Against the division of labor in scope and binding

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Different quantifiers take scope differently.

(1) Island(/locality/intervention) effects:
  a. Alice read every paper that a professor recommended.
  (*a professor* can take wide scope over *every paper that*)
  b. Alice read every paper that every professor recommended.
  (*every professor* cannot take wide scope over *every paper that*)

(2) Availability of inverse scope:
  a. 好像每個人都在找什麼人的樣子。
  Haoxiang meige ren dou zai zhao shenme ren de-yangzi
  seem every person all ASP seek what person seem
  'It seems that everyone is looking for someone.' ($\forall > \exists$, $\exists > \forall$)
  b. 好像每個人都在找一個人的樣子。
  Haoxiang meige ren dou zai zhao yige ren de-yangzi
  seem every person all ASP seek one person seem
  'It seems that everyone is looking for someone.' ($\forall > \exists$, $*\exists > \forall$)

Why? Two prominent accounts hypothesize semantic scope-taking mechanisms in addition to a syntactic mechanism like Quantifier Raising (May 1977) or Quantifying In (Montague 1974).

(3) Choice functions (Reinhart 1992, 1997; inter alia)

(4) Alternative sets (Hamblin 1973; Kratzer and Shimoyama 2002; Rooth 1985; Shimoyama 2001; sometimes used to implement unselective binding)

I have been arguing against such dichotomies between syntactic and semantic scope-taking, in several ways.

(5) Incorrect interaction between two scope-taking mechanisms (Section 1)

(6) Missing generalizations that hold across all scope-taking, especially in binding (Section 2)

(7) Greater variation among quantifiers and languages than would be expected from a binary distinction (Schwarz 2001; Shan 2003)

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1 Alternatives and variables do not mix

(8) Plain-vanilla function application:

$$[\![\beta]\!]\,([\![\gamma]\!]) : B$$

$$[\![\beta]\!] : \langle A, B\rangle \qquad [\![\gamma]\!] : A$$

(9) Alice saw Xavier.

Alice saw Xavier : t

Alice : e **Alice** — saw Xavier : $\langle e, t\rangle$

saw : $\langle e, \langle e, t\rangle\rangle$ **saw** — Xavier : e **Xavier**

To add alternatives, replace each type A with the type $\langle A, t\rangle$, in other words, the type of A-sets. Change the plain-vanilla function application rule (8) to:

(10) Alternative-friendly function application:

$$\{\, f(x) \mid f \in [\![\beta]\!] \wedge x \in [\![\gamma]\!]\,\} : \langle B, t\rangle$$

$$[\![\beta]\!] : \langle\langle A, B\rangle, t\rangle \qquad [\![\gamma]\!] : \langle A, t\rangle$$

(11) Who saw Xavier? (Alice did.)

{Alice saw Xavier, Barbara saw Xavier, Carol saw Xavier} : $\langle t, t\rangle$

{Alice, Barbara, Carol} : $\langle e, t\rangle$ **who** — {saw Xavier} : $\langle\langle e, t\rangle, t\rangle$

{saw} : $\langle\langle e, \langle e, t\rangle\rangle, t\rangle$ **saw** — {Xavier} : $\langle e, t\rangle$ **Xavier**

To add variables, replace each type A with the type $\langle g, A\rangle$, where g is the type of assignments. Change the plain-vanilla function application rule (8) to:

(12) Variable-friendly function application:

$$\lambda g.\, [\![\beta]\!]\,(g)([\![\gamma]\!]\,(g)) : \langle g, B\rangle$$

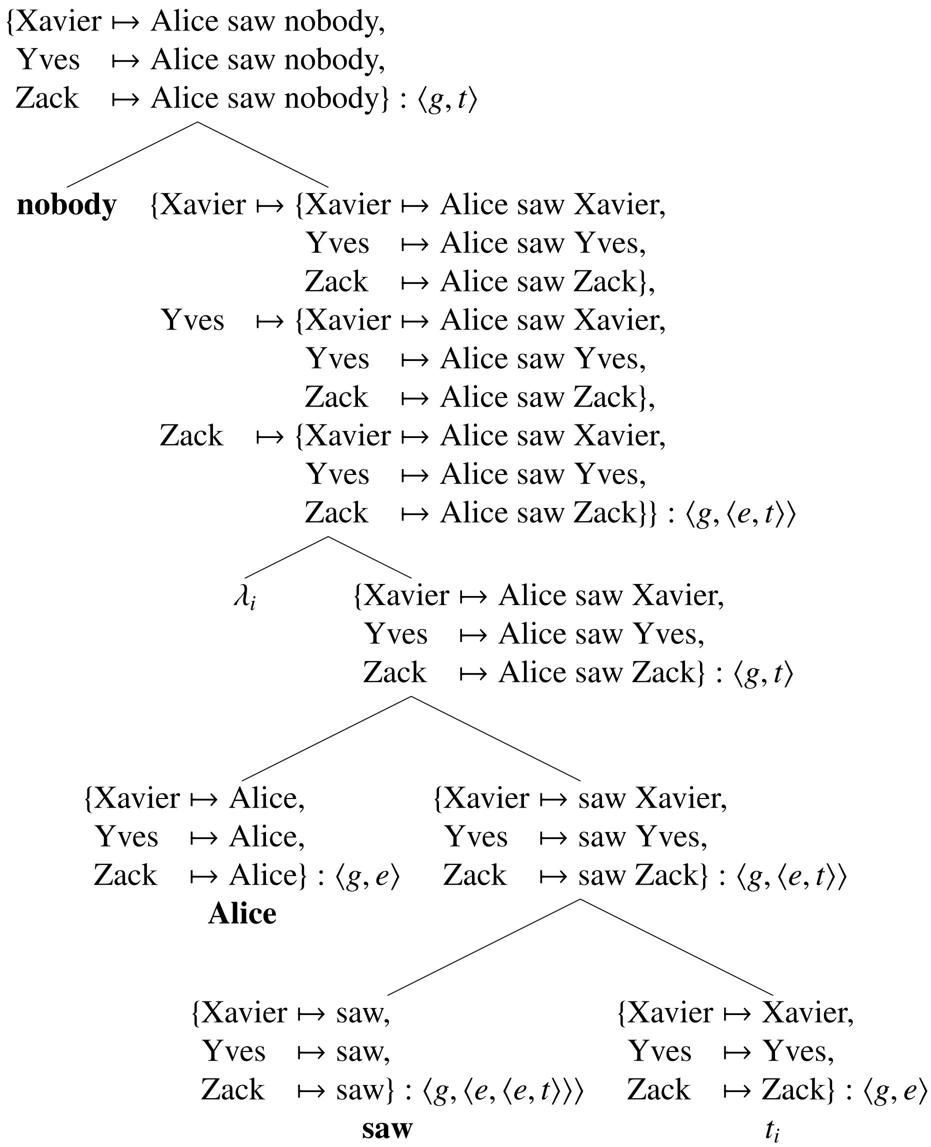
$$[\![\beta]\!] : \langle g, \langle A, B\rangle\rangle \qquad [\![\gamma]\!] : \langle g, A\rangle$$

(13) Predicate abstraction (Heim and Kratzer 1998):

$$\lambda g.\, \lambda x.\, [\![\beta]\!]\,(g[x/i]) : \langle g, \langle e, A\rangle\rangle$$

$$\lambda_i \qquad [\![\beta]\!] : \langle g, A\rangle$$

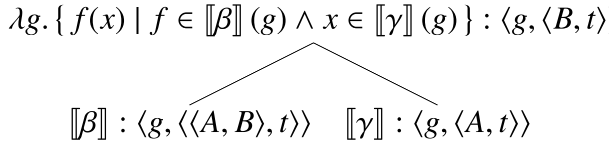
(14) Alice saw nobody.



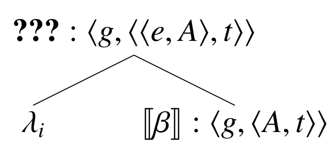
1.1 The problem

To mix alternatives and variables, replace each type A with $\langle g, \langle A, t\rangle\rangle$. The function application rule is easy to update, but there is no predicate abstraction rule that produces the correct denotation.

(15) Alternative-friendly, variable-friendly function application (Kratzer and Shimoyama 2002):



(16) Alternative-friendly predicate abstraction?



To see this, consider a sentence with a *wh*-phrase and a quantifier:

(17) Who saw nobody? (Alice did.)

??? : $\langle g, \langle\langle e,t\rangle, t\rangle\rangle$

λ_i {Xavier ↦ {Alice saw Xavier, Barbara saw Xavier, Carol saw Xavier},
Yves ↦ {Alice saw Yves, Barbara saw Yves, Carol saw Yves},
Zack ↦ {Alice saw Zack, Barbara saw Zack, Carol saw Zack}}
: $\langle g, \langle t,t\rangle\rangle$

{Xavier ↦ {Alice, Barbara, Carol},
Yves ↦ {Alice, Barbara, Carol},
Zack ↦ {Alice, Barbara, Carol}}
: $\langle g, \langle e,t\rangle\rangle$
who

{Xavier ↦ {saw Xavier},
Yves ↦ {saw Yves},
Zack ↦ {saw Zack}}
: $\langle g, \langle\langle e,t\rangle, t\rangle\rangle$

{Xavier ↦ {saw},
Yves ↦ {saw},
Zack ↦ {saw}}
: $\langle g, \langle\langle e, \langle e,t\rangle\rangle, t\rangle\rangle$
saw

{Xavier ↦ {Xavier},
Yves ↦ {Yves},
Zack ↦ {Zack}}
: $\langle g, \langle e,t\rangle\rangle$
t_i

We want a constant function that maps every assignment to the following set of functions.

(18) {{X ↦ Alice saw X, Y ↦ Alice saw Y, Z ↦ Alice saw Z},
{X ↦ Barbara saw X, Y ↦ Barbara saw Y, Z ↦ Barbara saw Z},
{X ↦ Carol saw X, Y ↦ Carol saw Y, Z ↦ Carol saw Z}} : $\langle\langle e,t\rangle, t\rangle$.

Predicate abstraction must "transpose" a function to sets (type $\langle e, \langle t,t\rangle\rangle$) into a set of functions (type $\langle\langle e,t\rangle, t\rangle$). But the denotation of the scope may as well be written

(19) {Xavier ↦ {Barbara saw Xavier, Alice saw Xavier, Carol saw Xavier},
Yves ↦ {Alice saw Yves, Carol saw Yves, Barbara saw Yves},
Zack ↦ {Carol saw Zack, Alice saw Zack, Barbara saw Zack}} : $\langle g, \langle t,t\rangle\rangle$,

whose "transpose" is not what we want predicate abstraction to produce:

(20) {{X ↦ Barbara saw X, Y ↦ Alice saw Y, Z ↦ Carol saw Z},
{X ↦ Alice saw X, Y ↦ Carol saw Y, Z ↦ Alice saw Z},
{X ↦ Carol saw X, Y ↦ Barbara saw Y, Z ↦ Barbara saw Z}} : $\langle\langle e,t\rangle, t\rangle$

Kratzer and Shimoyama (2002) try to get around the problem by including every "transpose":

(21) Kratzer and Shimoyama's alternative-friendly predicate abstraction:

$$\lambda g.\, \{\, f_{\langle e,A\rangle} \mid \forall x_e.\, f(x) \in [\![\beta]\!]\,(g[x/i])\,\} : \langle g, \langle\langle e,A\rangle, t\rangle\rangle$$

λ_i $[\![\beta]\!] : \langle g, \langle A,t\rangle\rangle$

(22) "There is a question about the correctness of [(21)]. It does not quite deliver the expected set of functions. As far as we can see, however, no wrong predictions are actually made, as long as we only use the definition for generating propositional alternatives."

(23) Who saw nobody?
a. *His$_i$ mother saw nobody$_i$.
b. *Barbara didn't see Xavier, Alice didn't see Yves, and Carol didn't see Zack.

(Another problem with the rule (21) occurs when one *wh*-phrase binds into another:

(24) Which man$_i$ sold which of his$_i$ paintings?

If any individual has no painting, then Kratzer and Shimoyama predict that no answer is felicitous. However, if Munch is under discussion, then *Munch sold "The Scream"* is a perfectly felicitous answer. This problem is easy to fix: just change the rule to produce

(25) $\lambda g. \{ f_{\langle e,A \rangle} \mid \forall x_e. (f(x) \in [\![\beta]\!] (g[x/i])) \lor (f(x) \text{ is undefined and } [\![\beta]\!] (g[x/i]) \text{ is empty}) \}$

instead.)

1.2 Two solutions

Do it all in the syntax: Beghelli and Stowell 1997; Karttunen 1977.

Do it all in the semantics: Do not try to "transpose" a function to sets into a set of functions! Generate a set of functions to start with. In general, generate a function to sets of functions to ....

(26) Which man$_i$ told nobody$_j$ about which of his$_i$ paintings?

To analyze (26), binding by i must take place outside—yet binding by j must take place inside—the alternative layer. Thus we must handle each binding separately, as variable-free semantics does. Shan (2004) shows how to mix alternatives and binding properly, by extending Barker's (2002) integration of Jacobson's variable-free semantics (1999, 2000) and Hendriks's Flexible Types for quantification (1988, 1993).

2 Choice functions do not cross over

(27) Every book that some professor$_i$ wrote impressed all of her$_i$ students.

(28) $\exists p. \text{professor}(p) \land \forall b. \text{wrote}(p, b) \Rightarrow \forall s. \text{student}(s, p) \Rightarrow \text{impressed}(b, s)$

(29) $\exists f. \text{choice-function}(f) \land \forall b. \text{wrote}(f(\text{professor}), b) \Rightarrow \forall s. \text{student}(s, \mathbf{her}) \Rightarrow \text{impressed}(b, s)$

How does *some professor* bind *her*? Two possibilities:

(30) *her* is a paycheck pronoun just like *some professor*: $\mathbf{her} = f(\text{professor})$

(31) *her* is a paycheck pronoun bound by *every book*: $\mathbf{her} = \iota p'. \text{wrote}(p', b)$

Must rule out (30) yet allow (31), in order to account for weak crossover.

(32) *Every book that she$_i$ wrote impressed all of some professor's$_i$ students.

Even though both paycheck denotations are contextually salient, f is a choice-function variable whereas b is a λ-bound variable. Hence, stipulate that a paycheck pronoun must be bound by a λ-bound variable, not a choice-function variable (cf. Büring 2004; Reinhart 1983). This stipulation acknowledges that, in this respect, choice-function variables behave like traces rather than pronouns in this respect, so existential closure of choice-function variables behaves like movement.

3 Conclusions

Beware the division of labor between syntax and semantics for scope-taking!

- Two scope-taking mechanisms must interact smoothly. Alternatives and variables do not.
- Constraints on binding, like crossover, may need to be restipulated, as for choice functions.

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