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This paper proposes an analysis of embedded questions with quantifiers, where a quantified expression in the embedded question takes scope over an indefinite which c-commands it from the embedding clause, as illustrated below:

(1) **Some professor** found out [$_{CP}$ which woman **every student** dated]

(1) has a ∀∃-reading, where professors vary with students. This fact poses a problem for the theory of quantifier scope, for the following two reasons. First, it is genreally assumed that Quantifier Raising (QR) is clause-bounded. This claim is supported by examples such as (2)a, where [every professor] cannot take scope over the indefinite:

(2) a. **Some student** thought that **every professor** was crazy.
b. *[every professor][some student thought that t was crazy]

Secondly, it has has been claimed that questions cannot be quantified into. This claim is supported by the example in (3)a, which cannot be analyzed either as (3)b (with "long" QR) or as (3)d (with "short" QR):

(3) a. John wonders what no man should forget.
b. *[no man] [John wonders what t should forget]
c. $\forall x(man'(x) \rightarrow \neg wonder'(j, \lambda p \exists y[p = {}^\wedge forget'(x,y)]))$
d. *John wonders[[no man][what t should forget]]
e. $wonder'(j, \lambda p \forall x(man'(x) \rightarrow \neg \exists y[p = {}^\wedge forget'(x,y)]))$

The problem with (3)c is that it implies that for every man, John does not wonder what he should forget (which clearly is not the meaning of (3)a). The problem with (3)e is that the complement set of *wonder* admits false propositions (see Engdahl (1986) for further discussion).

I propose an anlysis of (1) which is consistent with these two claims. The analysis relies on the assumption that at LF, the embedded question which hosts the quantified expression (and not the quantified expression itself) has the option of QR-ing within the boundaries of its own clause, and adjoining to a position higher than the indefinite. In this I follow Szabolcsi & Moltmann (1994). My analysis differs from theirs in that it relies on the assumption that the embedded question contains a functional dependency (in the sense of Engdahl (1986), Groenendijk & Stokhof (1984), Chierchia (1991, 1993), and Dayal (1996)). When the embedded question is QR-ed, the resulting LF of (1) is (4), and the interpretation that is "read off" it is roughly as in (5):[1]

(4) [which woman$_j$ every student$_i$ dated t_j^i]$_j$ some professor found out t_j

(5) There is a function *f* which maps every student *x* to the question 'which woman did *x* date', and for every *x* in the domain of *f*, there is a professor *y* such that *y* found out the answer to the question 'which woman did *x* date'. (For example, *some professor found out which woman John dated and some profesor found out which woman Bill dated*).

This analysis is shown to be consistent with the standard assumptions regarding quantifier scope.

I begin by discussing Szabolcsi & Moltmann's (1994) solution to the problem, pointing out its strengths and weakensses.

1. A Layered Quantifier Analysis

Szabolcsi and Moltmann observe that (1) has both a ∃∀- and a ∀∃-reading. They paraphrase the ∃∀-reading as: "There is a professor who found out for every student *x*, which woman *x* dated"; and the ∀∃-reading as: "For every student *x*, there is a professor *y*, such that *y* found out which woman *x* dated."

Szabolcsi and Moltmann also observe that (6), where the quantifer in the embedded question is *no student*, and (7), where the embedded clause is a declarative, have a ∃∀-reading, but not a ∀∃-reading:

(6) **Some professor** found out [$_{CP}$ which woman **no student** dated] ∃∀, *∀∃

(7) **Some professor** found out [$_{CP}$ that **every student** dated his best friend's girlfriend] ∃∀, *∀∃

[1] A PWPL reviewer pointed out to me that the ∀∃-reading is somewhat marginal (and improves if *every* is replaced by *each*). I take this to be a dialectal difference, and do not discuss the *every/each* alternation here.

They note that the unavailability of a ∀∃-reading in (7) is consistent with the standard assumption that QR is clause-bounded, but they also note that this contrasts sharply with the availability of this reading in (1). They argue that Clause-boundedness should be maintained, and in order to account for the ∀∃-reading of (1), they propose what they call a "layered quantifier" analysis, according to which it is the entire embedded question which (locally) takes wide scope over the matrix clause (and, as a result, over the indefinite). In this case the embedded question denotes a generalized quantifier over individual questions:

(8) $\lambda R \forall x[\text{student}'(x) \rightarrow R(\text{which woman } y[x \text{ dated } y])]$

If the embedded question is locally QR-ed, it is interpreted as in (8), and when combined with the denotation of the matrix clause, yields the following:

(9) a. [which woman every student dated]$_j$ [some professor found out t_j]

b. $\lambda R \forall x[\text{student}'(x) \rightarrow R(\text{which woman } y[x \text{ dated } y])]$ $(\lambda v[\exists z[\text{professor}'(z) \ \&\ \text{find-out}'(z, v)]]) =$ $\forall x[\text{student}'(x) \rightarrow \exists z[\text{professor}'(z) \ \&\ \text{find-out}'(z, \text{which woman } y\ [x \text{ dated } y])]]$

Szabolcsi and Moltmann assume that an embedded question inherits the properties of the quantifier it hosts. This accounts for the absence of a ∀∃-reading in (6): We know that decreasing quantifers do not QR from object position (e.g., *some student hates no professor* does not have a ∀∃-reading). It follows that an embedded question which hosts such a quantifier cannot QR either.

The appeal of this proposal is that it preserves Clause-boundedness, and predicts that the set of quantified expressions which support such a reading is limited to those quantifiers which can QR from object position. It is less clear, however, why (7) does not give rise to the ∀∃-reading: If the embedded clause inherits the properties of the quantifier it hosts in principle, then the embedded clause in (7) should be able to QR, and be interpreted as a generalized quantifier over propositions. The authors are well aware of this problem, and explore several possible explanations, all of which require independent assumptions - some better motivated than others.

I would like to suggest a different approach to the problem, which takes into account a fact that Szabolcsi and Moltmann ignore. Recall that they claim that (1) has one ∃∀-reading. In point of fact, it has two ∃∀-readings: One reading is the pair-list reading, which asserts that a single professor found out that Student A dated Woman 1, Student B dated woman 2, etc. Let us call this reading the "pair-list ∃∀-reading" (and this is the reading that Szabolcsi and Moltmann consider). The other reading is the functional reading, which asserts that a single professor found out what the function which maps every student to the woman he dated is (say, *his best friend's girlfriend*). Let us call that reading the "functional ∃∀-reading". That these two readings are not simply variants of each other is demonstrated by the the fact that (6) lacks a pair-list ∃∀-reading, but does have a functional ∃∀-reading (e.g., "some professor found out that no student dated his best friend's girlfriend").

The approach I am proposing explores the possibility that there is a connection between the two ∃∀-readings available in (1), its ∀∃-reading, and the unavailability of a ∀∃-reading in (7). In other words, I claim that the ∀∃-reading is not obtained via a separate mechansim of layered quantification, but rather that the mechanism which interprets embedded questions in-situ, is the same one which interprets them in the QR-ed position. This mechanism cannot, *in principle*, apply to declaratives, because it relies on the presence of a functional dependency created by wh-movement. Therefore, (7) is predicted to lack a ∀∃-reading.

The goal of the proposed analysis, then, is to preserve Szabolcsi & Moltmann's (1994) predictions, but also to predict the three readings of (1), and the unavailability of a ∀∃-reading in (7). The core idea which is borrowed from their approach is that an embedded clause can undergo (local) QR at LF. The difference between the two approaches is that the current approach is based on functional approaches to constituent questions with quantifiers.

In section 2, I discuss the functional/pair-list distinction in matrix questions. In section 3, I show how the analysis of functional dependencies is applied to questions with quantifiers. Section 4 extends this analysis to the cases exemplified by (1), predicting its three-way ambiguity and the lack of a ∀∃-reading in (7).

2. Functional and Pair-List Questions

The literature on questions with quantifiers (e.g., Engdahl (1980, 1986), Groenendijk & Stokhof (1984), May (1985, 1988), Chierchia (1991, 1993), Dayal (1996), and Bittner (to appear)) recognizes that a matrix question such as (10) has (in addition to the individual reading, which does not concern us here), a "functional" reading and a "pair-list" reading:[2]

(10) Q: Which woman did every student date?
A: a. His roommate.
b. John, Mary; Bill, Sally...

There is no concensus in the literature as to whether the functional and pair-list readings are two distinct readings, or one is derived from the other. Here I adopt the position taken in, for example, Chierchia (1993) and Dayal (1996), where it is argued that functional and pair-list questions are distinct from each other, and furthermore, neither one is derived from the other. The empirical evidence which supports this view is the following: First, functional readings arise with almost any quantified expression, but pair-list readings typically arise with quantifiers such as *every-NP*, *each-NP*, definite NP's and names, but not with, for example, decreasing quantifiers. This is illustrated by (11), where the quantified expression is of the *no-NP* type. A functional answer is possible here, but a pair-list answer is not:

(11). Which woman did no student date?
a. His girlfriend.
b. *John, Mary; Bill, Sally.

(11) shows that quantifiers such as *no-NP* participate in functional readings but not in pair-list readings. The reader can verify that the same is true of, for example, *most-NP*, *few-NP* and *almost-every/almost-no-NP*.

Secondly, functional and pair/list questions display different uniqueness effects (see Groenendijk & Stokhof (1984)). For example, *his roommate* can be a felicitous answer to (10) even if some student or other dated another woman in addition to his roommate. But *John dated Sally and Bill dated Mary* is not a felicitous answer to (10), in a situation where, say, John dated two women.

A theory of questions which treats functional questions as distinct from pair-list questions can account for both these differences. The Chierchia-

[2] As most authors note, the individual reading can be seen as a case of the functional reading. Thus, *which woman does John love* can be viewed as asking about the function which maps John to the woman he loves.

Dayal approach is one example. They capture the functional/pair-list distinction by assuming that both questions involve functions from individuals to individuals, but that the functional question involves a "natural" function (such as 'mother-of', 'sister-of', etc.), and the pair-list question involves a list of arbitrary pairs.[3]

Following ideas in Groenendijk & Stokhof (1984), and in Engdahl (1986), both Chierchia and Dayal assume that a question such as (10) involves a functional dependency: the wh-phrase binds a doubly indexed trace (which carries a function index - the subscript "f" and an argument index - the superscript "a"). The function index is bound by the wh-phrase (*which woman*) and the argument index is bound by the quantified expression (*every student*):

(12) which woman_f did every student_a date t_f^a

The functional trace is interpreted as $f(x)$, where f is a function from individuals to individuals, and x is an individual, yielding the following interpretation for (12):

(13) What is the function f such that every student_x dated $f(x)$?

The functional answer to this question provides the "name" of a function (as in (10)a). The pair-list answer provides the extension of some function (as in (10)b).

The syntactic motivation behind this analysis is that it predicts a subject/object asymmetry in both functional and pair-list questions. (14), which does not have either a functional or a pair-list reading, illustrates this point:

(14) Which woman dated every student?
  a. *His girlfriend.
  b. *Mary dated John and Sally dated Bill.

Chierchia argues that while the trace of *which woman* is, like any wh-trace, governed by Principle C of the Binding Theory, it contains a pronominal element (i.e., the argument variable), governed by the principles that govern

[3]See Chierchia (1993) and Bittner (to appear) for discussion of the formal distinction between natural functions and pair-lists.

pronouns (in particular, Weak Crossover).[4] This implies that in order for either the functional or pair-list reading to come about, it is necessary that the trace of the wh-phrase be in the scope of the quantified expression at s-structure (as is indeed the case in (12)). Otherwise, neither one of these readings is possible, (as is the case in (14), whose structure is given below):

(15) Which woman_f t_f^a dated every student_a?
LF: $[\text{which woman}]_f$ $[\text{every student}]_a$ t_f^a dated t_a

Neither (14)a nor (14)b are possible answers to (15), because (15) contains a WCO violation.

The subject/object asymmetry, then, is the syntactic motivation for positing a functional dependency in questions with quantifiers. The next section discusses the assumptions underlying the semantic analysis of these questions.

3. The Analysis of Functional/Pair-List Questions

The analysis of questions assumed here consists of three major assumptions: (1) That a well-formed answer to a question is derived by applying the Answerhood operator to the question denotation; (2) That questions with quantifiers involve quantification over functions, introduced by a set of type-shifting operations; and (3) That the question complementizer has more than one lexical meaning. The particular meaning selected in a given question may trigger either standard or non-standard QR.

3.1. Uniqueness Effects in Constituent Questions

According to the classical Hamblin-Karttunen approach to questions (Hamblin (1973), Karttunen (1977)), every constituent question comes with an existence presupposition (see Comorovski (1989) for discussion). For example, *which man came to the party?* presupposes the existence of a man who came to the party. The question itself denotes a set of propositions (which is the set of

[4]See May (1985, 1988) for an alternative approach, based on Pesetsky's (1982) Path Containment Condition. See also Chierchia (1991, 1993), Dayal (1996) , and Sharvit (1997) for arguments against the Path Containment analysis.

possible answers).[5] The existence presupposition is "built into" the question denotation, as follows:

(16) $\lambda p \exists x[\text{man}'(x) \ \& \ p = {}^\wedge\text{come-to-the party}'(x)]$

In Dayal (1996), it is argued that in addition to the existence presupposition, a constituent question comes with a uniqueness/maximality presupposition (see Rullmann (1995) for a related approach). *Which man came to the party?* presupposes the existence of a unique man who came to the party. If more than one man came to the party, the presupposition has to be rejected (a question/answer pair consistent with the presupposition that more than one man came is, for example, *which men came to the party*? *John and Bill*). In addition, a question with a quantifier in subject position and a wh-phrase in object position presupposes that the answer will exhaustively pair each member of the subject term with the unique/maximal relevant member of the object term (see Comorovski (1989)).

Satisfaction of the Maximality principle, according to Dayal, is imposed by the Answerhood operation, which applies to a question denotation and yields the maximal true answer:

(17) $\text{Ans}(\lambda p[\ldots.p\ldots.]) = \iota p'[{}^\vee p' \ \& \ \lambda p[\ldots p\ldots](p') \ \& \ \forall p''[({}^\vee p'' \ \& \ \lambda p[\ldots p\ldots](p'')) \rightarrow p' \subseteq p'']]$

According to (17), a well-formed answer to *which man came to the party*, can be, for example, *Bill came*, which is picked out of the set: {Bill came; John came; Fred came;...}. A well-formed answer to *which men came* (where the wh-phrase contains a plural term), is predicted by Answerhood to list *all* the men that came to the party. A well formed answer to the question *which women does every man like* must list for every man, *all* the women that he likes (satisfying both Maximality and Exhaustivity).

The Answerhood operator plays an important role in Dayal's analysis of embedded questions, which builds on Berman (1991) and Lahiri (1991). According to this view, a question embedded under a verb such as *know* or *find out* is interpreted as the unique/maximal true proposition which is the

[5] According to Karttunen, a question denotes the set of *true* answers. As will be seen shortly, this is captured by the Answerhood operation applied to the Hamblin-type question denotation (i.e., the set of all possible answers).

answer to the question. For example, *John knows which man came to the party* means "John knows the answer to the question 'which man came to the party?'":

(18) $know'(j, Ans(\lambda p \exists x[man'(x) \ \& \ p = {}^\wedge come\text{-}to\text{-}the\text{-}party'(x)]))$

In the spirit of this anlaysis, I will assume that if an embedded question moves, it leaves behind a trace which is interpreted as Ans(Q) - where *Q* is a variable of type $<<s,t>,t>$ (i.e., a set of propositions). For example, a question such as *what did John find out*, where the complement of *find out* is a trace, can be interpreted as follows:

(19) a. What did John find out t
b. $\lambda p \exists Q[find\text{-}out'(j, Ans(Q))]$
Roughly: What is the question that John found out the answer to?

The assumption that Answerhood applies to a question denotation is, of course, a general assumption about questions (and not about functional or pair-list questions in particular). The next two sections are concerned with the interpretation of functional/pair-list questions.

3.2. Type Shifting Operations

Beginning with Engdahl (1986) and Groenendijk & Stokhof (1984), all analyses of functional questions, and related analyses of functional relative clauses (e.g., von Stechow (1990) and Jacobson (1994)) assume some kind of type-shifting mechanism which turns an expression which denotes a property of individuals (such as *woman*) into a property of functions from individuals to individuals:

(20) $woman' \rightarrow \lambda f \forall x(x \in Dom(f) \rightarrow woman'(f(x)))$

This operation takes an expression of type $<e,t>$, and turns it into an expression of type $<<e,e>,t>$. As we shall see in 3.3, the existence of this type shifting operation is what triggers existential quantification over functions in questions such as *which woman did every student date*.

Generalizing this operation to other semantic types yields a type-shifting mechanism which takes any expression of the general type $<X,t>$

(where X can be of any semantic type), and turns it into an expression of type $<<e,X>,t>$. This general operation is given below:

(21) $\lambda P \lambda h[\forall x(x \in Dom(h) \rightarrow P(h(x)))]$, where P is of type $<X,t>$, and h is of type $<e,X>$.

If $X=e$, then P is of type $<e,t>$ (e.g., woman'), and h is of type $<e,e>$. This is the case in (20), where the operation yields a property of functions from individuals to individuals. But X can have other values. In particular, if $X=<<s,t>,t>$ (i.e., a set of propositions), then P is of type $<<<s,t>,t>,t>$, and h is of type $<<e,<<s,t>,t>>$ (i.e., a function from individuals to sets of propositions - or from individuals to questions). We will use this particular instance of the general type-shifting operation in the analysis of embedded questions.

The second type-shifting mechanism which we will make use of takes a function of the general type $<e,X>$ and turns it into a function from possible domains (type $<e,t>$) to $<e,X>$-type functions:

(22) $\lambda h' \lambda P \iota h[Dom(h)=P \ \& \ \forall x(x \in Dom(h) \rightarrow h(x)=h'(x))]$

For example, (22) can take a function of type $<e,e>$ (such as the 'mother-of' function) and turn it into a function from possible domains to $<e,e>$-type functions:[6]

(23) mother-of'
$\lambda x \iota y[\text{mother-of-x}'(y)]$ (Type: $<e,e>$)

(24) $\lambda P \iota h[Dom(h)=P \ \& \ \forall x(x \in Dom(h) \rightarrow h(x)=\iota y[\text{mother-of-x}'(y)])]$ (Type: $<<e,t>,<e,e>>$)

(24) denotes a function which maps the set of men to the function from men to their mothers, the set of women to the function from women to their mothers, etc.

But (22) can also take a function from individuals to questions (i.e.,

[6] This type-shifting operation is introduced and motivated in Sharvit (1997), where it is claimed that "natural" functions are, in fact, of type $<<e,t>,<e,e>>$, and that pair-list functions are of type $<e,e>$. Space limitations prevent me from going into the motivation for this operation.

a function of type <e,<<s,t>,t>>) and turn it into a function from possible domains to functions from individuals to questions. For example, if we take a function which maps every individual to the question "who does he love", then (22) turns this into a function which maps the set of men to the function which maps them to the relevant question, the set of women to the function which maps them to the relevant question, etc. It is this instance of (22) which will be relevant to us in the analysis of embedded questions with quantifiers.

3.3. Ambiguous Comp and Two Types of QR

According to what has become by now an assumption common to many theories of questions, the +wh-Comp in a question introduces a variable of type <s,t> (i.e., a proposition) and the wh-phrase introduces an existential quantifier which binds an individual variable. Accordingly, (25) is interpreted as in (26):

(25) [who] [Comp [t left]]

(26) $\lambda p \exists x[p = {}^\wedge leave'(x)]$

The discussion of functional and pair-list questions has led some authors to propose that either [who] or Comp (or both) can also introduce existential quantification over functional variables. In particular, Dayal (1996) proposes that Comp displays a lexical ambiguity, and that the functional/pair-list ambiguity of, say, *which woman does every man love* is due to a lexical ambiguity of Comp. Pursuing this idea, I adopt the translation that Dayal assumes for "pair-list" Comp, but I use a different translation for "natural function" Comp. I assume that in a question that contains a functional dependency, Comp is translated as one of the following expressions:

(27) $\lambda F \lambda F' \exists f[f \in G \;\&\; {}^\vee F'(f) \;\&\; p = {}^\wedge{}^\vee F(f)]$

(28) $\lambda K \lambda P \lambda F \exists f[Dom(f) = P \;\&\; F(f) \;\&\; p = \cap \lambda p' \exists y[P(y) \;\&\; p' = {}^\wedge{}^\vee K(f, y)]]$

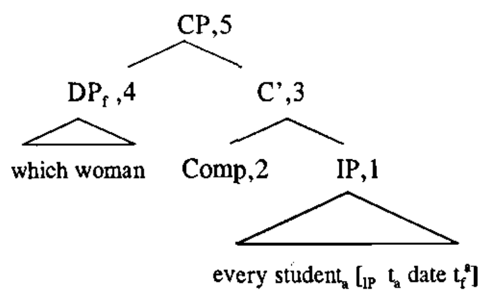
The first meaning of Comp is the one which yields the natural function reading of *which woman does every man love*. It is an expression which takes two properties of functions (*F* and *F'*) and yields an expression which existentially quantifies over functions which belong to the contextually restricted set *G* (the set of salient natural functions - 'mother-of', 'sister-of', etc.). A well-formed answer is, for example, *every man loves his mother*.

The expression in (28) (Dayal (1996), with minor modifications), is the meaning of Comp that yields the pair-list reading of *which woman does every man love*. This expression is designed to account for the fact that a well-formed answer to a pair-list question is an exhaustive "list" of propositions (for example: *John loves Mary; Bill loves Sally; and Tom loves Susan*). It does so by introducing a function whose domain is fixed by the variable *P*, and by intersecting the propositions obtained for each member of *P*. Fixing the value for the domain of the function is done by extracting a set out of the quantified expression. This requires that the quantified expression (in this case, *every man*) move to a position where its meaning (or its derived meaning - the set that is extracted out of it) can combine directly with the meaning of Comp.

This leads us to posit two types of QR: (a) standard QR - the familiar QR which results in adjunction to IP. This operation takes place if (27) is selected as the meaning of Comp, and the meaning of the quantifier does not combine directly with (27); (b) non-standard QR, which results in adjunction to a position higher than Comp. This operation takes place if (28) is selected as the meaning of Comp, and the derived meaning of the quantifier combines directly with (28).

We now turn to the actual derivations. The full derivation of the natural function reading of *which woman did every student date* is given below:

(29) a.



b. $[\text{Comp}] = \lambda F \lambda F' \exists f[f \in G \ \& \ {}^{\vee}F'(f) \ \& \ p = {}^{\wedge\vee}F(f)]$, and standard QR applies to [every student]

c. 1. $\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))$

1'. $\lambda f[\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))]$

2. $\lambda F \lambda F' \exists f[f \in G \ \& \ {}^{\vee}F'(f) \ \& \ p = {}^{\wedge\vee}F(f)]$

(by (27))

3. $\lambda F \lambda F' \exists f[f \in G \ \& \ {}^{\vee}F'(f) \ \& \ p = {}^{\wedge\vee}F(f)]$
$({}^{\wedge}\lambda f[\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))])$
$\Rightarrow \lambda F' \exists f[f \in G \ \& \ {}^{\vee}F'(f) \ \&$
$p = {}^{\wedge}\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))]$

4. woman'

4.' $\lambda f[\forall x(x \in \text{Dom}(f) \rightarrow \text{woman}'(f(x)))]$
(by (20), (21))

5. $\lambda F' \exists f[f \in G \ \& \ {}^{\vee}F'(f) \ \& \ p = {}^{\wedge}\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))]({}^{\wedge}\lambda f[\forall x(x \in \text{Dom}(f) \rightarrow \text{woman}'(f(x)))])$
$\Rightarrow \exists f[f \in G \ \& \ \forall x(x \in \text{Dom}(f) \rightarrow \text{woman}'(f(x)))$
$\& \ p = {}^{\wedge}\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))]$

5'. $\lambda p \exists f[f \in G \ \& \ \forall x(x \in \text{Dom}(f) \rightarrow \text{woman}'(f(x)))$
$\& \ p = {}^{\wedge}\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))]$

Let us briefly go through the derivation. Node #1 is translated as the proposition in Line #1, and in Line #1' *f* is abstracted over, to yield a property of functions. Node #2 is translated as "natural function" Comp, and it takes Line #1' as its argument. Node #4 is interpreted, via (20), as a property of functions (I assume, with Dayal (1995) that the basic translation of [which woman] is simply woman'). This expression serves as the second property required by [Comp] (to fix the range of the function), yielding the expression in Line #5. Abstracting over *p* in Line #5' yields a set of propositions, which contains quantification over the the salient "natural" functions which are restricted by the free variable.

It is important to note that the domain of the function in Line #5 is not specified, but rather determined pragmatically. As the following example shows, this domain need not be restricted to the set of men:

(30) Q: Which woman does every professor love?
A: The woman that every student hates (namely, his mother).

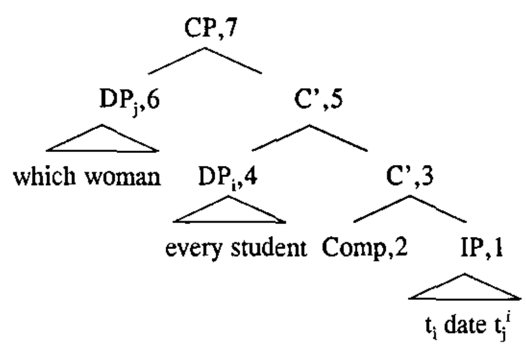
If the domain were restricted by the quantified expression, the answer in (30) would be impossible. On the other hand, in some cases the quantified expression does determine the value of the domain, as the following example (due to a PWPL reviewer) shows:

(31) Q: Which woman did every male student bring to the party?
A: *His spouse.*

The 'spouse' function is allowed, even though it is not a uniformly woman-valued function. In this case, the domain of the function is pragmatically restricted to (married) males (but not necessarily to male students). We conclude from this discussion, that although the domain of the function need not always be constrained by the quantified expression, it may sometimes be, depending on the context.

Let us now turn to the derivation of the pair-list reading of *which woman did every student date*. This reading comes about when (28) is selected as the meaning of Comp, triggering non-standard QR, which adjoins the quantified expression to C'. This is done in order to fix the domain of the function. Building on various ideas in Groenendijk & Stokhof (1984), Chierchia (1993), Szabolcsi (1993), and Dayal (1996), let us assume that the domain is determined as the unique minimal witness set (UMWS) of the quantified expression. According to Barwise & Cooper (1981), a witness set is a subset of the common noun in a generalized quantifier, which is a member of the quantifier. A minimal witness set does not have subsets that are also witness sets. So, for example, the UMWS set of [every man] is the set of men. As Dayal proposes, by adjoining the quantified expression to a position higher than C', we can "feed in" its extracted UMWS into the meaning of Comp. This non-standared (though local) QR is the syntactic operation which enables the domain of the function in a pair-list question to receive its value. The full derivation is given below (where 'ιW(QP)' stands for the UMWS of QP):

(32) a.



b. [Comp] = $\lambda K \lambda P \lambda F \exists f[Dom(f)=P$ & $F(f)$ & $p = \cap \lambda p' \exists y[P(y)$ & $p = {}^{\wedge\vee}K(f, y)]]$, and non-standard QR applies to [every student].

c.

1. $date'(x, f(x))$

1'. $\lambda x \lambda f[date'(x, f(x))]$

2. $\lambda K \lambda P \lambda F \exists f[Dom(f)=P \;\&\; F(f) \;\&\; p = \cap \lambda p' \exists y[P(y) \;\&\; p = {}^{\wedge\vee}K(f, y)]]$ (by (28))

3. $\lambda K \lambda P \lambda F \exists f[Dom(f)=P \;\&\; F(f) \;\&\; p = \cap \lambda p' \exists y[P(y) \;\&\; p' = {}^{\wedge\vee}K(f, y)]]({}^{\wedge}\lambda x \lambda f[date'(x, f(x))])$
$\Rightarrow \lambda P \lambda F \exists f[Dom(f)=P \;\&\; F(f) \;\&\; p = \cap \lambda p' \exists y[P(y) \;\&\; p' = {}^{\wedge}date'(y, f(y))]]$

4. $\iota W[\lambda P \forall x(student'(x) \rightarrow P(x))]$
$\Rightarrow$ student'

5. $\lambda P \lambda F \exists f[Dom(f)=P \;\&\; F(f) \;\&\; p = \cap \lambda p' \exists y[P(y) \;\&\; p' = {}^{\wedge}date'(y, f(y))]](student')$
$\Rightarrow \lambda F \exists f[Dom(f)=student' \;\&\; F(f) \;\&\; p = \cap \lambda p' \exists y[student'(y) \;\&\; p' = {}^{\wedge}date'(y, f(y))]]$

6. woman'

6'. $\lambda f[\forall x(x \in Dom(f) \rightarrow woman'(f(x)))]$ (by (21))

7. $\lambda F \exists f[Dom(f)=student' \;\&\; F(f) \;\&\; p = \cap \lambda p' \exists y[student'(y) \;\&\; p' = {}^{\wedge}date'(y, f(y))]](\lambda f[\forall x(x \in Dom(f) \rightarrow woman'(f(x)))])$
$\Rightarrow \exists f[Dom(f)=student' \;\&\; \forall x(x \in Dom(f) \rightarrow woman'(f(x))) \;\&\; p = \cap \lambda p' \exists y[student'(y) \;\&\; p' = {}^{\wedge}date'(y, f(y))]]$

7'. $\lambda p \exists f[Dom(f)=student' \;\&\; \forall x(x \in Dom(f) \rightarrow woman'(f(x))) \;\&\; p = \cap \lambda p' \exists y[student'(y) \;\&\; p' = {}^{\wedge}date'(y, f(y))]]$

Node #1 is interpreted as a relation between individuals and $<e,e>$-type functions (Line #1'). Node #2 is interpreted as "pair-list" Comp, which needs a relation, a property of individuals (to fix the domain of the function), and a property of functions (to fix its range). The relation is supplied by Node #1.

The UMWS of *every man* (i.e., the set of men) fixes the domain of the function (Line #5). Node #6 fixes the range (Line #7). The variable p is abstracted over at the CP-level, to yield a set of propositions.

Dayal's analysis of pair-list Comp is an extension of Chierchia's (1993) Absorption mechanism, which derives similar results without moving the quantified expression. The difference between Chierchia's semantics for pair-list readings and Dayal's is that each answer in the latter spells out the graph of a function. So if John and Bill are the men in the domain, and Mary and Sally are the women, Chierchia has {{John loves Mary, John loves Sally, Bill loves Mary, Bill loves Sally}} as the denotation of the question. A possible answer is the conjunction of a subset of this set (with the result that Uniqueness and Exhuastivity are not predicted). For Dayal, the question denotation is as above. A possible answer is picked out of this set by the Answerhood operation (with the result that both Uniqueness and Exhaustivity are predicted).

The two possible readings of *which woman did every student date* are repeated below:

(33) **Functional interpretation:**

a. $\lambda p \exists f[f \in G \ \& \ \forall x(\text{woman}'(f(x))) \ \& \ p = {}^\wedge \forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))]$

b. "What is the woman-valued function f such that every student x dated $f(x)$?"

c. Possible answers: Every student dated his girlfriend; Every student dated his roommate; Every student dated his favorite neighbor; etc.

(34) **Pair-list interpretation:**

a. $\lambda p \exists f[\text{Dom}(f) = \text{student}' \ \& \ \forall x(\text{student}'(x) \rightarrow \text{woman}'(f(x))) \ \& \ p = \cap \lambda p'[\exists y(\text{student}'(y) \ \& \ p' = {}^\wedge \text{date}'(y, f(y)))]]$

b. "What is the woman-valued function f, whose domain is the set of students, and for every x in the domain of f, x dated $f(x)$?"

c. Possible answers: John dated Mary and Bill dated Sally; John dated Mary and Bill dated Mary; John dated Sally and Bill dated Mary; John dated Sally and Bill dated Sally.

What emerges from this analysis is that (a) a funtional question involves quantification over natural functions (i.e., contextually salient functions such as 'mother-of', 'sister of', etc), whereas a pair-list question involves quantification over sets of arbitrary pairs; (b) the domain of a natural function is determined pragmatically, whereas the domain of a pair-list function is determined semantically (by UMWS extraction).[7]

The different properties of natural and pair-list functions account for the two differences between functional and pair-list questions discussed in section 2. First, notice that we predict the following uniqueness effect: applying the Answerhood operation to (33)a yields the unique/maximal relevant propsition. For example, *every student dated his girlfriend*. This answer is felicitous even if some student or other dated another woman besides his girlfriend. As long as the function which maps that student to the other woman he dated is not in the set *G*, there is no danger of violating the uniqueness requirement imposed by Answerhood.

Applying Answerhood to (34)a also yields the relevant unique proposition, for example: *John dated Mary and Bill dated Sally*. But this answer cannot be felicitous in a situation where John dated some other woman, because the above proposition will fail to be unique.

Secondly, notice that the assumption that the domain of a pair-list function is fixed as the UMWS set of the quantified expression predicts that only quantified expressions which have a UMWS can support pair-list questions: *every man*, *each man*, *the man*, *John*, etc. Any quantifier which does not have a UMWS (e.g., *most men*, *three men*, *few men*) do not support pair-list questions (*no man* has the empty set as its UMWS, but can be ruled out on pragmatic grounds). This prediction is largely borne out, as the following example shows:

(35) Which woman do most men love?
  a. Their mother.
  b. *John, Mary; Bill Sally.

---

[7] The analysis is also applied to wh-phrases which contain an anaphoric or pronominal element which is interpreted as bound by the quantifier (see above references for details):

(1) Which woman that **he** liked did **every man/no man** see?

(2) $\lambda p \exists f[\forall x(x \in Dom(f) \rightarrow woman'(f(x)) \ \& \ like'(x, f(x))) \ \& \ \forall x(man'(x) \rightarrow see'(x, f(x)))]$

(3) $\lambda p \exists f[\forall x(x \in Dom(f) \rightarrow woman'(f(x)) \ \& \ like'(x, f(x))) \ \& \ \forall x(man'(x) \rightarrow \neg see'(x, f(x)))]$

While *their mother* is a good answer to (35), the pair-list answer is not. The same is true for *few-NP*, *almost-no-NP*, *almost-every-NP*, etc.

Recall that quantifying into questions is disallowed (see (3) and the discussion following it). For functional questions, this is predicted by the analysis in (29), because [every student] does not move past the question operator. However, the analysis of pair-list questions assumes that the quantified expression moves to a position higher than Comp. This amounts to quantifying-in, and may pose a problem. But as Chierchia (1993) claims, Absorption (and, by extension, non-standard QR) is a special kind of quantifying into questions, which is highly restricted, and where the quantified expression does not combine directly with the rest of the sentence (rather it is the witness set extracted from it which combines with the rest of the sentence). The result is that we maintain the prediction that (3)c and (3)e are not possible readings of (3)a.

We can now return to the issue of embedded questions (as in *some professor knows which woman every student dated*) . We will argue that the ∀∃-reading is triggered by the functional dependency in the embedded question. But before turning to to the actual analysis, let us go over the basic assumptions:

A. Answerhood applies to a question denotation to yield the unique/maximal true proposition (section 3.1);

B. Functional and pair-list questions involve functional dependencies. In a pair-list question, the domain of the function is determined as the UMWS of the quantified expression;

C. There is a type-shifting operation which turns an expression of type $<X,t>$ into an expression of type $<<e,X>,t>$ (section 3.2);

D. There is a type-shifting operation which turns an expression of type $<e,X>$ into an expression of type $<<e,t>,<e,X>>$ (section 3.2).

4. Embedded Questions

The goal of this section is to account for the three-way ambiguity of sentences such as (1), repeated here:

(36) Some professor found out [which woman every student dated].

Our analysis predicts the following readings:

(37) **Functional ∃∀-reading:**
Some professor found out the answer to the functional question 'which woman every student dated'.

(38) **Pair-list ∃∀-reading:**
Some professor found out the answer to the pair-list question 'which woman every student dated'.

(39) ∀∃-reading:
For every student x there is a professor y such that y found out the answer to the question 'which woman x dated'.

4.1. ∃∀-Readings

Readings (37) and (38) are obtained by applying the Answerhood operator *directly to the denotation of the embedded question in-situ:*

(40) a. Some professor found out [Ans(functional "which woman every student dated")].

b. $\exists y[\text{professor}'(y)\ \&\ \text{find-out}'(y, \text{Ans}(\lambda p \exists f[f \in G\ \&\ \forall x(\text{woman}'(f(x)))\ \&\ p = {}^{\wedge}\forall x(\text{student}'(x) \rightarrow \text{date}'(x, f(x)))]))]$

(41) a. Some professor found out [Ans(pair-list "which woman every student dated")]

b. $\exists y[\text{professor}'(y)\ \&\ \text{find-out}'(y, \text{Ans}(\lambda p \exists f[\text{Dom}(f) = \text{student}'\ \&\ \forall x(\text{student}'(x) \rightarrow \text{woman}'(f(x)))\ \&\ p = \cap\lambda p'[\exists y(\text{student}'(y)\ \&\ p' = {}^{\wedge}\text{date}'(y, f(y)))]]))]$

As we have seen before, the pair-list reading involves extracting a UMWS out of the quantified expression. Such is the case in (41), which contains an embedded pair-list question. We therefore predict the pair-list ∃∀-reading not to be available in *some professor found out which woman no student dated* (and as the reader can verify, also with other quantified expressions which do not have unique minimal witness sets). However, the functional ∃∀-reading (which does not involve extracting a unique minimal witness set) is available with *no student*, *most students*, *few students*, *almost-every/no-student*, etc. For example, *some professor found out which woman almost no student dated*, can imply, under this reading "some professor found out that almost no student dated his best friend's girlfriend".

4.2. The ∀∃-Reading

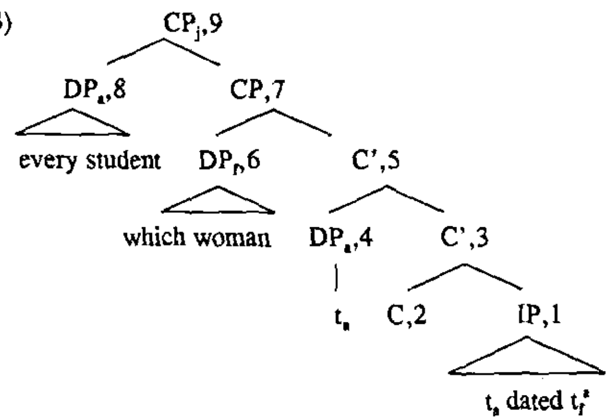
In order to account for the ∀∃-reading, I follow Szabolcsi & Moltmann (1994) in assuming that an embedded question which contains a quantified expression inherits its properties, and can optionally move by standard QR:

(42) [which woman every student dated] [some professor found out t]

In addition, I assume that the trace of the embedded question is interpreted as Ans(Q). The intuitive idea behind this proposal is that the raised question is interpreted as a function from students to questions, and that the IP (namely, [some professor found out t]) is interpreted as a predicate of functions from individuals to questions. The IP denotation is predicated of the raised question denotation.

Suppose we interpret the raised question as a pair-list question. Recall from section 3.3, that a pair-list reading involves moving *every student* to a position higher than C' (see (32)). Let us assume that (43) is the structure of the raised pair-list question:

(43)



Since this is the pair-list interpretation, we must assume that Comp is interpreted as "pair-list" Comp (i.e., as in the corresponding (32)). But notice a difference between (43) and the corresponding (32): Here *every student* is adjoined to C', and then to CP, leaving behind a trace. In other words, instead of assuming one local movement of the quantified expression (as in the matrix question case), in the embedded question case I assume that two movements take place within the same local domain. Each one of these movements results in fixing the domain of a function. Following is the full derivation of (43):

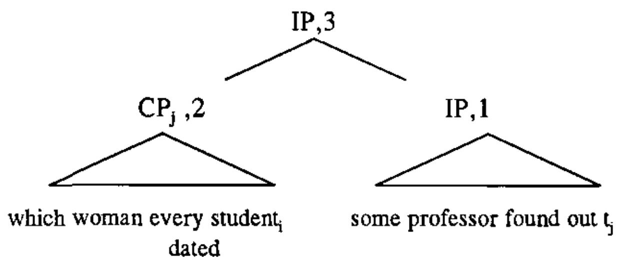
(44)
1. $\text{date}'(y, f(y))$
1'. $\lambda y \lambda f[\text{date}'(y, f(y))]$
2. $\lambda K \lambda P \lambda F \exists f[\text{Dom}(f)=P \ \& \ F(f) \ \& \ p=\cap\lambda p' \exists y[P(y) \ \& \ p'={}^{\wedge\vee}K(f, y)]]$
3. $\lambda K \lambda P \lambda F \exists f[\text{Dom}(f)=P \ \& \ F(f) \ \& \ p=\cap\lambda p' \exists y[P(y) \ \& \ p'={}^{\wedge\vee}K(f, y)]]({}^{\wedge}\lambda y \lambda f[\text{date}'(y, f(y))])$
   $\Rightarrow \lambda P \lambda F \exists f[\text{Dom}(f)=P \ \& \ F(f) \ \& \ p=\cap\lambda p' \exists y[P(y) \ \& \ p'={}^{\wedge}\text{date}'(y, f(y))]]$
4. x
4'. $\lambda y[y=x]$
5. $\lambda F \exists f[\text{Dom}(f)=\lambda y[y=x] \ \& \ F(f) \ \& \ p=\cap\lambda p' \exists y[y=x \ \& \ p'={}^{\wedge}\text{date}'(y, f(y))]]$
6. woman'
6'. $\lambda f[\forall x(x\in \text{Dom}(f) \rightarrow \text{woman}'(f(x)))]$
   (by (21))
7. $\lambda F \exists f[\text{Dom}(f)=\lambda y[y=x] \ \& \ F(f) \ \& \ p=\cap\lambda p' \exists y[y=x \ \& \ p'= {}^{\wedge}\text{date}'(y, f(y))]](\lambda f[\forall x(x\in \text{Dom}(f) \rightarrow \text{woman}'(f(x)))])$
   $\Rightarrow \exists f[\text{Dom}(f)=\lambda y[y=x] \ \& \ \forall x(x\in \text{Dom}(f) \rightarrow \text{woman}'(f(x))) \ \& \ p=\cap\lambda p' \exists y[y=x \ \& \ p'={}^{\wedge}\text{date}'(y, f(y))]]$
   $\Rightarrow \exists z[\text{woman}'(z) \ \& \ p={}^{\wedge}\text{date}'(x, z)]$
7'. $\lambda x \lambda p \exists z[\text{woman}'(z) \ \& \ p={}^{\wedge}\text{date}'(x, z)]$
7". $\lambda P \iota k[\text{Dom}(k)=P \ \& \ \forall x(x\in \text{Dom}(k) \rightarrow k(x)=\lambda p \exists z[\text{woman}'(z) \ \& \ p={}^{\wedge}\text{date}'(x, z)])]$
   (by (22))
8. $\iota \hat{W}(\lambda P[\forall x(\text{student}'(x) \rightarrow P(x))])$
   $\Rightarrow \text{student}'$
9. $\lambda P \iota k[\text{Dom}(k)=P \ \& \ \forall x(x\in \text{Dom}(k) \rightarrow k(x)=\lambda p \exists z[\text{woman}'(z) \ \& \ p={}^{\wedge}\text{date}'(x, z)])](\text{student}')$
   $\Rightarrow \iota k[\text{Dom}(k)=\text{student}' \ \& \ \forall x(x\in \text{Dom}(k) \rightarrow k(x)=\lambda p \exists z[\text{woman}'(z) \ \& \ p={}^{\wedge}\text{date}'(x, z)])]$

Node #1 denotes a proposition. The variables *y* and *f* are abstracted over, yielding a relation which is of the right type to combine with the Comp denotation in Node #2. Node #4 is interpreted as a singleton set, which fixes the domain of the function introduced by Comp. Node #6 fixes the range of that function. Turning to Line #7, it asserts the existence of a function whose domain is a singleton set, and whose range is a woman, and the single member of the domain dated a member of the range. It follows, therefore, that there exists a woman that the individual denoted by *x* dated. This expression contains two free variables (x and p) which are abstracted over to yield a function from individuals to sets of propositions (i.e., from individuals to questions). In order for this expression to be able to combine with *every student,* we apply the type-shifting operator in (22) to yield a function from possible domains to functions of the same type. This expression combines with the UMWS of *every student*, yielding a function from students to questions.

Notice that the transition from Line #7 and Line #7', and then to 7", are the crucial steps here. These are the steps which enable us to build a function from individuals to questions. Without having a free individual variable in Line #7, this step would be impossible, and the reading would be predicted not to exist.[8]

Now, (43) is a subtree which represents the moved constituent in *some professor found out which woman every student dated.* The meaning of this subtree can now combine with the rest of the sentence:

(45)



The trace of the moved embedded question is interpreted as Ans(Q), in accordance with the assumptions in Section 3.1, so that the full IP is

[8] These two movements cannot take place in a matrix question, because of an independent principle requiring a matrix CP to denote a proposition or a set of propositions.

interpreted as: "some professor found out Ans(Q)". By abstracting over Q, we get a property of questions (i.e., λQ[some professor found out Ans(Q)]). This expression cannot combine with the denotation of the moved CP (which is a function from individuals to questions). In order to combine the two, we need to apply the type shifting operation in (21) to the IP denotation, to yield a set of functions from individuals to questions:

(46) $\lambda Q[\ldots.\mathrm{Ans}(Q)\ldots] \rightarrow \lambda k[\forall x(x \in \mathrm{Dom}(k) \rightarrow \lambda Q[\ldots\mathrm{Ans}(Q)..](k(x)))]$

The full derivation of *some professor found out which woman every student dated* is given below:

(47)
1. $\exists y[\mathrm{professor}'(y)\ \&\ \mathrm{find\text{-}out}'(y, \mathrm{Ans}(Q))]$
1'. $\lambda Q\exists y[\mathrm{professor}'(y)\ \&\ \mathrm{find\text{-}out}'(y, \mathrm{Ans}(Q))]$
1". $\lambda k[\forall x(x \in \mathrm{Dom}(k) \rightarrow \exists y[\mathrm{professor}'(y)\ \&\ \mathrm{find\text{-}out}'(y, \mathrm{Ans}(k(x)))])]$ **(by (46))**
2. $\iota k[\mathrm{Dom}(k)=\mathrm{student}'\ \&\ \forall x(x \in \mathrm{Dom}(k) \rightarrow k(x)=\lambda p\exists z[\mathrm{woman}'(z)\ \&\ p={}^\wedge\mathrm{date}'(x, z)])]$
(Line #9 in (44))
3. $\lambda k[\forall x(x \in \mathrm{Dom}(k) \rightarrow \exists y[\mathrm{professor}'(y)\ \&\ \mathrm{find\text{-}out}'(y, \mathrm{Ans}(k(x)))])](\iota k[\mathrm{Dom}(k)=\mathrm{student}'\ \&\ \forall x(x \in \mathrm{Dom}(k) \rightarrow k(x)=\lambda p\exists z[\mathrm{woman}'(z)\ \&\ p={}^\wedge\mathrm{date}'(x, z)])])$

"The unique function k whose domain is the set of students, and which maps every x in its domain to the question "which woman did x date", is such that for every x in the domain of k, there is a professor which knows the answer to $k(x)$."

In node #1, the trace of CP is interpreted as Ans(Q), which is of the right type to combine with *find out*. By applying the type-shifting operation in (21) to the IP denotation (#Line 1'), we get a set of functions, which is of the right type to combine with the function denoted by Node #2.

Notice that the anlaysis correctly predicts that any expression which has a UMWS supports such a reading. The universal quantifier appears in Line #1" independently of the particular expression in the subject position of the raised question.

In addition to predicting that only quantifiers which have a UMWS can support such readings, we make the following prediction. Embedded declaratives (as in *some professor found out that every student dated his* *roommates*, see (7) above) do not exhibit scope interactions (or do not have a ∀∃-reading), because in order for such a reading to come about, we would need to QR the embedded declarative, and interpret it as a function from individuals to propositions. But the basis for such a reading, as we have seen above, lies in the presence of a functional dependency. Since a declarative sentence does not contain wh-movement, it cannot contain such a dependency. As as a result, there is no way to form a function from individuals to propositions.

At this point the reader may wonder whether an embedded question can undergo non-standard QR, yielding a ∀∃-reading for (48)a:

(48) a. Which professor found out who every student dated.
b. [who every student dated] [which professor found out t]

Clearly, we do not want the theory to make this wrong prediction. And in fact it does not, because non-standard QR is not free: it is triggered by "pair-list" Comp, and results in C'-adjunction (below the wh-phrase), and not CP adjunction (above the wh-phrase).

The reader may also wonder whether the raised question can be interpreted as a functional question, giving rise to something like: "The unique natural function h which maps every x in its domain to the question 'which woman did x date', is such that for every x in the domain of h, there is a professor which knows the answer to $h(x)$." Clearly, we do not want to predict this interpretation (one reason being that the domain of the function has to be restricted to the set of men). In fact, we predict this reading to be impossible, for the following reason. Recall that the crucial step is the transition from Line #7 to Line #7'. This step is what enables us to construct a function from individuals to questions. By looking at the representation of the functional reading of the matrix question in (29), we can see that there is no source for a similar interpretation, because there is no node where we can abstract over a free individual variable to yield a function from individuals to questions. The conclusion is that a raised embedded question is never interpreted as functional.

5. Summary and Open Questions

The proposed analysis of scope interactions in embedded questions succeeds in preserving the insights of the Chierchia-Dayal analysis of matrix functional and pair-list questions, and the insights of the Szabolcsi & Moltmann (1994) analysis of embedded questions by predicting the following:

(a) Standard QR is clause-bounded. Whether it is a "bare" quantified expression (such as *every man*) which moves, or a clause containing a quantified expression (such as an embedded question), the movement is always local;

(b) Quantifying into questions is possible only under the circumstances created by non-standard QR/Absorption;

(c) The subject/object asymmetry exhibited by matrix functional questions is preserved in embedded questions, due to the presence of a functional trace;

(d) There are two $\exists\forall$-readings for embedded questions with a c-commanding indefinite: functional and pair-list. This is done by interpreting the embedded question in-situ, via the Answerhood operator;

(e) The $\forall\exists$-reading is possible only with an embedded question, not with an embedded declarative. This is because a declarative sentence does not contain a functional dependency.

An important difference between the two theories is that under the current approach, the availability of a $\forall\exists$-reading is contingent upon the quantifier having a UMWS. Under the Szabolcsi & Moltmann approach, it is the inherited properties of the embedded question which determine whether it can QR or not. However, notice that nothing in the current theory excludes the possibility that the alternative is correct. Indeed, it would be interesting to see what the relationship between the two classes of quantifiers is, and whether there is cross-linguistic variation.

In particular, it would be interesting to see if the two theories can be combined, in order to solve the following problem. The UMWS hypothesis establishes a one-to-one correspondence between the availability of a pair-list $\exists\forall$-reading and a $\forall\exists$-reading. In other words, if the quantifer in question has a UMWS set, both these readings should be possible, and if it doesn't, then both should be impossible. This prediction is largely borne out. In particular, it is borne out for the class of quantifiers which are argued in Groenendijk & Stokhof (1984) not to induce pair-list readings (namely, *no*, *few*, *most* and indefinites). However, as noted in Szabolcsi (1993), and further discussed in Szabolcsi & Moltmann (1994), in point of fact there is no such one-to-one correspondence. This becomes evident when one examines quantifiers such as *more than* and *less than*. As an example, consider the following contrast:

(49) a. Which woman did more than five boys date? *pair-list

b. I know which woman more than five boys dated. pair-list

c. Some student knows which woman more than five boys dated. ∃∀-pair list - OK
∀∃ - not OK

The Szabolcsi & Moltmann approach, which assigns the ∀∃-reading a "layered quantifier" analysis, and does not relate the in-situ interpretation to the raised interpretation, can deal with this surprising contrast better than the proposed analysis. This is so because neither reading is dependent on the other. Ideally, insights from both approaches should combine to provide a unified account.

Finally, it is worth pointing out that the theory can account for the following contrast (where a quantifier is embedded in the wh-phrase):

(50) Which woman that every student$_i$ liked did he$_i$ date?
(51) *Which woman that no student$_i$ liked did he$_i$ date?

Every student can "escape" the relative clause boundary, but *no student* cannot (contrast these examples with the ones in Footnote 7). I refer the reader to von Stechow (1990), Jacobson (1994), and Sharvit (1997) for possible analyses of relative clauses with quantifiers. In particular, in Sharvit (1997) it is argued that relative clauses, like questions, are ambiguous between a "pair-list" reading and a "functional" reading. The pair-list reading involves the percolation of the index of [every man] to the node of the DP which contains it (because [every man] moves to Comp to fix the domain of the function). The functional reading does not involve such index percolation, because the quantifier does not move to Comp. Now, in (50), if the relative clause is interpreted as a pair-list function, the percolated index of *every man* can bind the pronoun *he* in the question. But in (51), the relative clause cannot have a pair-list interpretation at all (becuase, as we know, *no-NP* does not support pair-list readings) so *he* cannot be bound. The contrast between (50) and (51) is therefore predicted.

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