PLIN0056 Semantics Research Seminar

Lecture 7: Multiple *wh*-questionos

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1 Introduction

Multiple *wh*-questions can be felicitously answered by **single-pair (SP) answers** or **pair-list (PL) answers**.

(1) Q: Who is teaching what (right now)?
A: Nathan is teaching Semantics.

(2) Q: Who is teaching what (this term)?
A: Nathan is teaching Semantics, Klaus is teaching Syntax, and Jamie is teaching Phonology.

(We use these terms descriptively)

We shouldn't conclude from the above examples that we need different LFs for SP and PL answers.

- Maybe SP answers are just special cases of PL answers, when there is only one true pair.
- We at least need to be able to derive PL answers.

It will be important later that both answer types are felicitous with multiple singular *which*-questions as well.

(3) Q: Which linguist is teaching which module right now?
A: Nathan is teaching Semantics.

(4) Q: Which linguist is teaching which module this term?
A: Nathan is teaching Semantics, Klaus is teaching Syntax, and Jamie is teaching Phonology.

Recall that single singular *which*-questions are associated with uniqueness presuppositions.

(5) Q: Which linguist is teaching right now?
A: Nathan is.

(6) Q: Which linguist is teaching this term?
A: ??Nathan, Klaus, and Jamie are.

2 Anti-uniqueness

In single *wh*-questions, *who* and *what* are compatible with singular, as well as plural answers.

(7) Q: What did you read in November?
A_{sg}: *Animal Farm*.
A_{pl}: *Animal Farm*, *The Master and Margarita*, and Patrick's dissertation.

(8) Q: Who did you invite?

A_{sg}: Patrick.
A_{pl}: Patrick, Anna, and Stavroula.

Bošković 2001: p. 2 observes that *Who bought what?* in English cannot be asked felicitously in the following situation.

(9) John is in a store and in the distance sees somebody buying a piece of clothing, but does not see who it is and does not see exactly what the person is buying. He goes to the sales clerk and asks: “#Who bought what?”

- Based on this, Bošković 2001 claims that *Who bought what?* does not have an ‘SP reading’.
- But above, we saw that multiple *wh*-questions can generally be felicitously answered by SP answers. Similarly:

  (10) Q: I know you and your friends went shopping yesterday. Who bought what?
  A: Andy bought a drone. That’s it.

- The restriction seems to be: If you know that the answer will be SP, then *Who bought what?* is infelicitous; but if you don’t know if it will be SP or PL, then it is felicitous.

This restriction seems to be more accurately described as an ‘anti-presupposition’ (Percus 2006, Heim 2011, Sauerland 2008). I’ll leave open how to derive it (especially what alternative is to be used).

But Dayal 2002: fn. 3 gives the following example:

(11) Who hit who first?

Note that multiple *which*-questions can be asked when the answer is known to be a SP.

(12) I hear that one of our students sued one of the professors.
Which student sued which professor?

As discussed in Lecture 3, *which*-phrases come with independent felicity conditions (‘D-linking’), so for Bošković’s example, *which* cannot be used.

It seems that no one discusses cases like (13).

(13) Who bought which product?

(14) Which student sued who?

Also, embedded cases:

(15) a. Who bought what just now?
b. Can you tell me who bought what just now?
c. Does anyone know who bought what just now?
d. How can I check who bought what just now?

Bošković 2001 and subsequence research (Grebenyova 2004, Šimik 2010) further observe cross-linguistic variation: While German, Bulgarian and Russian pattern with English, *Who bought what?* in Japanese, Serbo-Croatian, and Mandarin Chinese are felicitous in the above context.

(16) *Japanese*
dare-ga nani-o katta no?
who-NOM what-ACC bought Q

‘Who bought what?’

(17) *Serbo-Croatian*
Ko je šta kupio?
who AUX what bought
‘Who bought what?’ (Bošković 2001: p. 4)

According to Bošković 2001, word order matters in French: (18a) is infelicitous and (18b) is felicitous in a scenario like the one above.

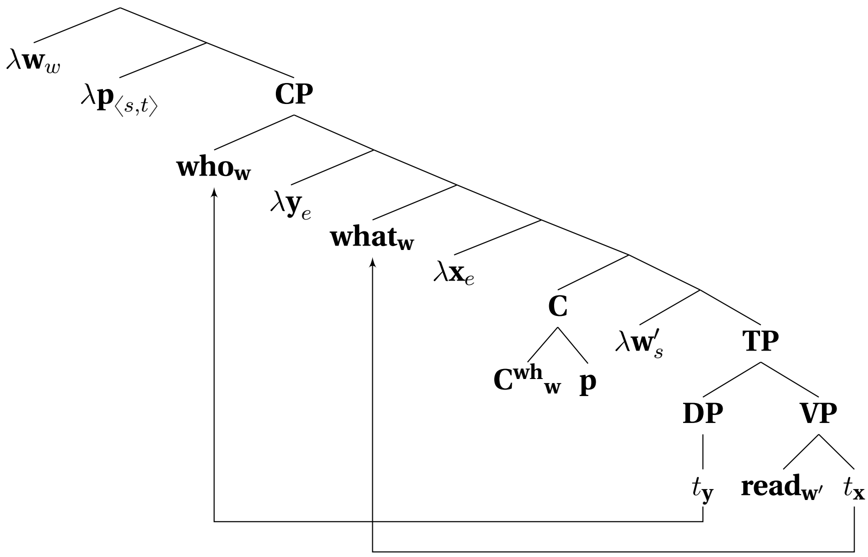
(18) *French*
a. Qu’a-t-il donné à qui?
what’has-EV-he given to whom
‘What did he give to whom?’
b. Il a donné quoi à qui?
he has given what to whom
‘What did he give to whom?’ (Bošković 2001: p. 3)

3 Predictions

Let’s see what our theory of question semantics so far predict.

3.1 *Who read what?*

(19)



Wh-phrases are existential quantifiers (that project presuppositions universally). They must move across the *wh*-complementiser.

(20) a. $[\![\textbf{who}]\!]^g = \lambda w_s.\lambda P_{\langle e,t\rangle}\colon \bigsqcup\{\, x \mid {}^{\star}\textbf{person}_w(x)\,\} \in \mathrm{dom}(P).\, \exists x \sqsubseteq \bigsqcup\{\, x \mid {}^{\star}\textbf{person}_w(x)\,\}\,[P(x)]$
b. $[\![\textbf{what}]\!]^g = \lambda w_s.\lambda P_{\langle e,t\rangle}\colon \bigsqcup\{\, x \mid {}^{\star}\textbf{thing}_w(x)\,\} \in \mathrm{dom}(P).\, \exists x \sqsubseteq \bigsqcup\{\, x \mid {}^{\star}\textbf{thing}_w(x)\,\}\,[P(x)]$

(21) $\star \coloneqq \lambda P_{\langle e,t\rangle}\lambda x_e\colon\ \exists Y_{\hat{e}}[\bigsqcup Y = x \wedge \forall y \in Y[y \in \mathrm{dom}(P)]].\ \exists Y_{\hat{e}}[\bigsqcup Y = x \wedge \forall y \in Y[P(y)]]$

(22) $\left[\!\!\left[\textbf{C}^{\textbf{wh}}\right]\!\!\right]^g = \lambda w_s.\ \lambda p_{\langle s,t\rangle}.\lambda q_{\langle s,t\rangle}\colon\ w \in \mathrm{dom}(q).\ q = p$

(23) $[\![(19)]\!]^g = \lambda w_s.\lambda p_{\langle s,t\rangle}.\ \exists x \sqsubseteq \bigsqcup\{\, x \mid {}^{\star}\textbf{thing}_w(x)\,\}\, \exists y \sqsubseteq \bigsqcup\{\, y \mid {}^{\star}\textbf{person}_w(y)\,\}\,[p = \lambda w'_s.\ \textbf{read}_{w'}(y,x)]$

(We assume *read* to be lexically cumulative and distributive on both arguments)

For any possible world w, $[\![(19)]\!]^g(w)$ characterises:

$$\left\{ \lambda w'_s.\ \mathbf{read}_{w'}(y,x) \;\middle|\; x \sqsubseteq \bigsqcup\{\, x \mid {}^*\mathbf{thing}_w(x)\,\}, y \sqsubseteq \bigsqcup\{\, y \mid {}^*\mathbf{person}_w(y)\,\} \right\}$$

If in w there are three people (p_1, p_2, p_3) and two things (t_1, t_2), this set will be:

$$\left\{ \begin{array}{lll} \lambda w'_s.\ \mathbf{read}_{w'}(p_1,t_1), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_2,t_1), & \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_1,t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_2,t_2), & \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_1,t_1 \sqcup t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_2,t_1 \sqcup t_2), & \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_2,t_1), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_3,t_1), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_2 \sqcup p_3,t_1) \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_2,t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_3,t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_2 \sqcup p_3,t_2), \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_2,t_1 \sqcup t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_3,t_1 \sqcup t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_1 \sqcup p_2 \sqcup p_3,t_1 \sqcup t_2), \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_3,t_1), & \lambda w'_s.\ \mathbf{read}_{w'}(p_2 \sqcup p_3,t_1), & \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_3,t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_2 \sqcup p_3,t_2), & \\ \lambda w'_s.\ \mathbf{read}_{w'}(p_3,t_1 \sqcup t_2), & \lambda w'_s.\ \mathbf{read}_{w'}(p_2 \sqcup p_3,t_1 \sqcup t_2) & \end{array} \right\}$$

The complete answer to this question in w is the conjunction of all the true propositions and the negations of all the false propositions in this set.

For example, if p_1 only read t_1 and p_3 only read t_2 and p_2 read nothing, then the following proposition is the complete answer:

$$\lambda w'_s.\ \bigwedge \left\{ \begin{array}{l} \mathbf{read}_{w'}(p_1,t_1), \\ \mathbf{read}_{w'}(p_3,t_2) \end{array} \right\} \wedge \bigwedge \left\{ \begin{array}{l} \neg\mathbf{read}_{w'}(p_1,t_2), \\ \neg\mathbf{read}_{w'}(p_2,t_1), \\ \neg\mathbf{read}_{w'}(p_2,t_2), \\ \neg\mathbf{read}_{w'}(p_3,t_1) \end{array} \right\}$$

Typically, one only says the true part, as in (24), but what is meant is the complete answer:

(24) Patrick read *The Tempest*, and Paul read *The Trial*.

If p_1 read t_1 and there's no other purchase, then the complete answer will be:

$$\lambda w'_s.\ \mathbf{read}_{w'}(p_1,t_1) \wedge \bigwedge \left\{ \begin{array}{l} \neg\mathbf{read}_{w'}(p_1,t_2), \\ \neg\mathbf{read}_{w'}(p_2,t_1), \\ \neg\mathbf{read}_{w'}(p_2,t_2), \\ \neg\mathbf{read}_{w'}(p_3,t_1), \\ \neg\mathbf{read}_{w'}(p_3,t_2) \end{array} \right\}$$

(25) Patrick read *The Tempest*.

So we can explain both PL and SP answers to *Who read what?* without further ado.

3.2 *Which boy read which book?*

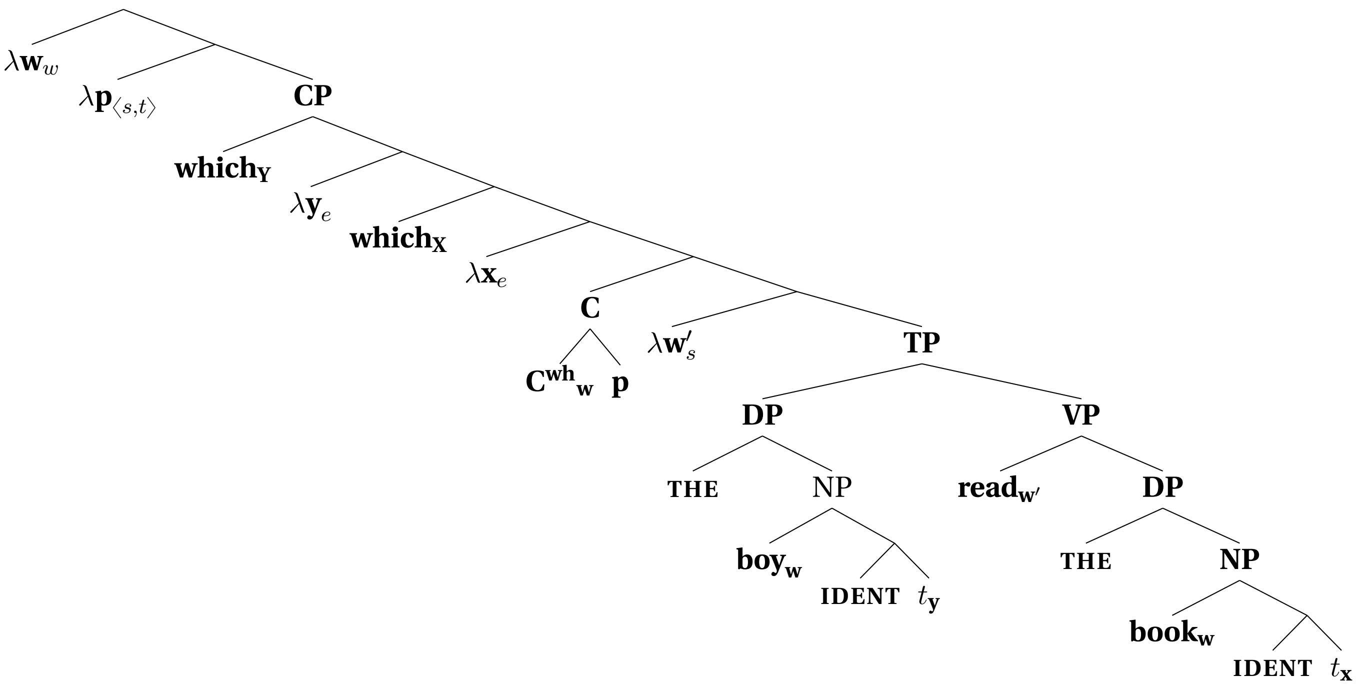
The above result crucial relies on the number neutrality of *who* and *what*.

To capture the effect of number marking on *which*-phrases, we need to require singular *which*-phrases to range only over atomic entities. (More on this next week)

(26) Q: Which linguist is teaching today?
A: Nathan is.

(27) Q: Which linguist is teaching this term?
A: ??Nathan, Klaus, and Jamie are.

(28)



(29) $[\![\textbf{which}]\!]^g = \lambda w_s.\lambda X_{\hat{e}}.\lambda P_{\langle e,t\rangle}\colon \bigsqcup X \in \text{dom}({}^\star P).\ \exists x \sqsubseteq \bigsqcup X[P(x)]$

(30) a. $[\![\textsc{ident}]\!]^g = \lambda w_s.\lambda x_e.\lambda P_{\langle e,t\rangle}.\lambda y_e\colon\ y \in \text{dom}(P).\ y = x \wedge P(y)$
b. $[\![\textsc{the}]\!]^g = \lambda w_s.\lambda P_{\langle e,t\rangle}\colon\ |\max_{\sqsubseteq}\{\, x \in D_e \mid P(x)\,\}| = 1.\ \iota y[y \in \max_{\sqsubseteq}\{\, x \in D_e \mid P(x)\,\}]$

(31) $[\![(28)]\!]^g = \lambda w_s\colon\ {}^\star\textbf{book}_w(\bigsqcup g(\mathbf{X})) \wedge {}^\star\textbf{boy}_w(\bigsqcup g(\mathbf{Y})).$
$\lambda p_{\langle s,t\rangle}.\ \exists x \sqsubseteq \bigsqcup g(\mathbf{X})\exists y \sqsubseteq \bigsqcup g(\mathbf{Y})[p = \lambda w'_s\colon\ \textbf{book}_w(x) \wedge \textbf{boy}_w(y).\ \textbf{read}_{w'}(y,x)]$

Suppose that in w, there are exactly three boys (a_1, a_2, a_3) and exactly two books (b_1, b_2) and $g(\mathbf{Y}) = \{\, a_1, a_2, a_3 \,\}$ $g(\mathbf{X}) = \{\, b_1, b_2 \,\}$.

Then $w \in \text{dom}([\![(28)]\!]^g)$ and $[\![(28)]\!]^g(w)$ characterises:

$$\{\, \lambda w'_s.\ \textbf{read}_{w'}(y,x) \mid y \in \{\, a_1, a_2, a_3 \,\}, x \in \{\, b_1, b_2 \,\}\,\}$$

This set only contains the following six propositions:

$$\left\{\begin{array}{l} \lambda w'_s.\ \textbf{read}_{w'}(a_1,b_1), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_1,b_2), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_2,b_1), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_2,b_2), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_3,b_1), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_3,b_2) \end{array}\right\}$$

Crucially, this does not contain any case with plural arguments. As Dayal 1996 and Fox 2018 discuss, this set will yield a presupposition that only one of these propositions is true. So it's predicted that only an SP answer is possible.

4 PL readings

Dayal 1996 observes two properties of the PL readings of multiple singular *which*-questions: **domain exhaustivity** and **point-wise uniqueness**.

4.1 Domain exhaustivity

In a multiple *wh*-question, one of the *wh*-phrases, usually the highest/leftmost one on the surface, has a special interpretive property (Kuno & Robinson 1972, Comorovski 1989, Dayal 1996): A complete answer needs to say something about everything it ranges over.

(32) [There are 4 boys and 4 girls.]
Which of the four boys will dance with which of the four girls?

(33) [There are 4 boys and 7 girls.]
Which of the four boys will dance with which of the seven girls?

(34) [There are 7 boys and 4 girls.]
??Which of the seven boys will dance with which of the four girls?

Xiang 2023 more recently observes counterexamples to the above generalisation.

(35) (Guess) Which candidate will get which job? (Cf. *Which job will every candidate get?*)

This is, however, not necessarily a problem for the idea that one of domain exhaustivity; it could be explained if the *which job* is the one that's domain-exhaustive.

Xiang 2023: p. 435 argues that that is not even true, based on the following example.

(36) [Context: Four boys and four girls will form four boy-girl pairs to perform in a dance competition, but only two of the pairs will get into the final round.]
Guess which one of the four boys will dance with which one of the four girls in the final round.

In her own proposal Xiang does not encode domain exhaustivity in multiple *wh*-questions, but it's not clear how she is to account for classical examples.

4.2 Point-wise uniqueness

When both *which*-phrases are singular, there's a uniqueness presupposition that applies to each thing that the exhaustive *wh*-phrase ranges over.

(37) Which boy kissed which girl? ⇒ each boy killed one and only one girl

Compare:

(38) Which boy kissed which girls?

(39) Which member of staff is teaching which module(s) this term?

5 Family-of-questions approach

Dayal 1996 proposes to derive PL readings with domain exhaustivity and point-wise uniqueness in terms of functions that are total with respect to the restrictor of one of the *wh*-phrases. More specifically she postulates a separate complementiser that quantifies over functions whose domain is the restrictor of the domain-exhaustive *wh*-phrase.

But this requires some uncomfortable syntactic assumptions. In particular, I don't see whether she could have NP reconstruction for the domain-exhaustive *wh*-phrase. This would be an issue in sentences like:

(40) a. Which property of his did each English duke bequeath to which relative?
b. Let's find out which property of his each English duke bequeath to which relative.

According to the **family-of-questions** approach, a multiple *wh*-phrase, under its PL reading, denotes a set of questions (Hagstrom 1998, Fox 2012, Nicolae 2013, Kotek 2018).

5.1 Ingredients

This is achieved by adding one more layer of CP.

Recall the *wh*-complementiser creates a set of propositions:

(41) $$\left[\!\left[\mathbf{C^{wh}}\right]\!\right]^g = \lambda w_s.\ \lambda p_{\langle s,t\rangle}.\lambda q_{\langle s,t\rangle}\colon\ w \in \mathrm{dom}(q).\ q = p$$

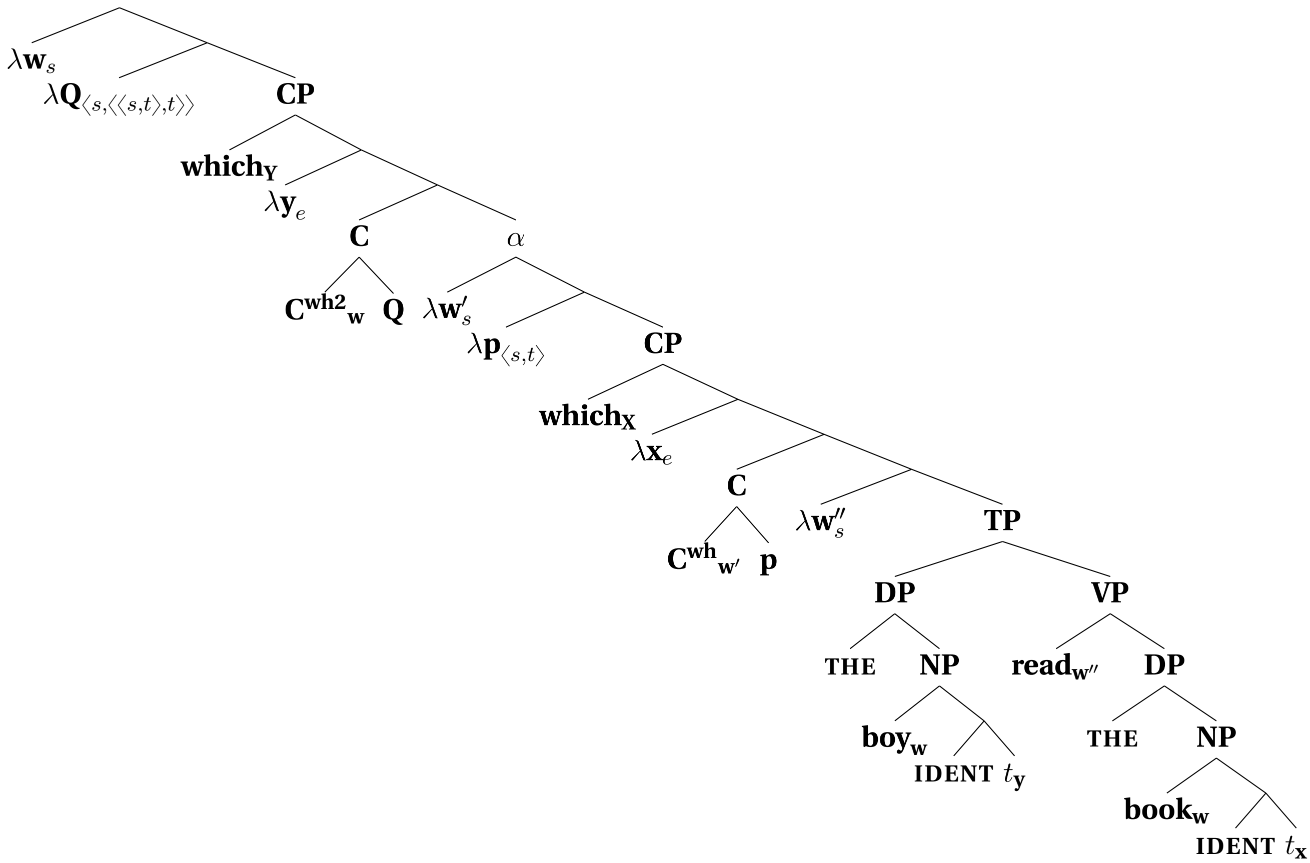
If we apply this again, we will create a set of sets of propositions:

(42) $$\left[\!\left[\mathbf{C^{wh2}}\right]\!\right]^g = \lambda w_s.\ \lambda Q_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}.\lambda R_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}\colon\ w \in \mathrm{dom}(R).\ Q = R$$

5.2 Example

(43) Which boy read which book?

(44)



(45) $[\![(44)]\!]^g = \lambda w_s \colon {}^\star\textbf{book}_w(\bigsqcup g(\textbf{X})) \wedge {}^\star\textbf{boy}_w(\bigsqcup g(\textbf{Y})).$
$\lambda Q_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}.\ \exists y \sqsubseteq \bigsqcup g(\textbf{Y})[$
$Q = \lambda w'_s \colon {}^\star\textbf{book}_w(\bigsqcup g(\textbf{X})) \wedge \textbf{boy}_w(y).\lambda p_{\langle s,t\rangle}.\ \exists x \sqsubseteq \bigsqcup g(\textbf{X})[$
$p = \lambda w''_s \colon\ \textbf{book}_w(x) \wedge \textbf{boy}_w(y).\ \textbf{read}_{w''}(y,x)]]$

Suppose, as before, that in w, there are exactly three boys (a_1, a_2, a_3) and exactly two books (b_1, b_2) and $g(\textbf{Y}) = \{ a_1, a_2, a_3 \}$ $g(\textbf{X}) = \{ b_1, b_2 \}$.

Then $w \in \text{dom}([\![(44)]\!]^g)$ and $[\![(44)]\!]^g(w)$ characterises:

$$\{ \lambda w'_s.\ \lambda p_{\langle s,t\rangle}.\ \exists x \in \{ b_1, b_2 \} [p = \lambda w''_s.\ \textbf{read}_{w''}(y,x)] \mid y \in \{ a_1, a_2, a_3 \} \}$$

Each of these is a question intension, and when applied to w, it returns (for different boys $y \in \{ a_1, a_2, a_3 \}$):

$$\{ \lambda w''_s.\ \textbf{read}_{w''}(y,x)] \mid x \in \{ b_1, b_2 \} \}$$

The set $\{ \mathsf{set}(Q(w)) \mid Q \in \mathsf{set}([\![(44)]\!]^g(w)) \}$ will be:

$$\left\{ \left\{ \begin{array}{l} \lambda w'_s.\ \textbf{read}_{w'}(a_1,b_1), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_1,b_2), \end{array} \right\}, \left\{ \begin{array}{l} \lambda w'_s.\ \textbf{read}_{w'}(a_2,b_1), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_2,b_2), \end{array} \right\}, \left\{ \begin{array}{l} \lambda w'_s.\ \textbf{read}_{w'}(a_3,b_1), \\ \lambda w'_s.\ \textbf{read}_{w'}(a_3,b_2), \end{array} \right\} \right\}$$

5.3 Summary

For *Which boy read which book?* we have two possible LFs:

(46) a. SP: $\ldots$ [CP which$_\text{Y}$ $\ldots$ which$_\text{X}$ $\ldots$ C$^\text{wh}$ $\ldots$ [t_y $\ldots$ read $\ldots$ t_x $\ldots$]
b. PL: $\ldots$ [CP which$_\text{Y}$ $\ldots$ C$^\text{wh2}$ $\ldots$ [CP which$_\text{X}$ $\ldots$ C$^\text{wh}$ $\ldots$ [t_y $\ldots$ read $\ldots$ t_x $\ldots$]

The SP denotation yields a set of propositions like:

$$\left\{\begin{array}{l}\lambda w'_s.\ \mathbf{read}_{w'}(a_1,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_1,b_2),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_2,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_2,b_2),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_3,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_3,b_2)\end{array}\right\}$$

The PL denotation yields a set of questions (= a set of sets of propositions):

$$\left\{\left\{\begin{array}{l}\lambda w'_s.\ \mathbf{read}_{w'}(a_1,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_1,b_2),\end{array}\right\},\left\{\begin{array}{l}\lambda w'_s.\ \mathbf{read}_{w'}(a_2,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_2,b_2),\end{array}\right\},\left\{\begin{array}{l}\lambda w'_s.\ \mathbf{read}_{w'}(a_3,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_3,b_2),\end{array}\right\}\right\}$$

The PL denotation does not encode domain exhaustivity or point-wise uniqueness, but neither does the SP denotation encode uniqueness.

The idea is to derive these presuppositions out of the denotations, following Dayal 1996 and Fox 2018, among others. We'll hear more about this next week.

But notice the asymmetry for the LP denotation. If *which book* were in the second CP layer, the set of questions will be sorted according to the books:

$$\left\{\left\{\begin{array}{l}\lambda w'_s.\ \mathbf{read}_{w'}(a_1,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_2,b_1),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_3,b_1)\end{array}\right\},\left\{\begin{array}{l}\lambda w'_s.\ \mathbf{read}_{w'}(a_1,b_2),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_2,b_2),\\ \lambda w'_s.\ \mathbf{read}_{w'}(a_3,b_2)\end{array}\right\},\quad\right\}$$

As discussed above the (surface) syntax determines (in most cases) which one is higher at LF.

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