On the semantics of *wh*-questions

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1 Summary

Over the past four decades: Extensive literature on...[1]

- The syntax of *wh*-questions (Ross, 1967; Perlmutter, 1971; Kuno and Robinson, 1972; Chomsky, 1977; Huang, 1982; Lasnik and Saito, 1984; É Kiss, 1986; Nishigauchi, 1986; Pesetsky, 1987; Cheng, 1991; Lasnik and Saito, 1992; Hornstein, 1995; Chomsky, 1995; Pesetsky, 2000; Richards, 2001; Cable, 2007, 2010, among many others)
- The semantics of *wh*-questions (Pope,1972; Hamblin,1973; Karttunen,1977; Groenendijk and Stokhof, 1984; Engdahl, 1986; Comorovski, 1989; Dayal, 1996; Hagstrom, 1998; Reinhart, 1998; Kratzer and Shimoyama, 2002; Dayal, 2002; Shimoyama, 2006; Cheng and Demirdache, 2010; Fox, 2012; Nicolae, 2013, among many others)
- Intervention effects in *wh*-questions (Beck, 1996; Kim, 2002; Beck, 2006; Beck and Kim, 2006; Grohmann, 2006; Haida, 2007; Tomioka, 2007; Mayr, 2010, 2014; Li and Law, 2014, a.o.)

My goal: an interrogative syntax/semantics for questions that draws on insights from all three bodies of literature (Kotek, 2014).

Today:

① Background on superiority, the readings of multiple questions (concentrating on English data), syntactic assumptions.

② A new semantics for questions

- Superiority effects
- Readings of multiple questions
- Presuppositions of multiple questions
- Intervention effects

☞ Wide empirical coverage, and at the same time simpler than other theories (e.g. Cable, 2007, 2010; Cheng and Demirdache, 2010; Fox, 2012; Nicolae, 2013).

③ A new description of *intervention effects* (Beck, 2006, a.o.).

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[1]These lists are non-exhaustive!

2 Background

2.1 Questions, multiple questions, and superiority effects

The formation of a question in English involves fronting of one *wh*-phrase.

(1) *Which* book did John read ___?

In a multiple question, again only one *wh*-phrase fronts:

(2) a. *Which* student ___ read *which* book? superiority-obeying
b. *Which* book did *which* student read ___? superiority-violating

Based on syntactic considerations, as well as evidence from intervention effects, licensing of Antecedent Contained Deletion, different underlying structures have been proposed for superiority-obeying and superiority-violating questions (Pesetsky, 2000; Beck, 2006; Cable, 2007, 2010; Kotek, 2014):

(3) **Different syntactic assumptions for obeying and violating questions:**
a. *Which* student *which* book C ___ read ___? (= 2a)
b. *Which* book C did *which* student read ___? (= 2b)

2.2 The readings of multiple questions

- Multiple questions have *single-pair* and *pair-list* readings.

(4) *Which* student read *which* book?
a. Single pair: *John read Moby Dick*.
b. Pair-list: *John read Moby Dick, Mary read War & Peace, Bill read Oliver Twist*.

- The pair-list reading involves answering a set of questions. For each individual in the domain of *student*, we ask: which book did that individual read?

(5) **A set of *which book* questions ranging over students:**
{ Which book did John read?
Which book did Mary read?
Which book did Bill read? }

- The meaning of a question is the set of possible answers to the question (Hamblin, 1973; Karttunen, 1977).
- This yields a family of questions "sorted" by *students* (Roberts, 1996; Hagstrom, 1998; Krifka, 2001; Büring, 2003; Willis, 2008; Fox, 2012; Nicolae, 2013; Constant, 2014, a.o.) :

(6) **A family of questions denotation for superiority-obeying question in (4):**

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{John read WP} \\ \text{John read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Mary read MD} \\ \text{Mary read WP} \\ \text{Mary read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Bill read MD} \\ \text{Bill read WP} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

- For the superiority-violating question, we construct a set of questions about the books in the domain:

(7) **A set of questions for the superiority-violating question:**
Which book did *which* student read?

$$\left\{ \begin{array}{l} \text{Which student read Moby Dick?} \\ \text{Which student read War and Peace?} \\ \text{Which student read Oliver Twist?} \end{array} \right\}$$

- This now yields a family of questions sorted by *books*:

(8) **A family of questions denotation for a superiority-violating question:**

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{Mary read MD} \\ \text{Bill read MD} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read WP} \\ \text{Mary read WP} \\ \text{Bill read WP} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read OT} \\ \text{Mary read OT} \\ \text{Bill read OT} \end{array} \right\} \right\}$$

- Note the denotations of obeying and violating questions are different in terms of the structure of these possible answer sets.
- These are motivated by the differences in the presuppositions of the question (cf Dayal, 2002; Fox, 2012)

☞ The goal: model the pair-list readings of multiple questions as these nested set structures.

On the presuppositions of multiple questions:
Dayal (2002) shows that multiple questions have two presuppositions (see also Fox, 2012).

(9) **The presuppositions of a multiple question (Dayal, 2002):**
a. Domain exhaustivity: every member of the set quantified over by the overtly moved *wh* is paired with a member of the set quantified over by the in-situ *wh*.
b. Point-wise uniqueness (*functionhood*): every member of the set quantified over by the overtly moved *wh* is paired with no more than one member of the set quantified over by the in-situ *wh*.

This can be paraphrased as saying that for each question in the family of questions there must be exactly one true answer. For (8), this means that there must be a unique student who read each book, and we must provide information about each book in the domain. Under this description, all the books must have a reader, but it is possible that some students will not have read any book.

2.3 Alternative semantics

- Sentences are interpreted in a multi-dimentional system: Each node has an *ordinary value* $[\![\cdot]\!]^o$ and a *focus-semantic value* $[\![\cdot]\!]^f$ (Rooth, 1985, a.o.).
- The focus-semantic value is the set of *alternatives* for a node.
- Some *Op*s (e.g. *only*, Question operator) operate on alternative values.

(10) **Ordinary and alternative values for *John*$_F$ slept:**

a. $[\![\text{TP}]\!]^o$=
John slept
$[\![\text{NP}]\!]^o$= John
John$_F$
$[\![\text{VP}]\!]^o$= $\lambda x.x$ slept
slept

b. $[\![\text{TP}]\!]^f$=
{John slept, Mary slept}
$[\![\text{NP}]\!]^f$= {John, Mary}
John$_F$
$[\![\text{VP}]\!]^f$= {$\lambda x.x$ slept}
slept

3 Proposal

- The derivation of a question involves three interrogative components: *Wh*-words, the interrogative complementizer C, and a question operator: **?**.

☞ *Wh*-words are elements that introduce alternatives into the derivation (Hamblin, 1973). They do not have an ordinary semantic value (Beck, 2006; Cable, 2010).

(11) **The denoatation of *who* is a set of individuals:**
Ordinary value: $[\![who]\!]^o$ is undefined
Alternative value: $[\![who]\!]^f = \{x_e : x \in \text{human}\}$

(12) **The focus-semantic denotation of a *which*-NP phrase is the NP extension:**
$[\![which\ \text{student}]\!]^f = [\![\text{student}]\!]^o$ = { Alex, Bobby, Chris, Dana... }

☞ The interrogative complementizer, C triggers interrogative movement.
It plays no role in the semantics of the question, and simply passes up the denotation of its sister.

☞ The ?-operator sits on the clausal spine and drives interrogative semantics.
It takes a set of propositions (or a set of such sets...) and returns the focus-semantic value of that set as the ordinary value of the question (This is a type-flexible version of Shimoyama 2001; Beck and Kim 2006's semantics for C).

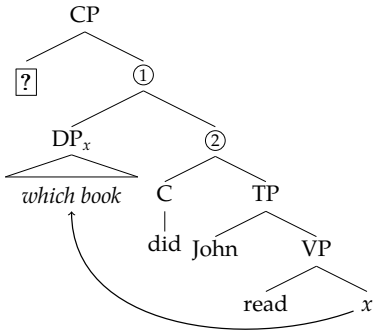
(13) **The semantics of the ?-operator:**
a. $[\![?\ \alpha_\sigma]\!]^o = [\![\alpha_\sigma]\!]^f$
b. $[\![?\ \alpha_\sigma]\!]^f = \{\ [\![?\ \alpha_\sigma]\!]^o\ \}$ $\quad \sigma \in \{\langle st, t\rangle, \langle\langle st, t\rangle, t\rangle, ...\}$

(This proposal is compatible with Cable's 2007; 2010 syntax for pied-piping, as well as Heck's 2008; 2009 syntax for pied-piping.)

4 Derivations

4.1 The derivation of a simplex question

(14) **The (simplified) LF of a simplex question:**[2]



(15) a. $[\![①]\!]^f = \{\lambda w.\ \text{John read } x \text{ in } w : x \in book\}$.
b. **?** takes $[\![①]\!]^f$ and returns it as the ordinary value of the question.

(16) **A set of possible answers to the question:**
$\{$ John read MD, John read WP, John read OT $\}$

☞ **The contribution of C is separated from that of ?.**

- **C** is syntactically ***below*** the *wh*-phrase, and is responsible for interrogative syntax.
- **?** is syntactically ***above*** the *wh*-phrase, and is responsible for interrogative semantics.
- Here, the denotation of **?** is identical to the denotation for C given in Shimoyama (2001); Beck and Kim (2006).

Meanwhile in presupposition land...
A question must a unique maximally informative true answer (Dayal, 1996).

(17) **The *Ans* operator as Max$_{inf}$ (Dayal 1996, cf Fox 2012):**[3]
$[\![Ans]\!]\,(P) = \text{Max}_{inf}(P)$
$\text{Max}_{inf}(P)(w) = \iota p \in P$, s.t. $w \in p$ and $\forall q \in P\ (w \in q \rightarrow p \subseteq q)$

The propositions in (16) are logically independent of one another. Therefore there can only be one true member in the set. This correctly models the contribution of the singular *which*-question here.

[2] I assume, but do not show here and in other LFs, successive-cyclic *wh*-movement through phase edges, A-movement of the *v*P internal subject, T-C movement of the auxiliary verb, etc. I furthermore do not represent in the tree the λ-abstraction steps introduced by the movement of *wh*-phrases in the structure.

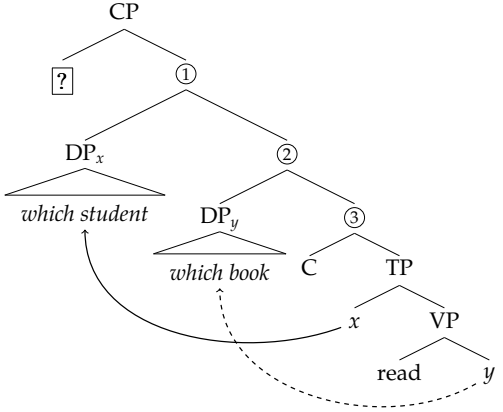
[2] To simplify the notation, I represent assignment dependent elements in the denotation using unbound variables.

[3] Dayal does not use the term Max$_{inf}$, but the definition she provides is equivalent to Max$_{inf}$, as proposed in Fox and Hackl (2006) and subsequent work.

4.2 The single-pair reading of a multiple question

- For a superiority-obeying question:[4] (cf 3a)

(18) **The LF of a sup.-obeying multiple question with a single-pair reading:**



(19) a. $[\![③]\!]^f = \{\ [\![③]\!]^o\ \} = \{\ \lambda w.\ x \text{ read } y \text{ in } w\ \}$.
b. This set pointwise composes with the set of books at node ② and with the set of students at node ①:
$[\![①]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book, x \in student\}$.
c. **?** takes $[\![①]\!]^f$ and returns it as the ordinary value of the question.

- The resulting meaning is a 'flat' set of propositions, corresponding to the possible answers to the question, giving rise to a single-pair reading.

(20) **A single-pair reading is modeled as a 'flat' set of propositions:**
$\left\{ \begin{array}{l} \text{John read MD, John read WP, John read OT, Mary read MD,} \\ \text{Mary read WP, Mary read OT, Bill read MD, Bill read WP, Bill read OT} \end{array} \right\}$

☞ **The same ingredients are used here as with the simplex question.**

The alternatives from all *wh*-phrases in the structure pointwise compose with one another first; **?** then returns the product as the meaning of the question.

Meanwhile in presupposition land...
The propositions in (20) are logically independent of one another.

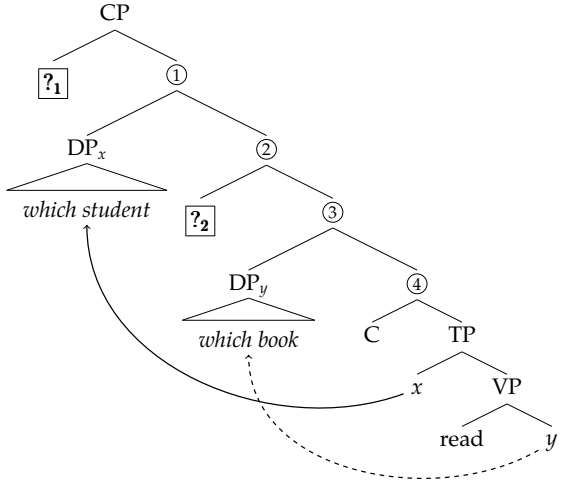
Applying the *Ans*-operator (17) to this set, the question is defined iff there is exactly one true member in the set. Hence, the result here is a single pair reading.

[4] The same logic will hold for the interpretation of a superiority-violating question, but the syntax will be different, as shown in section 4.4.

4.3 The pair-list reading of a superiority-obeying multiple question

- Syntax as in (18) with a single difference: a second **?**-operator. (cf 3a)

(21) **The LF of a sup.-obeying multiple question with a pair-list reading:**



(22) a. Derivation as in (19) up to node 3:
$[\![③]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\}$.

b. **$?_2$ returns this as the ordinary value of ②.**

c. Point-wise compose *student* with $[\![②]\!]^f$, to create a nested structure:
$[\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : y \in book\} :\ x \in student\}$

d. $?_1$ returns this as the ordinary meaning of the question.

(23) **A family of questions sorted by *student* yields a pair-list reading:**

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{John read WP} \\ \text{John read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Mary read MD} \\ \text{Mary read WP} \\ \text{Mary read OT} \end{array} \right\}, \left\{ \begin{array}{c} \text{Bill read MD} \\ \text{Bill read WP} \\ \text{Bill read OT} \end{array} \right\} \right\} \quad (= 6)$$

Meanwhile in presupposition land...
Based on Dayal's *Ans*-operator in (17), I recursively define an operator that will apply to sets of questions, or sets of sets of questions, etc.

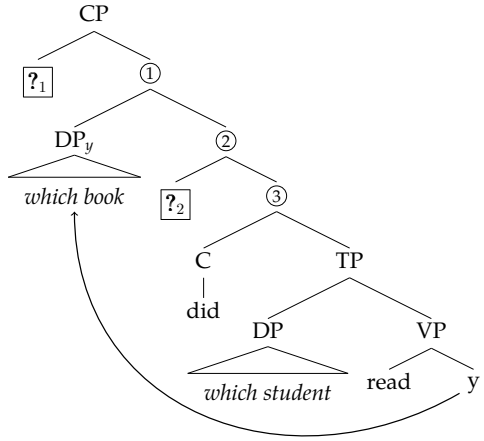
This operator correctly models the exhaustivity and uniqueness presuppositions of the question described on page 3.

(24) **A recursive definition for *Ans*:**
$[\![Ans]\!]\left(P_{\langle st,t\rangle}\right) = \lambda w.\text{Max}_{inf}(P)(w)$
$[\![Ans]\!]\left(K_{\langle\sigma,t\rangle}\right) = \lambda w.\forall P_\sigma \in K\left([\![Ans]\!](P)(w)\right)$ $\qquad \sigma \in \{\langle st,t\rangle, \langle\langle st,t\rangle,t\rangle, \ldots\}$
where $\text{Max}_{inf}(P)(w) = \iota p \in P$, s.t. $w \in p$ and $\forall q \in P\,(w \in q \rightarrow p \subseteq q)$

4.4 The pair-list reading of a superiority-violating multiple question

- DP_y fronts to Spec,CP over DP_x; second **?**-operator on the spine.[5] (cf 3b)

(25) **The LF of a superiority-violating question with a pair-list reading:**



(26) a. Focus alternatives here used in larger portion of the structure.

b. $[\![③]\!]^f = \{\lambda w.\ x \text{ read } y \text{ in } w : x \in student\}$.[6]

c. **$?_2$ returns this as the ordinary value of ②.**

d. Point-wise compose *book* with $[\![②]\!]^f$, to create a nested structure:
$[\![①]\!]^f = \{\{\lambda w.\ x \text{ read } y \text{ in } w : x \in student\} :\ y \in book\}$

e. $?_1$ returns this into the ordinary meaning of the question.

(27) **A family of questions sorted by *book* yields a pair-list reading:**

$$\left\{ \left\{ \begin{array}{c} \text{John read MD} \\ \text{Mary read MD} \\ \text{Bill read MD} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read WP} \\ \text{Mary read WP} \\ \text{Bill read WP} \end{array} \right\}, \left\{ \begin{array}{c} \text{John read OT} \\ \text{Mary read OT} \\ \text{Bill read OT} \end{array} \right\} \right\} \quad (= 8)$$

☞ **The ?-operator** is syntactically *higher* than the *wh*(s) it interprets.
It is type-flexible.
It can iterate more than once in a structure.

☞ **Interrogative C** is syntactically *lower* than the *wh*(s) it attracts to its specifier(s).
It is semantically inert.
It only occurs once in a question.

[5] More technically: probe for *wh*; Agree with DP_x but do not Attract it; continue probing. Agree with and Attract DP_y (Pesetsky, 2000). Alternatively, within Cable's (2007, 2010) Q-theory, merge a Q-particle with DP_y, but not DP_x.

[6] This will help explain the distribution of intervention effects in English questions, see section 5, as proposed in Pesetsky (2000); Beck (2006).

5 The intervention effects generalization

☞ This theory allows for a unified description of intervention effects in questions and in *wh*-question pied-piping.

Descriptively: Intervention effects happen when an ***intervener*** occurs between an in-situ *wh*-phrase and the interrogative complementizer.

- This is most easily seen in *wh*-in-situ languages such as Japanese.
  - (28b) shows an intervention effect with 'no one.'
  - Intervention is avoided if *wh* is scrambled above the quantifier, (28c).

(28) **Japanese** (Data from Tomioka 2007):
  a. ✓ Hanako-ga *nani-o* yon-da-no?
  Hanako-nom what-acc read-past-Q
  'What did Hanako read?'
  b. ?* **Daremo** *nani-o* yom-ana-katta-no?
  anyone what-acc read-neg-past-Q
  c. ✓ *Nani-o* **daremo** ___ yom-ana-katta-no?
  what-acc anyone read-neg-past-Q
  'What did no one read?'

- In German, intervention affects in-situ *wh*-phrases in multiple questions. Intervention can be avoided by scrambling in-situ *wh* above the intervener.

(29) **German** (Data from Beck 1996)
  a. ✓ *Wer* hat Luise *wo* angetroffen?
  who has Luise where met
  'Who met Luise where'?
  b. ?? Wer hat **niemanden** *wo* angetroffen?
  who has nobody where met
  c. ✓ Wer hat *wo* **niemanden** ___ angetroffen?
  who has where nobody met
  'Who didn't meet anybody where'?

(30) **The intervention configuration** (cf Beck 2006):
  a. * [$_{CP}$ C ... **intervener** ... *wh*]
  b. ✓ [$_{CP}$ C ... *wh* **intervener** ... t]

- In English, intervention effects affect superiority-violating questions but not superiority-obeying questions (Pesetsky, 2000).

(31) **Intervention effects in English questions** (Pesetsky, 2000):
  a. ✓ *Which* student$_1$ **didn't** ___ read *which* book$_2$? obeying
  b. * *Which* book$_2$ **didn't** *which* student$_1$ read ___? violating

(32) a. ✓ *Which* book$_1$ did **only Mary** give ___ to *which* student$_2$? obeying
  b. * *Which* student$_2$ did **only Mary** give *which* book$_1$ to ___? violating

(33) **LFs in a ?-based system** (cf Pesetsky 2000; Beck 2006; Cable 2007, 2010):
  a. ✓ [$_{CP}$? wh_1 wh_2 C ... **intervener** ...] obeying
  b. * [$_{CP}$? wh_2 C ... **intervener** ... wh_1 ...] violating

☞ Captured by the intervention configuration (30).

- Intervention effects also happen inside pied-piping constituents (Sauerland and Heck (2003); Cable (2007, 2010); Kotek and Erlewine (to appear)):

(34) **Intervention effect in English overt pied-piping** (Cable, 2007):
  a. ✓ [A picture of *which* president] does Jim own ___?
  b. * [**No** pictures of *which* president] does Jim own ___?

(35) **LFs in a ?-based system**:
  a. ✓ [$_{CP}$? [$_{\text{pied-piping}}$ ... *wh* ...] C ...]
  b. * [$_{CP}$? [$_{\text{pied-piping}}$ ... **intervener** ... *wh* ...] C ...]

☞ Not captured by the intervention configuration (30).

- **Previously:** Intervention happens **between *wh* and C** (*wh*-questions) AND **between *wh* and the edge of pied-piping** constituents (*wh*-pied-piping).
- However the ungrammaticality in both cases appears to have the same cause.

☞ A unified description of intervention-effect configurations.

(36) **Proposal: Configuration of an intervention effect:**
  a. * [$_{CP}$? ... **intervener** ... *wh*]
  b. ✓ [$_{CP}$? ... *wh* **intervener** ... t]

- **Intervention happens in the region between ? and *wh*.**
  - Above *wh*-in-situ in questions.
  - Inside pied-piping constituents.

6 Conclusions

A new proposal for interrogative syntax-semantics.

- **A well-motivated syntax** for simplex and multiple questions.
- Compatible with both major approaches to **pied-piping** (Cable; Heck).
- **A simple semantics** for interrogative components of the derivation:
  - *Wh*-words introduce alternatives into the derivation.
  - **C** passes up the denotation of its sister.
    Occurs once in the structure, *below* moved *wh*-phrases.
  - **?** returns the focus value of its sister as its ordinary value.
    Type flexible, can recur, occurs *above wh*-phrases it interprets.
- **Single-pair and pair-list readings** derived from minimally different LFs.
- **Superiority, presuppositions** of the question are modeled.
- Combines with existing theory of **intervention effects**.
- Allows for a **unified description** of intervention effects in matrix *wh*-questions and in *wh*-question pied-piping.

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