Notes on Interrogative Semantics

1. Questions denote sets of propositions

The basic intuition behind the approach to questions which we will spell out here is that a question denotes a set of propositions, which correspond to the alternatives from among which the addressee is expected to choose her answer. Here are some illustrations for yes-no questions, alternative questions, and constituent questions. We use *that*-clauses to refer to propositions.²

1. Is John a student?
   \{that John is a student, that John is not a student\}

2. Is John a student or a professor?³
   \{that John is a student, that John is a professor\}

3. Which subway line goes to the airport?
   \{that the red line goes to the airport, that the blue line goes to the airport, that the green line goes to the airport, that the orange line goes to the airport\}

A speaker that utters one of these questions thereby indicates that she doesn't know of any proposition in the set whether it is true or false, and that she would like the addressee to specify which of them are true and which are false.

Example (3) indicates that it is sometimes a contingent matter which particular set of propositions a given interrogative sentence denotes. Given that there are, in fact, exactly

1. The analysis we are about to develop in this and the following sections derives from the work of C. L. Hamblin (1973) "Questions in Montague Grammar," *Foundations of Language* 10, and L. Karttunen (1977) "Syntax and Semantics of Questions," *Linguistics & Philosophy* 1.1. It isn't exactly the same as Hamblin's or Karttunen's analysis, but it shares their common basic features and mixes specific details from both of them. One salient difference between Karttunen's proposal and the one we are developing here is that Karttunen's question extensions contain only *true* propositions. We will consider the significance of this difference when we talk about question-embedding predicates.

2. But don't be tempted to think that propositions are 'that'-clauses! We are still using the term 'proposition' in the technical sense introduced earlier: a proposition is a function from possible worlds to truth-values. E.g., the proposition that we are referring to with the 'that'-clause 'that John is a student' is the function \( \lambda w. \text{John is a student in } w \).

3. This question also has another reading, as a yes-no question. On that reading, it denotes the set \{that John is a student or a professor, that John is neither a student nor a professor\}.
4 subway lines, namely the red, blue, green, and orange lines\(^4\), (3) happens to denote the four-membered set of propositions specified above. But there could have been more or fewer or different subway lines, and in that case the same interrogative sentence would have denoted an accordingly different set. So the set of propositions given under (3) is the extension of this question, whereas its intension is a non-constant function from worlds to sets of propositions.

We can now say a bit more precisely how the semantic values of interrogative clauses figure in the speech act of question-asking:

(4) When an interrogative clause \(\phi\) is uttered in a world \(w\), the utterer thereby requests to be told which of the propositions in \([[[\phi]]_w]\) are true in \(w\).

For example, when I ask the question Which subway line goes to the airport? in the actual world \(w_0\), I request to be told which propositions in the set \([[[\text{which subway line goes to the airport?}]]_{w_0}\) are true in \(w_0\).

Technical interlude: ways of defining sets of propositions

The sets of propositions denoted by \(\text{wh}\)-questions are generally quite large or even infinite. (The example in (3) is atypical, in that the noun subway line (in Boston) happens to have a very small extension.) We will need a different way of defining such sets than by listing their members.

Here are three ways of describing the extension of the question Which subway line goes to the airport? in the actual world \(w_0\). In all the definitions, \('w_0'\) refers to the actual world, and the letters ‘R,’ ‘G,’ ‘B,’ and ‘O’ refer to the red line, the blue line, the green line, and the orange line respectively (which we take to be four individuals in \(D_e\)).

(5) \([[[\text{which subway line goes to the airport?}]]_{w_0}\) =  
\{that R goes to the airport, that B goes to the airport, that G goes to the airport, that O goes to the airport\}

(6) \([[[\text{which subway line goes to the airport?}]]_{w_0}\) =  
\{\(p \in D_{<s,s,t>}: \exists x[x \in \{R, G, B, O\} \& p = \text{that x goes to the airport}]\}\}

(7) \([[[\text{which subway line goes to the airport?}]]_{w_0}\) =  
\{that x goes to the airport: x \in \{R, G, B, O\}\}

\(^{4}\)Pretend here that Boston is the whole world.
The equivalence between (5) and (6) is worth contemplating a little, since the type of formulation that you see in (6) shows up all over the place in the formal semantics literature on interrogatives. How would we go about proving that (5) and (6) indeed pick out identical sets?

Part 1: Suppose $p$ is a proposition in the set defined in (5). There are 4 possible cases.

Case 1: $p = \text{that } R \text{ goes to the airport.}$ Then there is an $x \in \{R, G, B, O\}$, namely $R$, such that $p = \text{the proposition that } R \text{ goes to the airport} = \text{the proposition that } x \text{ goes to the airport.}$ So $p$ fulfills the condition for membership in the set defined in (6).

Case 2: $p = \text{that } G \text{ goes to the airport.}$ ... (The proof proceeds analogously for this and 3rd and 4th case).

So we have shown that every proposition in (5) is also in (6).

Part 2: Suppose $p$ is a proposition in the set defined in (6). This means that the following condition holds:

$$\exists x \ [x \in \{R, G, B, O\} \& p = \text{that } x \text{ goes to the airport}]$$

So there is something – call it 's' – for which the following holds:

$$s \in \{R, G, B, O\} \& p = \text{that } s \text{ goes to the airport}$$

Since $s \in \{R, G, B, O\}$, there are 4 cases.

Case 1: $s = R$. Then $p = \text{that } R \text{ goes to the airport.}$ This proposition is listed in (5).

Case 2: $s = G$. ... (The proof proceeds analogously for this and 3rd and 4th case).

So we have shown that every proposition in (6) is also in (5).

End of Proof

The formulation in (7) is an abbreviated version of (6), which is more common in the literature on focus than on questions. The abbreviation that's used here is the same as in the following mathematical examples:

$$(10) \quad \begin{align*}
\{x + y : x \in \mathbb{N} & \& y \in \mathbb{N}\} \\
&= \{ z : \exists x \exists y \ [x \in \mathbb{N} \& y \in \mathbb{N} \& z = x + y] \}
\end{align*}$$

$$(b) \quad \begin{align*}
\{x^2 : x \in \mathbb{N}\} \\
&= \{ y : \exists x \ [x \in \mathbb{N} \& y = x^2] \}
\end{align*}$$

The general convention is (11):

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5It was used, for example, in Mats Rooth's dissertation. (M. Rooth, Association with Focus, UMass Amherst Ph.D. thesis, 1985).
(11) If $\alpha$ and $\phi$ contain the free variables $\nu_1, \ldots, \nu_n$, and $\nu_0$ is a variable not occurring free in $\alpha$ or $\phi$, then
\[
\{ \alpha \colon \phi \} := \{ \nu_0 \colon \exists \nu_1. \ldots. \exists \nu_n [ \phi \land \nu_0 = \alpha] \}.
\]
Evidently, the general format of the definitions in (6) or (7) is also suitable for infinite sets of propositions, which we could not possibly define by lists. If instead of $\{R, G, B, O\}$ we specify some large or infinite set of individuals $A$, we will get an accordingly large or infinite set of propositions:

(12) $\{ p \in D_{<s,t>} : \exists x \in A. p = \text{that } x \text{ goes to the airport} \}$

(13) $\{ \text{that } x \text{ goes to the airport: } x \in A \}$

When we implement the present analysis of questions within the standard type-system that we have been using, we cannot literally employ sets of propositions. Instead, our official denotations for interrogative clauses will be characteristic functions of such sets; in other words, functions of type $<s,t>$. For example:

(14) $[[\text{which subway line goes to the airport?}]]^{w_0} = \\
\lambda p \in D_{<s,t>}. \exists x [x \in \{R, G, B, O\} \land p = \text{that } x \text{ goes to the airport}]$

For most informal purposes, however, we will continue to be using set talk instead of the officially correct function talk.

### 2. Compositional interpretation of constituent questions

#### 2.1 First attempt

Setting aside yes-no and alternative questions for the time being, let us see how denotations for constituent questions (such as the denotation described in (5) - (7) above), might be built up from the meanings of their parts. It seems that the SS and LF of the sentence $\text{which subway line goes to the airport}$ looks minimally as in (15), where wh-movement has applied to the DP $\text{which subway line}$, in the manner familiar from relative clauses.
If we assume that there is nothing of semantic significance in the C-node, then the semantic value of the predicate abstract which forms the right daughter of CP is determined by our previous assumptions:

(16) For any w,

\[
[[1. \text{t}_1 \text{ goes to the airport}]]^w = \lambda x.x \text{ goes to the airport in } w.
\]

If moreover we assume, as above, that the whole CP has the value defined in (17),

(17) For any w,

\[
[[\text{which subway line } 1. \text{t}_1 \text{ goes to the airport}]]^w = \lambda p \in D_{<s,t>}. \exists x [x \text{ is a subway line in } w \land p = \text{that } x \text{ goes to the airport}]
\]

then it is a routine exercise to work out what the interpretation of \textit{which subway line} will have to be, if the whole structure is to be interpretable by standard composition rules:

(18) For any w,

\[
[[\text{which subway line}]]^w =
\lambda P_{<s,et>}. \lambda p_{<s,t>}. \exists x [x \text{ is a subway line in } w \land p = \lambda w'. \mathcal{P}(w')(x)]
\]

Exercise: Determine which composition rule applies at the CP-node, and verify that (17) follows from (16) and (18).

From (18), we can further factor out the meaning of the wh-determiner \textit{which}, since the meaning of \textit{subway line} is already given as well. (The obvious lexical entry for this is:

\[
[[\text{subway line}]]^w = \lambda x. x \text{ is a subway line in } w.
\]

(19) \[
[[\text{which}]] =
\lambda f_{<e,t>}. \lambda P_{<s,et>}. \lambda p_{<s,t>}. \exists x [f(x) = 1 \land p = \lambda w'. \mathcal{P}(w')(x)]
\]
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Notice the absence of a world-superscript, which means that the extension of which (like that of non-interrogative determiners and other "logical" words) is constant across all possible worlds. The extension of the interrogative generalized quantifier [which NP], however, will vary from world to world whenever the NP's extension does. (19) yields (18) by ordinary Functional Application.

This analysis assumes the following semantic types for the interrogative determiners and DPs: The type of [[which]] is <et,<<s,et>,<st,t>>, and the type of [[which subway line]] is <<s,et>,<st,t>>. To shorten complex type-labels like these, we introduce an abbreviation for the type of (the extension of) interrogative clauses:

\[
\tau_q := <st,t> \quad \text{(question-extensions)}
\]

So what have is this:

\[
\text{type of } [[\text{which}]]: \quad <et,<<s,et>,\tau_q>>
\]
\[
\text{type of } [[\text{which subway line}]]^{w} := <<s,et>,\tau_q>
\]

2.2. A problem with multiple questions

According to the lexical entry in (19), the determiner which does a lot of semantic work. It simultaneously accomplishes an existential quantification over the elements in its restriction (the subway lines, in this example), and a shift from a declarative-sentence intension (= proposition) to a question-extension (set of propositions). In examples like the one we have analyzed, this is not a problem. But it is a fundamental impediment to the analysis of multiple questions, such as (23).

(23) Which driver takes which bus?

We would like this to denote a set of propositions which, for any pair <x,y> of a driver x and a bus y, contains the proposition that x takes y. More precisely, we want to obtain the result in (24).

\[
[[\text{which driver takes which bus}]]^{w} =
\lambda p <s,t>. \exists x \exists y \left[ x \text{ is a driver in } w \land y \text{ is a bus in } w \land p = \text{that } x \text{ takes } y \right]
\]

(24) predicts correctly that the answers to this question are assertions like "John takes #77, and Mary takes #78", where John and Mary are drivers and #77 and #78 are buses.

But how do we obtain such a meaning compositionally from an interpretable LF for (23)? It is clear that the second which-DP, the object which bus, cannot be interpreted in situ in its surface position. It definitely doesn't have the right type to combine with a
transitive verb meaning (extension type \(<e,et>\), intension type \(<s,<e,et>>\)). So it must move somewhere else at LF. Where? Its type being \(<<s,et>, \tau_q>\), it has to adjoin to a node of type \(t\) (so that the abstract created by the movement will have an extension of type \(<e,t>\) and an intension of type \(<s,et>\)). That could only be the IP or C' (with C being vacuous, these two are semantically indistinct). So the LF-structure would have to be (25).

\[
(25)
\]

\[
\text{CP} \\
\text{DP} \\
\text{which driver}
\]

\[
\text{DP} \\
\text{which bus}
\]

\[
t_1 \text{ takes } t_2
\]

This has \textbf{which bus} in the right environment to make the node above it interpretable, but there is trouble higher up: by the time we get to the topmost abstract (the one starting with 1), we have a denotation of type \(<e,\tau_q>\). The extension of \textbf{which driver}, which is of type \(<<s,et>, \tau_q>\), cannot combine with this by either FA or IFA. Other conceivable landing sites for \textbf{which bus} lead to similar type-mismatches. For instance, if we raise \textbf{which bus} above \textbf{which driver}, we just shift the problem: \textbf{which driver} then gets the appropriate type of argument, but \textbf{which bus} doesn't. Whichever way we line up the two \textbf{which}-DPs, only the lower one will be interpretable.

The reason for this problem is, so to speak, that you can only step up from a declarative-type meaning to a question-type meaning once. Then you are up there and can't take the same step again. As we have designed the meanings of \textbf{which}-DPs, each of them by itself effects such a change in type. So they can't iterate.

\textbf{2.3 Karttunen's solution: factoring out the Q-morpheme}

Karttunen solved this problem by factoring what we have so far taken to be the meaning of the interrogative determiner \textbf{which} into two separate semantic operations, which are performed by two different items in the LF-tree. His LFs are accordingly a little more abstract than ours have been so far: They have an additional, semantically non-vacuous,
morpheme in the head-position of the CP, a so-called Q-morpheme\(^6\), which we will write as \(?\). Here is Karttunen's analysis of our original, non-multiple, example (compare (15) above).\(^7\)

(26) new LF:

\[
\begin{array}{c}
\text{CP} \\
\text{DP} \\
\text{D} \\
\text{which} \\
\text{NP} \\
\text{subway line} \\
\text{I} \\
\text{C} \\
\text{C'} \\
\text{IP} \\
\text{t} \text{ goes to the airport}
\end{array}
\]

The Q-morpheme has a (world-invariant) extension of type \(<s,t,\tau_q>\), and the following lexical entry:

(27) \[
\text{[[?]}} = \lambda p_{<s,t>} . \lambda q_{<s,t>} . q = p
\]

What this says is less opaque if we translate it into "set talk":

(27') \[
\text{[[?]}} = \lambda p. \{q: q = p\} = \lambda p. \{p\}
\]

So the Q-morpheme simply forms the singleton-set containing the intension of the IP. The resulting C'-denotation is what Karttunen calls a "proto-question": it already has the semantic type of a full-grown question, but it can't serve as a real question yet, because it doesn't represent a non-trivial choice between two or more propositions.

With the new Q-morpheme having taken over one part of its previous semantic labor, the interrogative determiner \textbf{which} must now receive the following denotation (compare to (19)).

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\(^6\)The idea that interrogative clauses contain an abstract "Q-morpheme" has a long tradition in the syntactic literature. See e.g. Katz & Postal (1964) and Baker (1968).

\(^7\)These attributions to Karttunen must be taken with a grain of salt: He was working in Montague Grammar, a framework in which there was a heavier penalty for positing LFs with non-overt items like Q-morphemes than for multiplying construction-specific composition rules. What we present here as his analysis is actually a translation of it into our framework. We will say a little more about the relation between Karttunen's original proposal and our present one in section 2.4 below.
\[(28) \quad [[\text{which}]]= \lambda f_{<e,t>}. \lambda P_{<e,\tau_q>}. \lambda p_{<s,t>}. \exists x [f(x) = 1 \& P(x)(p) = 1]. \]
\[(\text{in set talk: } \lambda f. \lambda P. \lambda p. \exists x [f(x) = 1 \& p \in P(x)] )\]

So the revised (and final) types are as follows (compare to (22)):

\[(28') \quad \text{type of } [[\text{which}]]: \quad <et,<e,\tau_q>,\tau_q>>\]
\[\text{type of } [[\text{which subway line}]]^w: \quad <<e,\tau_q>,\tau_q>>\]

To see how the pieces all fit together, let's interpret the tree in (26).

For any \(w\):
\[\text{[(26)]}^w = [[\text{which}]]([[\text{subway line}]]^w)(((1. \text{ ?. } t_1 \text{ goes to the airport})])^w) = \lambda p. \exists x [[\text{subway line}]]^w(x) = 1 \& [[1. \text{ ?. } t_1 \text{ goes to the airport}]]^w(p) = 1 = \lambda p. \exists x [x \text{ is a subway line in } w \& [[?]([[t_1 \text{ goes to the airport}]]^w[1\rightarrow x])(p) = 1] = \lambda p. \exists x [x \text{ is a sw-line in } w \& p = [[t_1 \text{ goes to the airport}]]^w[1\rightarrow x]]\]
\[\text{[[t_1 \text{ goes to the airport}]]}^w[1\rightarrow x] = \lambda w'. x \text{ goes to the airport in } w'\]

Therefore, \[\text{[(26)]}^w = \lambda p. \exists x [x \text{ is a subway line in } w \& p = \lambda w'. x \text{ goes to the airport in } w' ]\]

\text{Exercise: } Check the calculation above. Identify each applicable composition rule. Spell out the intermediate steps involved in the elimination of [[\text{which}]] and of [[?]], using (a) the official versions, and (b) the set-talk versions of entries (27) and (28).

As desired, this calculation gave us the same overall result as our previous analysis without a Q-morpheme.

The advantage of the new division of semantic labor shows up when we return to our multiple question, (23). It can now be assigned the following LF.
In the derivation of (29), \textit{which driver} moved to Spec of CP in the overt syntax, and then \textit{which bus} underwent covert movement to a 2nd Spec-of-CP position below the first.\footnote{This derivation involves "tucking in" in the sense of Richards (1997). Karttunen's syntax for multiple wh-questions corresponds more closely to earlier analyses, on which the covertly moved wh-phrase adjoined to CP, thus landing higher than the overtly moved one. Our semantics makes both hierarchical orders interpretable, with equivalent results.}

There are no type-mismatches anymore: The C-bar ("proto-question") has an extension of type $\tau_q$. Functional abstraction by the binder index 1 turns this into type $\langle e, \tau_q \rangle$. The extension of \textit{which bus}, of type $\langle e, \tau_q, \tau_q \rangle$, can apply to this, and we are back to type $\tau_q$. Next, abstraction by index 2 yields $\langle e, \tau_q \rangle$, and application of the extension of \textit{which driver} to this yields again $\tau_q$. It is clear that a third or fourth wh-phrase would also create no interpretability problem: for each \textit{which}-DP, the abstraction induced by its movement, followed by functional application of its denotation, takes us from $\tau_q$ to $\langle e, \tau_q \rangle$ and from $\langle e, \tau_q \rangle$ back to $\tau_q$. The process is indefinitely iterable, and we correctly predict that there is no upper limit on the number of wh-phrases in a given question.

Of course, it is not enough to ascertain that the types all fit. We also want to be sure that the meaning predicted for (29) is indeed the one we want (as specified above in (24)).

\textbf{Exercise:} Calculate the interpretation of (29).

\section*{2.4 Interpretability and the LF-distribution of wh-phrases}

We have so far concentrated on wh-phrases of the form [DP \textit{which} NP], but the analysis generalizes easily to the pronominal wh-DPs \textit{who} and \textit{what}, which we take to be equivalent to 'which person' and 'which thing' respectively.\footnote{This is not quite accurate. A closer look at the behavior of \textit{who} suggests that, despite being syntactically singular, it is semantically neutral between singular and plural. So a better paraphrase would be 'which person or persons'. The situation with \textit{what} is even more complicated: it is not only neutral with respect to number, but also with respect to the count/mass distinction. In other words, \textit{what} means something like}
the homophonous relative pronouns here, of course. These are different lexical items.) DPs of the form which+NP, who, and what may be called "interrogative generalized quantifiers". According to the semantic analysis that we have arrived at, they have extensions of type <<e,τ_q>,τ_q>. This is similar to the familiar type <<e,t>,t> for ordinary generalized quantifiers (such as some+NP, every+NP), except that we have τ_q (=st,t>) in the place of t. In other words, we have the type of (the extension of) an interrogative clause substituting for the type of (the extension of) a declarative clause.

The systematic difference in the semantic types of interrogative and non-interrogative DPs leads to certain general predictions about interpretability: First, if a sentence contains an interrogative DP but no Q-morpheme anywhere, it will have no interpretable LF at all. Due to its type, the wh-DP is not interpretable either in situ or in any place it could be moved to. Second, all interrogative DPs must move to a position above some ?, either right above it or separated from it only by other interrogative quantifiers. Nowhere else will they be interpretable. Third, an ordinary, non-interrogative, quantifier cannot occupy a position right above ?. We predict, in effect, that interrogative and non-interrogative DPs have complementary distributions at LF, and that wh-movement is obligatory for semantic reasons. The latter prediction, of course, only holds for wh-movement by LF. To the extent that wh-movement is obligatory in the overt syntax, this cannot follow from interpretability considerations alone, but must have syntactic or morphological reasons.

Historical note: Karttunen (1977) did not actually make this semantic distinction between interrogative and non-interrogative generalized quantifiers. On his analysis, the extensions of which+NP, who, and what were simply of type <<e,t>,t>. In fact, these interrogative DPs received exactly the same denotations as the non-interrogative indefinite DPs some+NP, someone, and something respectively. This simpler semantics for the interrogative DPs, however, had its price. Karttunen needed to introduce a special composition rule for the combination of the interrogative quantifier with its sister-constituent. He also needed to stipulate that all and only interrogative quantifiers move above the Q-morpheme at LF. The analysis that we have developed here, by contrast, uses only the standard composition principles of intensional semantics, and (as we just pointed out) it derives the complementary distribution of interrogative and non-interrogative DPs at LF from the principle of interpretability.

'which thing or things or stuff'. Since we have not had a systematic discussion of the semantics of plurals and mass nouns, we have to abstract away from these matters here.

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Exercises

A. Suppose we replace our lexical entry for *which* in (28), sec. 2.3, by the one below.

(i) \[ \text{[[which]]} = \lambda f_{\langle e,t \rangle}. \lambda g_{\langle e,t \rangle}. \exists x [f(x) = 1 \land g(x) = 1] \]

Now *which* means exactly the same thing as *some*. If we change nothing else, the LFs in (26) and (29) are uninterpretable.

(a) Write a new composition rule which can combine the *which*-DPs with their sister nodes in (26) and (29).

(b) Compare the rule you just wrote to the *WH-QUANTIFICATION RULE* on p. 19 of Karttunen (1977). What do they have in common? What is different?

(c) Suppose now that we don't introduce any new composition rule like the one you wrote in (a), but instead we posit a more abstract LF-structure for interrogative DPs:

(ii) \[
\begin{array}{c}
\text{DP} \\
\text{WH} \\
\hbar \\
\text{D} \\
\text{which} \\
\text{NP} \\
\end{array}
\]

In (ii), there is an abstract WH-feature in addition to the determiner. Still assuming the simple semantics for *which* in (i), what denotation would you have to assign to the WH-feature in order to make LFs like (iii) interpretable (by standard composition rules)?

(iii) \[
\begin{array}{c}
\text{CP} \\
\text{DP} \\
\text{WH} \\
\text{D} \\
\text{which} \\
\text{NP} \\
\text{subway line} \\
\end{array}
\]

B. Wh-questions containing universal quantifiers are often ambiguous between a "single answer" reading and a "pair-list" reading. A standard example is (iv).

(iv) Which book did every student read?
On the single-answer reading, (iv) elicits answers like 'Every student read LGB', or 'Every student read SPE'. On the pair-list reading, the expected answers are conjunctions like 'John read LGB, Mary read SPE, and Bill read LGB,' or 'John read SPE, Mary read LGB, and Bill read Montague Grammar' (assuming that John, Mary, and Bill are all the students that there are).

The analysis of the single-answer reading is straightforward. If we assign to (iv) the obvious interpretable LF in (v) and interpret it by the semantics we have developed in these notes, we generate the denotation in (vi).

\[(v) \left[ \text{which book } 1 \left[ ? \left[ \text{every student read } t_1 \right] \right] \right] \]

\[(vi) \text{ For any } w: [(v)]^w = \lambda p. \exists x [x \text{ is a book in } w \& p = \lambda w'. [\text{every student in } w' \text{ read } x \text{ in } w']] \]

The correct analysis of the pair-list reading, by contrast, is not at all obvious and continues to be debated in the literature. In this exercise, you are not expected to come up with an analysis, but only to appreciate some of the initial difficulties.

A number of authors have assumed that the pair-list reading arises when the universal quantifier takes scope over the interrogative quantifier, as in the structure in (vii).

\[(vii) \]

Here the universal quantifier has been QRed above the \textbf{which-}DP.

On the assumptions we have spelled out in the text, (vii) is not an interpretable LF. There is a type-mismatch at the top, where an ordinary generalized quantifier (type $<e,t>$) is trying to combine with an abstract of type $<e,\tau_q>$.
(vii) is interpretable, however, if you use the special composition rule that you have written in part (a) of exercise A.\textsuperscript{10} Work out the interpretation that you get with that rule, and explain why it doesn't adequately represent the pair-list reading (or any other acceptable reading) of sentence (iv).

\textsuperscript{10}Another way to make (vii) interpretable, without the special composition rule, is by adjoining the WH-feature (from part (c) of exercise A) to the every-DP. Not surprisingly, this leads to the same (bad) prediction as the use of the special composition rule.
Some recommended readings in interrogative semantics

A. The following works provide arguments for and against Hamblin's and Karttunen's choices of semantic values for interrogative clauses. They also propose or discuss alternatives. Most of the argumentation is based on considerations about the lexical meanings of question-embedding verbs.


B. This group contains the most important references about the interaction of interrogative and non-interrogative quantifiers in so-called 'pair-list' and 'functional' readings of questions.


C. The works in this group are especially relevant to the analysis of which-phrases and issues relating to the semantic motivation for wh-movement, in-situ interpretation, and reconstruction.

Engdahl, Elisabet (1986) [see above], especially ch. 4, sec. 4 ("A relational approach to interrogative quantifiers"), sec. 5 ("Interaction between interrogative quantifiers and other quantifiers") and sec. 9 ("An alternative approach"), pp. 169 - 204 and 241 - 252.


D. The papers in this last group are relevant specifically to the analysis of the internal composition of alternative questions and yes/no questions.

Larson, Richard (1985) "The Syntax of Disjunction Scope," NLLT. See especially the sections on whether ... or


Vainikka, Anne (1987) "Why can or mean and or or?" in J. Blevins & A. Vainikka (eds.) UMOP 12, Amherst: GLSA, pp. 148 - 186. See especially sec. 2.4 "or in questions: vai vs. tai in Finnish," pp. 164 - 166.