Proceedings of SALT 35: 783–800, 2025

Nested *wh*-phrases and degenerate questions*

Danny Fox
Massachusetts Institute of Technology

Yasutada Sudo
University College London

Abstract Question with nested *wh*-phrases like *which book by which author* cannot receive pair-list readings. We propose that this restriction falls out of a general constraint against questions whose answers are all Strawson-equivalent, together with certain independently motivated assumptions about the syntax-semantics of multiple *wh*-questions. Support for our proposal comes from Bulgarian, a language that has been argued to display key components of the LF of *wh*-questions overtly. If this is true, the language teaches us that there are two LFs that can in principle be associated with nested *wh*-questions, only one of which is subject to the restriction observed in English. This distinction is a direct consequence of our proposal.

Keywords: nested *wh*-phrases, pair-list readings, degenerate questions, covert *wh*-movement, superiority, family of questions

1 Introduction

Multiple *wh*-questions like (1) generally receive *pair-list (PL) readings*.

(1) Which book on the table was written by which author?

But this does not hold for all multiple *wh*-questions. Our main interest in this paper is the generalization pointed out by Higginbotham & May (1981) and Elliott (2016) that when one singular *which*-phrase contains another, PL readings are systematically absent.[1] To see this, consider the following example.

(2) Which book by which author is on the table?

* We thank Luka Crnic, Patrick D. Elliott and David Pesetsky for helpful discussion and comments on various stages of this work, and Snejana Iovtcheva for judgments in Bulgarian. We would also like to thank the audiences at HUJI, MIT and SALT 35 for feedback. All remaining errors are our own. The appendices to this paper are available at https://osf.io/nq7pz/overview?view_only=912477e728204c849fee159a372f9e01.

1 There appear to be speakers of English for whom (2) does have a PL reading. For the time being, we simplify the English data by assuming that the generalization in question is correct, ignoring the judgments of such speakers. We will discuss this and other related empirical complications in Section 5.2. It should also be noted that plural *which*-phrases allow for what look like PL readings for all speakers, but they are presumably due to cumulativity (see Dayal 1996, 2016 and Johnston 2023 for relevant discussion).

This question most naturally invites a single-pair (SP) answer, rather than a PL answer. To sharpen this intuition, consider the following variants of the example, which are infelicitous as the *except*-phrase and the adverb *for the most part* would only make sense if the multiple *wh*-question received a PL reading.

(3) a. * Except for *War and Peace*, I know which book by which author is on the table.

b. * The linguist knows for the most part which book by which author is on the table.

Compare these to the following acceptable variants of (1).

(4) a. Except for *War and Peace*, I know which book on the table was written by which author.

b. The linguist knows for the most part which book on the table was written by which author.

The goal of this paper is to understand this restriction on PL readings. Our strategy is to explain it as a special case of the general ban on questions whose answers are all Strawson-equivalent. Questions of this sort are ruled out as *degenerate* on straightforward pragmatic considerations: either the semantic presuppositions are not satisfied in the common ground, or else the questions are already settled by the common ground and hence cannot play an inquisitive role. And indeed, the unacceptability of such questions is easily verifiable on independent grounds (see Ross 1967; Simonenko 2016; Schwarz & Simonenko 2018 for related discussion). For instance, consider the following unacceptable question from Japanese.

(5) # dono yuumeijin-no kono shashin-ga tsukue-no ue-ni aru
which celebrity-GEN this picture-NOM table-GEN surface-LOC exist
no?
Q
'(lit.) Which celebrity is such that this picture of them is on the table?'

As *wh*-in-situ in Japanese is not island sensitive, constraints on wh-scope are unlikely to account for the unacceptability of this example. We suggest, instead, that the property responsible for unacceptability is that the answers to the question are all Strawson-equivalent. Specifically, these answers are partial propositions that differ in their definedness conditions (they are defined for possible worlds in which the referent of the demonstrative subject—call it *a*—is a picture of a particular celebrity), but then agree on the truth conditions, once the definedness conditions are met (i.e., each of them is true in a world it is defined for iff *a* is on the relevant table in that world). In other words, these propositions are Strawson-equivalent: For any two of

them, p and q, whenever $w \in \text{dom}(p)$ and $w \in \text{dom}(q)$, $p(w) = q(w)$.[2]

Returning to the nested *which*-question, we will show that the unavailability of a PL reading can be explained on the basis of the same constraint. If we adopt a family of questions approach to PL readings (Fox 2012; Kotek 2018), the availability of a PL reading for a multiple *wh*-question will be determined by the possibility of denoting a family of single *wh*-questions. And we will see that in the special case of nested *which*-phrases, the family of questions that can be derived will be a family of degenerate questions in the sense described above.

This explanation, as we will see, relies on certain assumptions about the mapping between the surface and LF structures of multiple *wh*-questions, and on the way denotations are assigned to these LFs. In order to learn about possible LFs for nested *which*-phrases, we will examine Bulgarian, which has been claimed to display a more transparent mapping between the surface and LF structure than English. The key observation is that the surface word order matters for the interpretation of nested *which*-phrases in Bulgarian. We will provide an analysis for this observation, which we will use to understand the English data. To the extent that our explanation is successful, it will provide new evidence for the auxiliary assumptions about the relationship between the surface and LF structures, and the mechanisms of semantic interpretation involved.

2 The syntax of nested *wh*-questions

Previous research has uncovered certain constraints on the LF structure of multiple *wh*-questions in English, based on parasitic gap licensing, the nature of PL readings and the cross-linguistic distribution of the superiority condition (most notably, Richards 1997; Pesetsky 2000; Richards 2004; Fox & Pesetsky 2009; Fox 2012). Following this literature, we make the following two assumptions:[3]

(6) a. The *wh*-phrase that moves overtly in English is the highest *wh*-phrase among all those that move overtly in Bulgarian, and sits (at LF) in the highest specifier of CP.

b. The *wh*-phrases that move covertly in English are inner specifiers of CP.

2.1 Nested *wh*-questions in Bulgarian

Richards 2004 discusses nested *wh*-questions in Bulgarian (which he calls 'Russian

2 If we assume that the picture is a picture of only one celebrity, there will be only one defined proposition in every possible world, and the answers will be Strawson-equivalent for trivial reasons.

3 Based on data of parasitic gap licensing by nested *which*-phrases, Fox & Nissenbaum (2018) argue for a relaxation of the assumptions in (6) for English. We will come back to this in Section 5.2 in relation to the inter-speaker variation mentioned in fn 1.

doll questions'; see also Zompì 2024). In this language, either *wh*-phrase can precede the other, unlike in English, as illustrated in (7).

(7) a. Koya kniga ot koy avtor e na masata?
which book by which author is on table
'Which book by which author is on the table?'

b. Ot koy avtor koya kniga e na masata?
by which author which book is on table
'Which book by which author is on the table?'

Richards 2004 introduces structural diagnostics that can identify the syntactic positions of the two *wh*-phrases in (7). However, existing literature does not discuss the interpretive consequences. We observe that (7a) only receives a SP reading, while the other order in (7b) allows for a PL reading.

The judgments are further reinforced by the exceptive test, which shows that only the inverse word order is compatible with an exceptive phrase.

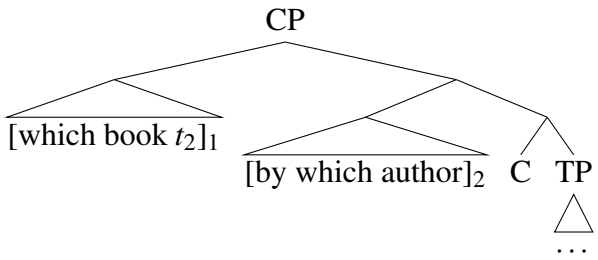
(8) a. * Osven ot Vasov znam koya kniga ot koy avtor e na masata?
except from Vasov know.1SG which book by which author is on table

b. Osven ot Vasov znam ot koy avtor koya kniga e na masata?
except from Vasov know.1SG by which author which book is on table
'Except for Vasov, I know which book by which author is on the table.'

2.2 From Bulgarian to English

Richards 2004 provides compelling evidence that in both structures of nested questions in Bulgarian, the two *wh*-phrases are independent specifiers of CP. If this is indeed correct, it follows from the assumptions in (6) above, that English nested *wh*-questions, in which the containing *wh*P is the one that moves overtly, has a structure with the dominating *wh*-phrase sitting in the higher specifier of CP, as in (9), the structure that Richards proposes for (7b). And this, in turn, is supported by the observed interpretations of the two word order possibilities for Bulgarian nested *wh*-questions.

(9)



We expect that if English sentences with the LF structure of (7a) existed, they should allow PL readings. Unfortunately, this expectation cannot be verified directly, as such structures are often unacceptable due to restriction on overt movement out of a DP (cf. the Condition on Extraction Domain of Huang 1982). In some limited cases, however, they are acceptable and the expectation is verified. For example, (10) has a PL reading.

(10) Except for Clinton, I know about which politician you read which book.

For this example, the nested word order is also a possibility, as in (11), but in this word order, it can only receive a SP reading, as expected.

(11) (*Except for Clinton/*Except for this book) I know which book about which politician you read.

3 The semantics and pragmatics of *wh*-questions

Before delving into the nuts and bolts of the compositional semantics of *wh*-questions, let us sketch, in informal terms, the core intuition behind our proposal.

We adopt the family-of-questions approach to PL readings (Fox 2012; Kotek 2018), according to which a multiple *wh*-question, under a PL reading, denotes a set of sets of propositions, or more intuitively, a set of traditional question denotations of single *wh*-questions.

To illustrate this idea, consider the Bulgarian example in (7b), which does have a felicitous PL reading. Since higher *wh*-phrase in this example is *ot koy avtor* 'by which author', it ends up functioning as the 'sorting key'. In other words, the structure denotes a family of questions differing with respect to the authors. For example, if the relevant authors are Jane Austen, Charles Dickens, and George Orwell, the family of questions corresponding to the PL reading of (7b) will be:

$$\left\{ \begin{array}{l} \text{Which book by Jane Austen is on the table?,} \\ \text{Which book by Charles Dickens is on the table?,} \\ \text{Which book by George Orwell is on the table?} \end{array} \right\}$$

Asking this family of questions amounts to asking all the single *wh*-questions in this set in one go.

Crucially, the example that lacks a PL reading, (7a), as well as its English counterpart, will be analyzed as denoting a different family of questions whose sorting key is *which book*. If the relevant books are *Emma*, *Oliver Twist*, and *Animal Farm*, for example, the family of questions will be the following:

$$\left\{ \begin{array}{l} \text{Which author } x \text{ is such that } \textit{Emma} \text{ by } x \text{ is on the table?,} \\ \text{Which author } x \text{ is such that } \textit{Oliver Twist} \text{ by } x \text{ is on the table?,} \\ \text{Which author } x \text{ is such that } \textit{Animal Farm} \text{ by } x \text{ is on the table?} \end{array} \right\}$$

We will see that the component questions in these paraphrases are degenerate in the sense discussed at the outset: they have only Strawson-equivalent answers. For instance, the first question will denote a set of propositions, each of which presupposes that *Emma* was written by a different author, and asserts that *Emma* is on the table. Such a question, we claim, is ruled out as pragmatically degenerate as all its propositional members (the potential answers) are Strawson-equivalent. It follows that a family of such pragmatically degenerate questions is ruled out.

In the remainder of this section, we will spell out the details of the compositional semantics of *wh*-questions and the consequences for the ban on questions whose answers are all Strawson-equivalent. As we will see, each specific assumption we will make is supported on independent grounds

3.1 The semantics of single *wh*-questions

We adopt the Hamblin-Karttunen approach to question semantics, where single *wh*-questions denote sets of propositions. Concretely, ignoring presuppositions for now, *What is interesting?* has the following extension at an evaluation world w.

(12) $[\![\textbf{What is interesting?}]\!]^w = \{\, \lambda w'.\ \mathsf{interesting}_{w'}(x) \mid x \in D_e \,\}$

Wh-phrases are analyzed as existential quantifiers. We will be particularly concerned with *which*-phrases, which we will assume have an implicit domain of quantification, D. For ease of exposition, we will omit the assignment function and conflate the object language and metalanguage (see Appendix A for the full details).

(13) $[\![\textbf{which}_D]\!]^w = \lambda P_{\langle e,t\rangle}.\lambda Q_{\langle e,t\rangle}.\ \exists x \in D[P(x) \wedge Q(x)]$

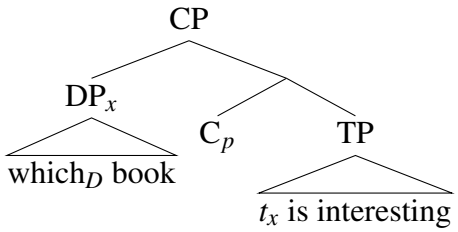
Wh-phrases take scope over the Karttunen interrogative complementizer, C. Anticipating the analysis of PL readings of multiple *wh*-questions, we assume that C is type polymorphic.

(14) $[\![\textbf{C}]\!]^w = \lambda p_\tau.\lambda q_\tau.\ p = q$

The LF of a single *wh*-question looks like (15). Here and below, we will only present simplified LF representations without λ-operators and world pronouns where

unpronounced arguments are indicated as subscripts (see Appendix A for a more detailed formulation).

(15)



This LF denotes the following function (at evaluation world w).

(16) $\lambda p_{\langle s,t\rangle}.\ \exists x \in D[\mathsf{book}_w(x) \wedge p = \lambda w'.\ \mathsf{interesting}_{w'}(x)]$

This function in turn characterizes the following set of propositions:

$$\{\, \lambda w'.\ \mathsf{interesting}_{w'}(x) \mid \mathsf{book}_w(x) \,\}$$

3.2 Reconstruction

It will be important in the following discussion that the NP portion of a *which*-phrase can reconstruct (and must, if reconstruction is necessary for interpretability). Following Rullmann & Beck 1998 and Heim 2012, we assume that a reconstructed *which*-phrase triggers a presupposition. Specifically, we adopt Copy Theory of Movement and assume Trace Conversion (Fox 2002), which achieves reconstruction by converting at LF the copy of a moved *which*-phrase from '[$_{\text{DP}}$ ~~which~~ NP]' to '[$_{\text{DP}}$ THE [$_{\text{NP}}$ IDENT$_x$]]', where x is bound by the moved copy. The items introduced by Trace Conversion are interpreted as follows.

(17) a. $[\![\textbf{THE}]\!] = \lambda P_{\langle e,t\rangle}:\ \exists!x[P(x)].\ \iota x[P(x)]$

b. $[\![\textbf{IDENT}]\!] = \lambda x.\lambda y.x = y$

We assume that a reconstructed NP can be either *de re* or *de dicto*, while a non-reconstructed NP is always *de re*. In the case of the previous example in (15), if the NP is reconstructed and interpreted *de re*, the denotation of the question (at evaluation world w) will be (18).[4]

(18) $\lambda p_{\langle s,t\rangle}.\ \exists x \in D[p = \lambda w':\ \mathsf{book}_w(x).\ \mathsf{interesting}_{w'}(x)]$

The crucial difference from (16) is that book is a presupposition, due to THE. This (total) function thus characterizes the following set of partial propositions:

$$\{\, \lambda w':\ \mathsf{book}_w(x).\ \mathsf{interesting}_{w'}(x) \mid x \in D \,\}$$

4 The NP can also be interpreted *de dicto*, in which case the question will denote: $\lambda p_{\langle s,t\rangle}.\ \exists x \in D[p = \lambda w':\ \mathsf{book}_{w'}(x).\ \mathsf{interesting}_{w'}(x)]$.

3.3 The family-of-questions approach to PL readings

Turning now to multiple *wh*-questions, we adopt the family-of-questions approach (Fox 2012; Kotek 2018). An advantage of this approach consists in an account of the relationship between the uniqueness presuppositions of singular *which*-phrases and the functional nature of PL readings. We will simply refer interested readers to the works cited here for details.

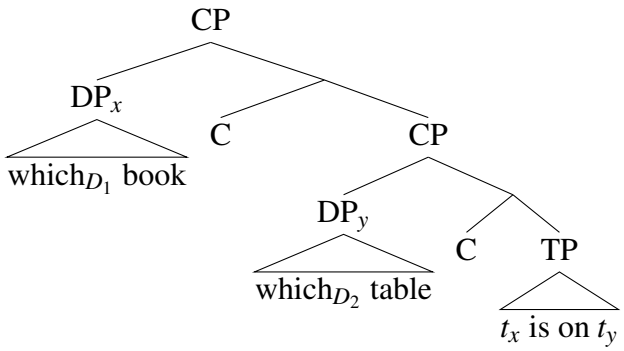
The family-of-questions approach analyzes the PL reading of a mutliple *wh*-questions in terms of a set of single *wh*-questions, or a set of sets of propositions.[5] This follows automatically from the above Hamblin-Karttunen framework the moment a second CP layer is added on top of a single *wh*-question.

To illustrate, let us consider the following example.

(19) Which book is on which table?

We assume the following LF for the PL reading of this example (without reconstruction).

(20)



The extension of this LF (at evaluation world w) will be the following function.

(21) $\lambda Q.\exists x \in D_1[\mathsf{book}_w(x) \wedge Q = \lambda p.\exists y \in D_2[\mathsf{table}_w(y) \wedge p = \lambda w'.\ \mathsf{on}_{w'}(x,y)]]$

This function characterizes a set of questions, each of which asks – for a particular book x in D_1 – for the identity of the table that x is on. Asking this set of questions amounts to asking these questions all in one breath, which calls for an answer to each of them.

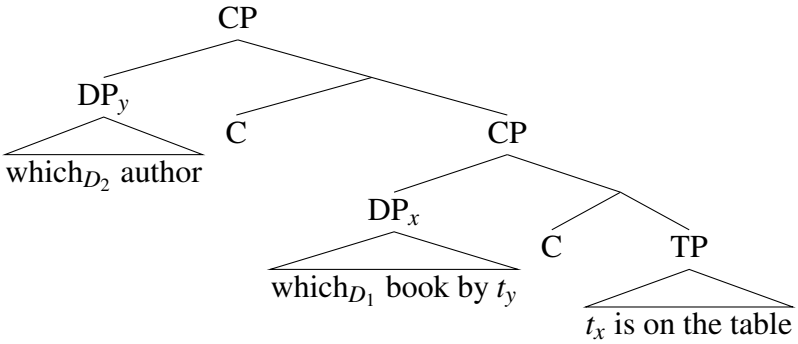
3.4 Licit PL readings of nested *which*-questions

We are now ready to return to nested *which*-questions. Let us first analyze the Bulgarian example that has a PL reading, (7b), in which the dominated *which*-phrase *koy avtor* 'which author' precedes the dominating *which*-phrase *koya kniga*

5 We will not analyze SP readings in this paper, but they involve a single CP layer and denote a set of propositions similarly to single *wh*-questions. See the Appendix for details.

'which book' on the surface. Since this surface structure, by assumption, directly corresponds to the LF structure in Bulgarian, the LF should look like (22) (with English words for readability's sake).[6]

(22)



This LF denotes the following function at evaluation world w (with the meaning of the predicate *is on the table* simplified to declutter).

(23) $$\lambda Q.\exists y \in D_2 \left[\begin{array}{l} \mathsf{author}_w(y) \wedge \\ Q = \lambda p.\ \exists x \in D_1 \left[\begin{array}{l} \mathsf{book}_w(x) \wedge \mathsf{by}_w(x,y) \wedge \\ p = \lambda w'.\ \mathsf{on.table}_{w'}(x) \end{array} \right] \end{array} \right]$$

To understand what family of questions this function characterizes, let us take a concrete case where D_2 contains three authors, Jane Austen, Charles Dickens, and George Orwell. Then the family of questions will be:

$$\left\{ \begin{array}{l} \text{Which book by Jane Austen is on the table?,} \\ \text{Which book by Charles Dickens is on the table?,} \\ \text{Which book by George Orwell is on the table?} \end{array} \right\}$$

More precisely, each of the component questions is the following set of propositions about a specific author y in w:

$$\{\, \lambda w'.\ \mathsf{on.table}_{w'}(x) \mid x \in D_1 \wedge \mathsf{book}_w(x) \wedge \mathsf{by}_w(x,y) \,\}$$

A couple of technical remarks are in order. Firstly, there is an independent constraint requiring that at least *by* in the dominating DP be interpreted *de dicto* (i.e., with respect to w'), so the denotation in (23) is actually unavailable (see Heim 2011; Sudo 2017). When only *by* is interpreted *de dicto*, the denotation will look like (24).

(24) $$\lambda Q.\exists y \in D_2 \left[\begin{array}{l} \mathsf{author}_w(y) \wedge Q = \lambda p.\ \exists x \in D_1 \\ [p = \lambda w':\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,y).\ \mathsf{on.table}_{w'}(x)] \end{array} \right]$$

6 In (22), we have undone the pied-piping of the preposition *ot* 'by'. Nothing crucial hinges on this. See the Appendix A for more discussion.

Note that the NP portion of the dominating DP, *book by y*, contributes to the presuppositions of the propositions that consist of the component questions. Consequently, some of these propositions may not be defined for the worlds compatible with the common ground. For the sake of concreteness, suppose that D_1 consists of six books—*Sense and Sensibility (SS)* and *Emma (E)* by Jane Austen, *Oliver Twist (OT)* and *Bleak House (BH)* by Charles Dickens, and *Animal Farm (AF)* and *1984* by George Orwell. The component questions in the family of questions will be the following set of six propositions for different authors y in D_2.

$$\left\{\begin{array}{l}
\lambda w'\colon \mathsf{book}_w(SS) \wedge \mathsf{by}_{w'}(SS,y).\ \mathsf{on.table}_{w'}(SS),\\
\lambda w'\colon \mathsf{book}_w(E) \wedge \mathsf{by}_{w'}(E,y).\ \mathsf{on.table}_{w'}(E),\\
\lambda w'\colon \mathsf{book}_w(OT) \wedge \mathsf{by}_{w'}(OT,y).\ \mathsf{on.table}_{w'}(OT),\\
\lambda w'\colon \mathsf{book}_w(BH) \wedge \mathsf{by}_{w'}(BH,y).\ \mathsf{on.table}_{w'}(OT),\\
\lambda w'\colon \mathsf{book}_w(AF) \wedge \mathsf{by}_{w'}(AF,y).\ \mathsf{on.table}_{w'}(AF),\\
\lambda w'\colon \mathsf{book}_w(1984) \wedge \mathsf{by}_{w'}(1984,y).\ \mathsf{on.table}_{w'}(1984)
\end{array}\right\}$$

If it is common knowledge which author wrote which books, only two propositions in each component question will be defined for the possible worlds compatible with the common knowledge (e.g., for $y =$ Jane Austin, only the first two propositions will be compatible).

The Bulgarian multiple *wh*-question in (7b) can be felicitously asked under the PL reading against such common knowledge, so it might appear as if not all of the presuppositions of the propositions in each component question project. It is easy to see, however, that presuppositions triggered in single *wh*-questions project universally. For instance, the following question has a presupposition that each of the 10 students has failed the exam.

(25) Which of the 10 students are unaware that they have failed the exam?

If presuppositions universally project, we would expect the presupposition of (7b) to fail in a context where it is commonly known which author wrote which books, contrary to fact.

To deal with this difficulty, we assume that the domain of *which* can be functional. In our example, suppose that the domain D_1 for the dominating *which*-phrase, *which book by y*, contains a variable 'y' that is bound by the dominated *which*-phrase, *which author*, so that for each author, D_1 only contains the books that they are commonly known to have written.

$$(26)\quad \lambda Q.\exists y \in D_2 \left[\begin{array}{l}\mathsf{author}_w(y) \wedge Q = \lambda p.\ \exists x \in D_1(y)\\ \qquad\qquad [p = \lambda w'\colon \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,y).\ \mathsf{on.table}_{w'}(x)]\end{array}\right]$$

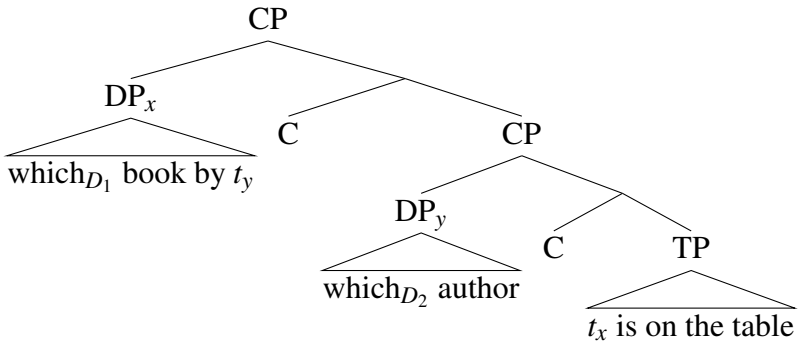
Assuming that the functional domain D_1 maps Jane Austin to $\{SS,E\}$, Charles Dickens to $\{OT,BH\}$, and George Orwell to $\{AF,1984\}$, we can maintain the

assumption that presuppositions universally project in *wh*-questions.[7]

3.5 Illicit PL readings of nested *which*-questions

Let us finally come back to the nested *wh*-question that lacks a PL reading. On our analysis, the syntax permits it to have the following LF in English, as well as in Bulgarian for the word order in (7a). Importantly, the dominating *which*-phrase, *which book by y*, now sits above the dominated *which*-phrase, *which author*.

(27)



Since the dominated *which*-phrase binds into the NP restrictor of the dominating *which*-phrase, it is necessary for the latter to reconstruct in order for the structure to be interpretable, while the reconstruction of the former is optional. Without loss of generality, let us zoom in on one of the interpretable LFs where only the dominating *which*-phrase is reconstructed and only *by* is interpreted *de dicto*. The denotation of this LF will be as follows.

(28) $\lambda Q.\exists x \in D_1 \left[\begin{array}{l} Q = \lambda p.\ \exists y \in D_2[\mathsf{author}_w(y) \wedge \\ \qquad p = \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,y).\ \mathsf{on.table}_{w'}(x)] \end{array} \right]$

Assuming that D_2 is the same set as above consisting of Jane Austen (JA), Charles Dickens (CD), and George Orwell (GO), the component questions will denote the

7 Another possibility is to assume that local accommodation of the presupposition at the level of the lower CP, so that the presupposition of the reconstructed NP will be treated as part of the asserted meaning.

(i) $\lambda Q.\exists y \in D_2 \left[\begin{array}{l} \mathsf{author}_w(y) \wedge \\ Q = \lambda p.\ \exists x \in D_1[p = \lambda w'.\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,y) \wedge \mathsf{on.table}_{w'}(x)] \end{array} \right]$

A denotation like this might be necessary given that the question seems to be felicitously used when nothing is commonly known about which author wrote which books. Note that the two solutions to the problem of universal projection—functional domains and local accommodation—are compatible with each other. While it is a legitimate question whether one is dispensable in favor of the other, it should be acknowledged that independent support exists for each of them. Having said local accommodation will have to be constrained so as not to generally alow question to denote Strawson equivalent sets of propositions.

following set of propositions for different books x in D_1:

$$\left\{ \begin{array}{l} \lambda w' \colon \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x, \mathrm{JA}).\ \mathsf{on.table}_{w'}(x), \\ \lambda w' \colon \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x, \mathrm{CD}).\ \mathsf{on.table}_{w'}(x), \\ \lambda w' \colon \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x, \mathrm{GO}).\ \mathsf{on.table}_{w'}(x) \end{array} \right\}$$

We see that these component questions are each pragmatically degenerate in the sense characterized at the outset: each of them is made up of three propositions that are Strawson-equivalent with one another. As mentioned in the introduction, there is independent empirical evidence, as well as conceptual reason, that such questions are pragmatically ruled out. Since asking a family of questions amounts to asking its component questions in one sentence, if any of these component questions is degenerate, the whole family of questions will be as well.

4 Predictions

4.1 A third *wh*-phrase

Our proposal predicts that adding a third *wh*-phrase (that is not nested in the others) will enable a PL reading, because it will turn the propositions in each component question not Strawson-equivalent. This prediction is borne out, as illustrated by the following example.

(29) Which book by which author is on which table?

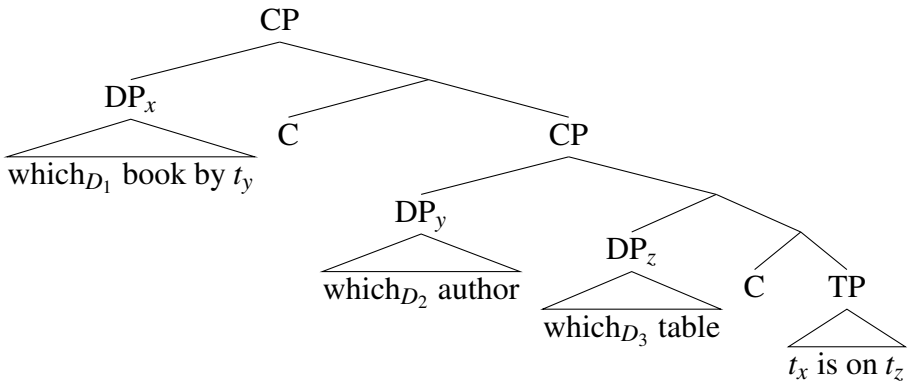
The judgments are further corroborated by the compatibility with exceptive phrases.

(30) a. Except for Math 101, I know which class taken by which student is in which catalogue.

b. # Except for Math 101, I know which class taken by which student is in this catalogue.

To understand the prediction, assume the LF for the PL reading of (29) will be one where the relative positions of the three *which*-phrases are the same at the surface structure and LF (though see Richards 1997 and Pesetsky 2000 for arguments that some flexibility might be warranted):

(31)



With reconstruction of the NP of the highest *which*-phrase, the LF will denote the following function.

(32) $\lambda Q.\exists x \in D_1 \left[\begin{array}{r} Q = \lambda p.\ \exists y \in D_2 \exists D_3 [\mathsf{author}_w(y) \wedge \mathsf{table}_w(z) \\ p = \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,y).\ \mathsf{on}_{w'}(x,z)] \end{array} \right]$

The component questions of this family of questions are all made up of propositions whose assertions are about different tables, so they are non-degenerate.

There is an additional complication here regarding which *wh*-phrase is the sorting key. First, observe that an exceptive can only be about the sorting key in simple non-nested multiple *wh*-questions, which is by default the overtly moved *wh*-phrase.

(33) a. Except for the article by Chomsky, I know which article was assigned to which of my students.

b. # Except for John, I know which article was assigned to which of my students.

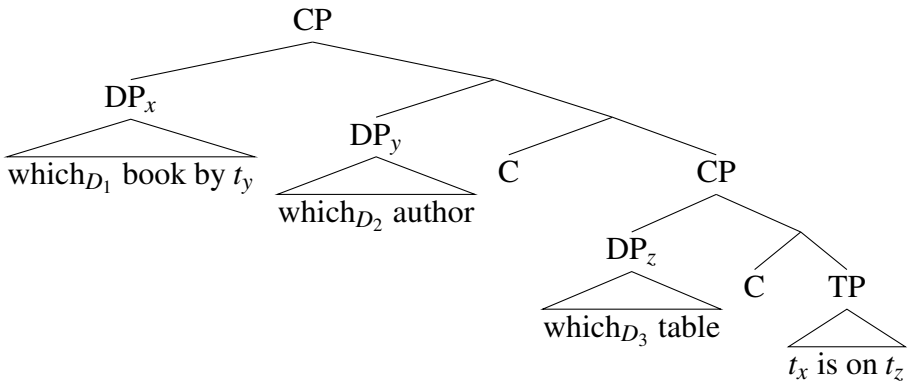
Now, we observe that for a multiple *wh*-question with nested *which*-phrases and an independent third *wh*-phrase, an exceptive phrase about the second, embedded *wh*-phrase is acceptable, unlike an exceptive phrase about the third, independent *wh*-phrase:

(34) a. Except for Bill, I know which class taken by which student is in which catalogue.

b. # Except for this catalogue, I know which class taken by which student is in which catalogue.

We account for the acceptability of (34a) with the following LF, where the second *wh*-phrase is in the higher CP layer, together with the first *wh*-phrase. Importantly, this LF is consistent with the syntactic assumptions in (6).

(35)



Similarly to the previous LF, this LF denotes a family of non-degenerate questions, but the crucial difference from it is that it has a 'pair sorting key' in the sense that each component question is about a class-student pair. This analysis accommodates the acceptability of an exceptive phrase in (34a) as follows: It operates on the class-student pairs, saying that for each class-student pair except for the ones involving Bill, I know which class is in which catalogue.

Note also that the two LFs should have different uniqueness presuppositions as well. When the first *wh*-phrase is the sole one in the higher CP layer, the *wh*-phrase with three *wh*-phrases should presuppose that for each class, there is exactly one student-catalogue pair such that the student took the class and the class is in the catalogue, while when the first two *wh*-phrases are both in the higher CP layer, it will presuppose that for each class-student pair, there is exactly one catalogue containing the class. The fact that the sentence clearly has an interpretation without a presupposition that each class had only one (relevant) student gives empirical support for postulating the LF with two *wh*-phrases in the higher CP layer as well.[8]

4.2 Bound pronouns

Similar reasoning leads to a prediction that having a bound pronoun outside the nested *which*-phrases that is bound by the dominated *which*-phrase should enable a PL reading, because with it, the dominated *which*-phrase will matter for the assertive meaning, not just for the presupposition. This prediction is, however, not borne out. Take, for example, (36), which does not have a PL reading, even if *his* is read as bound by *which author*.

(36) Which book by which author made him rich?

8 It is an analytical possibility under our theory to have three CP-layers, in which case the denotation will be a family of families of questions. The predicted meaning would be, roughly, 'For each relevant book x, answer the following family of questions: For each author y, which table is the book x by y on?'. This will have a contradictory presupposition that each book was written by multiple authors.

Our analysis makes the wrong prediction that a PL reading is available, if this question can receive the following PL reading.

(37) $\lambda Q.\exists x \in D_1 \left[\begin{array}{l} Q = \lambda p.\ \exists y \in D_2[\mathsf{author}_w(y) \wedge \\ \qquad p = \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,y).\ \mathsf{made.rich}_{w'}(x,y)] \end{array} \right]$

The propositions of each component question are then not Strawson-equivalent. Concretely, suppose that $D_2 = \{\mathrm{JA}, \mathrm{CD}, \mathrm{GO}\}$, then for each book $x \in D_1$, we will have the following question:

$$\left\{ \begin{array}{l} \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,\mathrm{JA}).\ \mathsf{made.rich}_{w'}(x,JA), \\ \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,\mathrm{CD}).\ \mathsf{made.rich}_{w'}(x,CD), \\ \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,\mathrm{GO}).\ \mathsf{made.rich}_{w'}(x,GO) \end{array} \right\}$$

These propositions have distinct assertive contents, so this question is not degenerate, so we fail to exclude the PL reading for this question.

We pursue the following solution: the bound pronoun is actually not directly bound by *which author* (due to Weak Crossover) but is a disguised definite description containing a variable bound by *which book by y* as in (38) (Heim 1990; Büring 2004; Chierchia 2020).[9]

(38) $\lambda Q.\exists x \in D_1[Q = \lambda p.\ \exists y \in D_2[\mathsf{author}_w(y) \wedge$
$p = \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,y).\ \mathsf{made.rich}_{w'}(x, \iota z[\mathsf{author.of}_{w'}(z,x)])]]$

Consequently, the propositions in the following set are all Strawson-equivalent.

$$\left\{ \begin{array}{l} \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,\mathrm{JA}).\ \mathsf{made.rich}_{w'}(x, \iota z[\mathsf{author.of}_{w'}(z,x)]), \\ \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,\mathrm{CD}).\ \mathsf{made.rich}_{w'}(x, \iota z[\mathsf{author.of}_{w'}(z,x)]), \\ \lambda w' :\ \mathsf{book}_w(x) \wedge \mathsf{by}_{w'}(x,\mathrm{GO}).\ \mathsf{made.rich}_{w'}(x, \iota z[\mathsf{author.of}_{w'}(z,x)]) \end{array} \right\}$$

5 Further issues

5.1 Extraposition

We will end this paper by mentioning some loose ends. The first issue is discussed by Elliott (2016), who reports that for some speakers, PL readings of nested *which*-phrases are more readily available with extraposition. Concretely, for such speakers, there is a contrast between the following examples.

9 For a sentence like the following, there will be a question about the uniqueness.

(i) Which friend of which politician likes him?

The issue is that a friend of a politician can well be friends another politician, so a simple definite analysis would not account for the correct bound interpretation. There are ideas that could be used to solve this issue. See, in particular, Chatain (2018); Chierchia (2022).

(39) a. Which book by which author is on table?

b. Which book is on the table by which author?

To add to this observation, the exceptive test indicates that the extraposed *wh*-phrase seems to be the sorting key.

(40) a. # Except for *Animal Farm*, I know which book is on the table by which author.

b. Except for George Orwell, I know which book is on the table by which author.

This observation suggests an LF where the extraposed *wh*-phrase being interpreted in the higher CP layer. The predicted denotation of this question, then, is not a family of necessarily degenerate questions, as it should be similar to the PL reading of the following non-nested multiple *wh*-question (modulo *de re/de dicto*).

(41) Which author wrote which book on the table.

However, this analysis raises non-trivial syntactic questions, which we hope to address in future work.

5.2 Variation among English speakers

As briefly remarked in fn. 1, some speakers of English seem to systematically allow PL readings for questions with nested singular *which*-phrases like (2). Our proposal is strictly committed to the prediction that the LF in (27) will not allow a PL reading, but has some wiggle room in the mapping between English word order and LF to accommodate such speakers. Specifically, we can assume that that these speakers can assign the LF in (22), in violation of (6).

Fox & Nissenbaum (2018) argue for this relaxation of (6) based on parasitic gap licensing by nested *which*-phrases. If they are right, it is possible that PL readings in English are actually always possible for nested *which*-phrases for all speakers, and that the judgments reported in the literature reflect a preference rather than a categorical effect. In fact, in some examples like (42) (brought to our attention by Shrayana Haldar), PL readings seem to be more easily accessible.

(42) Except for the article by Chomsky, I know which section of which article to assign to my students.

Importantly, we do not predict the same variability in judgments for Bulgarian.

We note, however, that our proposal predicts that to the extent that PL readings are possible in English for nested questions like the one above, the sorting key for these readings will have to be the contained *wh*-phrase, as in the LF in (22). This is supported by the contrast between (42) above and (43) below.

(43) * Except for this section, I know which section of which article to assign to my students.

If (6) is relaxed for the relevant speakers more generally (not just for the nested configuration, as assumed by Fox & Nissenbaum 2018), we would predict that such speakers would more easily allow any *wh*-phrase to be the sorting key in a multiple *wh*-question. At this point we cannot provide compelling tests for this prediction.

References

Büring, Daniel. 2004. Crossover situations. *Natural Language Semantics* 12(1). 23–62. doi:10.1023/B:NALS.0000011144.81075.a8.

Chatain, Keny. 2018. Gaps in the interpretation of pronouns. In Sireemas Maspong, Brynhildur Stefánsdóttir, Katherine Blake & Forrest Davis (eds.), *Semantics and Linguistic Theory (SALT) 18*, 177–196. doi:10.3765/salt.v28i0.4405.

Chierchia, Gennaro. 2020. Origins of weak crossover: when dynamic semantics meets event semantics. *Natural Language Semantics* 28(1). 23–76. doi:10.1007/s11050-019-09158-3.

Chierchia, Gennaro. 2022. 'People are fed up; don't mess with them': Non-quantificational arguments and polarity reversals. *Journal of Semantics* 39(3). 475–521. doi:10.1093/jos/ffac006.

Dayal, Veneeta. 1996. *Locality in WH quantification: questions and relative clauses in Hindi*. Dordrecht: Kluwer. doi:10.1007/978-94-011-4808-5.

Dayal, Veneeta. 2016. *Questions*. Oxford: Oxford University Press. doi:10.1093/acprof:oso/9780199281268.001.0001.

Elliott, Patrick D. 2016. Nested *wh*-phrases and the locality of scope taking. Slides from ConSOLE XXIV.

Fox, Danny. 2002. Antecedent-contained deletion and the copy theory of movement. *Linguistic Inquiry* 33(1). 63–96. doi:10.1162/002438902317382189.

Fox, Danny. 2012. The semantics of questions. Lecture notes, MIT.

Fox, Danny & Jon Nissenbaum. 2018. Pied-piping and covert movement: evidence from parasitic gap licensing. Handout for a talk at the Workshop in Honor of Shigeru Miyagawa.

Fox, Danny & David Pesetsky. 2009. Rightward movement, covert movement, and cyclic linearization. Handout for a talk at Ben Burion University.

Heim, Irene. 1990. E-type pronouns and donkey anaphora. *Linguistics and Philosophy* 13(2). 137–177. doi:10.1007/BF00630732.

Heim, Irene. 2011. Interpreting reconstruction in interrogative clauses: the case of *de dicto* readings. Handout for a talk at the 18th Amsterdam Colloquium.

Heim, Irene. 2012. Functional readings without type-shifted noun phrases. Ms., MIT.

Higginbotham, James & Robert May. 1981. Questions, quantifiers and crossing. *The Linguistic Review* 1(1). 41–80. doi:10.1515/tlir.1981.1.1.41.

Huang, Cheng-Teh James. 1982. *Logical relations in Chinese and the theory of grammar*: MIT PhD dissertation.

Johnston, William. 2023. Pair-list answers to questions with plural definites. *Semantics & Pragmatics* 16(2). 1–23. doi:10.3765/sp.16.2.

Kotek, Hadas. 2018. *Composing questions*. Cambridge, MA: MIT Press. doi:10.7551/mitpress/10774.001.0001.

Pesetsky, David. 2000. *Phrasal movement and its kin*. Cambridge, MA: MIT Press. doi:10.7551/mitpress/5365.001.0001.

Richards, Norvin. 1997. *What moves where when in which language?*: MIT PhD dissertation.

Richards, Norvin. 2004. Against bans on lowering. *Linguistic Inquiry* 35(3). 453–463. doi:10.1162/0024389041402643.

Ross, John. 1967. *Constraints on Variables in Syntax*: MIT PhD dissertation.

Rullmann, Hotze & Sigrid Beck. 1998. Presupposition projection and the interpretation of *which*-questions. In Devon Strolovitch & Aaron Lawson (eds.), *Semantics and Linguisstic Theory (SALT) 8*, 215–232. Cornell University. doi:10.3765/salt.v8i0.2811.

Schwarz, Bernhard & Alexandra Simonenko. 2018. Factive islands and meaning-driven unacceptability. *Natural Language Semantics* 26. 253–279. doi:10.1007/s11050-018-9146-2.

Simonenko, Alexandra. 2016. Semantics of DP islands: The case of questions. *Journal of Semantics* 33(4). 661–702. doi:10.1093/jos/ffv009.

Sudo, Yasutada. 2017. *De re* eradings of nested *which*-phrases in embedded questions. *Snippets* 31. 29–30. doi:10.7358/snip-2017-031-yasu.

Zompì, Stanislao. 2024. A principled exception to the Müller-Takano Generalization: A belated follow-up to Richards (2004). *Glossa* 9(1). 1–31. doi:10.16995/glossa.6404.

Danny Fox
Massachusetts Institute of Technology
Department of Linguistics and Philosophy
77 Massachusetts Avenue
Room 32-D808
Cambridge, MA 02139
USA
fox@mit.edu

Yasutada Sudo
University College London
Department of Linguistics
2 Wakefield Street
London WC1N 1PF
UK
y.sudo@ucl.ac.uk