Quantifier Scope Ambiguities

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1   Introduction

Sentences containing quantifiers, especially those containing two or more of them, like (1), are often ambiguous:

(1)   Some man danced with every woman.

(1) has the two readings paraphrased under (2a) and (2b), among others:

(2) a. There is at least one man (among the men in a given domain) who danced with every woman (in a given domain).
     b. For every woman (in a given domain), there is at least one (possibly different) man (among the men in a given domain) who danced with her.

The meaning difference between (2a) and (2b) can be characterized in different terms. In (2a), in which the interpretation of the prepositional object quantifier is dependent on the interpretation of the subject quantifier, the subject quantifier is said to have scope over the object quantifier (or to have wider or broader scope than the object quantifier). In the case of (2b), the relative scope of the quantifiers is the opposite of that in (2a): the object quantifier has the wider or broader scope; the subject quantifier is in the scope of the object. This reading is an instance of *inverse scope* (i.e. a quantifier being in the scope of a quantifier that follows it in surface order). The fact that the interpretation of the subject may covary with the different individuals in the domain of the object quantifier is a consequence of the fact that the subject is distributed over the object. In contrast, (2a) is an instance of *direct scope* (i.e. a quantifier being in the scope of a quantifier that precedes it).

Additionally, it might be possible to interpret the two quantifiers in (1) independently of each other, that is, to assume that the value of neither quantifier is a function of the other (= branching quantification).

Quantifiers, in the sense of DPs with quantificational determiners (*each*, *every*, *most*, *several*, *some*, *few*, *no*, etc.), scopally interact with one another as in (1) and with other elements, among them *wh*-phrases (3a), negation (3b), and some kinds of adverbials (3c). This is the phenomenon of the relative scope of quantifiers. A quantifier can sometimes take either embedded scope or matrix scope – as happens both in (3d) and in (3e).

(3) a. Who did everybody meet?
         'Which is the person that everybody met?'
         '(Tell me) for everybody, which (possibly different) person he met.'
     b. Many celebrities didn't respect John.
         'There are many celebrities who did not respect John.'
         'It is not the case that many celebrities respected John.'
     c. Some of us always showed up.
         'Some of us are the ones who always showed up.'
         'It was always the case that some of us showed up.'
     d. Someone seems to deserve credit for that.
         'There is someone who seems to deserve credit for that.'
         'It seems that someone deserves credit for that.'
     e. Where does Bobby think every detective will go for vacation?
         'Which is the place that Bobby thinks that every detective will go for vacation?'
         '(Tell me) for every detective, which place Bobby thinks that he or she will go for vacation.'

In the framework of generative grammar, where semantic interpretation is basically determined by syntactic structure, sentences displaying scopal ambiguity are often believed to be structurally ambiguous. Unlike in other cases of ambiguity, however, intuition gives no clue as to how sentences like those in (1) or (3) can be mapped on two alternative structures, at which level of representation the two alternative structures should be constructed, and by what means.

Furthermore, the ambiguity expected in the case of sentences containing two scope-bearing operators is not always present. Thus, the following set of examples, though parallel with those in (3a)–(3e) in several respects, lack one of the two readings that their counterparts in (3a)–(3e) have:

(4) a. Who met everybody?
     b. John didn't respect many celebrities.
     c. Always, some of us showed up.
     d. Someone seems to himself to deserve credit for that.
     e. Which is the place that Bobby thinks that every detective will go for vacation?

(4a)–(4c) do not have the inverse scope readings that (3a)–(3c) have (i.e. the scope order of the two operators cannot be the opposite of their surface order). In (4d), the quantifier can only have matrix scope, whereas in (4e) it can only have embedded scope. An adequate analysis of scope ambiguities should be able to predict two readings for (3a)–(3e), and should block one of them in the case of (4a)–(4e) in a principled way.

2   The treatment of scope ambiguities in early generative grammar

The Standard Theory of Generative Grammar, in which the deep structure of the sentence was subject to semantic interpretation, provided limited means of assigning two deep structures to a quantified sentence. What it could handle was the scopal ambiguity of sentences with negative quantifiers like *no one* (see Klima 1964). *No one* (e.g. that in (5a)) was claimed to be the output of a *neg*-transportation transformation merging *not* with *anyone*. It was assumed that the negative particle was adjoined as a modifier to the constituent that it had scope over; hence, the ambiguity in (5a) was derived from whether in deep structure the negative particle was adjoined to the matrix VP, as in (5b), or to the embedded VP, as in (5c):

(5) a. I demand that you marry no one.
     b. I not demand that you marry anyone.
     c. I demand that you not marry anyone.

As pointed out by Kayne (1998, 128), this approach cannot predict the subject–object asymmetry attested in *neg*-transportation. It remains unclear why (6a) is not ambiguous, that is, what prevents *neg*-transportation from deriving (6a) from (6b):

(6) a. I demand that no one marry you.
     b. I not demand that anyone marry you.

In the Extended Standard Theory, and then in its revised version, scope interpretation was referred to surface structure, which led to a theory in which the relative scope of quantifiers was determined by surface c-command (see Reinhart 1976). This approach predicted a scope ambiguity only among quantifiers mutually c-commanding each other; hence, it could not handle such obvious cases of scope

ambiguity as transitive clauses with a subject quantifier and an object quantifier, for example:

(7)   In this office somebody speaks every official language of the UNO.

Reinhart's (1976) theory also wrongly predicts the scope interpretation of NPs containing a quantified head and a quantified PP, such as the subject of (8):

(8)   Many children in every city are waiting for Santa Claus.

In the case of (8), the predicted scope order is the opposite of the attested scope order: the quantifier embedded in the PP adjunct has wider scope than the matrix quantifier c-commanding it.

Fundamental problems of these types have led to the conclusion that quantifier scope cannot be disambiguated either in D-structure or in S-structure. Lakoff (1965/ 1970) and McCawley (1968) propose a level of representation where, besides predicate–argument and anaphor–antecedent relations, quantifier scope is represented. This level was designed as a labeled tree connected with surface structure via transformations. Lakoff's (1965/1970) rule of quantifier lowering moved quantifiers, being predicates in the underlying representation, to the respective noun phrase positions in surface structure. In contrast to this generative semanticists' view, Chomsky (1975) and May (1977) assume a level of representation, called Logical Form (LF), where logical operators are assigned scope and which is derived from S-structure by rules not affecting phonological interpretation. In the so-called T-model of grammar, there is no direct mapping between LF and PF; their relation is mediated by S-structure as follows:

(9)
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            DS
            |
           SS
          /    \
       LF        PF
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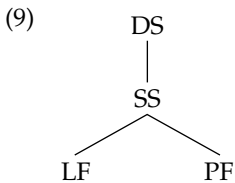
May (1977) claims that the rule deriving quantifier scope, called *quantifier raising* (Q-raising), applied in the course of mapping SS on LF, adjoins a quantifier to S (IP). Q-raising is subject to the same conditions, particularly to the same island constraints, as the rules mapping DS on SS. It leaves a trace that acts as a variable. Q-raising is triggered by the Condition on Quantifier Binding in (10), and its output is subject to the Condition on Proper Binding in (11):

(10)   *Condition on Quantifier Binding*
       Every quantified phrase must properly bind a variable.

(11)   *Condition on Proper Binding*
       Every variable in an argument position must be properly bound [c-commanded by a binding phrase].

The scope of a quantifier is everything that it c-commands at LF.

In sentences with multiple quantifiers, adjunction to S is iterated, and the adjunction operations are allowed to cross. Scope ambiguity arises from the fact that the quantifiers of a sentence can be subject to Q-raising in any order, as a consequence of which an S-structure can be mapped on more than one LF. Consider the two LFs derivable from (12a):

(12)   a.   Some man loves every woman.
        b.   [$_S$ [some man]$_i$ [$_S$ [every woman]$_j$ [$_S$ t$_i$ loves t$_j$]]]
        c.   [$_S$ [every woman]$_j$ [$_S$ [some man]$_i$ [$_S$ t$_i$ loves t$_j$]]]

May's (1977) framework correctly predicts that in complex NPs containing a quantified head and a quantified NP embedded in a PP, the scope order of quantifiers is the opposite of their surface order. Consider an instance of this construction, and the LF derived from it, displaying *inverse linking*. (May calls pairs of quantifiers linked if one of the quantified NPs includes the other. Quantifiers binding sister variables are non-linked.)

(13)   a.   Everybody in an Italian city met John.
        b.   [$_S$ an Italian city$_i$ [$_S$ [everybody in t$_i$]$_j$ [$_S$ t$_j$ met John]]]

If the quantifiers were adjoined to S in the opposite order, as in (14), then the trace of the PP-internal NP, t$_i$, would not be properly bound, in violation of the Condition on Proper Binding:

(14)   *[$_S$ [everybody in t$_i$]$_j$ [$_S$ [an Italian city]$_i$ [$_S$ t$_j$ …

If the quantified NP containing the PP adjunct is in the object position, then, naturally, we also obtain two non-linked readings, because the PP can also be interpreted as an immediate constituent of the matrix VP:

(15)   John [$_{VP}$ [$_{VP}$ met [$_{NP}$ everybody]] [$_{PP}$ in some Italian city]]

This S-structure is predicted to be ambiguous: the two quantifiers can undergo Q-raising in any order.

Interestingly, the inverse scope attested in the case of quantified NPs containing a quantified PP is missing if the noun phrase has a *wh*-feature; such NPs are ungrammatical:

(16)   a.   *Which man in some city did you meet?
cf.   b.   Which man in Cleveland did you meet?

The ungrammaticality of (16a) is derived from the assumption that, with the *wh*-phrase moved to S', and the quantifier adjoined to S, the Condition on Proper Binding is not satisfied (the trace of *some city* is not bound):

(17)   [$_{S'}$ [Which man in t$_i$]$_j$ [$_S$ [some city]$_i$ [$_S$ did you meet t$_j$]]]

In some idiosyncratic cases, quantified NPs with a quantified PP adjunct are scopally ambiguous: they can be understood to involve inverse linking, or they can be assigned direct (or natural) scope, interpreted from left to right. For example:

(18) Every senator on a key congressional committee voted for the amendment.

(19) a. *Inverse Linking*
          [$_S$ a key congressional committee$_i$ [$_S$ [every senator on t$_i$]$_j$ [$_S$ t$_j$ voted for the amendment]]]
      b. *Natural Scope*
          every senator > on a key congressional committee

Whether or not the natural scope reading also exists in addition to the regular inverse scope depends on several factors, among them the lexical selection of the preposition. For instance, a quantifier complementing the preposition *in* only allows inverse linking. The lexical selection of the quantifier also plays a role. Compare (18), which is ambiguous, with (20a) and (20b), which only have an inversely linked reading:

(20) a. Each (of the) senator(s) on a key congressional committee voted for the amendment.
      b. All senators on a key congressional committee voted for the amendment.

The depth of embedding of PPs also affects the scope reading. Thus, whereas (21a) is ambiguous, (21b) is disambiguated by the embedding of an additional PP under the lower quantifier:

(21) a. Every exit from a freeway is badly constructed.
      b. Every exit from a freeway to some California city is badly constructed.

The idiosyncrasy of these factors is regarded by May (1977) as evidence indicating that the natural, non-inversely linked reading is not derived by the rules of sentence grammar.

    In possessive constructions with a quantified genitive and a quantified complement or adjunct, for example in those under (22)–(23), the two quantifiers are not linked. They undergo Q-raising (i.e. adjunction to S) separately, in an optional order, which yields two readings:

(22) Some company's refusal of every merger offer began a panic.

(23) Every city's destruction by some pestilence was assured by their misdeeds.

A *wh*-phrase, moved to S′, on the other hand, necessarily has wider scope than a clause-mate quantifier. Thus, whereas (24), containing two clause-mate quantifiers, is ambiguous, (25a) and (25b), containing a quantifier and a *wh*-phrase, are not:

(24) John recorded one song on every album.

(25) a. Which song did John record on every album?
      b. Which album did John record one song on?

In some cases, the *wh*-operator can also have narrow scope with respect to a clause-mate quantifier, for example:

(26) a. What did everyone order?
      b. Where did everybody go?

May (1977) dismissed the unpredicted wide-scope reading of the quantifier in (26a) and (26b) as a marked, idiosyncratic case that need not be accounted for in sentence grammar. However, it soon became clear that the phenomenon is not idiosyncratic but displays a subject–object asymmetry characteristic of sentence grammar; namely, whereas object quantifiers can have wide scope with respect to a *wh*-phrase, subject quantifiers, for example those in (27a) and (27b), cannot:

(27) a. Who ordered everything?
      b. Who went everywhere?

Q-raising is a clause-bound process (as predicted by subjacency); hence, embedded quantifiers have clause-bounded scope – in the unmarked case. In certain instances, however, the quantifier can scope out of the embedded clause. For example, in (28a) *someone* can have scope over the verb *believe*, and in (28b) *too many people* can have scope over the verb *want*, as is clear from the paraphrases of the relevant readings:

(28) a. Ralph believes that someone is a spy.
          'There is someone who Ralph believes to be a spy.'
      b. Harry wanted us to invite too many people.
          'It was too many people that Harry wanted us to invite.'

The marked readings are, again, excluded from the realm of sentence grammar by May (1977).
   Raising subjects (e.g. that in (29a)) – as opposed to control subjects (e.g. that in (29b)) – can have narrow scope with respect to the matrix predicate, and even with respect to the embedded object:

(29) a. Some politician is likely to address every rally in John's district.
      b. Some politician wants to address every rally in John's district.

May's (1977) theory accounts for the additional narrow scope of the subject in (29a) by allowing Q-lowering in raising constructions.

3   Logical Form in Government and Binding Theory

The emergence of the Empty Category Principle (ECP) made May's (1977) explanation of the scope ambiguity of sentences containing both a subject quantifier and an object quantifier obsolete. It was no longer possible to Q-raise the subject and the

object quantifiers in any order. The subject trace needed a local antecedent, hence the Q-raising of the subject had to precede the Q-raising of the object. Furthermore, the asymmetry noticed between the scope possibilities of subject and object quantifiers (see (26)–(27)) also required an explanation. These problems led to the formulation of a more sophisticated theory of LF in May (1985).

In May (1985), the scope of a constituent is still identical with its c-command domain; however, the definition of c-command is modified as follows:

(30)   *C-Command*
       a c-commands *b* if every maximal projection dominating *a* dominates *b*, and *a* does not dominate *b*.

In the LF under (31b), derived from (31a), the quantifiers mutually c-command each other (the first maximal projection dominating each one is S′), so they have identical scopes (i.e. they can be interpreted in either scope order). (31c), on the other hand, is ruled out by the ECP:

(31)   a.   Every student admires some professor.
       b.   [$_S$ some professor$_i$ [$_S$ every student$_j$ [$_S$ t$_j$ admires t$_i$]]]
       c.   *[$_S$ every student$_j$ [$_S$ some professor$_i$ [$_S$ t$_j$ admires t$_i$]]]

The subject–object asymmetry attested in the scope relation of *wh*-phrases and quantifiers also happens in the framework of May (1985). Consider again the relevant cases:

(32)   a.   What did everyone buy for Max?
       b.   Who bought everything for Max?

The ambiguity of (32a) is unproblematic, as the Q-raising of the subject and the *wh*-movement of the object result in an LF in which the quantifier and the *wh*-phrase mutually c-command each other:

(33)   [$_{S′}$ What$_i$ [$_S$ everyone$_j$ [$_S$ t$_j$ buy t$_i$ for Max]]]

Owing to a technical innovation of May (1985), the explanation also carries over to the post-*Barriers* (Chomsky 1986) framework of generative syntax, in which S is also analyzed as a maximal projection (IP); namely, a node created by adjunction to a maximal projection is not a maximal projection, but merely a segment of a maximal projection. The phrase providing the adjunction site, and the node created by adjunction to it, make up a maximal projection together. Hence, the quantifier and the *wh*-phrase in (32a) will continue to c-command each other, given that the first maximal projection dominating each of them is CP.

As for (32b), neither quantifier adjunction to S nor quantifier adjunction to S′ yields a grammatical output. Compare:

(34)   a.   *Who$_j$ [$_S$ everything$_i$ [$_S$ t$_j$ buy t$_i$ for Max]]
       b.   *everything$_i$ [$_{S′}$ who$_j$ [$_S$ t$_j$ buy t$_i$ for Max]]

(34a) is out because it violates the (standard version of the) ECP, whereas (34b) is illegitimate because S′ is not a possible adjunction site. However, adjunction to other maximal projections, among them the VP, is possible; hence, (32b) can be assigned the following LF:

(35)   Who$_j$ [$_S$ t$_j$ [$_{VP}$ everything$_i$ [$_{VP}$ buy t$_i$ for Max]]]

Assuming that S = IP is maximal, *who* in (35) asymmetrically c-commands *everything* (S, the first maximal projection dominating *everything*, does not also dominate *who*); hence, (35) is not ambiguous.

Evidence for the possibility of the VP adjunction of object quantifiers is provided by the pair of examples in (36) (see Sag 1980). Whereas (36a) is ambiguous, the ambiguity disappears in (36b), in which the sentence is followed by a parallel sentence involving ellipsis. In (36b), the object quantifier is bound to have narrow scope:

(36)   a.   Some student admires every professor.
       b.   Some student admires every professor, but John doesn't.

The narrow scope of the object quantifier in (36b) results if we assume that the elided VP is reconstructed at LF, and a reconstructed VP must not contain a free variable. Then the reconstructed VP must have the *every* phrase adjoined to it, as in (36b′); that is why it will necessarily have narrower scope than the subject quantifier, adjoined to S:

(36)   b′.   [$_S$ some student$_2$ [$_S$ e$_2$ [$_{VP}$ every professor$_3$ [$_{VP}$ admires e$_3$]]]], but John doesn't
             [$_{VP}$ every professor$_3$ [$_{VP}$ admire e$_3$]]

The way May (1985) defines c-command enables a quantifier adjoined to a subject or object NP to have sentential scope (given that the quantifier adjoined to the NP will only be dominated by a segment of NP). Observe how the two readings of a quantified NP containing a quantified PP are derived. The matrix quantified NP (NP3) is adjoined to S, whereas the embedded quantified NP (NP2) is adjoined to the matrix NP. Hence both have sentential scope, and the sentence is ambiguous:

(37)   a.   Every exit from a freeway is badly constructed.
       b.   [$_S$ [$_{NP3}$ [$_{NP2}$ a freeway] [$_{NP3}$ every exit from e$_2$]] [$_S$ e$_3$ is badly constructed]]

4   Scope ambiguity or lexical ambiguity?

As discussed in detail in Noun-to-Determiner Movement, Fodor and Sag (1982) raised the possibility that the ambiguity attested in the case of indefinites like that in (38) is not scopal in nature but is a lexical ambiguity:

(38)   Every professor met a student in the syntax class.

That is, the indefinite has both a quantifier interpretation, meaning that the set of students meeting every professor is not empty, and a referential interpretation. Under its quantifier interpretation, the indefinite enters into a scopal relation with

its clause-mate quantifiers. Thus, the indefinite of (38) as a quantifier can either have narrow scope with respect to the universal quantifier ('Each professor met a possibly different student.…'), or have a wide-scope interpretation ('The set of students in the syntax class that every professor met is not empty'). However, the sentence also has a third meaning, with the indefinite understood as referential: 'There was a particular student in the syntax class who every professor met'.

   Fodor and Sag (1982) present the following evidence for the referential reading of indefinites:

(i)   An indefinite can scope out of an island. Thus, both the indefinite in the complex NP in (39) and that in the *if*-clause in (40) can refer to an individual who does not merely exist in the hypothetical world of the complex NP or the *if*-clause:

   (39)   John overheard the rumor that a student of mine had been called before the dean.

   (40)   If a friend of mine from Texas had died in the fire, I would have inherited a fortune.

   If the scope of the indefinite transgresses an island, the indefinite is claimed by Fodor and Sag (1982) always to have maximal scope. Thus, if the indefinite in (41) has matrix scope, it is also claimed to have scope over the universal quantifier – which is only possible if it is a referential expression with a maximally wide-scope existential quantifier:

   (41)   Each teacher overheard the rumor that a student of mine had been called before the dean.

(ii)   As was discussed in connection with (36), VP deletion is blocked if the deleted VP contains a quantifier whose scope is larger than the VP. Whichever quantifier is assigned wider scope in (42a), neither quantifier will scope out of the deleted VP, hence both readings are licensed. (42b), on the other hand, has only one reading: the universal quantifier has narrow scope – or else it would have a scope wider than the deleted VP:

   (42)   a.   Sandy thinks that someone loves each of my friends.
                Chris does, too.
          b.   Sandy thinks that someone loves each of my friends.
                Chris thinks that someone does, too.

   This constraint apparently does not hold in the case of a deleted indefinite:

   (43)   a.   Sandy thinks that every student in our class plays chess better than a guy I beat this morning.
                Chris does, too.
          b.   Sandy thinks that every student in our class plays chess better than a guy I beat this morning.
                Chris thinks that every student does, too.

   The elliptical sentence (43b) is just as ambiguous as that in (43a), also meaning, "There is a guy I beat this morning such that Sandy thinks that every student in

our class plays chess better than him." This is only possible if *a guy* is a refer-
ring expression.

Fodor and Sag (1982) conclude that indefinites are lexically ambiguous. They are
either quantifiers, binding a variable, entering into a scope relation with other quan-
tifiers; or they are referring expressions that have no scope, but that presuppose, or
imply, existential quantification of maximal scope. Under the latter interpretation,
they refer to an unidentified but identifiable individual. The initial sentences of the
following dialogues illustrate this ambiguity. Whereas that in (44a) involves a
referential indefinite, that in (44b) is an instance of a wide-scope existential quantifier:

(44)   a.   A student in syntax 1 cheated on the exam. His name is John.
       b.   A student in syntax 1 cheated on the exam. We are all trying to figure out who
            it was.

In fact, however, an indefinite can have intermediate scope (see Farkas 1981), pro-
vided there is a contextually salient way of picking elements of the NP set of the
indefinite and pairing them with the individuals that the wider-scope quantifier
ranges over (Kratzer 1998). For example, (45a) can have the scope reading in (45b):

(45)   a.   Each student has to hunt down every paper that shows that some condition
            proposed by Chomsky is wrong.
       b.   each student > some condition > every paper

In a widely adopted approach proposed by Reinhart (1997), the island-free scope
of indefinites is derived by the existential closure of a choice function variable.
A choice function chooses an element of any set that it applies to. In the case of
(45a), the existential closure of the choice function variable can yield the interpre-
tation in (45b'):

(45)   b'. 'For each student x there is a choice function f such that for every y that is a
            paper and shows the element that f picks from the set of conditions [proposed
            by Chomsky] to be wrong, x hunts down y.'

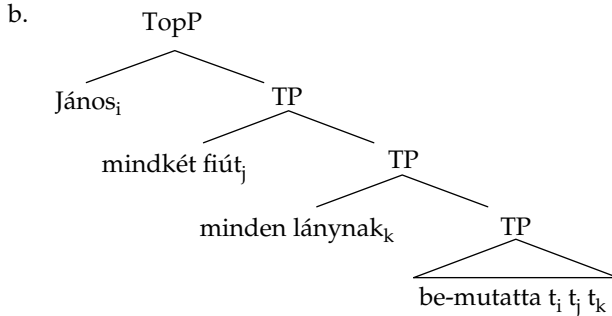<div align="right">(see Szabolcsi 2010, 94)</div>

Indefinite noun phrases remain a puzzling domain of research, as they seem to
exhibit distinct interpretational possibilities, which lead to heterogeneous scope
behavior: there are quantificational and non-quantificational uses, there are unspe-
cific and (different kinds of) specific uses, and there are generic and non-generic
uses (see, among others, Ruys 1992; Abusch 1994; Reinhart 1997; Kratzer 1998; Mat-
thewson 1998; Pafel 2005; Ionin 2010; Brasoveanu and Farkas 2011; Dobrovie-Sorin
and Beyssade 2012).

5   Visible LF in Hungarian

In Hungarian (see Kiss 1991; 2010) – as well as in Bantu KiLega (Kinyalolo 1990),
Palestinian Arabic (Khalaily 1995), and Chinese (Bartos 2002) – quantifiers land
in the left periphery of the sentence, adjoined to T(ense)P or to F(ocus)P. That is,
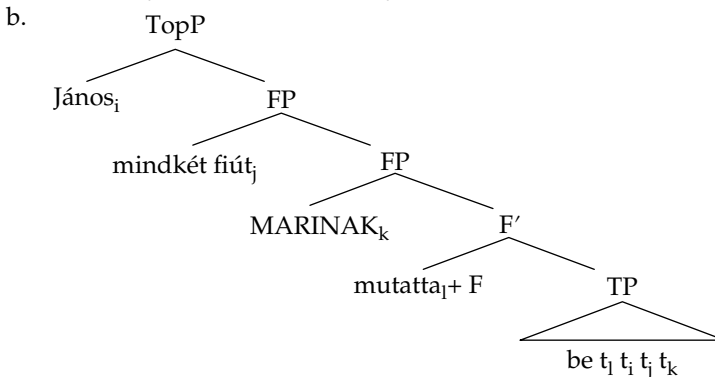
Q-raising is a visible operation: it is adjunction to the left edge of a functional layer of the predicate phrase. Here is a Hungarian example containing two quantifiers, and an updated version of the structure assigned to it in Kiss (1991):

(46) a. János mindkét fiút minden lánynak be-mutatta.
    John both boy.ACC every girl.DAT PRT-introduced
    'John introduced both boys to every girl.'

   b.

       TopP
     ┌─────┴─────┐
    János$_i$ TP
       ┌──────┴──────┐
     mindkét fiút$_j$ TP
         ┌──────┴──────┐
      minden lánynak$_k$ TP
           be-mutatta t_i t_j t_k

If the sentence also contains a focus, Q-raising can be adjunction to the Focus phrase:

(47) a. János mindkét fiút MARINAK mutatta be
    John both boy.ACC Mary.DAT introduced PRT
    'Both boys were introduced by John to MARY.'

   b.

       TopP
     ┌─────┴─────┐
    János$_i$ FP
       ┌──────┴──────┐
     mindkét fiút$_j$ FP
         ┌──────┴──────┐
      MARINAK$_k$ F′
         ┌──────┴──────┐
      mutatta$_l$+ F   TP
            be t_l t_i t_j t_k

Quantifiers and the Focus are analyzed differently, the former adjoined to the predicate phrase (TP or FP), and the latter substituted into SpecFP so as to account for an empirical difference between their syntactic behaviors: whereas Focus movement triggers verb movement across the verbal particle, Q-raising does not do so.

  Owing to the fact that quantifiers are moved to scope positions at S-structure, Hungarian sentences with two or more quantifiers are not ambiguous; surface c-command relations, and surface order even, disambiguate them. Compare the word order and the meaning difference of the following pair of sentences:

(48) a. Jánost mindkét lány többször is meghívta.
    John.ACC both girls several.times DIST invited
    'It is stated about John that each of the two girls invited him on several occasions.'

b. Jánost   többször   is   mindkét lány meghívta.
   John.ACC several.times DIST both   girls invited
   'It is stated about John that on several occasions, both girls invited him.'

In both sentences the first quantifier, asymmetrically c-commanding the second one, has scope over it, but not vice versa.[1]

   In a language like Hungarian, where scope relations are determined by surface c-command and surface precedence, the following generalizations are expected to hold: (i) a QP in the specifier position of a noun phrase cannot have narrower scope than the quantifier associated with the head; and (ii) a QP in the complement position of a noun phrase cannot have wider scope than the quantifier associated with the head. Both predictions are borne out. The first one will be demonstrated by the examples in (49) and (50):

(49) [Minden családtag   [két fényképe]] jól   sikerült.
     every   family.member's two   photos   well   came.out
     'Two photos of each family member came out well.'

As predicted, (49) cannot mean that 'two photos showing all the family members came out well'. The slightly marginal (49) also has a fully grammatical version, in which the possessor is case marked and extraposed, and then undergoes Q-raising on its own. The remnant noun phrase occupies the focus slot in SpecFP:

(50) [$_{FP}$ Minden családtagnak   [$_{FP}$ két fényképe sikerült jól]]
     every   family.member.DAT   two   photos   came.out   well

The second generalization is illustrated under (51a). The pragmatically possible scope reading, with the complement taking scope over the quantified head, cannot be derived because the complement does not c-command the quantifier of the head. The intended reading can only be achieved if the complement is realized as a genitive specifier (see (51b)), or, still better, if it is realized as a case-marked possessor extraposed and then Q-raised (see (51c)). To demonstrate that the possessor has undergone Q-raising independently, I will supply it with the (usually optional) formative appearing on the right-hand side of distributive quantifiers:

(51) a. *[Minden [bejárat [több   boltba]]] megrongálódott.
        every   entrance several   store.to   was.damaged
        'Every entrance to several stores was damaged.'
     b. [Több   bolt   [minden bejárata]] megrongálódott.
        several   stores'   every   entrance   was.damaged
     c. [$_{TP}$ Több   boltnak   is   [$_{TP}$ minden bejárata [$_{TP}$ megrongálódott]]]
        several store.DAT even   every   entrance   was.damaged

   Hungarian facts have been used as evidence in arguing for LF Q-raising (if Q-raising is visible in some languages, it must be covertly present in other languages as well). At the same time, they have also been regarded as evidence for a grammatical model without LF, in which scope relations can be read off S-structure – as in Williams (1986).

6   A chain binding theory of quantifier scope

It had already been observed in May (1977), and particularly in May (1985), that the movement of a quantifier, or the movement of another operator across a quantifier, may result in ambiguity. Thus, a raised quantified subject may have either embedded or matrix scope:

(52)   a.   A hippogryph is likely to be apprehended.
　　　 b.   'There is a hippogryph which is likely …'
　　　 c.   'It is likely that a hippogryph …'

May (1985) could only account for the narrow-scope reading of the raised quantifier by assuming Q-lowering at LF, with the output in (53):

(53) e_i is likely a hippogryph$_i$ [e_i to be apprehended]

A *wh*-phrase raised across a quantifier into a higher clause may also have either wide scope or narrow scope with respect to the quantifier:

(54)   Who do you think that everyone saw at the rally?

It appeared that the wide-scope reading of the subject quantifier in (54) can only be derived at the cost of giving up the assumption that Q-raising observes the ECP. At the same time, the ECP did not prove to be completely irrelevant; for example, the embedded subject quantifier, capable of taking scope over the matrix *wh*-phrase in (54), cannot take scope over a matrix subject quantifier. Compare:

(55)   Some men think that everyone saw Mary at the rally.

Aoun and Li (1989) approached these problems by replacing the notion of variable binding with the notion of chain binding in quantifier scope interpretation. They sought to account for a complex set of English and Chinese data that display some unexpected differences; namely, whereas an English transitive sentence containing two quantifiers is ambiguous, its Chinese counterpart is not (as was observed by Huang 1982) – see (56a)–(56b)). However, a Chinese passive sentence with two quantifiers is ambiguous, whereas an English double object construction is not – compare (57a) and (57b):

(56)   a.   Someone tried every dish.
　　　 b.   Yaoshi　liangge　ren　zhaodao　meige　xiansuo
　　　　　　if　　　 two　　　men　found　　 every　clue

(57)   a.   Yaoshi　liangge　xiansuo　bei　meigeren　zhaodao
　　　　　　If　　　 two　　　clues　　 by　everyone　 found
　　　 b.   John assigned someone every problem.

Aoun and Li (1989) propose the following Scope Principle:

(58) *Scope Principle (Aoun and Li* 1989)
      A quantifier A has scope over a quantifier B if A c-commands a member of the chain containing B.

Q-raising is claimed to be constrained by the Minimal Binding Requirement, which forbids stacked quantifiers, that is, structures of the type Q_i Q_j [t … t], whether the quantifier–variable relations are nested or crossing:

(59) *Minimal Binding Requirement*
      Variables must be bound by the most local potential A′-binder.

As a consequence of (58) and (59), LF representations of multiple quantifier constructions can be of two basic types:

(60) a. Q_i [… t_i … Q_j [… t_j …]
      b. Q_i [… t_i … Q_j [… t_i … t_j …]

The lower t_i in (60b) does not violate the Minimal Binding Requirement because it is an NP trace, not a variable. Whereas (60a) is disambiguated, (60b) is ambiguous: both Q_i and Q_j have scope over the other, because each c-commands a trace of the chain containing the other. According to Aoun and Li (1989), a Chinese transitive sentence with a subject and an object quantifier has the structure of (60a). In English, however, the subject is generated inside the VP; hence, an English sentence like (56a) is to be mapped on the LF in (60b). (Chinese Infl, unlike English Infl, is not lexical, and the non-L-marked VP blocks subject raising to SpecIP.) In a Chinese passive sentence, however, the subject quantifier does bind a VP-internal trace; that is why it is scopally ambiguous. (As Hornstein (1995, 39) notes, it is unclear, though, why the non-L-marked Chinese VP does not block NP-movement in this case.) The English double object construction is claimed to be similar to the Chinese active transitive sentence in the respect that the indirect object and the direct object are claimed to form a small clause, in which the VP-external constituent has no trace in the VP.

This is the relevant section of the LF that Aoun and Li (1989) would assign to (54), given again as (61a):

(61) a.   Who do you think that everyone saw at the rally?
      b. Q_i [… [$_{CP}$ t_i [$_{IP}$ Q_j [t_j [$_{VP}$ t_j t_i]]]]]

The sentence is correctly predicted to be ambiguous: Q_i, the *wh*-operator, c-commands every member of the chain headed by Q_j; and Q_j, the embedded subject operator, also c-commands the root of the chain headed by Q_i.

However, (55), given again as (62a), is correctly predicted to be non-ambiguous, given that the lower quantifier does not c-command a member of the chain headed by the higher quantifier:

(62) a.   Some men think that everyone saw Mary at the rally.
      b. Q_i [$_{VP}$ t_i … [$_{CP}$ [$_{IP}$ Q_j [$_{IP}$ t_j [$_{VP}$ t_j]]]]]

(32a) and (32b) appear, at first sight, to violate the Minimal Binding Requirement. These are the chains they involve:

(63) a. What did everyone buy for Max?
        $Q_j Q_i [_{IP} t_i [_{VP} t_i t_j]]$
      b. Who bought everything for Max?
        $Q_j [_{IP} t_j Q_i [_{VP} t_j t_i]]$

Actually, the problem with the Minimal Binding Requirement is eliminated by a qualification added to the requirement, according to which *a* only qualifies as a potential A-bar binder for *b* if *a* c-commands *b*, *a* is in an A-bar position, and coindexing of (*a*, *b*) would not violate any grammatical principle. Aoun and Li (1989) argue that the coindexing of the *wh*-phrase (Q_j) with t_i would be a Principle C violation, hence Q_j is not a potential binder for t_i. The real problem, pointed out by Ruys (1992), is that (63b), with Q_i binding both t_j and t_i, is predicted to be just as ambiguous as (63a), contrary to fact.

In this framework, the scopal ambiguity attested in raising structures can be accounted for without lowering. Observe the LF assigned to an English raising structure:

(64) a. Someone seems to have attended every rally.
      b. someone$_i$ [t_i seems [every rally$_j$ [t_i to have attended t_j]]]

Every rally can have scope over *someone* because it c-commands a trace of the chain containing *someone*. This approach, however, cannot solve a problem first noticed by Aoun (1981); namely, in (65a), the matrix reflexive forces the existential quantifier binding it to have matrix scope. Nevertheless, the LF assigned to (65a) by Aoun and Li (1989), represented in (65b), is as ambiguous as any raising structure:

(65) a. Someone seems to himself to have attended every rally.
      b. someone$_i$ [t_i seems to himself [every rally$_j$ [t_i to have attended t_j]]]

A further problem is that Chinese raising structures, for example that in (66), are not ambiguous:

(66) Yaoshi liangge ren keneng kandao meigeren
       if   two   men likely see   everyone

Aoun and Li (1989) explain the lack of narrow scope of the raised subject in (66) by claiming that in Chinese, the raising predicate and the embedded predicate are restructured to form a single complex predicate (because otherwise the non-L-marked matrix VP, a barrier, would not let the embedded subject through).

In a revised version of the scope interpretation theory of Aoun and Li (1993), only the bare quantifiers are Q-raised out of the quantified NPs. Hence, the new theory does not refer to NP-traces any longer; the Scope Principle interprets only non-NP links of chains. That is:

(67) *The Scope Principle (Aoun and Li* 1993*)*
      X takes scope over Y just in case some part of X's A'-chain c-commands some part of Y's A'-chain.

Aoun and Li (1989) assume the following Generalized Binding Condition:

(68) An A′-binder B is a potential antecedent for a variable V if indexing B and V does not violate any grammatical principle, for example Principle C, the theta-criterion, and so on.

Adopting the adjunction theory of *Barriers* (Chomsky 1986), Aoun and Li (1989) only allow adjunction to XPs in non-theta-positions. That is, whereas the subject NP is a potential adjunction site, the object NP is not. A subject quantifier assumes wide scope by being adjoined to IP, and it assumes narrow scope by being adjoined to the subject NP, which dominated it originally. (In Aoun and Li's (1989) framework, a Q adjoined to NP does not c-command outside the NP; hence, the Minimal Binding Requirement is not violated.) An object quantifier, however, takes wide scope by being adjoined to IP, and narrow scope by being adjoined to VP. Compare:

(69) a. Some student attended every class.
      b. $[_{IP}$ Every$_i$ $[_{IP}$ $[_{NP}$ some$_j$ $[_{NP}$ t$_j$ student]] attended $[_{NP}$ t$_i$ class]]]
      c. $[_{IP}$ Some$_j$ $[_{IP}$ $[_{NP}$ t$_j$ student] $[_{VP}$ every$_i$ $[_{VP}$ attended $[_{NP}$ t$_i$ class]]]]]

In Chinese active sentences, SpecIP is a theta-position; hence, structure (69b), in which the subject has narrow scope with respect to the object, is illicit. In Chinese passive sentences, however, SpecIP is not a theta-position, allowing adjunction.

In raising constructions, the subject can be lowered into the embedded subject position in both languages. In English, the lowered subject can have its quantifier adjoined locally to the subject NP, which is a non-theta-position – see (70). In Chinese, where the embedded subject position is a theta-position, this move is impossible; hence, the lowered subject cannot assume narrow scope with respect to the embedded object:

(70) $[_{IP}$ t$_i$ … $[_{IP}$ Q$_j$ $[_{IP}$ $[_{NP}$ Q$_i$ $[_{NP}$ t$_i$ N′]] … $[_{NP}$ t$_j$ N′]]]]

The optional lowering does not take place in (71) because it would leave an unbound anaphor:

(71) Someone seemed to himself to have attended every rally.

The appeal of this approach is somewhat diminished by the fact that the Q-raising rule it assumes is not identical anymore with the visible Q-raising of, for example, Hungarian, which involves quantified NPs.

7 A minimalist approach to scope ambiguities

In the minimalist framework, the Q-raising transformation is problematic for at least two reasons. Phrasal adjunction, in general, is an atypical operation in minimalism. Phrasal movement should be substitution, and, furthermore, it should be motivated by the need of morphological feature checking. Quantifiers actually

do bear morphological markers; so if they had an invariant landing site, it would not be inconceivable to analyze their landing site as the specifier of an abstract quantifier head with a quantifier feature to check. However, May (1985), Aoun and Li (1993), and others have convincingly shown that the English scope facts cannot be accounted for unless Q-raising is allowed a variable landing site.

These considerations have led to new approaches to quantifier scope interpretation. Hornstein's solution is the simplest (see Hornstein 1995, ch. 8): he eliminates Q-raising, and derives its effects from regular A-movement to *Spec, AgrS* and *Spec, AgrO*. His theory is based on the standard minimalist premises that the subject moves to Spec, AgrS, whereas the object moves to Spec, AgrO, and movement is copying and deletion. He also makes the following specific assumptions:

(i)   At the CI interface, an A-chain has at most one and at least one lexical link (the rest of them are deleted).

(ii) A definite argument must be outside the VP shell at the CI interface (as required e.g. by the Mapping Principle of Diesing 1992).

In Hornstein's (1995) theory, quantifiers are moved via A-movement – which explains why quantifier scope normally cannot transgress a sentence boundary. Wide-scope quantifiers are interpreted in the head positions of their chains, whereas narrow-scope quantifiers are interpreted in the root positions of their chains. A transitive sentence with two quantifiers, like that in (72a), can be associated with four possible CI interface representations, spelled out in (72b)–(72e). The chain links to be deleted are put into brackets:

(72) a. Someone attended every seminar.
      b. [$_{AgrS}$ Someone [$_{TP}$ Tns [$_{AgrO}$ every seminar [$_{VP}$ (someone) [$_{VP}$ attended (every seminar)]]]]]
      c. *[$_{AgrS}$ Someone [$_{TP}$ Tns [$_{AgrO}$ (every seminar) [$_{VP}$ (someone) [$_{VP}$ attended every seminar]]]]]
      d. *[$_{AgrS}$ (Someone) [$_{TP}$ Tns [$_{AgrO}$ (every seminar) [$_{VP}$ someone [$_{VP}$ attended every seminar]]]]]
      e. [$_{AgrS}$ (Someone) [$_{TP}$ Tns [$_{AgrO}$ every seminar [$_{VP}$ someone [$_{VP}$ attended (every seminar)]]]]]

(72c) and (72d) are illegitimate representations, because they contain a definite argument (the *every* phrase) in the VP and thereby violate the Mapping Principle of Diesing (1992). (72b) is the representation yielding direct scope, whereas (72e) is the representation yielding inverse scope.

In this model, a subject universal quantifier (e.g. that in (73)) is bound to have wide scope, as the Mapping Principle does not allow it to be interpreted inside the VP:

(73) Every man kissed a woman.

The women kissed may be different for each man or may be the same woman, which looks like a difference in relative scope. Hornstein (1995), however, is forced to deny the ambiguity, and to call the sentence vague instead.

Hornstein's (1995) theory correctly predicts the ambiguity of raising structures of the following type:

(74) a. Someone seemed to attend every class.
  b. [$_{AgrS}$ Someone seemed [$_{AgrS}$ someone to [$_{AgrO}$ every class [$_{VP}$ someone attend (every class)]]]]

Since the chain headed by *someone* has members both above and below the universal quantifier in Spec, AgrO, any of which is legitimate at the CI interface, *someone* can have either wide scope or narrow scope with respect to the universal quantifier.

Hornstein's (1995) theory is successful in treating cases in which one of the scope possibilities is excluded because it does not meet some independent binding requirement. For example, the usual ambiguity of transitive sentences with two quantifiers disappears in (75a) because only the higher subject chain link, c-commanding Spec, AgrO, binds the pronoun embedded under the object:

(75) a. Someone$_i$ played every piece of music he$_i$ knew.
  b. [$_{AgrS}$ Someone [$_{Tns}$ [$_{AgrO}$ every piece of music he knew [$_{VP}$ (someone) [$_{VP}$ played (every piece of music he knew)]]]]]

Raising structures in which only one of the scope possibilities meets a binding requirement are analyzed similarly:

(76) a. Every picture of his$_i$ dog seemed to someone$_i$ to be out of focus.
  b. [$_{AgrS}$ (every picture of his dog) [$_{VP}$ seemed to someone$_i$ [$_{AgrS}$ every picture of his$_i$ dog to be out of focus]]]

(77) a. Someone$_i$ seemed to himself$_i$ to be reviewing every report.
  b. [$_{AgrS}$ someone$_i$ [$_{VP}$ seemed to himself$_i$ [$_{AgrS}$ (someone) to be [$_{AgrO}$ every report [$_{VP}$ (someone) [reviewing (every report)]]]]]]

In (76), the matrix prepositional object can bind the pronoun only in the subject link occupying the embedded AgrS. The link in the higher Spec, AgrS is not in its c-command domain. The link in the lower VP, however, is ruled out by Diesing's Mapping Principle (1992); it is a definite NP, which must leave the VP. Hence, the raised subject has narrow scope with respect to the matrix prepositional object. In (77), however, the matrix subject can only have wide scope because only the highest chain link c-commands the matrix anaphor.

The Chinese facts also follow if we assume that in Chinese the subject chain has no VP-internal chain link except in passive sentences.

8   Scope interpretation constrained by economy

The approach of Fox (2000) maintains the Q-raising and quantifier-lowering rules of May (1985), and argues that they are restricted by economy considerations. This theory is built on the insight that shorter derivations are less costly; hence, among derivations with the same semantic interpretation, that involving the least moving is the optimal one. In other words, a quantifier moves only to establish a

semantically significant scopal relation. Compare the possible derivations of (78a) and (79a):

(78) a. A boy loves every girl.
     b. $[_{IP}$ a boy$_1$ … $[_{VP}$ every girl$_2$ $[_{VP}$ t$_1$ loves t$_2]]]$
     c. $[_{IP}$ every girl$_2$ $[_{IP}$ a boy$_1$ … $[_{VP}$ t$_1$ loves t$_2]]]$

(79) a. John loves every girl.
     b. $[_{IP}$ John$_1$ … $[_{VP}$ every girl$_2$ $[_{VP}$ t$_1$ loves t$_2]]]$
     c. $^*[_{IP}$ every girl$_2$ $[_{IP}$ John$_1$ … $[_{VP}$ t$_1$ loves t$_2]]]$

Although the derivation in (78c) is longer than that in (78b), the two derivations have different interpretations; hence, they do not belong to the same reference set, and need not be compared with respect to economy. In the case of (79), however, the additional layer in (79c) does not yield a further interpretation; hence, the (79c) variant is less optimal than the shorter (79b).

Fox's (2000) theory provides a natural account of a wide range of problematic scope interactions. Consider first the interaction of scope and VP ellipsis, discussed in connection with (36). Recall that the problem is represented by the lack of ambiguity in (80b), as opposed to (80a):

(80) a. Some boy admires every teacher.
     b. Some boy admires every teacher and Mary does too.

The explanation quoted in connection with (36) is based on the assumption that VP reconstruction at LF requires the elided VP to contain the operator binding the VP-internal variable. This explanation, however, only works if VP reconstruction is ordered after QR in LF. What is worse, VP ellipsis does not always eliminate ambiguity. In (81), the elided object quantifier can have scope over the subject:

(81) Some boy admires every teacher and some girl does too.

That is, whereas (82a) is an impossible LF for (80b), (82b) is a possible LF for (81):

(82) a. *every teacher$_1$ [some boy admires t$_1$] and
         every teacher$_2$ [Mary admires t$_2$]
     b. every teacher$_1$ [some boy admires t$_1$] and
         every teacher$_2$ [some girl admires t$_2$]

In the case of (80a)/(82), the derivation is interpretively identical with the derivation involving no adjunction to IP; hence, as the less economical variant, it is discarded. In the case of (80b)/(82b), adjunction to IP elicits a meaning that is otherwise not available; hence, economy considerations are irrelevant. The requirement of parallelism between elided material and its antecedent coupled with the economy principle in question yield the following generalization:

(83) *Ellipsis Scope Generalization*
The relative scope of two quantifiers, one of which is in an antecedent VP of an ellipsis construction, may differ from the surface c-command relation only if the parallel difference will have semantic effects in the elided VP.

Extraction out of coordinate structures is also known to limit scope interpretation possibilities. Compare the ambiguous (84a) with (84b), in which across-the-board quantifier lowering eliminates one of the scope readings: the object quantifier within the coordinated VP cannot take scope over the subject:

(84) a. A different student likes every professor.
      b. A different student [[likes every professor] and [hates the dean]].

This fact has led May (1985) and Ruys (1992) to the conclusion that QR obeys the Coordinate Structure Constraint. However, this explanation cannot be extended to cases like (85):

(85) A guard is standing in front of every church and sitting at the side of every mosque.

This sentence is understood to describe a situation in which the guard varies with the churches and the mosques. This reading can be represented by an LF involving VP-level QR in both conjunctions, and across-the-board lowering of the subject to the two coordinate VPs, as follows:

(86) – is [$_{VP}$ every church$_1$ [$_{VP}$ [a guard] standing in front of t$_1$]]   and
          [$_{VP}$ every mosque$_1$ [$_{VP}$ [a guard] standing at the side of t$_1$]]

The question is why the proposed derivation (i.e. across-the-board lowering) is not allowed in the case of (84b). The answer is provided by the economy principle in question, together with the following independently motivated assumptions:

(87) a. Extraction is possible out of a coordinate structure only if there are two independent structures, each composed of one of the coordinates together with material above it up to the antecedent.
      b. Grammatical constraints are checked independently in the two derivative structures.

It follows from (87) that lowering is only possible if it is across the board. Furthermore, as required by economy, lowering must yield a distinct interpretation in both derivative structures. This is satisfied in (86a) and (86b), but would not be satisfied in (84b). Consider its LF:

(88) [$_{VP}$ every professor [$_{VP}$ a different student likes]] and
      [$_{VP}$ the dean [$_{VP}$ a different student likes]]

Fox's (2000) approach can also explain why Q-raising is clause-bounded in most cases: because QR takes place successive-cyclically, and each step must be motivated by a shift in semantic interpretation. Compare the following minimal pair:

(89) a.   One girl knows that every boy bought a present for Mary.
      b.   One girl knows what every boy bought for Mary.

In (89a), the universal quantifier cannot take scope over the matrix existential quantifier. The reason is that there is no motivation for the first step of successive-cyclic Q-raising to take place. Movement in one swoop across the clausal boundary, however, would violate regular constraints of A-bar-movement – hence, the quantifier is stuck. In (89b), however, the movement of the universal quantifier over the *wh*-operator is semantically motivated (it provides a pair-list reading). The quantifier raised that high is available for Q-raising into the matrix sentence.

9   Quantifiers and scope-relevant properties

Almost from the beginning, linguistic research in quantifier scope has been looking for the reason why the relative scope of quantifiers is not essentially free (see Kroch 1974; Ioup 1975; VanLehn 1978). Surface order, grammatical function, and lexical properties (like distributivity), among others, have been proposed as the determining factors for the complex pattern of ambiguous and unequivocal sentences in English and other languages. However, no encompassing picture has emerged. Around the start of the 1990s, the search for scope-relevant properties of quantifiers received a boost (Liu 1990/1997; Kuno 1991; Kurtzman and MacDonald 1993; Pafel 1993; Beghelli and Stowell 1997; Szabolcsi 1997; and others). Basically, two distinct accounts have been developed: multi-factor theories (section 9.1) and the theory of relativized scope (section 9.2).

9.1   Multi-factor theories

A multi-factor account urges first and foremost to acknowledge the complexity of the data. First, sentences with several quantifiers or operators exhibit a complex pattern of ambiguous and unequivocal sentences; and, second, scope readings are gradient in character, that is, they are more often than not distinctly preferred, a fact that cannot be explained by world knowledge or performance aspects. It is the linguistic system, the grammar, which, according to this account, is responsible for this trait and the complex pattern.

The interaction between ordinary quantifiers and *wh*-phrases might illustrate these points. In (90), there is a subject–object asymmetry: subject preceding the object leads to an unambiguous sentence (wide scope of the *wh*-phrase is the only possible reading), and object preceding the subject leads to an ambiguous sentence (see May 1985).

(90) a.   What did everyone buy for Max?
      b.   Who bought everything for Max?

This pattern, however, depends crucially on certain properties of the *wh*-phrases and the quantifiers. Vary these properties, and the pattern vanishes. In contrast to (90a), sentences (91a) and (91b) do not have a wide-scope reading of the quantifier (see Liu

(1990/1997, 151) and May (1985, 166, fn. 8)). Quantifiers headed by *most* or *two*, among others, differ in their behavior from those headed by *every* (or *each*).

(91)   a.   Which novel did most critics have to review?
       b.   Which professor do two students admire?

In contrast to (90b), sentences (92a)–(92c) do have a wide-scope reading of the quantificational object (see Kuno 1991).

(92)   a.   What worried everyone?
       b.   What gave everyone the will to survive?
       c.   Who bought each thing for Max?

(92c) points to a stronger wide-scope tendency of *each* in contrast to *every*; (92a) and (92b) seem to indicate that the semantic role of a quantifier can influence its tendency to wide scope.

The contrast in (93) indicates that focusing a quantifier diminishes its tendency to wide scope: whereas (93a) is ambiguous (cf. (92b)), wide scope of the quantifier becomes unavailable in (93b) (see Kuno 1991):

(93)   a.   What is giving everyone his biggest headache?
       b.   What is giving EVERYONE his biggest headache?

Last, but not least, *how many* phrases and *which* phrases differ in their tendency to wide scope. In neutral contexts, wide scope of the quantifier is preferred in sentences like (94a), whereas wide scope of the *which* phrase is clearly preferred in sentences like (94b) (see Villalta 2003):

(94)   a.   How many movies did everybody see?
       b.   Which magazines did everybody read?

(There are almost identical contrasts in German with the exception that there is no counterpart to *each* in German; see Pafel 2005.)

On the basis of data samples like the one just sketched, multi-factor theories strive to identify the factors that might be responsible for the observed (un)availability of certain scope readings. It becomes apparent that configurational approaches, which rely exclusively on syntactic relations like c-command (with or without QR), have severe difficulties in coping with the facts (see Kuno, Takami, and Wu (1999) and the subsequent debate with Aoun and Li on this question in later issues of *Language*). Multi-factor theories, in contrast, assume that relative scope is determined by a variety of syntactic and non-semantic properties, which interact in a weighted and/or cumulative way (see Kuno 1991; Kuno, Takami, and Wu 1999; Higgins and Sadock 2003; Pafel 2005; AnderBois, Brasoveanu, and Henderson 2012). These accounts are able to cope with the complex pattern of ambiguous and unequivocal sentences and the gradient character of scope readings to a remarkable degree. As for Chinese, English, German, and Japanese, multi-factor analyses have been presented that have a broad empirical coverage.

The factors that have been proposed in different multi-factor accounts are not identical but, for the most part, quite similar. It is uncontroversial that there is a purely syntactic scope-relevant relation, be it linear precedence or some kind of a command relation. In one way or another, subjects have a special status in comparison to objects. The semantic role assigned to a quantifier plays a certain role, too. Furthermore, the character of the quantificational elements has a certain influence, with distributivity being at least a decisive ingredient, and a quantifier being or not being discourse-bound is of relevance too. (For more scope-relevant properties and thorough discussion of their need and nature, see the literature cited above.) There is psycholinguistic evidence for several factors and their (weighted, cumulated, and/or competitive) interaction (see Kurtzman and Mac-Donald 1993; Villalta 2003; Filik, Paterson, and Liversedge 2004; Bott and Radó 2007).

9.2   The theory of relativized scope

Liu (1990/1997) was among the first to point out that the scope possibilities of a quantifier also depend on its type, and initiated an important new line of research in the area of scope ambiguities, which has culminated so far in a volume of papers edited by Anna Szabolcsi, among them Beghelli and Stowell (1997) and Szabolcsi (1997) (for further developments, see Brody and Szabolcsi 2003; Bernardi and Szabolcsi 2008; and, for critical assessments, see Kuno, Takami, and Wu 1999, 99 n. 35; Pafel 2005, 255 ff.).

Liu (1990/1997) divided quantified NPs into two types (generalized-specific (g-specific) and non-specific NPs), but Beghelli and Stowell (1997) have argued for the necessity of a more sophisticated classification. They distinguish five types of quantified phrases:
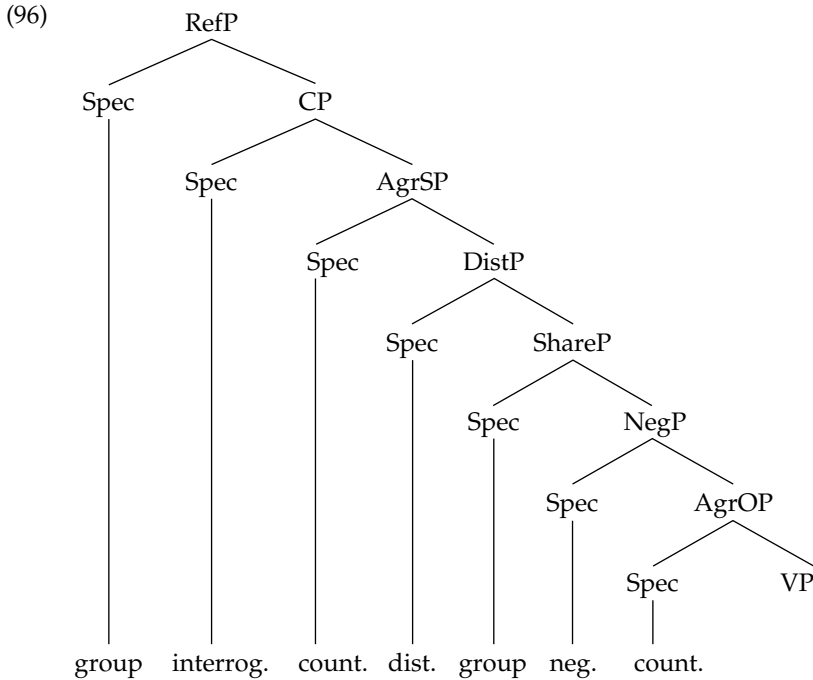
(95)   a.   Interrogative QPs: *what*, *which man*.
      b.   Negative QPs: *nobody*, *no man*.
      c.   Distributive-universal QPs: *every/each man*.
      d.   Counting QPs: *few girls*, *at most three students*.
      e.   Group-denoting QPs: *one man*, *three men*, *a man*, *the men*.

They claim that these types of quantified phrases have their own designated landing sites in sentence structure, where they participate in feature checking. Their scope extends over the domain they c-command at LF; hence, the fact that they can occupy only certain positions indirectly imposes constraints on their scope possibilities, and on their relative scope as well.

Beghelli and Stowell (1997) argue for a much more articulated left periphery for the English sentence than was previously assumed. Although they base their claim on evidence internal to English, facts from languages with visible quantifier movement, primarily Hungarian, also support their proposal.

The structure they assign to the English sentence is represented under (96). Different types of quantifiers move to the specifiers of different projections in order

to have their particular feature checked. The diagram indicates what type of quan-
tifier each position can be filled with:

(96)

```
                    RefP
              ┌──────┴──────┐
            Spec            CP
             │        ┌──────┴──────┐
             │      Spec          AgrSP
             │       │       ┌──────┴──────┐
             │       │     Spec          DistP
             │       │      │       ┌──────┴──────┐
             │       │      │     Spec          ShareP
             │       │      │      │       ┌──────┴──────┐
             │       │      │      │     Spec          NegP
             │       │      │      │      │       ┌──────┴──────┐
             │       │      │      │      │     Spec          AgrOP
             │       │      │      │      │      │       ┌──────┴──────┐
             │       │      │      │      │      │     Spec          VP
             │       │      │      │      │      │      │            │
           group  interrog. count. dist. group  neg.  count.
```

Simple indefinites of the type including *a man* and *men* can also remain in the VP as
bound variables. Beghelli and Stowell (1997) are forced to analyze also *every* phrases
that are in the scope of, for example, negation (see (97)) as VP-internal bound variables:

(97)   The students could not answer every question.

The proposed structure leaves room only for a few types of scope ambiguity. Thus,
a group-denoting QP (e.g. *two books* in (98)) can have either wider or narrower scope
than a distributive QP – given that it can occupy either Spec, RefP above DistP, or
Spec, ShareP below DistP at LF:

(98)   Each student read two books.

The system correctly predicts the lack of scope ambiguity in a wide range of cases,
which remained a mystery for all previous approaches. For example, a counting QP
of object function (e.g. that in (99a) and (99b)) can never take inverse scope over a
group denoting QP or distributive QP in subject position:

(99)   a.   Some/one of the students visited more than two girls.
       b.   Every student visited fewer than three girls.

An interrogative QP is predicted to take wide scope with respect to any other QP in
its clause, other than a group denoting QP in Spec, RefP – which is borne out in most
cases, though it is not borne out in the type illustrated in (32a).

Beghelli and Stowell (1997) claim that they can predict that, of the seemingly similar constructions in (100a)–(100b) and (101a)–(101b), only the former have inverse scope:

(100)   a.   An American flag was hanging in front of two buildings.
        b.   Blossoms sprang out of two rosebushes.

(101)   a.   Five guards stood in front of two buildings.
        b.   Three blossoms sprang out of two rosebushes.

Simple indefinites (those supplied with *a/an*, and bare plurals), like *an American flag*, and *blossoms* in (100), have the possibility of a VP-internal bound variable interpretation; hence, they can have narrow scope with respect to a group-denoting QP occupying ShareP. In (101a) and (101b), however, the group-denoting subject QP will stand in Spec, RefP and the other one in Spec, ShareP; therefore, inverse scope is impossible. (It is not quite clear, though, why it could not be the other way around, with the locative taking scope in Spec, RefP and the subject in Spec, ShareP.)

It also can be seen from structure (96) that negation can have scope only over an object-counting QP, occupying Spec, AgrOP (see (102a)) but not over a subject-counting QP, occupying Spec, AgrSP (see (102b)):

(102)   a.   The students didn't read two books.
        b.   Two students didn't read this book.

The scope of negation cannot extend over a group-denoting QP, either, unless it is a bare indefinite or an *every* phrase acting as a VP-internal bound variable, as in (103a) and (103b):

(103)   a.   A student didn't write this book.
        b.   Every student didn't write an essay.

(96) also accounts for why an *each* QP more often takes wide scope than, for example, an *every* QP: an *each* QP can only sit in Spec, DistP. That is why an *each* QP in the scope of negation is marginal, at best – compare:

(104)   a.   John didn't read every book.
        b.   ??John didn't read each book.

Compare also the minimal pair in (105):

(105)   a.   One boy didn't read every book.
        b.   One boy didn't read each book.

In the case of (105a) the scope order *one > not > every* is perfectly possible, with *every* interpreted as a VP-internal bound variable. In (105b), on the other hand, the *each* QP must be raised to Spec, DistP; hence, only the opposite scope order (*each > one > not*) exists.

It still remains a question why (106) is marginal:

(106)   ??Every boy didn't leave.

Beghelli and Stowell claim that only *each* QPs are endowed with a [+Distributive]
feature that must be checked in Spec, DistP; *every* QPs are underspecified for
[Distributive]. Accordingly, *every* QPs only move to Spec, DistP if they are not
bound as variables by a closer binder such as negation.
   Szabolcsi (1997) argues against semantically blind scope-assigning rules like that
in (107) on a semantic basis:

(107)   α [$_D$ … β …] ⇒ (α scopes over β)

   She (Szabolcsi 1997) provides further minimal pairs in the case of which a seman-
tically blind rule would yield a wrong result. For example, not all direct-object QPs
can scope over the subject (cf. (108a) and (108b)), and not all direct-object QPs can
scope over negation (cf. (109a) and (109b)):

(108)   a.   Three referees read every abstract.
                  every N > three N
         b.   Three referees read few abstracts.
                  *few N > three N

(109)   a.   John didn't read many abstracts.
                  many N > not
         b.   John didn't read few abstracts.
                  *few N > not

As she points out, it is not the case that the missing readings are incoherent –
because they can be expressed by different constructions, such as those
in (110):

(110)   a.   Few abstracts were read by three referees.
                  few N > three N
         b.   Few abstracts were not read by John.
                  few N > not

Szabolcsi (1997) claims that quantification involves a variety of distinct, semanti-
cally conditioned processes. She distinguishes two basic types of scope-taking
mechanisms:

 (i)   The noun phrase introduces a logical subject of predication (i.e. basically a dis-
         course referent).
 (ii) The noun phrase performs a counting operation on an independently defined
         predicate denotation.

The two mechanisms, associated with different left-peripheral positions, result in
different interpretations. These can be observed particularly clearly in Hungarian,
where the left-peripheral positions in question (those identified by Beghelli and

Stowell 1997) are filled visibly, at S-structure. Compare, for example, the following Hungarian examples:

(111)   a.   Tegnap   sok   diákunk   meg   betegedett.
             yesterday   many   student.our PREFIX   got.sick
         b.   Tegnap   sok   diákunk   betegedett   meg.
             yesterday   many   student.our got.sick   PREFIX

(111a), with the quantified phrase in Spec, DistP, involves a "subject of predication" mode of operation (i.e. we take a set of students and claim that each of them fell ill). In contrast, (111b), with the quantified phrase in Spec, AgrSP, involves a counting operation: we take those who fell ill, and count our students among them.

10   The theory of overt quantifier movement

Kayne (1998) adopts Beghelli and Stowell's (1997) claim that quantified phrases occupy various designated landing sites in the left periphery of the sentence. What is new in his approach is the claim that movement to scope position invariably takes place in visible syntax; in other words, it always means the movement of phonologically realized phrases. Constructions in which an operator nevertheless does not c-command its scope at S-structure involve the subsequent movement of the phrase c-commanded by the operator into a position above the operator.

Kayne's (1998) starting point is the Norwegian construction in (112a)–(112b), in which the negative object is assumed to occupy the specifier of NegP, a projection above VP and below CP. As shown by (112c)–(112d), the preposing of a negative object into Spec, NegP is obligatory, and movement to Spec, NegP is restricted to negative objects:

(112)   a.   [$_{CP}$ Jon   [$_{C'}$ leser   [$_{NegP}$ ingen   romaner]]]
                   John   reads   no   novels
         b.   [$_{CP}$ Jon   [$_{C'}$ har   [$_{NegP}$ ingen   romaner   lest]]]
                   John   has   no   novels   read.
         c.   *Jon   har   lest   inger   romaner.
                   John   has   read   no   novels.
         d.   [$_{CP}$ Jon   har   [$_{NegP}$ ikke   [$_{VP}$ lest   noen   romaner]]]
                   John   has   not   read   any   novels.

Kayne (1998) claims that the movement of *no*-phrases to Spec, NegP takes place in English, as well – see (113). However, in sentences containing a lexical verb, its effect is covered by subsequent VP movement into a higher specifier position – see the derivation in (114):

(113)   a.   [$_{CP}$ John [$_{C'}$ is [$_{NegP}$ no Einstein]]]
         b.   [$_{CP}$ John [$_{C'}$ has [$_{NegP}$ no car]]]

(114)   John reads no novels ⇒ (negative phrase preposing)
        John no novels$_i$ reads t$_i$ ⇒ (VP preposing)
        John [reads t$_i$]$_j$ no novels$_i$ t$_j$

Nobody and *somebody* do not occupy the same positions in this framework, which is also clear from the following minimal pair:

(115)   a.   Nobody is bound to be there.
        b.   Somebody is bound to be there.

Whereas (115a) cannot be assigned the interpretation in (116a), with *nobody* having narrow scope, (115b) can be assigned the interpretation in (116b), with *somebody* having narrow scope:

(116)   a.   *'There is bound to be nobody there.'
        b.   'There is bound to be somebody there.'

Nobody could only assume narrow scope in the Spec, NegP of the embedded clause. Its movement from there to the matrix subject position, however, would be improper (A'-to-A) movement; that is why its narrow-scope reading is impossible.

   The asymmetrical scope possibilities of subjects and objects occur in this theory for free. Consider again the minimal pair quoted above under (5a) and (6a), repeated here as (117):

(117)   a.   I demand that you marry no one.
        b.   I demand that no one marry you.

The negative object of (117a) assumes wide scope through the following series of movements:

(118)   a.   I demand that you marry no one ⇒ (neg preposing)
        b.   I no one$_i$ demand that you marry t$_i$ ⇒ (VP preposing)
        c.   I [demand that you marry t$_i$]$_j$ no one$_i$ t$_j$

The subject of (117b) cannot assume wide scope simply because a subject cannot be moved across a filled complementizer into a matrix A'-position (a constraint traditionally derived from the ECP).

   A similar analysis is applied to *only* and *even* phrases, as well. The fact that these phrases follow their operator head *only* or *even* instead of appearing in its specifier position is derived by the further movement of the head to a higher W position, where it has its + w [word order] feature checked. That is:

(119)   a.   … only criticized Bill ⇒ (movement to Spec, *only*)
        b.   … Bill$_i$ only criticized t$_i$ ⇒ (raising of *only* to W)
        c.   … only$_j$ Bill$_i$ t$_j$ criticized t$_i$ ⇒ (VP preposing)
        d.   … [criticized t$_i$]$_k$ only$_j$ Bill$_i$ t$_j$ t$_k$

The theory does not appear to be particularly suitable for the handling of scope ambiguity; Kayne (1998) has to assume – in a way contradicting his program – that scope ambiguity arises from the possibility of reconstruction. Consider the following German example:

(120)   weil   irgendjemand   auf   jeden   gespannt   ist
        because   someone   for   everyone   anxious   is

Irgendjemand originates in a position below *auf jeden*, into which it can be reconstructed. (As suggested in Kayne (1998, fn. 110), the verb-final order may be the result of V movement to I, and the preposing of the verbless VP to Spec, IP. *Auf jeden* is in the specifier of a Distributive Phrase.) In (121), however, in which the universal quantifier is in an infinitival object presumably left in situ, *jemand*, the matrix subject, does not originate in a position below that of *jeden* – that is why *jeden* cannot have wide scope:

(121)   weil   jemand   versucht   hat   jeden   reinzulegen
        because   someone   tried   has   everyone   to.cheat

The question remains why the English equivalent of (121) is ambiguous:

(122)   (since) someone has tried to cheat everyone

Compare also:

(123)   At least one student has tried to fool every professor.

In these English examples, the *every* phrase is claimed to have been raised overtly into the matrix clause, followed by VP preposing. Compare:

(124)   a.   Someone has tried to cheat everyone. $\Rightarrow$ (distributive phrase preposing into
             Spec, DistP)
        b.   Someone everyone$_i$ has tried to cheat t$_i$ $\Rightarrow$ (VP movement to Spec, W)
        c.   Someone [has tried to cheat t$_i$]$_j$ everyone$_i$ t$_j$.

Kayne (1998) claims that in German, VP movement is systematically absent.

   Kayne's theory of scope interpretation, eliminating post-spell-out A′-movement, simplifies grammar at the cost of deriving extremely complex sentence structures with projections of no independent motivation (e.g. WPs).

11   Scope and lexical semantics

Farkas (1997) claims that structural considerations underdetermine scope; they determine a necessary condition of an expression taking scope over another one, which, however, is not a sufficient condition.

   Here is a case illustrating Farkas' point. The scope of universal quantifiers is usually clause-bound (unlike the scope of existentials, which is unbounded). For example:

(125)   a.   A politician said that every city should be the capital.
        b.   A politician said that the President lives in every city.

In these sentences, the universal cannot have "extra-wide scope," extending over the existential in the main clause, by any means. On the other hand, its extra-wide scope is perfectly possible in the following sentence:

(126)   A student made sure that every invited speaker had a ride.

The structural conditions are identical in (125) and (126); what is different is, according to Farkas and Giannakidou (1996), the lexical semantics of the main predicates. This is the generalization that accounts for the possibility of the wide-scope reading of the universal in (126):

(127)   Extra-wide scope of a distributive universal over an indefinite is possible if the two arguments are co-participants in some eventuality *e* in virtue of the lexical semantics of the predicates involved. In this case, the two arguments are related in some relation *R*.

12   Scope and prosody

The fact that the relative scope of negation and focus, and that of negation and a universal quantifier, is affected by prosody has been known for a long time (see Jackendoff 1972; Büring 1997; Krifka 1998; and section 9.1). Hunyadi (2002) argues that relative scope is universally expressed by sentence prosody. In the type of language represented by, for example, Hungarian, an operator has scope over the intonational phrase that it is the head of. The head of an intonational phrase is the constituent bearing primary stress; hence, a stressed quantifier has scope over the unstressed quantifiers of the same intonational phrase. Operators heading separate intonational phrases are ambiguous scopally (unless they are inherently ranked and occupying different positions in a stipulated hierarchy of operators, in which the focus is preceded by quantifiers, and quantifiers are preceded by so-called sentence operators).

Jackson (2006) tested how prosody affects the interpretation of English quantified sentences containing an indefinite and an *every* NP, and an indefinite and *a few* NP. Participants were presented a test sentence and a pair of pictures representing its two scope readings, and were asked to read the test sentence so as to convey one of the readings. Speakers tended to express the wide scope of the indefinite by lengthening.

13   The processing of quantified sentences

A much-studied question of psycholinguistics is how speakers resolve potential scope ambiguities; what clues determine their scope preferences. The first studies, such as Ioup (1975); Catlin and Micham (1975); Micham et al. (1980); Gil (1982); Fodor (1982); Johnson-Laird, Byrne, and Tabossi (1989); and Gillen (1991), simply collected speakers' judgments. More recent studies try to avoid making speakers conscious of the interpretive options; they compare decision times in contexts eliciting different interpretations of the same sentence. For example, Kurtzman and McDonald (1993), Tunstall (1998), and Villalta (2003) employed word-by-word self-paced reading. Subjects were given a quantified sentence (S1) followed by a

continuation sentence (S2), which was consistent with only one of the readings of S1. For example:

(128)   Kelly showed a photo to every critic last month.
   a. The photo was of a run-down building.
   b. The photos were of a run-down building.

If the relative scope of the quantifiers had been determined by the time the subject and the verb of S2 were read, then there were slower reading times on those words if they did not match the reading assigned to S1. The preferred scope reading turned out to be determined by various – sometimes conflicting – factors. Thus the universal–indefinite scope order is preferred to the indefinite–universal order (see also Anderson 2004; Filik, Paterson, and Liversedge 2004); direct scope is preferred to inverse scope; as is also known from the earlier tests, subject wide scope is preferred to object wide scope; and agent wide scope is preferred to patient wide scope.

   Musolino (2009) tested the processing of doubly quantified sentences among English-speaking preschoolers. He found that children can access the readings resulting from scope dependence (i.e. they readily accept sentences like *Three boys are holding two balloons* if the total number of balloons shown in the picture that is being talked about is six). A series of experiments have shown that preschoolers can understand the scope interaction of negation and *all*, too. English children tend to assign wide scope to the first operator (Musolino, Crain, and Thornton 2000). However, in the case of Kannada, a left-branching language, children prefer inverse scope, which indicates that scope is determined by structural hierarchy (c-command) rather than linear order (Lidz and Musolino 2002). Preschoolers can also access inverse scope readings; however, they need more contextual-pragmatic support than adults (Musolino and Lidz 2006). Zhou and Crain (2009) found that Mandarin Chinese-speaking children start off with a flexible scope relation between the universal quantifier and negation; they do not yet have the constraint blocking the inverse scope reading in adult language. In other words, children's grammar allows flexibility in the mappings between syntax and semantics. Interestingly, children interpret *each* differently from adults; they find a sentence like *Each flower was in a vase* ungrammatical in a situation also involving empty vases (i.e. they understand *each* as a quantifier over situations rather than objects) (see Philip 1995; Brooks and Braine 1996; Kang 2001; Brooks and Sekerina 2006).

14   Quantifier scope and Universal Grammar

Questions of encoding and interpreting operator scope have been in the focus of interest in generative linguistics since the 1970s; however, the answers have so far been based on a handful of languages. Studies aiming to account for cross-linguistic differences have also been very rare. Williams (2003) argues that syntactic economy is manifested in a principle of *shape conservation*, striving for the isomorphy of theta structure to case structure, of case structure to S-structure, and also of logical structure (i.e. scope relations) to S-structure. Language variation arises when

competing demands are put on a single representation by different representational relations, and languages give preference to different demands. In the same vein, Bobaljik and Wurmbrand (2012) assume "soft" economy constraints that value a particular type of correspondence between LF and PF representations (among them, scope at LF matched by precedence at PF). Scope rigidity (i.e. the lack of scope ambiguity) is not a property of languages, but of specific configurations, and the distribution of rigidity effects is largely predictable from independent variation in the syntactic resources of languages (e.g. from the possibilities for scrambling).

15   Conclusion

Research in scope relations primarily relies on introspective data, that is, data gathered in informal ways by eliciting intuitive speaker judgments. There is a growing, but still not huge, amount of data from other resources (psycholinguistic experiments and corpus-linguistic methods). Introspective data have to be compared to other data types, which are especially important in cases where there is disagreement about the (un)availability of scope readings. There are few in-depth, comprehensive analyses of scope relations in single languages, which would be a precondition for investigating the cross-linguistic variation in scope relations. The research, especially in the 1990s, made clear that the scope of quantifiers depends on certain properties the quantifiers have. The exact nature of these properties is not yet settled, and neither is the question of how to account for them in a theoretical approach to scope. There are several competing views of how to locate scope at the interface between syntax and semantics, views that differ in the extent that syntax determines scope.

SEE ALSO: Inverse Linking; Multiple-*Wh*-Questions; Quantifier-Float; Reconstruction, Binding, and Scope; Unexpected Wide-Scope Phenomena

Note

1. Postverbal word order in Hungarian is free; hence, if a doubly quantified construction like (48a) or (48b) is preceded by a focus or a negative particle, which attracts the verb across the quantifiers, the relative scope of the two postverbal quantifiers cannot be unambiguously reconstructed:

   (i) Jánost   mikor   hívta   meg   **mindkét   lány   többször   is**?
        John-ACC   when   invited   PRT   both   girl   several.times   DIST
        'When was it that each of the two girls invited John on several occasions?'
        'When was it that on several occasions, John invited both girls?'

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