Intensional independence without world variables in LFG+Glue

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Outline

Introduction: intensionality with an ‘s’

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Extensional and intensional contexts

(1) Elizabeth is Queen of the UK and Harald is King of Norway $\leftrightarrow$ Elizabeth is Queen of Australia and Harald is King of Norway .

Extensional context: substitution of coreferential expressions preserves truth value.

Extensional and intensional contexts

(1) Elizabeth is Queen of the UK and Harald is King of Norway $\leftrightarrow$ 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 ____.

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- Modals

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

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*)

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

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

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a. Specific *de re*:

$\Rightarrow$ $\exists x.\mathrm{LHP}' x w_@ \wedge \mathrm{want}'\mathrm{anna}'(\mathrm{win}' x) w_@$

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

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a. Specific *de re*:

$\Rightarrow$ $\exists x.\mathrm{LHP}' x w_{@} \wedge \mathrm{want}' \mathrm{anna}' (\mathrm{win}' x) w_{@}$

b. Non-specific *de re*:

$\Rightarrow$ $\mathrm{want}' \mathrm{anna}' (\lambda w.\exists x.\mathrm{LHP}' x w_{@} \wedge \mathrm{win}' x w) w_{@}$

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b. Non-specific *de re*:

$\Rightarrow$ $\mathrm{want}'\mathrm{anna}'(\lambda w.\exists x.\mathrm{LHP}'x w_{@} \wedge \mathrm{win}'x w)w_{@}$

c. *de dicto*:

$\Rightarrow$ $\mathrm{want}'\mathrm{anna}'(\lambda w.\exists x.\mathrm{LHP}'x w \wedge \mathrm{win}'x w)w_{@}$

(Where $w_{@}$ denotes the actual world)

Background

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Two theories of intensionality

The Binding Theory of Intensionality (BTI)

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- 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’.

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

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de dicto

[Anna [wants [Σ_1 [[[a *pro*$_1$] left-handed player] to win]]]]

non-specific *de re*

[Σ_1 [Anna [wants [[[a *pro*$_1$] left-handed player] to win]]]]

specific *de re*

[Σ_1 [[[a *pro*$_1$] left-handed player]$_2$ [Anna [wants [t$_2$ to win]]]]]

(after 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.

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

de dicto

[Anna [wants [[a left-handed player] to win]]]

specific *de re*

[[a left-handed player]$_1$ [Anna [wants [t$_1$ to win]]]]

non-specific *de re*?

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

de dicto

[Anna [wants [[a left-handed player] to win]]]

specific *de re*

[[a left-handed player]$_1$ [Anna [wants [t$_{1:e}$ to win]]]]

non-specific *de re*

[Anna [wants [[a left-handed player]$_1$ [$^{\triangle}$ [t$_{1:e}$ to win]]]]]

(Keshet 2011)

[[a left-handed player]$_1$ [Anna [wants [t$_{1:(e\to t)\to t}$ to win]]]]

(von Fintel & Heim 2011)

Background

Desiderata for a theory of intensionality

Unavailable *de re*

(Romoli & Sudo 2009)

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

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

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

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

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

Another unavailable *de re*

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

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

Another unavailable *de re*

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

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

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

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

Depth of embedding is not the issue

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

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

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

Independence from quantificational scope

(Keshet 2010, after Bäuerle 1983)

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

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

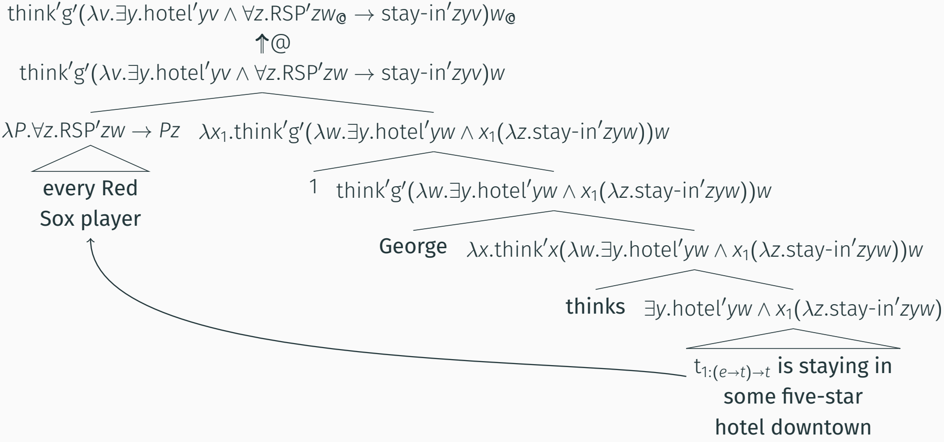
In this reading, *every Red Sox player* is in the scope of *some five-star hotel downtown*, which is intensionally dependent on *thinks*, but *every Red Sox player* is intensionally independent of *thinks*.

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

Background

The von Fintel & Heim (2011) suggestion

Higher-order traces



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.

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- This general idea will form the basis of my own proposal.

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.

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- 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.

An LFG+Glue approach

What ‘without world variables’ means

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- I will instead show that these constraints are met by using only a single world variable name: *w* (Zimmermann 1989).

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

(9) Jim smiles.

$$f : \begin{bmatrix} \textsc{pred} & \text{`smile'} \\ \textsc{subj} & g : [\ \text{``Jim''}\ ] \end{bmatrix}$$

$$\textit{Jim} \rightsquigarrow \text{jim}' : \uparrow$$

$$\textit{smiles} \rightsquigarrow \text{smile}' : (\uparrow \textsc{subj}) \multimap \uparrow$$

(9) Jim smiles.

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

$$\textit{Jim} \rightsquigarrow \text{jim}' : g$$

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

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$$\textit{Jim} \rightsquigarrow \text{jim}' : g$$

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

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

(10) A police officer guards every exit.

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

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

Scope ambiguity

(10) A police officer guards every exit.

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

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

$$f:\begin{bmatrix} \text{PRED} & \text{‘guard’} \\ \text{SUBJ} & g:\begin{bmatrix} \text{PRED} & \text{‘police officer’} \\ \text{SPEC} & i:\begin{bmatrix} \text{PRED} & \text{‘a’} \end{bmatrix} \end{bmatrix} \\ \text{OBJ} & h:\begin{bmatrix} \text{PRED} & \text{‘exit’} \\ \text{SPEC} & j:\begin{bmatrix} \text{PRED} & \text{‘every’} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Multiple proofs

$$
\begin{aligned}
a &\rightsquigarrow \lambda P.\lambda Q.\exists x.Px \wedge Qx \\
&\quad : ((\textsc{spec}\uparrow) \multimap \uparrow) \multimap (((\textsc{spec}\uparrow) \multimap \%A) \multimap \%A) \\
&\quad \%A = (\textsc{path}\uparrow) \\
\textit{police officer} &\rightsquigarrow \text{officer}' : (\textsc{spec}\uparrow) \multimap \uparrow \\
\textit{guards} &\rightsquigarrow \text{guard}' : (\uparrow \textsc{subj}) \multimap ((\uparrow \textsc{obj}) \multimap \uparrow) \\
\textit{every} &\rightsquigarrow \lambda P.\lambda Q.\forall y.Py \rightarrow Qy \\
&\quad : ((\textsc{spec}\uparrow) \multimap \uparrow) \multimap (((\textsc{spec}\uparrow) \multimap \%B) \multimap \%B) \\
&\quad \%B = (\textsc{path}\uparrow) \\
\textit{exit} &\rightsquigarrow \text{exit}' : (\textsc{spec}\uparrow) \multimap \uparrow
\end{aligned}
$$

Multiple proofs

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

Surface scope interpretation

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

Inverse scope interpretation

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

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

An LFG+Glue approach

Upgrading for intensional independence

The type of determiners

Standard extensional type

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

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Standard extensional type

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

Add argument positions for worlds (intensionalize)

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

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

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

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

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 $V :: ((e \to p) \to p) \to p$.

When quantificational and intensional scope are the same

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

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

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

When quantificational and intensional scope are the same

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

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

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

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

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

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

When they're not

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

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

$$f:\left[\begin{array}{ll}
\text{PRED} & \text{`think'} \\
\text{TENSE} & \text{PRES} \\
\text{SUBJ} & g:[\ \text{“George”}\ ] \\
\text{COMP} & h:\left[\begin{array}{ll}
\text{PRED} & \text{`stay'} \\
\text{TENSE} & \text{PRES} \\
\text{SUBJ} & i:\left[\begin{array}{ll}
\text{PRED} & \text{`player'} \\
\text{SPEC} & j:\left[\begin{array}{ll}\text{PRED} & \text{`every'}\end{array}\right]
\end{array}\right] \\
\text{OBL}_{\text{LOC}} & k:[\ \text{“in some five-star hotel downtown”}\ ]
\end{array}\right]
\end{array}\right]$$

Meaning constructors

think $\rightsquigarrow$ $\text{think}' : (\uparrow \textsc{subj}) \multimap (\uparrow \textsc{comp}) \multimap \uparrow$

George $\rightsquigarrow$ $\text{george}' : \uparrow$

Red Sox player $\rightsquigarrow$ $\text{RSP}' : \uparrow \multimap (\uparrow \textsc{spec})$

stay in $\rightsquigarrow$ $\text{stay-in}' : (\uparrow \textsc{subj}) \multimap (\uparrow \textsc{obl}_{\textsc{loc}}) \multimap \uparrow$

a hotel $\rightsquigarrow$

$[\textit{a hotel}] := \lambda U.\lambda w.\exists z.\text{hotel}' zw \wedge Uzw : (\uparrow \multimap \%A) \multimap \%A$

every $\rightsquigarrow$

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

$: ((\textsc{spec} \uparrow) \multimap \uparrow) \multimap ((((\textsc{spec} \uparrow) \multimap \%A) \multimap \%A) \multimap \%B) \multimap \%B$

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

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

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

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

$in\ a\ hotel \rightsquigarrow$

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

$every \rightsquigarrow$

$$[every] := \lambda F.\lambda V.\lambda w.\exists P.P = (\lambda x.Fxw) \wedge V(\lambda G.\lambda w.\forall z.Pz \rightarrow Gzw)w$$
$$: (i \multimap j) \multimap (((i \multimap h) \multimap h) \multimap f) \multimap f$$

The intended interpretation

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

The intended interpretation

$$\left[\begin{array}{c} G : \\ (i \multimap h) \multimap h \end{array}\right]^1 \qquad \begin{array}{c} \text{stay-in}' : \\ i \multimap k \multimap h \end{array}$$

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

$$\dfrac{\begin{array}{c} \vdots \\ [every]\text{RSP}' : \\ (((i \multimap h) \multimap h) \multimap f) \multimap f \end{array} \qquad \begin{array}{c}\lambda G.\text{think}'\text{george}'([a\ hotel](\lambda v.G(\lambda u.\text{stay-in}'uv))) : \\ ((i \multimap h) \multimap h) \multimap f\end{array}}{[every]\text{RSP}'(\lambda G.\text{think}'\text{george}'([a\ hotel](\lambda v.G(\lambda u.\text{stay-in}'uv)))) : f}$$

$$\equiv \lambda w.\exists P.P = (\lambda x.\text{RSP}'xw)$$

$$\wedge\ \text{think}'\text{george}'(\lambda w.\exists z.\text{hotel}'zw \wedge \forall y.Py \rightarrow \text{stay-in}'yzw)w : f$$

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

$$\lambda w.\exists P.P = (\lambda x.\text{RSP}'xw) \\ \wedge \text{think}'\text{george}'(\lambda w.\exists z.\text{hotel}'zw \wedge \forall y.Py \to \text{stay-in}'yzw)w$$

$$\Downarrow @$$

$$\exists P.P = (\lambda x.\text{RSP}'xw_@) \\ \wedge \text{think}'\text{george}'(\lambda w.\exists z.\text{hotel}'zw \wedge \forall y.Py \to \text{stay-in}'yzw)w_@$$

$$\lambda w.\exists P.P = (\lambda x.\text{RSP}'xw)$$

$$\wedge\ \text{think}'\text{george}'(\lambda w.\exists z.\text{hotel}'zw \wedge \forall y.Py \rightarrow \text{stay-in}'yzw)w$$

$$\Downarrow @$$

$$\exists P.P = (\lambda x.\text{RSP}'xw_{@})$$

$$\wedge\ \text{think}'\text{george}'(\lambda w.\exists z.\text{hotel}'zw \wedge \forall y.Py \rightarrow \text{stay-in}'yzw)w_{@}$$

$$\equiv \text{think}'\text{george}'(\lambda w.\exists z.\text{hotel}'zw \wedge \forall y.\text{RSP}'yw_{@} \rightarrow \text{stay-in}'yzw)w_{@}$$

An LFG+Glue approach

Formalising the constraints

The nature of QUANT_SCOPE_PATH

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

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

$$\text{QUANT\_SCOPE\_PATH} := \left(\begin{array}{ccc} \text{GGF}^{*} & \text{GF} & \text{SPEC} \\ \neg(\rightarrow \text{TENSE}) & & \end{array} \right)$$

John wants to meet the wife of the President

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

The STI and embedding

- All scope theories, including this one, predict the unavailability of the ‘wife’ *de re*, ‘president’ *de dicto* reading.

The 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]]

The nature of INT_SCOPE_PATH

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

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

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

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

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

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

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

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

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.

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

$$f:\begin{bmatrix} \text{PRED} & \text{‘think’} \\ \text{COMP} & g:\begin{bmatrix} \text{PRED} & \text{‘should’} \\ \text{TENSE} & \text{PRES} \\ \text{ADJ} & \left\{ h:\begin{bmatrix} \text{PRED} & \text{‘because’} \\ \text{OBJ} & i:\begin{bmatrix} \text{PRED} & \text{‘write’} \\ \text{OBJ} & j:\begin{bmatrix} \text{PRED} & \text{‘essay’} \\ \text{SPEC} & k:\begin{bmatrix} \text{PRED} & \text{‘every’} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \right\} \end{bmatrix} \end{bmatrix}$$

- Task: permit (INT_SCOPE_PATH k) $= g, h$ or i but not f.

$$f:\left[\begin{array}{ll}\textsc{pred} & \text{`think'}\\ \textsc{comp} & g:\left[\begin{array}{ll}\textsc{pred} & \text{`should'}\\ \textsc{tense} & \textsc{pres}\\ \textsc{adj} & \left\{h:\left[\begin{array}{ll}\textsc{pred} & \text{`because'}\\ \textsc{obj} & i:\left[\begin{array}{ll}\textsc{pred} & \text{`write'}\\ \textsc{obj} & j:\left[\begin{array}{ll}\textsc{pred} & \text{`essay'}\\ \textsc{spec} & k:\left[\textsc{pred}\ \ \text{`every'}\right]\end{array}\right]\end{array}\right]\end{array}\right]\right\}\end{array}\right]\end{array}\right]$$

- Task: permit $(\textsc{int\_scope\_path}\ k) = g, h$ or i but not f.
- Solution:

$$\textsc{int\_scope\_path} := \left(\begin{array}{ccccc}\textsc{ggf}^* & (\textsc{adj} \in) & \textsc{ggf}^* & \textsc{gf} & \textsc{spec}\\ \neg(\rightarrow \textsc{tense}) & & & & \end{array}\right)$$

$$f:\left[\begin{array}{ll} \text{PRED} & \text{‘think’} \\ \text{COMP} & g:\left[\begin{array}{ll} \text{PRED} & \text{‘should’} \\ \text{TENSE} & \text{PRES} \\ \text{ADJ} & \left\{ h:\left[\begin{array}{ll} \text{PRED} & \text{‘because’} \\ \text{OBJ} & i:\left[\begin{array}{ll} \text{PRED} & \text{‘write’} \\ \text{OBJ} & j:\left[\begin{array}{ll} \text{PRED} & \text{‘essay’} \\ \text{SPEC} & k:\left[\begin{array}{ll}\text{PRED} & \text{‘every’}\end{array}\right]\end{array}\right]\end{array}\right]\end{array}\right]\right\}\end{array}\right]\end{array}\right]$$

- Task: permit $(\text{INT\_SCOPE\_PATH}\ k) = g, h$ or i but not f.
- Solution:

$$\text{INT\_SCOPE\_PATH} := \left(\begin{array}{ccccc} \text{GGF}^* & (\text{ADJ} \in) & \text{GGF}^* & \text{GF} & \text{SPEC} \\ \neg(\rightarrow \text{TENSE}) & & & & \end{array} \right)$$

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

De re from within two finite clauses

$$f : \begin{bmatrix} \text{PRED} & \text{`know'} \\ \text{SUBJ} & [\ \text{“the Principal”}\ ] \\ \text{COMP} & \begin{bmatrix} \text{PRED} & \text{`think'} \\ \text{SUBJ} & [\ \text{“Mr. Smith”}\ ] \\ \text{COMP} & \begin{bmatrix} \text{PRED} & \text{`write'} \\ \ldots & \\ \text{SUBJ} \mid \text{SPEC} & g : \begin{bmatrix} \text{PRED} & \text{`every'} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

- INT_SCOPE_PATH :=

$$\left(\begin{array}{cccccc} \text{GGF}^* & (\text{ADJ} \in) & \text{GGF}^* & \text{GF} & \text{SPEC} \\ \neg(\rightarrow \text{TENSE}) & & & & \end{array} \right)$$

$$f : \begin{bmatrix} \textsc{pred} & \text{`know'} \\ \textsc{subj} & [\ \text{``the Principal''}\ ] \\ \textsc{comp} & \begin{bmatrix} \textsc{pred} & \text{`think'} \\ \textsc{subj} & [\ \text{``Mr. Smith''}\ ] \\ \textsc{comp} & \begin{bmatrix} \textsc{pred} & \text{`write'} \\ \ldots & \\ \textsc{subj}\,|\,\textsc{spec} & g : \begin{bmatrix} \textsc{pred} & \text{`every'} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

- INT_SCOPE_PATH :=
$$\left(\begin{array}{ccccc} \textsc{ggf}^{*} & (\textsc{adj} \in) & \textsc{ggf}^{*} & \textsc{gf} & \textsc{spec} \\ \neg(\rightarrow \textsc{tense}) & & & & \end{array} \right)$$
- Result: $(f\ \textsc{comp}\ \textsc{comp}\ \textsc{subj}\ \textsc{spec}) = g.$ ✓

Conclusion

Discussion

- I have proposed a method to rectify the undergeneration inherent in existing versions of the STI.

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- 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.

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.

Thanks!

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References

See the accompanying handout.