Scope Interactions with Pair-list Readings

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It is standardly assumed that quantifier scope assignment, whether it should rely on Quantifier Raising or on some other semantically equivalent technique, is clause-bounded. The type of example underlying this claim is (1):

(1) Some librarian or other found out that every student needed help.
 * 'for every student, there is some librarian who found out that he needed help'

We observe that the impossibility of a reading of (1) where librarians vary with the students contrasts sharply with the naturalness of such a reading of (2):

(2) Some librarian or other found out which book every student needed.
 'for every student, there is some librarian who found out which book he needed'

Does (2) motivate the assumption of long-distance quantifying in? We will argue that it does not.

The structure of this paper is as follows. We first present an analysis of the phenomenon in (2), according to which it is not <u>every student</u> but the whole complement clause <u>which book every student needed</u> that takes scope over the matrix subject. The analysis and its justification seem rather straightforward, so it will take up only part of the paper. The rest will be concerned with some background assumptions of the analysis and related phenomena.

1. Pair-list

Our basic claim is that the 'librarians vary with students' reading is due to the fact that the complement clause allows a particular interpretation: a pair-list reading. As is well-known, sentences like <u>Which book does every student need?</u> and their embedded counterparts are ambiguous; the second reading concerns a list of student-book pairs:

(3) John found out which book every student needs.
 (i) 'John found out that every student needs Ulysses'
 (ii) 'John found out that Mary needs The Iliad, Bill The Odyssey, and Frank The Aeneid'

Most, though not all, of the current literature assumes that pair-list readings result from the quantifier taking scope over the clausemate wh-phrase. We propose a specific implementation of this idea, according to which the complement pair-list reading denotes a generalized quantifier (over individual questions) of the following format. This is intended to be neutral with respect to details of question interpretation per se:

(4) $\lambda R \forall x[\text{student}(x) \rightarrow R(\text{which book } y[x \text{ needs } y])]$

When the relevant (ii) interpretation of (3) is derived, the variable R in (4) eventually gets replaced by John found out:

(5) $\forall x[\text{student}(x) \rightarrow \text{found-out}(\text{john, which book } y[x \text{ needs } y])]$

The layered quantifier in (4) is of the same kind as every man's mother or more than two men from every city. We will call them layered quantifiers.

(6) $\lambda P \forall x[\text{man}(x) \rightarrow P(\iota y[\text{mother}(y, x)])]$
John met every man's mother: $\forall x[\text{man}(x) \rightarrow \text{met}(\text{john}, \iota y[\text{mother}(y, x)])$

(7) $\lambda P \forall x[\text{city}(x) \rightarrow \exists_{>2} y[\text{man}(y) \,\&\, \text{from}(y, x) \,\&\, P(y)]]$
John met more than two men from every city:
$\forall x[\text{city}(x) \rightarrow \exists_{>2} y[\text{man}(y) \,\&\, \text{from}(y, x) \,\&\, \text{met}(\text{john}, y)]]$

As a novel step, we propose that like quantifiers in object position in general, the pair-list reading may scope over a quantificational subject. Note that the matrix subject is clause-mate to the complement as a whole. The wide scope reading of (2) is derived as follows:

(8) a. $\lambda R \forall x[\text{student}(x) \rightarrow R(\text{which book } y[x \text{ needs } y])]$
$(\lambda v[\exists z[\text{librarian}(z) \,\&\, \text{found-out}(z, v)]]) =$
b. $\forall x[\text{student}(x) \rightarrow \exists z[\text{librarian}(z) \,\&\, \text{found-out}(z, \text{which book } y[x \text{ needs } y])]$

The result in (8b) is exactly the same as what we would get if every student scoped out on its own. Proof that nevertheless, the syntactic process of obtaining that reading involves the assignment of wide scope to the whole complement clause, as indicated in (8a), comes from the fact that this reading is incompatible with a pronoun in the complement being bound by the matrix subject:

(9) Some librarian/i or other found out which book every boy stole from her/i.
* 'for every boy, there is some librarian who found out which book he stole from her'
* [which book every boy stole from her/i]/j[some librarian/i found out t/j]

This analysis also allows us to explain further restrictions on the availability of the critical reading. We will mention two of them. First, not all quantifiers support the relevant reading:

(10) Some librarian or other found out which book few students needed.
* 'for few students, there is some librarian who found out which book they needed'

(11) Some librarian or other found out which book more than five students needed.
* 'for more than five students, there is some librarian who found out which book they needed'

(10) is impossible because decreasing quantifiers like few students do not support pair-list readings to begin with (whatever the reason might be). That is, even (10') is unavailable:

(10') John found out which book few students needed.
* 'John found out about few students which book each needed'

More than five students, on the other hand, does support pair-list readings:

(11') John found out which book more than five students needed.
'John found out about more than five students which book each needed'

Only the further step by which this pair-list reading as a whole makes the matrix subject some librarian referentially dependent is impossible. But this is reminiscent of a deficiency that quantifiers like more than five N have, in distinction to every N. As discussed in Liu (1990), more than five N takes scope in situ but does not scope over a c-commanding quantifier. In Beghelli's (1993) terms, every N undergoes QR but more than five N does not:

(12) Some man read every book.
'for every book, there is some man who read it'
(13) Some man read more than five books.
* 'for more than five books, some man read them'

We show below that layered quantifiers "inherit" the properties relevant to scope taking from their internal wide scope quantifier. This predicts that the pair-list reading of which book every student needed is able to take inverse scope, but the pair-list reading of which book more than five students needed is not.

You may note that a contradiction appears to be lurking here. Namely, if the pair-list reading involves a 'quantifier > wh-phrase' scope relation, and more than five N does not undergo QR, how come the plain pair-list reading in (11') is available at all? The answer must be that in the (11') constellation more than five students can scope over which book even if it stays in situ. Kayne (1993), in conjunction with May (1985), is one theory that predicts this. Kayne argues that specifiers are essentially adjuncts. It follows then that the subject, standardly thought to sit in the specifier of IP, qualifies as an IP-adjunct instead, and thus automatically has the same scopal properties that are ascribed to QR'd quantifiers. What is relevant to us is that in May's terms, its scope extends to the next maximal projection, CP, where the wh-phrase is located.

Notice now that not only subject quantifiers can support a pair-list reading, for instance:

(14) I know which boy John introduced every girl to.
'I know about every girl which boy John introduced her to'

Our trick predicts that more than five girls does not support a pair-list reading from object position, since it does not undergo QR and its in-situ scope does not reach up to CP. This prediction is correct. (14) contrasts with (15):FN

(15) I know which boy John introduced more than five girls to.
* 'I know about more than five girls which boy John introduced her to'

[FN An alternative way to account for this contrast would be to say that more than five N undergoes movement, but only a very short one. Thus from subject position it can adjoin to wh, but from object position it cannot scope over the subject or CP. ELABORATE BOTH ALTERNATIVES]

Secondly, not all matrix verbs allow the critical reading:

(16) Some librarian or other wondered which book every student needed.
(i) 'some librarian wondered which was the unique book needed by every student'
(ii) 'some librarian wondered about the student-book pairs'
(iii)* 'for every student, some librarian wondered which book he needed'

This should derive from the standard assumption that verbs like wonder subcategorize for complement question interpretations as intensional objects. In fact, if the assumption is implemented in the style of PTQ, then the complement clause cannot be quantified in and consequently cannot acquire scope over the matrix subject, either.FN

(17) wonder (john, $^\wedge\lambda R \forall x[\text{student}(x) \rightarrow R(\text{which book } y[x \text{ needs } y])]$)

This is not to claim that Montague's (1974) treatment of intensionality is in general the correct one, but we anticipate that any superior theory will preserve this particular result.
[FN Two remarks. First, the absence of interpretation (iii) for (16) parallels the impossibility of having men vary with unicorns on the intensional reading of Some man or other seeks every unicorn. Of course, Some man or other seeks a unicorn from every city may have men varying with cities on the intensional reading. But this will be obtained by letting every city scope out on its own. There is nothing wrong with that when the intensional object is a noun phrase, not a clause. Second, Keenan & Faltz's (1985) general treatment of intensionality as well as Groenendijk & Stokhof's (1989) specific proposal for interrogatives differ from Montague's (1974), and in fact make different empirical predictions. Both proposals appear to yield too many readings elsewhere as well, so we refrain from adopting them as they are. See Moltmann (1993) for an alternative approach to intensionality.]

With this, we take it that our basic analysis of the puzzling data in (2) is substantiated. Now we turn to some of the questions that the analysis raises. Empirically, how general is the phenomenon that we observed? Theoretically, what motivates the non-trivial assumptions we made in the course of sketching the analysis? We are going to touch upon the following issues:

(18) Other wh-constructions exhibit similar scopal properties and are amenable to the proposed treatment
(19) The absence of apparent "long-distance" effects from whether and that complements and the clause-boundedness of quantifier scope

(20) Layered quantifiers "inherit" the scopal abilities of their internal wide scope quantifier
(21) The QP in complement pair-list readings contributes real quantificational force, not just a domain restriction
(22) The exceptional unavailability of certain pair-list readings

2. Other wh-constructions

Our account of pair-list readings does not make reference to any specific property of questions. Rather, pair-list readings arise whenever a quantifier takes scope over a wh-phrase. Semantically, such a scope order means that the quantifier will quantify into whatever semantic object the wh-phrase denotes. This analysis predicts that quantifying in of this sort should be possible for other wh-constructions as well.

In fact, Lerner & Pinkal (1992) give precisely this analysis for apparent exceptions to the clause-boundedness of quantifiers in comparatives such as,

(23) a. John is taller than every student is.
b. John read fewer books than every other student did.

As argued in Chomsky (1977), comparatives involve A-bar movement of an empty operator:

(24) John is taller than $[_{CP}$ 0/i $[_{IP}$ every student is t/i]]

Lerner & Pinkal argue that comparatives involve universal quantification over degrees, expressed by the 0-operator. So (23a) with the interpretation in (25) would imply that every student has the same height (or else (23a) is trivially false):

(25) $\forall d[(\forall x[student(x) \rightarrow tall(x, d)) \rightarrow \exists d'[tall(john, d') \ \& \ d' > d]]$

Hence Lerner & Pinkal assume that <u>every student</u> scopes over the 0-operator. This allows <u>every student</u> to quantify into the universal quantifier over degrees, as in (26):

(26) $\forall x[student(x) \rightarrow \forall d[tall(x, d) \rightarrow \exists d'[tall(john, d') \ \& \ d' > d]]]$

We note that also in comparative clauses the quantifier can apparently take scope over some other quantifier outside the clause:

(27) Some professor or other is as tall as every student is.
'for every student, there is a professor who is as tall as he is'

Moltmann (1992) furthermore observes that decreasing subject quantifiers do not allow quantifying in, nor do universals in object position:

(28) a. John is taller than no student is.

b. More students asked John than asked every other professor.

As was noted by von Stechow (1982), (28a) has no reasonable interpretation at all. A narrow scope reading of no student would render (28a) equivalent to 'John is infinitely tall,' (for every height d that no student has, John's height exceeds d). However, (28a) could have a natural reading, if no student could quantify into the comparative clause. But this is not available:

(29) 'for no student x, John is taller than x is'

(28b) on the other hand can only involve a comparison between the number of students that asked John and the number of students x such that x asked every other professor. It cannot have the reading

(30) 'for every professor x, the number of students who asked x exceeds the number of students that asked John'

To this we can add the observation that quantifiers such as more than five students also allow quantifying in, but fail to exhibit scope interactions with any other QP in the sentence:

(31) a. John is taller than more than five students are.
b. Some professor or other is taller than more than five students are.

Thus, comparatives exhibit exactly the same scope pattern as embedded interrogatives.

Also free relatives, as expected, behave the same way. Moltmann (1992) and Schein (1993) note the possibility of quantifying, with the same restrictions as above. Again, we may add the observation of scope interactions with other quantifiers:

(32) a. John read what every student wrote.
b. John read what no student wrote.
c. John watched what caused every fire.
d. Some professor or other read what every student read.

Thus, it appears that exactly the same quantifier scope possibilities are available for all wh-constructions with the relevant properties.FN But what happens in whether and that-clauses? We turn to these in the next section.

[FN Another construction that involves movement of an empty operator is before-clauses, cf. Larson (19??):
(i) a. John gave an introduction before every professor gave his speech.
b. Before every professor gave his speech, John gave an introduction.]

3. Whether/that complements and the clause-boundedness of QR

Why is quantifier scope assignment clause-bounded? The fact is generally acknowledged, although it does not seem to have any solid explanation.FN [FN: Only May (1985) offers an account by barring QP-adjunction to CP as well as raising QP to the next VP; the assumptions behind this strike us as ad hoc.] Since A-movement, in distinction to A-bar movement, is typically clause-bounded, we conjecture that an explanation may derive from assimilating QR to A-movement. This proposal appears compatible with preliminary suggestions in Beghelli (1993), but we will not explore it any further in this paper. Notice, however, that if all complement clauses containing a universal could be interpreted as layered quantifiers of the sort we introduced above, the effects of clause-boundedness would be mostly obscured. Essentially, only the cases with unbindable pronouns would signal that we do not have free scoping out, cf. (9).

But apparent "long-distance" phenomena like in (2) are rather scarce. (33) is one further example that clearly belongs here. Tim Stowell (p.c.) suggests that (34) from Lebeaux (1983), and (35) from Lasnik and Saito (1992, 4:2) may belong here, too.

(33) Who/i do you think everyone saw t/i at the rally?
'for everyone, who do you think he saw at the rally'
(34) John and Mary/i didn't know what each other/i had done.
(35) Who wonders what who bought? LF: who/i who wonders what t/i bought
'for what pair of persons, the one wonders what the other bought'

Let us tentatively assume that in (33) a pair-list reading is formed in the complement clause but the wh-phrase moves on, to clear the CP-complement of think of wh-content. (34) might be derived by first assigning each other scope over what, and then raising the whole complement to the matrix INFL, if these steps are independently justifiable. A similar analysis of (35) is more uncertain since what who bought itself is unacceptable.

Whatever the exact analysis of these examples might be, it is striking that apparent "long-distance" phenomena are limited to constituent wh-complements, that is, they do not arise in either whether-clauses or that-clauses. Every N never appears to scope out of that-clauses; whether-clauses have no pair-list readings; Lebeaux notes that (34) is surprisingly better than examples with that or if, and Stowell remarks a similar contrast in connection with (35):

(36) Some librarian or other found out that every student needed help. (=(1))
* 'for every student, there is a librarian who found out that he needed help'
(37) Mary found out whether every student needed help.
* 'Mary found out about every student whether he needed help'
(38) a.?? John and Mary think that each other will win.
b.? John and Mary wondered if each other would win.
(39) a.? Who thinks that who left?
b.? Who wonders whether who left?

Nothing that we have explicitly said excludes these. Restricting our attention to the types (36) and (37), recall that in (4) we formulated the interpretation of the pair-list reading using a generalized quantifier inside which the QP takes scope over the wh-phrase. As Groenendijk & Stokhof (1984) point out, interpreting interrogative complements as generalized quantifiers is independently necessitated by disjunctions. The reading on which matrix material distributes over the members of the disjunction can only be derived by interpreting <u>where I live or where you live</u> as in (41):

(40) He found out where I live or where you live.
'he found out where I live or he found out where you live'

(41) $\lambda R[R(\text{where I live}) \vee R(\text{where you live})](\lambda v[\text{found-out}(\text{he}, v)])$

But the same argument carries over to <u>whether</u> and <u>that</u>-clauses:

(42) a. He found out whether the painting was authentic or whether the princess was alive.
'he found out whether the painting... or he found out whether the princess...
b. He found out that the painting was authentic or that the princess was dead.
'he found out that the painting... or he found out that the princess...'

If these clauses take the same format as constituent wh-complements, then quantification into them is in principle equally possible; and in view of the "inheritance" argument, the layered quantifier should be able to take wider scope, too.

(43) a. whether every girl walks: $\lambda P \forall x[\text{girl}(x) \rightarrow P(\text{whether } x \text{ walks})]$
b. that every girl walks : $\lambda P \forall x[\text{girl}(x) \rightarrow P(\text{that } x \text{ walks})]$

At this point we are not sure why this does not happen; we tentatively suggest two lines of explanation. Both capitalize on the same basic distinction that Lahiri (1991) and Chierchia (1993) make between wh-XP and <u>whether</u> in accounting for the absence of pair-list readings in <u>whether</u>-clauses, namely, that wh-XP is a variable binding operator, but <u>whether</u> and <u>that</u> are not.

One explanation may be quite syntactic. Sloan (1989) notes that the examples in (43) have no pair-list reading, and Schein (1993) extends the observation to other wh-constructions:

(44) a. Who/i do you think [everyone saw [Mary talk to t/i]]? * pair-list
b. Who/i does everyone think [t/i saw you]]? * pair-list
c. Who/i did everyone say [that Bill saw t/i]? * pair-list

Sloan's stipulation, somewhat modified by Schein, is that the quantifier must be clause-mate to the wh-trace. With a slight modification, this can be restated as follows: Quantification into a lifted domain is possible only if that domain contains a clausemate variable. This rules out (43a,b), where <u>whether</u> and <u>that</u> are not variable binding operators.

Another explanation may be that QP cannot scope over <u>that</u> or <u>whether</u>. QP scoping over CP is an is an instance of inverse scope taking. Inverse scope is well-attested in the interaction of QP with wh-XP or another QP. On the other hand, inverse scope over non-variable binding operators is more limited. Many speakers find (45) and (46) unambiguous:

(45) I didn't read every book. [as opposed to: I didn't read any book.]
'not > every'

(46) You may$_{[deontic]}$ buy every book. [as opposed to: You may buy any book.]
'may > every'

Since <u>that</u> and <u>whether</u> fall together with <u>not</u> and <u>may</u> in not being variable binding operators, these data indicate that we must not expect inverse scope to be automatically available. We remain agnostic on what the rules of the game here are.

4. <u>The scopal abilities of layered quantifiers</u>

We assumed above that layered quantifiers "inherit" the semantic properties relevant for scope from the internal wide scope quantifier.FN Some further data that support this are as follows:

(47) a. At least two boys know every girl's address.
'for every girl's address, at least two boys know it'
b. At least two boys know more than three girls' addresses.
* 'for more than three girls' addresses, at least two boys know them'
c. At least two boys know envy fewer than three girls' addressses.
* 'for fewer than three girls' addresses, at least two boys know them'

(48) a. John read most of the books.
(i) * 'for each book, John read most of it'
(ii) 'John read the majority of the books'
b. John read most of every book.
(i) 'for each book, John read most of it'
(ii)* 'John read the majority of the books'

(49) a. John read most of what Mary wrote.
b. John read most of what every student wrote.
(i) 'for each student, John read most of what he wrote'
(ii)* 'John read the majority of student-written things'

(27) shows that the ability of <u>DP's N</u> to take inverse scope matches the ability of DP's ability to take inverse scope. The contrast in (28a,b) shows that in <u>most of DP</u>, DP must be a definite, not a universal. (29a) shows that the free relative <u>what Mary wrote</u> is definite. In (29b) we assume that the students did not write one piece collectively, i.e., we have a pair-list interpretation of the free relative. The contrast in (29b) parallels that in (28b), showing that <u>what every student wrote</u> is no more a definite than <u>every book</u>.

[FN Caveat: there are some data that do not conform to our preliminary generalization, and we do not yet understand why. Compare:

(i) To which girl/i did John introduce every boy t/i?
'for every boy, which girl did John introduce him to'

(ii) To which girl/i did John mention which book every boy read t/i?
* 'for every boy, to which girl did John mention which book he read'

The missing reading would arise if the pair-list reading of <u>which book every boy read</u> behaved scopally exactly like <u>every boy</u>. These examples differ from those in the main text only in that the layered quantifier should scope over a wh-phrase, not a QP.]

How can layered quantifiers inherit the scopal properties of the internal wide scope quantifier? Concerning the data in (47) we can make the following simple observation, suggested to us by Makoto Kanazawa. The layered quantifiers here can be paraphrased as below, where the determiner of the possessor becomes the determiner of the whole quantifier:

(50) a. every girl's address = every address that belongs to some girl
b. more than three girls' addresses = more than three addresses that each belong to some girl
c. fewer than three girls' addresses = fewer than three addresses that each belong to a girl

Given that a noun phrase's semantic properties and, we assume, scopal abilities depend on what its determiner is, the availability of these paraphrases predicts that the scope behavior of <u>every girls' address</u> will be the same as that of <u>every girl</u>, and similarly for the other examples.

These paraphrases are available because in the examples above there is a one-to-one function from girls to addresses. Note that this function need not map individuals to individuals, it can also map individuals to sets or groups. So the same holds for (51), an example that may appear problematic at first sight:

(51) a. few girls' books ≠ few books that belong to some girl
b. few girls' books = few maximal book-sets that each belong to some girl

In formula:

(52) $\lambda P_2 DETx[P_1(x), P_2(fx)] \;=\; \lambda P_2 DETy\exists x[(P_1(x) \;\&\; (y=fx)), P_2(y)]$ iff <u>f</u> is 1-1

On the other hand, consider the following quantifiers:

(53) exactly three poems by every poet

Here the internal and the layered quantifiers differ in crucial, scope-influencing logical properties. For instance, <u>every poet</u> is increasing, but <u>[every poet/i [exactly three poems by t/i]]</u>, like <u>exactly three poems</u>, is non-monotonic. Thus we do not get object wide scope in the following example:

(54) a. Some student or other read exactly three poems by every poet.
* 'for every poet, there are exactly three poems such that a potentially different student read them'

The difference in the behavior of the quantifiers in (47) and in (53) is due to the fact that only the former, but not the latter, involve a one-to-one function. The layered quantifier and its internal wide scope quantifier will still exhibit weaker similarities (see Keenan & Faltz (1985)), but these do not concern us here.

What does all this imply for pair-list readings like which book every student needs or which book more than five students need? Corresponding to every one of the students or of more than five students we have a unique question about that student. In other words, we have a one-to-one function from individuals to questions about those individuals. Thus schema (52) applies to pair-list readings, and their scope behavior is predicted, as desired.

5. Quantifying into questions?

Interpreting wh-complements as generalized quantifiers is widely accepted. On the other hand, "quantification into questions" is not the option adopted in most current literature, so the choice needs to be justified. Justification will be provided in two steps. First, we show that the analysis of the 'librarians vary with the students' reading that we proposed cannot be implemented using the standard alternative formalizations; we would need to develop a significantly different analysis if we wanted to stick with them. Second, we argue that the choice we make is both necessary and harmless, for independent empirical and theoretical reasons.

The current view in the literature is that in pair-list readings the QP does not act the same way as in other contexts. Rather than quantifying in, it contributes a domain restriction to the question.FN [FN This is undoubtedly true of Groenendijk & Stokhof (1984, 1989) and Chierchia (1993), but it holds even of Higginbotham (1991), since the latter formulates quantification into questions in terms which in the relevant respects are equivalent to G&S's.] To illustrate, (55) is assigned an interpretation parallel to (56):

(55) which book every student needs (matrix or complement)
(56) which student needs which book (matrix or complement)

On this view, every student contributes its minimal witness set, the set of students, which serves to restrict the domain of the question. Abstracting away from now irrelevant differences between authors, the pair-list reading quantifier takes the following general format:

(57) $\lambda R \exists A[\text{min.witness}(A, \|\text{every student}\|)\ \&\ R(\text{which } x \in A \text{ needs which book})]$

Let us see now what happens if, as was proposed at the outset of the paper, we assign wide scope to this quantifier over the matrix subject some librarian. Cf. (8):

(58) $\lambda R \exists A[\text{min.witness}(A, \|\text{every student}\|) \ \& \ R(\text{which } x \in A \text{ needs which book})]$
$(\lambda v[\exists z[\text{librarian}(z) \ \& \ \text{found-out}(z, v)]]) =$
$\exists A[\text{min.witness}(A, \|\text{every student}\|) \ \&$
$\exists z[\text{librarian}(z) \ \& \ \text{found-out}(z, (\text{which } x \in A \text{ needs which book})]$

We quantified (57) in, but the librarians do not end up varying with the students. Informally, you can convince yourself that this is a principled result, since the interpretation of the pair-list reading is modelled after that of multiple interrogation, and the latter indeed does not give rise to the relevant reading:

(59) Some librarian or other found out which student needed which book.
* 'for every student, there is some librarian who found out which book he needed'

Formally, the reason why (57) gives this result is that except for the selection of the witness set A, all the relevant action takes place inside the argument of the variable R. Thus, when quantifying in replaces R with some librarian found out, the latter remains outside the scope of that action.

Although we do not see how this scope problem could be simply fixed, it may be added that simple revisions of (57) may encounter a further problem. The librarians vary with students, not with student-book pairs, contrary to what the pair-list / multiple interrogation parallelism may suggest. (60) does not mean that if Mary needed two books, then two separate librarians found out about them; it had to be the same librarian for all Mary's book needs:

(60) Some librarian or other found out which books [plural!] every student needed.

Now we show that the domain restriction approach fails in an entirely independent way as well. The argument that follows is laid out in detail in Szabolcsi (1993).

Fundamental to this approach is that you pick a set A and restrict your attention to its members. But this is possible only if the quantifier that induces the pair-list question is monotone increasing. To illustrate the issue with a non-interrogative example:

(61) Two men walk = There is a set A of two men who walk
[it does not matter whether men outside A also walk]
(62) Few men walk $\neq$ There is a set A of few men who walk
[we must guarantee that men outside A do not walk]
(63) Exactly two men walk $\neq$ There is a set A of exactly two men who walk
[we must guarantee that men outside A do not walk]

All the examples we have looked at so far were increasing. The problem of decreasing quantifiers seems irrelevant because, as is well-known, decreasing quantifiers do not support pair-list questions at all:

(64) He found out which book few / at most two students needed.
* 'He found out about few / at most two students which book each needed'

But there is a relevant third class of quantifiers that no literature ever considers: the non-monotonic ones. These, we find, do support complement pair-list readings:

(65) He found out which book exactly three students needed.
'He found out about exactly three students which book each needed'

(Other non-monotonic examples are between three and ten students, more than two but certainly fewer than ten students, etc.) They pose the same logical problem as decreasing quantifiers would. That is, the schema of (57) inescapably misinterprets examples like (65)! (57) can be fixed by imposing a maximality condition. (66) is a minimal, and quite ad hoc, amendment. (67) is recast more radically and it also correctly excludes decreasing QPs:

(66) $\lambda R \exists A[\text{min.witness}(A, \|QP\|)$ & $R(\text{which } x \in A \text{ needs which book})$
& $\forall x[x \notin A \rightarrow \neg R(\text{which book } x \text{ needs})]]$

(67) $\lambda P \exists A \exists B[B$ is a non-$\varnothing$ minimal witness of $\|QP\|$ &
A is a witness of $\|QP\|$ & $B \subseteq A$ &
$\forall x[P(\text{which book } x \text{ needs})$ iff $x \in A]]$

The consequence of the amendment is that neither (66) nor (67) are pristine domain restriction schemata. But while (66) is now capable of accommodating non-monotonic QPs, quantifying it into the matrix clause would still not make the subject dependent. (67) on the other hand is equivalent to our initial quantificational schema (4) in all respects discussed in this paper.

The conclusion is that the pure domain restriction treatment of pair-list questions is not tenable in the face of non-monotonic quantifiers. Various alternatives can be considered; see (4), (66) and (67). For the sake of simplicity, in this paper we are using (4) but, in fact, (4) and (67) are equally good for our present purposes.

We have given two independent reasons for using a quantificational treatment of complement pair-list readings. But what about the arguments that militate against such a treatment? We observe that the main arguments have a full force in matrix questions only, and point out that, contrary to popular belief, the range of pair-list readings in the matrix and in the complement contexts is quite different, whence their treatment need not be the same. In fact, the schemata in (4), (66), or (67) are needed only in the complement case.

Straightforward quantification into matrix questions, as in (68a), is possible only if they are interpreted as propositions; an analysis that Groenendijk and Stokhof, but not other authors in the literature, accept. This problem does not arise in the complement case if the wh-complement is interpreted as a generalized quantifier. Compare:

(68) a. $\forall x[\text{student}(x) \rightarrow \text{which book does x need}]$
well-formed only if $\|$which book does x need$\|$ is a proposition
b. $\lambda R \forall x[\text{student}(x) \rightarrow R(\text{which book x needs})]$
well-formed since $\|$R(which book x needs)$\|$ is surely a proposition

But even if (68a) is theoretically acceptable, its format does not carry over to choice questions, i.e., to pair-list questions supported by an indefinite, rather than a universal. These have no unique complete and true answer, because they offer a choice as to what individuals you wish to answer the question about:

(69) What / Which books do two students need?
Answer 1: Mary needs Ulysses, and Peter Lolita.
Answer 2: Bill needs Aspects, and Frank Barriers. etc.

This claim is correct. But Szabolcsi (1993) observes that the data behind it are misleading: choice questions do not really exist in the matrix. Notice that the acceptability of a pair-list answer to questions like (69) decreases dramatically if the expressly singular wh-phrase <u>which book</u> is used and if <u>two students</u> is replaced by <u>more than two students</u>, for instance:

(70) Which book do more than two students need?
(i) Ulysses.
(ii)* Bill needs Ulysses, Frank Dubliners, and John Lolita.

This suggests that (69) is not a pair-list reading but a cumulative reading, exactly as Krifka (1991) and Srivastav (1991) argued for the type (71) with a definite:

(71) What / Which books do the students need?

The mark of cumulative readings is that they need to contain two semantically plural expressions capable of denoting groups, and they do not exhibit subject-object asymmetries characteristic of pair-list readings.

It is interesting to observe that the missing interpretation of (70) is perfectly natural in complement contexts (with non-intensional verbs):

(72) Tell me / I found out which book more than two students needed.
'Tell me / I found out about more than two students which book each needed'

This asymmetry can be explained as follows. Since they have no unique answer, choice questions must denote generalized quantifiers over normal questions, as argued in the literature. But the natural habitat of generalized quantifiers is the complement, i.e., argument position. They are not good denotations for matrix sentences. (This explanation is corroborated by data from another type of choice questions, question disjunctions, which exhibit the same matrix/complement contrasts.)

It follows now that only the treatment of complement interrogatives needs to accommodate indefinites. Matrix questions of the type Which book does every student need? can be interpreted analogously to Which student needs which book?, in the simplest domain restriction fashion, without invoking generalized quantifiers. This move is in fact beneficial for the characterization of the question/answer relation (a relation that is, again, irrelevant in the complement case).FN

[FN There are further, subtler arguments against the quantificational approach in Groenendijk & Stokhof (1984) and Chierchia (1993). The absence of pair-list readings with whether-complements has been discussed in Section 3. The issues of de dicto readings, quantificational variability, and the non-uniform behavior of quantifiers are discussed in Szabolcsi (1993).]

6. The exceptional unavailability of pair-list readings

Since our analysis treats the denotation of pair-list questions as quantifiers, we should expect the same scope interactions with other quantifiers in the sentence as in the case of quantified NPs. However, there are some differences which we briefly discuss in this section.

So far we have only discussed interrogatives in object position, and we have observed that in this position they can take scope over the subject. Interrogatives in object position, however, behave somewhat differently. Let us first look at subject interrogative clauses with universal quantifiers. Here we get pair-list readings as well as scope interactions with a quantifier in object position:

(73) Which book every student read was obvious to some professor or other.
'for every student, there is a possibly different professor to whom it is obvious which book the student read'

However, other quantifiers, for instance more than five students or exactly five students, do not allow for pair-list readings (74a), and hence for interaction with another quantifier (74b):

(74) a. Which book more than five students read was obvious to me.
* 'for more than five students, which book each read was obvious to me'
b. Which book more than five students read was obvious to some professor or other.
* 'for more than five students there is a possibly different professor to whom it was obvious which book the student read'

We suggest an explanation of these rather unexpected data. Following Koster (198?), we assume that sentential subjects are not in argument position (Spec of IP), but rather in topic position. Quantifiers are generally barred from topic position:

(75) a. John, Mary likes.

b.* Every boy, Mary likes.

Now if an interrogative is evaluated by quantifying in as defined in ..., it will denote a (layered) quantifier and should not be able to appear in topic position. Hence, as a general condition, quantifying-in will be impossible for "subject" interrogatives. This excludes both (73) and (74b).

But why then do universals as in (73) allow for pair-list readings? Here we invoke a result of the last section: universals can provide pair-list readings in another way, namely, by a domain restrictor interpretation. Thus we can say that the "subject" interrogative in (69) does not denote a quantifier, but rather a single question analogous to Which student read which book?.

The final question to answer is, why is then quantifier scope interaction with a QP in object position possible? We suggest is that this is simply due to an independently available distributive interpretation of the VP (cf. Link (1983), Roberts (1987), Moltmann (1992), as in (76):

(76) The children bought an ice cream.

For interrogatives, this means the following. A question with a domain restrictor is like a plural object: it has the questions about the individuals in the domain as its parts. When a VP is interpreted distributively, the property it expresses has to hold of every part of the group it is predicated of. In (73) then, every part of the (single) question denoted by which book every student read, that is, every question of the form 'which book a read' where a is a student, has the property 'was obvious to some professor or other.' Thus professors can vary with students.

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