Two Approaches to Quantifiers: Model Theory vs. Binding Theory*

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0. Introduction

Quantifiers have been studied not only by linguists but also by logicians, mathematicians, and philosophers. Their interests have been directed toward the classification of quantifiers. From the view of first-order logic, there are two types of quantifiers: the existential quantifier and the universal quantifier. Both types assert that a set has some property, but the existential quantifier asserts that the set of individuals having some property contains at least one member, while the universal quantifier asserts that the set contains all individuals. Some and many are assumed to belong to the existential quantifier, and every and all are assumed to belong to the universal quantifier. Many quantifiers have been pointed out not to be definable in terms of either the first-order existential or the universal quantifier.

Barwise and Cooper (1981) give two reasons: first, there are sentences which simply cannot be symbolized in a logic which is restricted to the first-order quantifiers, and second, the syntactic structure of quantified sentences in predicated calculus is completely different from the syntactic structure of quantified sentences in natural language. They analyze the nature of quantifiers by using the notion of inference or entailment, and try to develop Montaque's treatment of noun phrase (1974).

On the other hand, Hornstein (1984) classifies quantifiers by using Chomsky's Binding Theory (1981) with the assumption of quantifier movement (May 1977) at logical form (LF). I will compare both approaches and explore the mechanisms of the interpretation of quantified sentences with respect to the relative scope of negation. A major distinction between Government Binding proposed in Chomsky (1981) and model-theoretic semantics such as Montague Grammar is that meaning in natural language is handled in the former by syntactic theories without commitment to semantics, whereas it is handled in the latter by semantical theories with indifference to syntactic constructions. In this article I will argue against the semantic approach and argue for the syntactic approach.

1. The Problem

In Kitamoto (1985), I stated that two distinct interpretations have been observed in (1b) and (2c), but not in the others.

(1) a. Tom did not invite some fathers.
    b. Tom did not invite many fathers.
    c. Tom did not invite every father.
(2) a. Some fathers were not invited by Tom.
    b. Many fathers were not invited by Tom.
    c. Every father was not invited by Tom.

The following (3) and (4), which differ in the scope of quantifiers, may be possible LF-representations of (1) and (2), respectively, but the logical forms with an asterisk are inappropriate for the interpretation of corresponding sentences.

(3) a. i) (SOME x : x is a father) NOT (Tom invited x)
'There are some fathers whom Tom did not invite.'
ii) *NOT (SOME x : x is a father)(Tom invited x)

b. i) (MANY x : x is a father) NOT(Tom invited x)
'There are many fathers whom Tom did not invite.'
ii) NOT (MANY x : x is a father) (Tom invited x)
'It is not the case that there are many fathers whom Tom invited.'
i.e., 'There aren't many fathers whom Tom invited.'

c. i) NOT (EVERY x: x is a father) (Tom invited x)
'It is not the case that Tom invited every father.'
ii) *(EVERY x : x is a father) NOT (Tom invited x)

(4) a. i) (SOME x : x is a father)NOT (x was invited by Tom)
ii) *NOT (SOME x : x is a father)(x was invited by Tom)

b. i) (MANY x: x is a father) NOT (x was invited by Tom)
'There are many fathers who were not invite by Tom.'
ii) *NOT (MANY x : x is a father)(x was invited by Tom)

c. i) (EVERY x : x is a father) NOT (x was invited by Tom)
'No father was invited by Tom.'
ii) NOT (EVERY x : x is a father)(x was invited by Tom)
'Not every father was invited by Tom.'

(1a) is not ambiguous, but it has only one interpretation represented as (3ai), where some has wider scope than not. (1b) has two distinct interpretations: one interpretation is (3bi) where many has wider scope than not, and the other interpretation is (3bii), where not has wider scope than many. It has been recognized that the interpretation represented as (3bi) is marked whereas the interpretation represented as (3bii) is unmarked.[1] However, (1c) is not ambiguous. In other words (1c) has only one interpretation represented as (3ci), where not has wider scope than every, but it has not an interpretation like (3cii), where every has wider scope than not.

(2a) has only one interpretation like (1a), and in both cases some has wider scope than not. Compare (2b) with (1b). Though (1b) has two distinct interpretations, (2b) has only one interpretation expressed as (4bi) where many has wider scope than not. On the other hand, (2c) has two interpretations: one is (4ci), where every has wider scope than not and the other is (4cii), where not has wider scope than every. Generally, it has been construed that (4ci) is a preferred unmarked reading while (4cii) is a marked reading.

Thus we can observe subject-object asymmetry with respect to the relative scope between quantifiers and negation, depending on the idiosyncratic properties of quantifiers. There are two basic questions. One is whether the above ambiguities are due to syntactic problems or pragmatic problems, or something between them. The other is whether they are due to lexico-semantics or not. The ultimate problem is whether a unifying explanation about the scope difference of quantifiers with respect to negation can be found.

2. Model Theory

Under a model-theoretic appreach in Cooper (1983), quantifiers denote families of subsets of the domain E of discourse. Noun phrases denote families of a set. The noun phrase is considered as the set of all the possible VP-denotations. For example, the denotation of every man is the collection of sets which contain all men. The set corresponding to love a woman will be a member of the NP-denotation as long as the phrase all men is included in the VP-denotation. Therefore, a semantic interpretation rule checks whether the denotation of the VP is a member of the denotation of the NP in a sentence constitued of NP VP. If it is a member, the sentence is true, and if not, it is false.

Barwise and Cooper (1981) classify quantifiers in terms of monotonicity (5) depending upon whether they warrant an upward or a downward entailment.

(5) Monotonicity
Monotone increasing is an upward entailment from a subset to a superset.
Monotone decreasing is a downward entailment from a superset to a subset.
(See Barwise and Cooper 1981, pp. 184-185)

Cooper (1983) gives examples:

(6) a. Most of my friends voted for Carter.
b. Most of my friends voted. (Cooper 1983, p.8.)

The verb phrase voted for Carter in (6a) is a subset of the verb phrase voted in (6b). Barwise and Cooper claim that "most of my friends and any noun-phrase beginning with most is monotone increasing: if a sentence with this noun-phrase as subject is true with a verb -phrase representing a certain set, any sentence with a verb-phrase representing a superset of this set will also be true."[2] They try to use speaker's intuitions to determine the logic of quantifiers. Consider (7).

(7) a. Some fathers walk. ⟶ Some men walk.
Some men walk slowly. ⟶ Some men walk.
b. No man walks. ⟶ No father walks.
No mak walks. ⟶ No man walks slowly.
c. Every man walks. ⟶ Every father walks.
Every man walks slowly. ⟶ Every man walks. (Ladusaw 1979)

(7a) shows an upward entailment, (7b) a downward, and (7c) both a downward and an upward entailment. Following the monotonicity, May (1982) classifies quantifiers (8):

(8) some (sg., pl) :monotone increasing for argument X and Y.
no :monotone decresing for argument X and Y.
every, all, each :monotone decreasing for argument X, and increasing for argument Y.
many :not monotone for argument X, but monotone increasing for argument Y.

Under the model-theoretic approach, the scope of quantifiers is fixed on the domain of discourse, i.e., the set entities of things provided by the model.[3] In order to apply the monotonicity we always have to use entailments. Therefore, non-ambiguity of (1c) and the ambiguity of (2c) will be explained by the entailment of the relation of man and father, that is a superset and a subset.

In (8) every is monotone decreasing for argument X, i.e., the subject position argument. If (9ai) is true, then (9aii) is true. (9ai) and (9aii) are LF representations of (9i) and (9ii), respectively. There exists a downward entailment between (8ai) and (9aii). (9i) and (9ii) also have another reading (9bi) and (9bii), respectively. There exists an upward entailment between (9bi) and (9bii). (2c) is repeated as (9ii).

(9) i. Every man was not invited.
 ii. Every father was not invited.
 a.i. (EVERY x : x is a man) NOT (x was invited)
 ii. (EVERY x : x is a father) NOT (x was invited)
 b.i. NOT (EVERY x: x is a man)(x was invited)
 ii. NOT (EVERY x: x is a father)(x was invited)

The monotone increasing property of quantifier every is reversed by the immediate negation.[4] The sentence Not every man was invited is paraphrased as Some men were invited and some men were not invited. The sentence Not every father was invited is paraphrased as Some fathers were invited and some fathers were not invited. There exists as an upward entailment between them. Thus, the ambiguities of (9i) and (9ii) are explained by using entailments.

(10ii)(=(1c)) is not ambiguous. Let us assume X is in the object position. Every is monotone decreasing for argument X. There exists an upward entailment between the sentence It is not true that Tom invited every father, which is the interpretation of (10i), represented as (10ai) at LF, and the sentence It is not true Tom invited every father,which is the interpretation of (10ii), represented as (10aii) at LF. With respect to argument X, negation reverses the monotone property. In (10ii) every can not have wider scope than not. If every had wider scope than not, there would exist a downward entailment like the relation between (10b). But (10b) are not well-formed LF representations of (10i) and (10ii), respectively. It seems that we cannot rule out (10b) by monotonicity.

(10) i. Tom did not invite every man.
 ii. Tom did not invite every father.
 a.i. NOT (EVERY x : x is a man)(Tom invited x)
 ii. NOT (EVERY x : x is a father)(Tom invited x)
 b.i.*(EVERY x : x is a man) NOT (Tom invited x)
 ii.*(EVERY x : x is a father) NOT (Tom invited x)

As some is monotone increasing for argument X and Y in (8), and some has always wider scope than not, unambiguity of (1a) and (2a) will be explained by entailment. (See Kitamoto 1985).

(11ii) (=(2b)) is not ambiguous, and many cannot have narrow scope with respect to not in this structure. Many is not monotone for argument in the subject position. It is problematic that if the sentence Many fathers were not invited is true, then the sentence Many men were not invited is true. The former is represented as (11aii) and the latter as (11ai) at LF. Because many is proportional , eight fathers is quantified as many among ten men, but not among one hundred men.[5] And it is dubious whether there exists an entailment between the two logical forms (11b), where many is within the scope of not. As many is a quantifier depending on a context, it is impossible to determine the meaning by the entailment. We could not rule out (11b) and permit (11a) by the entailment.

(11) i. Many men were not invited.
ii. Many fathers were not invited.
a.i. (MANY x : x is a man) NOT (x was invited)
ii. (MANY x : x is a father) NOT (x was invited)
b.i. *NOT (MANY x : x is a man)(x was invited)
ii. *NOT (MANY x : x is a father)(x was invited)

In (8) many is monotone increasing for argument Y. (12i) and (12ii)(=(1b)) are ambiguous, their LF's are represented as (12ai) - (12bii), respectively. There exists an upward entailment between There are many father whom Tom did not invite and There are many men whom Tom did not invite, represented as (12a) at LF. In LF (12b) there seems to exist a downward entailment between There are not many men whom Tom invited and There are not many fathers whom Tom invited. Here, in (12b) the monotone increasing property of many is reversed by the immediate negation. However, the downward entailment does not always exist, because proportional reading is possible here.[6] It is difficult to explain the ambiguity of (1b) (=(12ii) in terms of monotonicity.

(12) i. Tom did not invite many men.
ii. Tom did not invite many fathers.
a.i. (MANY x : x is a man) NOT (Tom invited x)
ii. (MANY x : x is a father) NOT (Tom invited x)
b.i. NOT (MANY : x is a man)(Tom invited x)
ii. NOT (MANY : x is a father)(Tom invited x)

If we follow Barwise and Cooper (1981), the meaning of quantifiers are to be determined in a fixed context. Entailment will change by contexts. However, entailment is not always valid in defining the well-formed logical form. There seems to be some difficulty in extending logical entailment to the interpretation of natural language. The model theoretic approach, which depends on truth conditions, cannot always a satisfactory account for the relative scope of quantifiers and negations.

3. Binding Theory

The model theoretists consider semantics to be a formalization of a speaker's interpretation, and they assume that semantic rules might present a speaker's knowledge. Under the Government-Binding framework, the interpretation theory is based on syntax rather on semantics. Logical Form is a level of representation which interfaces the theories of linguistic form and interpretation. Logical Form represents properties of syntactic form relevant to semantic interpretation. Hornstein (1984) gives a typology of quantifiers (13) as an innate feature of the language faculty. He assumes that the parameter (± operator) is innate, and that the quantifier with (+operator) forms operator-variable structure whereas the quantifier with (-operator) does not. He suggests that in Universal

Grammar the operator-variable structures should be made the unmarked case for quantified NPs.

(13) Typology of quantifiers (Hornstein 1984)

Type I : any, a certain, which Quantifier Rule at LF does not apply to, Empty Category Principle (ECP) does not apply to, and has a scope across a clause boundary.[7]

Tyoe II: a, some, every, which Quantifier Rule applies to at LF, and ECP applies to and has a scope within a clause.

Type III: personne, which Quantifier Rule applies to at LF, and ECP applies to, and has a scope across a clause boundary.

He extends Binding Theory (Chomsky 1981) to Generalized Binding Theory (14):

(14) Generalized Binding Theory (Hornstein 1984, p.69)

A. An anaphor must be X-bound in its governing category.[8] (X is an argument position or non-argument position)

B. A pronominal must be X-free in its governing category.

C. An R-expression must be A-fre. (A is an argument position)

Therefore, operator-variable structures of quantified NPs are relevant to (14A). Type I quantifiers do not form operator-variable structures, but rather behave like a name, relatively insensitive to logical environment, and interpretively independent of other logical elements in the clause. They generally behave as if they have the widest possible scope and Quantifier Rule doesn't apply to them at LF. Type II quantifiers behave like an anaphor. Quantifier Rule applies to them at LF, and they have a clause boundary. They obey both the Leftness Condition, which prohibits a variable to be coindexed with a pronoun to its left, and the Empty Category Principle, which prohibits long movement of the quantifier phrase from the subject position of the tensed clause. Type III quantifiers like personne, or a 'wh-in-situ' of multiple wh-words in Who thinks that Tom bought what are subject to conditions on an anaphor in (14A) and an R-expression in (14C).[9] Quantifier Rule applies to them at LF, they are subject to the ECP, and have a scope across a clause boundary.

In order to classify many, let us give five diagnostic tests (15)-(19), following Hornstein (1984), as he imposes on quantifiers to decide their type. Each quantifier is required to pass all five tests. Type II quantifier has a minimal clause bound nature and many men in (15a) can not have a wide scope across the minimal clause boundary. (15i) is not a well-formed LF of (15a). On the other hand, a certain man, Type I, has a wide scope across the clause boundary, represented as (15ii), and (15b) is interpreted as There exists a particular person.

(15) a. Someone believes that many men are Republicans.

b. Someone believes that a certain man is a Republican.

i. *$(_S$ many men$_x$ $(_S$ someone$_y$ $(_S$ y beleives that x are Republicans)))

ii. $(_S$ a certain man$_x$ $(_S$ someone$_y$ $(_S$ y believes that x is a Republican)))

Type II quantifier in (16e) cannot be coindexed with the pronoun across a sentence boundary, whereas Type I quantifier in (16a) can be, because the quantified NP with any behaves as a free variable like a name. Pronouns in (16b) - (16d) are called E-type ones in Evans (1977), where the antecedent does not c-command the pronoun, but rather the pronoun is coreferential with the antecedent. These E-type pronouns are referring expressions.

(16) a. Take any number$_i$. Divide it$_i$ by two. (Hornstein 1984, p.44)

b. Pick every peach$_i$. Give {them$_i$ / *it$_i$} to Harry. (" " ")

c. Mary danced with many boys$_i$ and they$_i$ found her interesting. (" " p.156)

d. Many people$_i$ saw the movie. They$_i$ enjoyed it. (Lasnik 1972, p.23)

e. Not many people$_i$ saw the movie. *They$_i$ enjoyed it. (" " ")

Under Hornstein, (16c) does not mean that Mary danced with many boys who found her interesting. Here, relativised noun phrase is non-specific. It seems that non-referring, that is, quantificational many cannot have wide scope across a sentence boundary.

The Leftness Condition is imposed on Type II quantifiers in (17b) and (17c), but not on TypeIas in (17a).

(17) a. That he$_i$ was drafted shouldn't bother { any patriot$_i$. (Hornstein 1983, p.44)

b. every patriot$_j$ } (" " ")

c. That they$_i$ were drafted shouldn't bother many patriots$_j$.

Type II quantifiers in (18b) and (18c) are sensitive to other logical elements like negation, wheras Type I as in (18a) are not.

(18) a. Sue doesn't love { any man. (Hornstein 1983, p.44)

b. every man. } (" " ")

c. Sue doesn't love many men.

Every and many are interpreted respectively to be within the scope of negation while any is not in the scope of negation. Note that it is possible for many to have wider scope than negation as a marked reading. (We shall refer to this later.)

The Type II quantifier in (19b) is subject to locality restrictions on movement, for example, the Empty Category Principle, wheras the Type I quantifier in (19a) is not.

(19) a. John doesn't believe anyone is home. (Hornstein 1983, p.45)

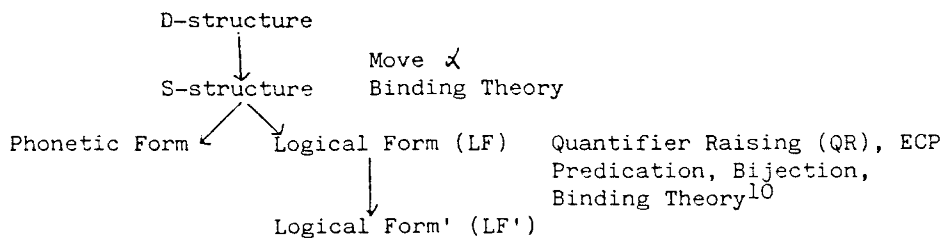
b. John doesn't believe many men are home.

Anyone can have wider scope outside the scope of the matrix negation. It is interpreted as There exists an actual person, as a de re reading or a specific reading. With respect to (19b) it is difficult to have a de re reading, that is, There actually exist many men about whom John doesn't believe to be home. Note that a de dicto reading or non-specific reading is possible in (19b). From the results of the above five tests, we shall regard many as a Type II quantifier.

4. The Framework

Under a version of the Extended Standard Theory, the Government-Binding framework, a grammar is organized as in (20):

(20)



D-structure is input to the syntactic transformational component but not the input to semantic interpretation. The S-structure is input to the rules of LF. LF rules operate on the S-structure to give structures that represent certain aspects of the meanings of sentences, called logical form (LF). The status of Logical Form' (LF') has not been definitely settled, but it seems to be the output of LF rules. For example, the distinction between a de re reading and a de dicto reading seems to be dealt with at LF'.

I adopt May's Quantifier Raising (1977) to derive logical form of quantified sentences. Quantifier Raising (21) is a movement rule in LF-component, relating S-structure to LF.[11]

(21) Quantifier Raising (QR)

Categories containing quantifiers are subject to a movement rule in logical form called Quantifier Raising which adjoins them to an S node by Chomsky-adjunction leaving a trace subject to the principles governing the syntax of Logical Form. The scope of α is the set of nodes which α c-commands at Logical Form.

Several approaches have been taken to decide the scope of negation. I assume Negation-movement (22) to decide the scope of negation at Logical Form.

(22) Negation-movement (Neg-movement)

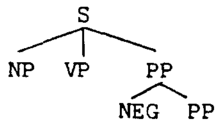
Neg-movement adjoins a negative (NEG) to an S, a VP, or a PP node by Chomsky-adjunction. The scope of negation is the set of nodes which NEG c-commands at Logical Form.

Different from Wh-movement or Quantifier-movement, Neg-movement does not leave a trace, because a negative is not an NP but a logical operator. The reason why Neg-movement adjoins a negative not only to an S node but also to a VP node is that sometimes the scope of negation is the entire S and sometimes it is over a PP or a VP.[12] (23a) is ambiguous and it is interpreted as (23b) and (23c) with some intonation.

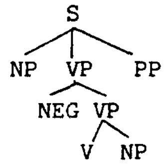
(23) a. We didn't buy this for your benefits. (Jackendoff 1977, p.61)
b. It is not for your benefits that we bought this.
c. It is for your benefits that we didn't buy this.

At LF NEG is adjoined to the PP in (23b) like (24) while NEG is adjoined to the VP at LF in (23c) like (25). In (23b) the only sentential PP is in the scope of negation.

(24) LF:



(25)LF:



We shall see examples where Neg-movement adjoins Neg to an S node in section 5. There remain some problems about the landing site of NEG.at NEG-movement in LF.

5. The Analysis

Returning to the problems proposed in section 1, QR applies to (26) (=(1a)), since some always has wider scope than negation, even though it is c-commanded by NEG at surface structure, the scope of NEG is restricted to the VP, it is not over the entire S. Thus (26a) is a correct LF of (26) but (26b) is not.

(26) Tom didn't invite some fathers.

a. $(_S$some fathers$_x$ Tom$_{VP}$(NEG $_{VP}$(invited x)))

b. *$(_S$NEG $(_S$some fathers$_x$ $_S$(Tom invited x)))

The variable is bound by an operator in (26a), but locally bound in (26b). Guéron (1981) proposes the Complete Constituent Constraint (27) as a constraint on LF outputs.

(27) The Complete Constituent Constraint (CCC)

A complete constituent is an X^n in which X^{n-1} is governed by a logical operator.

CCC rules out (28b) as the LF representation of (28a).

(28) a. I didn't ask everyone to do that problem. (Guéron 1981, p.98)

b. * $(_S$everyone$_x$ I $_{VP}$(NEG $_{VP}$(asked x to do that problem) (" " ")

However, CCC imposes (26b) as a well-formed LF, yet the LF of (26) is not (26b). Thus (26) will be a counter-example to CCC.

Now consider (29)(=(1b)). As the result of diagnostic tests, many is a Type II quantifier which is sensitive to other logical operators. In (29) many is c-commanded by NEG in the surface structure, and it takes a narrow scope within NEG, as an unmarked reading, thus differing from some.[13] After the application of QR to many and Neg-movement[14], not will become associated with many and forms a complex operator in (29a), which will be interpreted as Tom invited few fathers. This interpretation will be the contradictory reading of Tom invited many fathers. There seems to be no semantic difference between (29a) and (29b), from the distribution of truth-values, because (29b) entails (29a).[15] If many adjoins to the S, and NEG adjoins to the VP, even though many is c-commanded by NEG in the surface structure, then the marked reading (29c) is derived.

(29) Tom didn't invite many fathers.

a. ($_S$NEG–many fathers$_x$ ($_S$Tom invited x)) 'Tom invited few fathers.'

b. ($_S$NEG ($_S$many fathers$_x$ ($_S$Tom invited x)))'It is not the case that Tom invited many fathers.'

c. ($_S$many fathers$_x$ Tom ($_{VP}$NEG ($_{VP}$invited x)))'There are many fathers whom Tom did not invite.

The marked reading (29c) will be obtained with a special intonation. When many is outside the scope of NEG, even though it is c-commanded by NEG in the surface structure, it is referential like a name, that is, There are many fathers namely, Mr. Johnson, Mr. Smith, etc., whom Tom did not invite. To the contrary, a sentence like Not many people, namely John, Bill, Mike, etc., were invited is not possible. Many behaves like any in Type I quantifiers, which is insensitive to logical operator NEG. This referential many does not form an operator-variable structure. It differs from quantificational many in (29a), which does form an operator-variable stucture. I assume the interpretation (29c) will be obtained at LF' and that the distinction between quantificational and referential is done at LF'. As Barwise and Perry (1980 pp.27-28) note, the marked referential reading is highly context sensitive, and it is affected by intonation and suble pragmatic factors.

Next, in (30)(=(1c)), every father is c-commanded by NEG at surface structure. Every is a Type II quantifier, and it is sensitive to a logical operator, therefore (30) is not ambiguous. In (30a) NEG adjoins to the S node at LF, where it forms a complex operator with every moved by QR. In (30b) NEG is an operator on a quantified S, but (30b) seems to be logically equivalent to (30a).

(30) Tom didn't invite every father.

a. ($_S$NEG–every father$_x$ ($_S$Tom invited x)) 'Not every father did Tom invite.'

b. ($_S$NEG ($_S$every father$_x$ ($_S$Tom invited x)))'It is not the case that Tom invited every father.'

Now consider examples (31)(=2a)) and (32)(=2b)), where each quantifier is in the subject position. We assume that NEG is dominated by the VP at S-structure and the quantifier in the subject NP is not c-commanded by NEG in the S-structure. Both somefathers and many fathers are outside the scope of NEG. They are not ambiguous.

(31) Some fathers were not invited by Tom.

LF: ($_S$ some fathers$_x$ x ($_{VP}$NEG ($_{VP}$were invited by Tom)))

(32) Many fathers were not invited by Tom.

LF: ($_S$ many fathers$_x$ x ($_{VP}$NEG ($_{VP}$were invited by Tom)))

(33)(=(2c)) is ambiguous:

(33) Every father was not invited by Tom.

a. ($_S$every father$_x$ x($_{VP}$NEG ($_{VP}$ was invited by Tom))) 'No father was invited.'

b. ($_S$NEG–every father$_x$ x ($_{VP}$NEG ($_{VP}$was invited by Tom))) 'Not every father was invited by Tom.'

c. ($_S$NEG ($_S$ every father$_x$ ($_S$ x was invited by Tom))) 'It is not the case that every father was invited by Tom.'

As every father is not c-commanded by NEG in the surface structure of (33), the quantifier NP is outside the scope of NEG, and (33a) is an unmarked reading. In (33b), NEG optionally moves to the S node and forms a complex operator with the quantifier every moved by QR, even though every is not c-commanded by NEG at S-structure. The marked reading (33b) is derived at LF' with a special intonation. In (33c) NEG is an operator on a quantified S. There seems to be no semantic difference between (33b) and (33c). (33c) entails (33b).

The analysis presented here is that if Type II quantifiers like every or many are c-commanded by NEG in surface structures, the quantified phrase is in the domain of NEG, because Type II quantifiers are sensitive to other logical operators. An exception is some, which is always insensitive to negation. If Type II quantifiers are outside the domain of NEG, even when they are c-commanded by NEG in the surface structure, the interpretation which will be obtained at LF' is marked. If Type II quantifiers are in the scope of NEG even when they are not c-commanded by NEG, the interpretation which is derived at LF' by additional NEG-movement that enlarges NEG-scope is also marked.

Now consider (34).

(34) Nobody invited every father.
a. $(_S \text{nobody}_x (_S \text{every father}_y (_S x \text{ invited } y)))$
b.*$(_S \text{every father}_y (_S \text{nobody}_x (_S x \text{ invited } y)))$

Under the approach of Binding Theory, (34) would be ambiguous, by the application of QR to both nobody and every father. However, (34a) is a well-formed LF of (34), but not (34b). If nobody is replaced by somebody, like in (35), it is ambiguous like (35a) and (35b):

(35) Somebody invited every father.
a. $(_S \text{somebody}_x (_S \text{every father}_y (_S x \text{ invited } y)))$
b. $(_S \text{every father}_y (_S \text{somebody}_x (_S x \text{ invited } y)))$

In (35) either somebody or every father takes wider scope than the other quantifier. However, in (34) every father is c-commanded by nobody, which contains a logical operator, NEG, therefore every father cannot be exempted from the scope NEG. (34b) is ruled out for a syntactic reason.

Also, in (36), every senator cannot be within the scope of NEG, though it may have both an unmarked reading (36a) and a secondary reading (36b) where there is VP-negation.

(36) Every senator promised no election.
a. Every senator promises that there is no election.
b. Every senator does not promise any election.

In (36) subject NP every father is not c-commanded by a logical operator in object NP, so the former is not in the scope of NEG. In (37), optional QR does not apply to nobody.

(37) Every father invited nobody.
a. $(_S \text{every father}_x (_S \text{nobody}_y (_S x \text{ invited } y)))$
b.*$(_S \text{nobody}_y (_S \text{every father}_x (_S x \text{ invited } Y)))$

Every father is outside the scope of NEG, because it is not c-commanded by NEG in the object NP. While a NEG operator in the object NP cannot expand its scope over the entire S because of the condition 'c-command', a NEG operator in the subject NP can do so as in (34a).

5. Conclusion

In this study I have argued in favor of a framework where the syntactic components, syntax proper and LF are autonomous, and LF' is interpretive, with additional applications of QR and NEG-movement. I assume LF' contributes to the marked readings of (1b) and (2c). In (1b) the syntactic c-command in the surface structure is disregarded and many is optionally moved over the negated sentence in the marked reading. The referential reading of many is pragmatic rather than syntactic. The marked reading of every as in (2c) might not be defined on the basis of syntactic structure, but rather it might be due to the system of knowledge, such as inference or analogy, or empirical evidence just like the well-known usage All that glitters is not gold (from Shakespeare).

In sum, there are two procedures in the interpretation of quantified sentences with negation, because of the interaction of quantifiers and negation. First, the surface syntactic structure determines the scope of both quantifiers and negation, and also derives an unmarked reading. Second, the optional application of QR and/or NEG-movement contributes to a marked reading. The distinction of a marked or an unmarked reading is done at LF'.

Notes

*Prior discussion with K. Inoue, M. Muraki, students at ICU and the Univ. of Sophia were especially helpful to me in formulating the view presented here. Some of the content especially of section 1 and 2 overlap with that of the presentation at the annual meeting of the Linguistic Society in Japan, on June 10, 1984, and with that of "Quantification and Negation," Attempts in Linguistics and Literature, vol. 12, 1985. I am indebted to the audience at the workshop for their criticism and discussion. I am grateful to B. Heyter for his careful reading, which improved this paper.

1. In the framework of the Extended Standard Theory, the Government and Binding Theory, marked readings violate conditions on the core grammar, therefore language learners must learn that quantifiers are interpretable as having wide scope against the surface order when they encounter them. Unmarked readings are available to all speakers without special intonation, contexts, etc. See Chomsky (1981), pp.7-12.

2. See Cooper (1983) p. 8.

3. Cooper (1983) denounces the syntactic interpretation rule such NP-lowering, or QR, because it creates unnecessary syntactic ambiguity. Instead, he proposes 'storage,' a semantic interpretation rule, to give an additional wide scope reading. Technically, both of them have the same effect on the interpretation of quantified NP's. The problem seems to exist in that scope ambiguity is handled with syntax or semantics. Under the Government-Binding framework, the interpretation rule is the syntax of LF, whereas in the model theory the semantic rules reflect speaker's knowledg of natural language.

4. Barwise and Cooper (1981) proposes that negation reverses monotonicity. See p. 186.

5. Barwise and Cooper (1981) note that quantifiers like <u>many</u>, <u>most</u>, <u>few</u> are interpreted depending on a 'fixed context' while the interpretation of <u>every</u> is the same for every model.

6. I thank N. Matuda, Y. Nishiyama, and M. Tatsuta for pointing out to me.

7. I refer Quantifier Rule as May's Quantifier Raising (21) in section 4.
The ECP is defined as follows:
(i) An empty category [e] must be properly governed.
(ii) An element α properly governs an element β iff α governs β and
a. β is a variable bound by an operator or
b. α is adjacent to β.
(iii) α governs β iff
a. α is a lexical category and
b. α and β c-command each other.
See Chomsky (1981, 250ff) for further details.
As Hornstein (1984) notes, it is difficult to propose a direct evidence to ECP violations in English, especially in quantified phrases, because Type II quantifiers are not generally assigned scope across their minimal clause domains. Guéron and May (1984) claim that the trace of QR is not subject to the ECP, because it is in a specifier position and is a constituent of a thematic phrase, and is not assigned theta-role on itself, and that an empty category which is thematic is subject to the ECP.
c-command is defined as follows:
α c-commands β iff the first branching node dominating α dominates β.

See Reinhart (1976) for a full discussion of c-command.

8. A governing category is defined as:
α is a govening category for β iff α is the minimal maximal projection containing β, a govenor of β, and a subject accessible to β. Subject = AGR, or (NP, S).
α is accessible to β iff β is in the c-command domain of α and coindexing of (α, β) would not violate principle (C) of the binding theory, that is, an R-expression is free.
An element α is bound by an element β iff it is coindexed with β and β c-commands α. If α is not bound, it is free.
See Chomky (1981).

9. See Hornstein (1984) pp. 73-74 for the example, Aoun, Hornstein, and Sportiche (1980) for 'wh-in-situ' and Kayne (1979) for 'personne'.

10. See Williams (1980) for Predication, Koopman and Sportich (1981) for the Bijection Principle.

11. May (1977) suggests that QR can also lower a quantifier from the matrix S to the complement S, for example,
(i) Some politician is likely to address every rally in John's district.
(May 1977, 3.50)

(ii) There is a politician, e.g., Rockefeller, who is likely to address John's district.

(iii) It is likely that there is some politician (or other) who will address John's district.

May Considers (i) to be interpreted as (ii) and (iii), and in (iii) QR is lowered from the matrix S to the complement S.

12. In Chomsky (1981) 'move ' means 'move any category anywhere,' but under the recent investigation the landing site of movement rules has been limited. May and Guéron (1984, p.12) assume that with thematic heads, adjunction must be tp S in LF or to Comp as a result of wh-movemnt in S-structure and if the head is non-themetic, it must be adjoined to S' by LF-movement. It is said that Chomsky (in his recent class lecture) confines adjunction to S-adjunction and VP-adjunction in QR. It is a problem whether QR adjoins to NP or S'. NP and S' can be arguments, but it seems an open question whether S or VP will be possible to be an argument.

13. I assume that NEG in so called AUX is dominated by a VP, then subject NP may not be c-commanded by NEG dominated by a VP in S-structure.

14. I assume that there is no ordering between the application of QR and NEG-movement at LF. Rather, the landing site of the quantifier and NEG is crucial to decide the scope of them.

15. Guéron (1981, p.98) proposes that (28a) has acceptable interpretations:

(i) NOT-everyone$_x$ I asked x to do the problem (Guéron (124))

(ii) NOT $($everyone$_x$ $($ I asked x to do the problem$)_S)_S$ (Guéron (125))

Under her explanation, in (i) NEG moves to the S node at LF, and it forms a complex operator with everyone, as in the syntactic output (iii):

(iii) Not everyone did I ask to do the problem. (Guéron (125))

In (ii) the"contradictory" reading, NEG is an operator on a quantified S, as she explains. I consider (iii) external negation, because Subject-Aux Inversion occurs in it. It seems no semantic difference between (i) and (ii) from the truth-condition, as well as (29a) and (29b). I assume that (29a) is some sort of special case of (29b). For detailed discussion of external/internal negation, see Cormack (1980).

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