mathsf{think'smith'}\big(\mathsf{because'}(\lambda w.\forall z.(\mathsf{ETM'}zw_{@} \to \mathsf{write'lucy'}w))\\ (\mathsf{should'tim\text{-}detention'})\big)w_{@}$$

(9) The Principal knows that Mr. Smith thinks that Lucy wrote every essay that Tim wrote.

$$\Rightarrow \mathsf{know'principal'}\big(\mathsf{think'smith'}\big(\lambda w.\forall z.\mathsf{ETM'}zw_{@} \to \mathsf{write'lucy'}w\big)\big)w_{@}$$

Generalization: a nominal predicate can be interpreted *de re* from within two finite clauses, but not from within an ADJUNCT island within a finite clause.

$$
f:\left[\begin{array}{ll}
\text{PRED} & \text{'think'}\\
\text{TENSE} & \text{PRES}\\
\text{SUBJ} & [\text{"Mr. Smith"}]\\
\text{COMP} & g:\left[\begin{array}{ll}
\text{PRED} & \text{'should'}\\
\text{TENSE} & \text{PRES}\\
\text{SUBJ} & [\text{"Tim"}]\\
\text{XCOMP} & [\text{"get detention"}]\\
\text{ADJ} & \left\{ h:\left[\begin{array}{ll}
\text{PRED} & \text{'because'}\\
\text{OBJ} & i:\left[\begin{array}{ll}
\text{PRED} & \text{'write'}\\
\text{TENSE} & \text{PAST}\\
\text{SUBJ} & [\text{"Lucy"}]\\
\text{OBJ} & j:\left[\begin{array}{ll}
\text{PRED} & \text{'essay'}\\
\text{SPEC} & k:\left[\text{PRED}\quad \text{'every'}\right]\\
\text{ADJ} & \left\{[\text{"Tim wrote"}]\right\}
\end{array}\right]
\end{array}\right]
\end{array}\right]\right\}
\end{array}\right]
\end{array}\right]
$$

- Task: permit $(\text{INT\_SCOPE\_PATH}\ k) = g, h$ or i but not f.
- Solution: $\text{INT\_SCOPE\_PATH} := \left(\begin{array}{c}\text{GGF}^{*}\\ \neg(\to \text{TENSE})\end{array}\quad (\text{ADJ} \in)\quad \text{GGF}^{*}\quad \text{GF}\quad \text{SPEC}\right)$
- Result: $(f\ \text{COMP})$ (i.e. g) has a tense value and ADJ $\in$ is ungovernable, hence there's no instance of INT_SCOPE_PATH such that $(\text{INT\_SCOPE\_PATH}\ k) = f$.

The intution behind the constraint is as follows. Looked at from the inside out, what it says is that once you've passed through an adjunct you can't pass through any more adjuncts or a finite clause. The aim is to capture Grano's (2019) evaulation of Keshet's (2011) claims about constraints on *de re*:

Keshet (2011) aims to capture the putative generalization that nominals embedded under *two* scope islands cannot be interpreted de re. But the data supporting the generalization come from configurations in which the higher island is a finite clause and the lower island is of another sort (*if*-clauses, NP complements, coordinate structures). When a nominal is embedded under two finite clauses, it is not clear that the generalization holds.

(6) #Jim thinks that if most professors were professors, the course would be better taught.

$\not\Rightarrow$ $\text{think}'\text{jim}'\big(\text{if}'\big(\lambda w.\text{most}'(\lambda x.\text{prof}'x w_{@})(\lambda x.\text{prof}'x w)w\big)\text{better-taught}'\big)w_{@}$

$$f:\left[\begin{array}{ll} \text{PRED} & \text{‘think’} \\ \text{TENSE} & \text{PRES} \\ \text{SUBJ} & [\,\text{“Mary”}\,] \\ \text{COMP} & g:\left[\begin{array}{ll} \text{PRED} & \text{‘better\_taught’} \\ \text{TENSE} & \text{PRES} \\ \text{SUBJ} & [\,\text{“the class”}\,] \\ \text{ADJ} & \left\{ h:\left[\begin{array}{ll} \text{COMPFORM} & \text{IF} \\ \cdots & \\ \text{SUBJ}\,|\,\text{SPEC} & i:\left[\begin{array}{ll}\text{PRED} & \text{‘most’}\end{array}\right] \end{array}\right] \right\} \end{array}\right] \end{array}\right]$$

Result: $(f\ \text{COMP})$ (i.e. g) has a tense value and ADJ $\in$ is ungovernable, hence there's no instance of INT_SCOPE_PATH such that $(\text{INT\_SCOPE\_PATH}\ i) = f$.

***De re* from within two finite clauses**

$$f:\left[\begin{array}{ll} \text{PRED} & \text{‘know’} \\ \text{SUBJ} & [\,\text{“the Principal”}\,] \\ \text{COMP} & \left[\begin{array}{ll} \text{PRED} & \text{‘think’} \\ \text{SUBJ} & [\,\text{“Mr. Smith”}\,] \\ \text{COMP} & \left[\begin{array}{ll} \text{PRED} & \text{‘write’} \\ \cdots & \\ \text{SUBJ}\,|\,\text{SPEC} & g:\left[\begin{array}{ll}\text{PRED} & \text{‘every’}\end{array}\right] \end{array}\right] \end{array}\right] \end{array}\right]$$

- $\text{INT\_SCOPE\_PATH} := \left(\begin{array}{c} \text{GGF}^{*} \\ \neg(\rightarrow \text{TENSE}) \end{array} \quad (\text{ADJ} \in) \quad \text{GGF}^{*} \quad \text{GF} \quad \text{SPEC}\right)$
- Result: $(f\ \text{COMP COMP SUBJ SPEC}) = g.$ ✓

4 Conclusion

Discussion

- I have proposed a method to rectify the undergeneration inherent in existing versions of the STI.
- The method involves raising the type of determiner lexical entries to give them two, potentially distinct, scope positions: quantificational and intensional.
- This method is reminiscent of a suggestion from von Fintel & Heim (2011), but is not hamstrung by a conflict with a pre-existing syntactic theory of locality.
- In fact, the LFG+Glue architecture gives us just the tools we need to state the right, independent, constraints on quantificational and intensional scope.

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