The syntax of scope and quantification

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0. Introduction

The initial breakthrough in our understanding of natural language quantification came with Frege's insight that quantifiers are operators prefixed to an open sentence, binding a variable inside it. An examination of predicate logic formulae highlights features of the logical calculus that continue to be of relevance in current thinking on the topic of quantification:

1a. $\forall x$ [student(x) $\rightarrow$ study(x)]
 b. $\forall x \exists y$ like(x,y)
 c. $\exists y \forall x$ like(x,y)

A quantifier has scope over the formula to which it is attached: [*student(x)* $\rightarrow$ *study(x)*] in (1a), for example, is the scope of $\forall$. When a quantified formula itself includes a quantifier, the relational dimension in quantification emerges. We can then talk about wide or narrow scope: $\forall$ has scope over $\exists$ in (1b), and $\exists$ over $\forall$ in (1c). The syntax of predicate logic also allows for complex interactions between quantifiers and other scopal expressions, such as negation and intensional operators.

Though Frege's approach captured many important insights about natural language, the problem of deriving the appropriate logical forms from sentences of English grammar was not dealt with. The challenge of bringing natural language syntax in closer alignment with logical structure was first successfully met in Montague's analysis of English (Montague 1974, see also Dowty, Wall and Peters 1981). There are two related aspects of his analysis that are significant. The theory of generalized quantifiers, with its ability to quantify over properties, allows for a unified account of all types of quantifiers. These include proper names, universals, definites, indefinites, and complex quantifiers built on them, as well as quantifiers that cannot be captured by first order predicate logic, like *few* and *most*. It also allows for a compositional treatment of noun phrases. Thus *every student* has a denotation that is built up from the meanings of its constituents: it denotes the set of properties that include the common noun set in its denotation. This is a significant departure from predicate logic, where the components of meaning associated with the noun phrase are dispersed over the formula.

Montague claimed an inherent logical structure for English, positing semantic transparency of the kind seen in predicate logic formulae. The disambiguated structures in (2b) and (2c), for example, are abstract derivational histories of the sentence in (2a). The semantics he provides for such structures adequately captures the ambiguity of (2a):

2a. Every student likes some book.
 b. [every student$_i$ [Some book$_j$ [he$_i$ likes he$_j$]]]

c. [Some book$_j$ [every student$_i$ [he$_i$ likes he$_j$]]]

Generalized quantifier theory, unlike predicate logic, makes it possible to interpret quantifiers in situ. This is particularly straightforward in the case of quantifiers in subject position. In addition to (3b), where the universal forms an operator-variable chain with the pronoun in subject position, a syntactic analysis without such a relation is also possible (3c). (3b) and (3c) have the same truth conditions, they are true if and only if the property *sang* is one of the properties denoted by *every child*. In (3b), an open sentence has to be converted into a predicative term and then applied to the function denoted by the quantifier (see also Heim and Kratzer 1998). In (3c), the denotation of the predicate can combine directly with the denotation of the subject:

3a. Every child sang.
b. [Every child$_i$ [he$_i$ sang]]
c. [Every child [sang]]

It is also possible to interpret quantifiers in object position directly by having transitive verbs take generalized quantifiers as their first argument. This involves some complexity in the interpretive procedure but Montague argues that the complexity is desirable, particularly in the case of intensional verbs.

Montague's system, then, represents significant advances in the analysis of natural language quantification. Nevertheless, it inherits the weakness of overgeneralization inherent in Frege's approach. Not every possible structural analysis of a natural language sentence correlates with intuitively available readings for that sentence. The study of quantification within the generative tradition since Montague can be characterized as a search for principled ways of regulating scopal dependencies and interactions. The goal has been to find ways to derive all and only the set of logical representations that accord with speakers' intuitions about possible readings.

In section 1 I trace some of the major landmarks in our understanding of scope and scope interaction since Montague's seminal work, focusing primarily on quantified noun phrases and wh expressions. In section 2, I discuss the phenomena of quantifier split and quantifier float, showing how the challenges posed by syntactic deviations from the normal form of quantification have been addressed in research on the topic. Finally, in section 3 I turn to the scope marking and copy constructions, illustrating their special properties by comparing them to regular wh-extraction.

1. The Syntax of Scope

Montague's account of the proper treatment of quantification is the theoretical baseline for further developments in syntactic and semantic theories of scope. In reviewing these developments, our primary focus will be on the syntactic literature. We will refer to semantic proposals along the way, where they are relevant for the syntactic theory under discussion. (For discussion of the acquisition of scope, see chapter 25, sect. 6.4.)

1.1 Quantifier Scope and Logical Form

May (1977, 1985) marks a crucial point in the study of scope within the Government and Binding tradition (Chomsky 1981, 1986). The following principles governing scope, proposed in May (1985), highlight the original contribution of his approach:

4a. *The Condition on Quantifier Binding*: Every quantified phrase must properly bind a variable.
b. *Condition on Proper Binding*: Every variable in an argument position must be properly bound.
c. *C-command*: α c-commands β iff every maximal projection dominating α dominates β, and α does not dominate β.
d. *Scope Principle*: Mutually c-commanding quantifiers can take scope in either order.

By requiring a strict correspondence between operators and variables, vacuous quantification is ruled out. Furthermore, these conditions effectively make Quantifier Raising obligatory, resulting in logical structures isomorphic to predicate logic formulae. While their interpretive import is essentially the same as that of Montague's derivational analyses, the significance of May's account is that it builds in syntactic constraints on scope, analogous to those observed in overt forms of displacement, such as topicalization and wh-movement. The existence of such constraints gives theoretical bite to the notion of an abstract level of analysis by making explicit claims about the way it is derived. Logical Form (with capital letters) within generative syntax draws its inspiration from the notion of logical form (in small letters) in the philosophical tradition, but is distinct from it. LF refers to a level of syntax intermediate between surface form and semantic interpretation, lf to representations of the logical calculus. As a syntactic construct, LF provides a means for addressing the challenge of overgeneralization that besets quantification theory.

Conceiving of Quantifier Raising as a syntactic rule provides a general explanation for some of the restrictions on quantifier scope that had been observed earlier. As discussed by Rodman (1976), for example, [$_{PP}$ *in every corner of the room*] can take scope over [$_{DP}$ *a bone*] in (5a) but not (5b). This follows since the universal quantifier is inside a complex DP and cannot move to a position above the existential:

5a. There is a bone in every corner of the room.
b. # There is a bone which is in every corner of the room.

Similarly, the bound variable readings in (6) are predicted to be blocked. To get the desired reading in (6a), QR would have to occur out of a coordinate construction. These can be subsumed under the general label of locality violations (see chapter 18) and whatever principles of syntax rule out the formation of overt dependencies in these constructions can be tapped to rule out the creation of problematic covert dependencies at LF. Similar considerations apply to (6b), where a bound variable reading would require the quantifier to move over a variable to its left, a weak crossover (WCO) violation.

6a. * Every girl$_i$ is here and she$_i$ wants to study.
b. * His$_i$ mother loves every boy$_i$.

May puts the rule of QR to use in explaining other complex paradigms. (7a)-(7b), with a universal and a wh-expression, display a subject-object asymmetry. When the universal is in subject position and the wh binds a trace in object position (7a), a pair-list answer can be given, with individual students matched up with objects purchased (7c). When the wh binds a subject trace and the universal is in object position, as in (7b), such an answer is not possible:

7a. What$_i$ [did every student buy t_i]?
b. Who$_i$ [t_i bought every book]?
c. John bought *Namesake*, Bill bought *Anna Karenina* and Sue bought *The Idiot*.

(7b) can only be answered by naming an object such that every student bought that object, the individual answer. This is, of course, in contrast to sentences with ordinary quantifiers where no subject-object asymmetry is observed with respect to scopal interaction. May's explanation rests on the assumption that the scope domain of QR is IP, not CP. That is, locality is assumed to be a distinctive feature of QR. This yields the following potential LF's for (7):

8a. [$_{CP}$ what$_i$ [$_{IP}$ every student$_j$ [$_{IP}$ t_j buy t_i]]] *LF for 7a*
b. * [$_{CP}$ who$_j$ [$_{IP}$ every book$_i$ [$_{IP}$ t_j buy t_i]]] *LF for 7b*
c. [$_{CP}$ who$_j$ [$_{IP}$ t_j [$_{VP}$ every book$_i$ [$_{VP}$ buy t_i]]]] *LF for 7b*

In (8a) the wh and the universal mutually c-command each other. The IP dominating the universal does not count as a maximal projection, it is merely a segment of another maximal projection. According to the Scope Principle in (4d), the scope order of the two quantifiers is open. If the wh takes wide scope it yields the individual answer, if the universal takes wide scope it yields the pair-list answer. In order for this to happen in the case of (7b), an LF like (8b) would need to be derived. This is not a well-formed LF since there is an ECP violation with respect to the subject trace, which is neither lexically governed by the verb nor locally governed by its antecedent. An LF like (8c), which has the universal adjoined to VP, does not violate ECP but neither does it create the conditions under which the Scope Principle could apply. The wh obligatorily takes scope over the universal and the pair-list answer remains unavailable.

May's appeal to VP adjunction has independent motivation. He points to the ambiguity of sentences involving ellipsis (see chapter 19), discussed by Williams (1977). In (9a), QR of the universal to IP yields the distributed reading, while QR to VP yields the collective reading. This contrasts with (9b) which has only the collective reading. This is as expected if QR to IP is blocked when a wh-operator binds a subject trace. The only remaining option is adjunction to VP, resulting in the collective reading:

9a. Max saw everyone before Bill did.
b. Who saw everyone before Bill did?

Among the other scopal phenomena for which May's account provides an explanation are cases such as (10). (10a) is a case of inverse scope where a universal

inside the complex DP takes scope over the existential. This is accounted for by allowing adjunction to DP. (10b), a raising construction, differs from the control construction in (10c), in allowing the universal inside the embedded clause to take scope over the existential in a higher clause (on raising *vs* control, see chapter 16). In order to account for this, May admits the possibility of quantifier lowering in (10b), as part of the general option that moved expressions have to reconstruct to their position of origin (see Barss 2001 and Sportiche 2005). Once this happens, the Scope Principle ensures that the two quantificational expressions can interact and the relevant reading emerges:

10a. One politician from every city will attend the convention.
b. Some politician$_i$ is likely [t_i to address every rally in John's district].
c. Some politician$_i$ wants [PRO$_i$ to address every rally in John's district].

May's conception of QR as a syntactic operation subject to constraints regulating WCO and island violations entails that proper names and definites, which do not show sensitivity to these effects, can be interpreted in situ without the benefit of covert movement. This is in line with the flexible approach to DP interpretation (Partee and Rooth (1983), Partee (1987)), which takes the basic meaning of proper names and definites to be at the level of entities, while allowing them to shift to generalized quantifier interpretations when necessary.

There had been attempts to regulate scope possibilities directly on surface structures, most notably in Reinhart (1979), but they had not been particularly successful (see Chierchia and McConnell-Ginet 1990 and Szabolcsi 2001 for discussion). May's approach, which taps syntactic principles regulating movement in deriving Logical Form, is the first serious attempt that made substantive headway in limiting scopal interactions. It is worth keeping in mind, though, that his Logical Forms are not semantically transparent. Due to the *Scope Principle*, a single LF can map on to two lfs. For example, [$_{IP}$ everyone$_i$ [$_{IP}$ someone$_j$ [$_{IP}$ t_i saw t_j]]] corresponds to $\forall x\ \exists y\ saw(x,y)$ and $\exists y\ \forall x$ [*x saw y*]. This is a departure from Montague's structural analyses, which provided disambiguated structures for interpretation.

1.2 Extensions of the Theory to Wh-Movement

There have been several extensions and refinements of the theory of quantifier scope and Logical Form since May. Huang (1982) was the first to test its cross-linguistic applicability, focusing primarily on Chinese, a *wh-in-situ* language. His core claims can be illustrated with the following:

11a. Lisi mai-le sheme (ne)
Lisi buy-ASP what Q
"What did Lisi buy?"
b. ni xiang-zhidao [Lisi zeme mai-le sheme]
you wonder Lisi how bought-ASP bought
"For what object x, you wonder how Lisi bought x?"
* "For what manner x, you wonder what Lisi bought in that manner?"
c. ni zui xihuan [piping shei de shu]

You most like criticize who REL book
"For which x, you like the book that criticizes x?"

As (11a) demonstrates, wh-expressions remain in their base positions at S-structure. Additionally, there is a morpheme optionally identifying the clause as interrogative. Huang treats *wh-in-situ* as moving at LF in order to be interpreted. Under this view, fronting and non-fronting languages differ only in the level at which movement takes place. He shows that in a context like (11b) where the matrix verb selects a +WH complement, it is possible for the object *wh-in-situ* to be interpreted with matrix scope, but not the adjunct. The availability of a wide scope reading for the embedded object reveals an important property of LF movement that Huang argues for, namely the insensitivity to syntactic islands. This is further shown by the possibility of a direct question interpretation for (11c), where the wh-expression is contained inside a complex DP. Huang argued that movement at LF differs from overt movement in not being constrained by Subjacency, only by ECP. This is a non-trivial claim and has been challenged by Choe (1984), Nishigauchi (1986), Pesetsky (1987) and Dayal (1996).

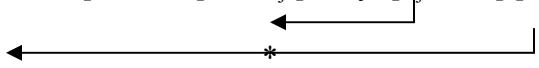
Nishigauchi argues that although the Japanese counterpart of (11c) does have a direct question interpretation, the Japanese translation for (11b) can only be understood with both embedded wh's taking narrow scope:

12a. Tanaka-kun-wa[Mary-ga doko-de dono hono-o katta]-ka sitte-imasu ka
Tanaka -TOP Mary-NOM where which book-ACC bought Q know Q
"Does Tanako know where Mary bought which book?"
*"For which book x, does Tanako know where Mary bought x?"
b. Kimi-wa [dare-ga kai-ta] hono]-o yomi masi-ta ka
You-TOP who-NOM write book-ACC read Q
"For which x, you read the book that x wrote?"

Nishigauchi takes the data as evidence that the scope of *wh-in-situ* is constrained by Subjacency. He adopts the unselective binding approach to wh-expressions and captures the facts by requiring wh in situ to be bound by the closest Q-operator (see also Pesetsky 1987). The apparent wide scope interpretation of (12b), he suggests, is due to local movement of the wh in situ to a DP adjoined position. Binding of the wh by the Q operator becomes possible after large scale pied piping of the DP.

A different approach to these facts is proposed by Watanabe (1992). He keeps to the view that LF wh movement is not subject to Subjacency, positing S-structure movement of an abstract wh-element in Japanese to account for the wh-island effect noted by Nishigauchi. As shown in (13), a wide scope reading for *dono hono-o* "which book" is not possible in Japanese because the null operator associated with it would have to cross a wh-island in order to reach the matrix Spec position:

13. [$_{CP}$ OP$_i$ [Tanaka [$_{CP}$ OP$_j$ [Mary [t$_j$ doko] [t$_i$ dono hono] bought] Q] know] Q]



Watanabe's proposal introduces an interesting division among *wh-in-situ* expressions. They can either have invisible operator movement at S-structure or they can move

covertly at LF. The former is marked by island sensitivity, the latter is not. Watanabe's view of Japanese wh is based on morphological considerations as well. According to him, the postulation of a null wh-operator that moves to associate with the overt Q morpheme fits in with the fact that the same expressions are interpreted as simple indefinites when there is no Q morpheme. In these cases, there is no null operator inside the noun phrase. For a recent account that relies on the role of interpretation in addressing these facts, see Shimoyama (2001).

Dayal (1996), like Pesestky and Nishigauchi, also argues against Huang's claim that LF movement of *wh-in-situ* is immune to Subjacency restrictions, but does so using facts that were previously thought to be evidence for such movement:

14a. Which student knows where Mary bought which book?
b. [which student$_i$ [t_i knows [which book$_j$ where$_k$ [Mary bought t_j at t_k]]]]
c. [which book$_j$ which student$_i$ [t_i knows [where$_k$ [Mary bought t_j at t_k]]]]

As noted originally by Baker (1970), the question can be answered by naming a single individual who knows the details of Mary's shopping or by a list pairing individuals and books. The first answer is thought to be derived by the LF in (14b), the second by the LF in (14c). Dayal (1996), taking her cue from Kuno and Robinson (1972), argues against this position on the basis of wide ranging cross-linguistic evidence.

Languages like Hindi do not allow wide scope interpretations for *wh-in-situ* inside finite complements, as shown by (15a). Yet the counterpart of (14a) admits pair-list answers. Languages like Bulgarian which obligatorily front all wh's, as shown in (15b), do so as well, even though the embedded wh is stuck in the embedded Spec position. Finally, an intervening clause of the kind seen in (15c) rules out the possibility of pair-list answers even though the intervening clause does not present an island:

15a. anu jaanti hai ki uma-ne kyaa khariida.
Amu knows that Uma what bought
"Anu knows what Uma bought."
b.koj znae kakvo kade e kupila Mariya
who knows what
c.Which student$_i$ [t_i said [that John knows [where Mary bought which book]]]]?
d. [[where did Mary buy which book]$_j$ [which student]$_i$ [t_i knows the answer to t_j]]

Dayal argues that the scope of *wh-in-situ* is local, just like that of quantified expressions. The effect of wide scope is achieved when there is a particular wh-configuration – there should be a wh-expression in the matrix clause and there should be a multiple wh-question as a complement of the matrix verb. The embedded multiple wh-question in such cases can be interpreted as a second order question. This family of questions can interact with the wh-expression in the immediately higher clause and yield a pair-list answer. As shown schematically in (15d), questions like (14a) are treated as multiple questions pairing values for *which student* with values for questions of the form: *where did Mary buy book-x? where did Mary buy book- y?* (see Dayal 2005 for further details). This approach effectively explains the correlation between a local triangular constellation of wh expressions and the possibility of multiple-pair answers, and proposes a more

straightforward characterization of LF as obeying locality. On the other hand, it entails explanations that require a move away from simple first order semantics for wh-questions. As such, approaches that look for ways to regulate long-distance LF movement of *wh-in-situ* continue to have currency (see, in particular, Richards 1997).

1.3. Further Refinements of the Theory of Quantifier Scope and Logical Form

In this section I will briefly discuss three further developments in syntactic accounts of quantifier scope. Aoun and Li (1989) noted that quantified expressions in Chinese do not show the same scopal properties as English. That is, the counterpart of the classic *Someone loves everyone* has only one interpretation, the one that respects the surface order. They propose the following to capture scope effects:

16a. Scope Principle: A quantifier A has scope over a quantifier B if some part of A's A′-chain c-commands some part of B's A′-chain.
b. Minimal Binding Requirement: A variable must be bound by the most local A′ binder.

17a. $[_{IP}$ someone$_i$ $[_{IP}$ t_i $[_{VP}$ everyone$_j$ $[_{VP}$ loves $t_j]]]]$
b. $[_{IP}$ someone$_i$ $[_{IP}$ t_i $[_{VP}$ everyone$_j$ $[t_i$ loves $t_j]]]]$

In (17a), *everyone* cannot have scope over *someone* since it does not c-command any member of the latter's chain. The universal is prevented from adjoining to IP by the Minimal Binding Requirement. This results in a fixed scopal relation. This, according to them, is the situation in languages like Chinese. Alternatively, a subject may originate inside VP, as shown in (17b), resulting in a configuration where both quantifiers c-command some member of the other's chain. Crucially, in this case there is no violation of the Minimal Binding Requirement since the VP internal trace is an NP trace, not a variable. This is the source of the scopal ambiguity seen in English.

Aoun and Li's approach is successful in accounting for the fact that sentences like (18a) have only a clause-bounded reading for the universal while sentences like (18b) allows the universal to take wide scope over the wh in matrix spec. This assumes, of course, that pair-list answers are a result of wide scope of the universal over the wh:

18a. Some student thinks that every professor is a genius.
b. What do you think everyone brought to the party?

Since the wh originates in the embedded object position, its trace will be c-commanded by the universal, which can then take scope over it. The main results of their theory carry forward to the revised version of Aoun and Li (1993). Their work has been influential in prompting a closer look at scope freezing effects, particularly in double object constructions, and requiring that scope theories be held up to a high empirical standard. Like Huang's approach to LF, Aoun and Li's theory is informed by a serious attention to cross-linguistic differences in quantifier scope possibilities.

Another major development in the theory of quantifier scope is Hornstein (1995), who considers the idea of QR as a free adjunction operation to be problematic within the

assumptions of the Minimalist framework. He proposes that all phenomena for which QR is posited can be as well or better accounted for by A-movement to Spec positions of functional projections within IP. In particular, subjects move to Spec of AgrS and objects to Spec of AgrO. It is assumed that one member of each chain must delete, and depending on whether the head or the tail of the chain is deleted, different scopal relations are obtained:

19a. Someone loves everyone.
b. [$_{AgrS}$ someone [$_{AgrO}$ everyone [$_{VP}$ (someone) [$_{VP}$ loves (everyone)]]]]
c. [$_{AgrS}$ (someone) [$_{AgrO}$ everyone [$_{VP}$ someone [$_{VP}$ loves (everyone)]]]]
d. *[$_{AgrS}$ someone [$_{AgrO}$ (everyone) [$_{VP}$ (someone) [$_{VP}$ loves everyone]]]]
e. * [$_{AgrS}$ (someone)[$_{AgrO}$ (everyone) [$_{VP}$ someone [$_{VP}$ loves everyone]]]]

Hornstein adopts the Mapping Hypothesis of Diesing (1992), which requires presuppositional expressions to move out of the VP. Under the view that universals are presuppositional, the LFs in (19d) and (19e) are ruled out. The LFs that respect the Mapping Hypothesis, (19b) and (19c), deliver the two readings associated with (19a).

Of course, this has consequences for universals in subject position:

20a. Everyone loves someone.
b. [$_{AgrS}$ everyone [$_{AgrO}$ someone [$_{VP}$ (everyone) [$_{VP}$ loves (someone)]]]]
c. [$_{AgrS}$ everyone [$_{AgrO}$ (someone)[$_{VP}$ (everyone) [$_{VP}$ loves someone]]]]

d. *[$_{AgrS}$ (everyone) [$_{AgrO}$ someone [$_{VP}$ everyone [$_{VP}$ loves (someone)]]]]
e.* [$_{AgrS}$ (everyone) [$_{AgrO}$ (someone) [$_{VP}$ everyone [$_{VP}$ loves someone]]]]

The LF in (20b) where the lower members of both chains are deleted, as well as (20c) in which the higher member of the object chain is deleted, yield the subject wide scope reading. (20d) and (20e), LFs in which the higher member of the subject term is deleted, violate the Mapping Hypothesis. This means that there is no LF in which *someone* can take scope over *everyone*. Hornstein derives the ∃∀ reading as a subcase of the available ∀∃ reading. Among the situations that make (20b) or (20c) true are those in which the same individual happens to be loved by everyone.

Hornstein also extends his account to differences in scope possibilities in raising vs. control constructions (see chapter 16, where Hornstein's 1999 more recent approach to control as involving movement is also discussed), as well as the interaction of scope facts with binding theory (see chapter 15)):

21a. Someone is likely to meet everyone.
b. [$_{AgrS}$ someone is likely [$_{AgrS}$ someone to [$_{AgrO}$ everyone
[$_{VP}$ someone meet (everyone)]]]]

While the existential can take scope in any of the three positions in this case, if there is a pronoun in one quantified expression that is bound by the other, scope possibilities are reduced in order to meet the demands of variable binding. Hornstein achieves several

interesting results. He can derive the effect of QR while adhering to Minimalist assumptions about grammar, he can derive the locality associated with QR without stipulation, and he can capture an array of rather complex facts about scope. Even so, there have been serious challenges to his theory. Kennedy (1997), in particular, argues against Hornstein's analysis of Antecedent Contained Deletion (ACD) and maintains that QR cannot be dispensed with.

Fox (1995) brings a fundamentally different perspective to the theory of Logical Form, claiming that movements regulating quantifier scope are regulated by semantic calculations. That is, LFs are not evaluated with respect to absolute standards of well-formedness but rather enter into competition with each other. To illustrate, consider the two possibilities for (22a) admitted by May's account:

22a. Some student admires every professor.
b. $[_{IP}$ some student$_i$ $[_{IP}$ t_i $[_{VP}$ every professor$_j$ $[_{VP}$ admires $t_j]]]]$
c. $[_{IP}$ every professor$_j$ $[_{IP}$ some student$_i$ $[_{IP}$ t_i admires $t_j]]]$

While (22c) involves a longer movement for the universal than (22b), and is therefore a costlier operation, it is justified because the two outputs are semantically distinct. If the matrix quantifier were a proper name or another universal quantifier, however, considerations of economy would rule out adjunction to IP since there would be competition between a less and a more costly operation for the same semantic output.

The payoff of this approach is that it provides a natural explanation for some well-known problems in the theory of syntactic scope. Fox can successfully account for the fact that although the universal in standard cases of ellipsis loses its potential for wide scope, as demonstrated by (23a), it is able to take wide scope when there is a quantified subject in the ellipsis sentence (23b):

23a. Some student admires every professor and John does too.
b. Some student admires every professor and some administrator does too.

24a.*[[every professor$_j$ [some student admires t_j]] and [every professor$_j$ [John admires t_j]]]
b. [[every professor$_j$ [some student admires t_j]] and [every professor$_j$ [some adminstrator admires t_j]]

In the case of (23a), the LF with wide scope for the universal is ruled out because it has no semantic impact on the elided sentence after material from the antecedent is reconstructed in the ellipsis site (24a). In (23b), however, there is a difference between QR to VP and QR to IP, so the LF with universal wide scope is admitted (24b). Fox's approach marks a shift in the relation between syntax and semantics within the generative syntactic tradition. They are no longer considered autonomous components of grammar since semantic output regulates syntactic operations.

There are, of course, many other important proposals that have been made which I must set aside in the interests of space, referring the reader to Szabolsci (2001) and Kiss (2005), among others, for a more extensive survey.

1.4. The Checking Theory of Scope

The theories that we have looked at so far all have two properties in common. One, scope possibilities are determined by general principles governing syntactic dependencies rather than by properties of the particular quantifier. That is, the locus of explanation is the chain, not the members of the chain. Two, they all assume a semantics in which the operator binds an individual variable inside IP. The theories we will now consider represent significant departures with respect to these two dimensions.

A significant shift from the quantifier-blind approach is presented in Beghelli and Stowell (1997). Building on Liu (1990) and Szabolcsi (1997a), they take the fact that gaps in attested scope orders correlate with semantic classes of quantifiers seriously and reassess the standard assumption of the same scope for all quantifiers. They argue instead for an articulation of the landing site of quantifiers, claiming that different classes of quantifiers have designated landing sites based on their inherent semantic properties:

25a. [$_{\text{Ref P}}$GQP [$_{\text{CP}}$WhQP [$_{\text{AgrS-P}}$CQP [$_{\text{DistP}}$DQP [$_{\text{ShareP}}$GQP [$_{\text{NegP}}$NQP [$_{\text{AgrO-P}}$CQP VP]]]]]]]

b. QP-Types:

Interrogative QPs (WhQPs): *which N, what etc.*
Negative QPs (NQPs): *nobody, no N etc.*
Distributive Universal QPs (DQPs): *each* and, to some extent, *every*
Counting QPs (CQPs): *few, fewer than five, between six and eight etc.*
Group-Denoting QPs (GQPs): *a N, two N, the N etc.*

The basic idea is that movement of DPs is triggered by the demands of feature checking. Movement is to the Spec position of the relevant functional projection with the particular feature, as shown in (25a). It follows that for any given set of quantifiers in a sentence, the set of possible readings will be that subset which conforms to the scope hierarchy.

Beghelli and Stowell depart from standard assumptions in the generative syntax tradition in taking definites to also be scopal expressions. Along with indefinites, they can take widest scope, with a function roughly equivalent to a Topic. Additionally, a definite with a pronoun that is externally bound, or an indefinite, can take scope in ShareP, below WhQs and universal quantifiers. Finally, indefinites may be interpreted in situ. The system allows for the ambiguity observed in natural language while imposing non-trivial limitations on it:

26a. Each/every student read two books.
b. Two students read every/each book.

27a. Some/one of the students visited more than/fewer than three girls.
b. Every student visited more/fewer than three girls.

The sentences in (26) are ambiguous because there are two positions at which *two books/two students* can be interpreted, Spec of RefP which is higher than DistP, the landing site for the universal, or at Spec of ShareP, which is lower. The sentences in (27), on the other hand, are unambiguous because *more than/fewer than three girls* must

be interpreted in Spec of AgrO, which is below the positions at which the quantifiers in subject position can be interpreted (see also Szabolcsi 1997a).

Beghelli and Stowell introduce some further complexity into the system, in order to increase empirical coverage. For example, they include the possibility of interpreting *a N* and bare plurals, but not numeral NPs, as variables in the sense of Kamp (1981) and Heim (1982). This accounts for the contrast between (28a), originally due to Hirschbühler (1982), and (28b). *An American flag,* but not *five guards*, can be reconstructed below AgrAP, in its thematic position, and yield an inverse scope reading:

28a. An American flag was hanging in front of two buildings.
b. * Five guards stood in front of two buildings.

Beghelli and Stowell address at some length the scope properties of the universals *each, every* and *all (the)*. They classify the first two as strongly distributive. The data in (29) are predicted because the distributive semantics of *each* and *every* brings out the variation needed for the relevant reading of *a different boy* to emerge:

29a. Each boy/ every boy / *all the boys read a different book.
b A different boy read every book / each book / * all the books.

Note that the schema in (25) predicts that wh expressions can scope under Group Denoting NPs like *a N, two N, the N* but not under Distributive QPs *each* and *every*. We know, however, that the latter allow pair-list readings and if such readings arise from the quantifier scoping over wh, as often assumed, some modification of the schema is required. This question is taken up by Beghelli (1997) who argues that wh expressions can reconstruct to positions lower than DQP, into Spec of ShareP or their case positions. He also follows Szabolcsi (1996) in allowing universal quantifiers to be interpreted not only as generalized quantifiers but also as set-denoting terms. When they denote sets, they remain *in situ*. This gives rise to the following LF schema for questions with quantifiers:

30. $[_{CP}\ [\text{Q-Op}_i + t_i]\ [\ldots[_{AgrXP}\ [\text{every N}]_{k/i}\ldots]\ldots[_{AgrYP}\ \{\text{WhQP}\}_i\ldots]\ldots]]$

Beghelli takes the Q-operator in (30) to unselectively bind the reconstructed wh-phrase as well as the universal in its path. Subject-object asymmetries are captured because a universal in object position lies outside the path of the Q-operator and the reconstructed subject wh-phrase that it binds.

In the interest of space, we must set aside further issues regarding pair-list readings addressed by Beghelli (see also Szabolcsi 1994). We will also not discuss scope interaction between quantifiers and events and between quantifiers and negation (on the latter, see also chapter 21). We conclude by noting that the checking theory of scope represents a genuinely new approach to the problem of restricting QR. It gains strong empirical support from languages like Hungarian, studied by Kiss (1991), which transparently reflects in overt syntax the articulation of the scope domain proposed by Beghelli and Stowell for English. Kilega (Kinyalolo 1990), Chinese (Bartos 2000) and Palestinian Arabic (Khailaily 1995) have been claimed to be further instances of such

languages. It still remains somewhat mysterious, however, why cross-linguistic variation in the domain of quantification is negligible compared to variation in the domain of wh-movement, where *wh-in-situ* and obligatory multiple fronting mark two ends of a spectrum that includes several mixed cases as well.

1.5. Wh Expressions and Skolem Functions

So far we have considered accounts in which quantification involves a chain between an operator (represented by the DP, *every student, which boy* etc) and an individual variable (represented by a trace *t*). We now turn to accounts which depart from this view. In this section we will discuss Chierchia (1993), who argues for a functional trace to deal with subject-object asymmetries in questions with quantifiers. In the next, we will consider Reinhart (1997, 1998), who argues for choice functions over properties to account for unexpected wide scope effects for *wh-in-situ* and indefinites.

Chierchia (1993) builds on the view in Engdahl (1986) and Groenendijk and Stokhof (1984) that wh-expressions can quantify over functions from individuals to individuals (see Cooper (1983) and Hintikka (1986) for uses of functions in the semantics of definite and indefinite noun phrases). The domain of quantification for the wh expression, then, is not a set of individuals $\{a, b\}$, for example, but rather a set of functions, say $\{f_1, f_2, f_3, f_4\}$, from some set of individuals, $\{c,d\}$ to $\{a,b\}$: $f_1 = \{c \rightarrow a, d \rightarrow b\}$, $f_2 = \{c \rightarrow b, d \rightarrow a\}$, $f_3 = \{c \rightarrow a, d \rightarrow a\}$, $f_4 = \{c \rightarrow b, d \rightarrow b\}$. This means that the individual *a* can be referred to directly or via a function such as $f_2(d)$.

Chierchia argues for a syntactic reflex of this semantic option and uses it to explain the subject-object asymmetry in questions with quantifiers. Wh-expressions can optionally quantify over functions and when they do, their trace is doubly indexed. In (31b), for example, the subscripted i-index identifies the trace with the wh-operator *which book*, which quantifies over functions. The NP *book* provides its restriction by requiring the output of the function to be a book, for any argument y, as indicated in the underlined part of (31c). The superscripted a-index on the trace, which is bound by the c-commanding argument *every student*, is an individual variable. Intuitively, the a-index corresponds to the pronoun in functional answers, such as *Everyone read his favorite book* or *Everyone read her recently purchased novel,* and may be taken as having a pronominal character:

31a. Which book did every student read?
b. [which book$_i$ [every student$_i$ [t$_j$ read t$_i^j$]]]
c. $\lambda p\ \exists f\ [[\ \underline{\forall y[book(f(y))]} \wedge p = {}^{\wedge}\forall x[student(x) \rightarrow read(x, f(x))]]$

32a. Who read every book?
b. [who$_i$ [every book$_j$ [t$_i^j$ read t$_i$]]]

Since the quantification is over variables whose possible values are functions to a set of books an appropriate answer would name the function that picks out the proposition relating students and the book they read. That is, a wide scope wh-expression need not name a single book that every student read. Variation in interpretation is possible

without the universal actually taking scope over the fronted wh-expression because the functional trace is interpreted not as an individual but as a skolemized function *f(x)*, with x bound by the universal, as discussed above.

Let us see now how Chierchia exploits the syntax of the functional variable to explain the absence of a functional reading for (32a): ***Its author read every book.*** As shown in (32b), the i-index of the wh-trace is bound by the wh-expression *who*. In order for the universal term to bind the a-index of the trace, it must QR to a c-commanding position. This configuration, however, results in a WCO violation since the a-index has a pronominal character. Thus, Chierchia successfully accounts for a hitherto unnoticed subject-object asymmetry with respect to functional answers. The next step is to tie this in with the familiar subject-object asymmetry in pair-list answers.

The pair-list answer can be thought of as simply the graph of the function, as in Engdahl's original account, in which case the scope relations remain as represented for functional answers. It can also be argued to build on the functional representation, by extracting a set from the quantificational term and, in essence, distributing the question over members of that set. One reason for doing so is that all quantifiers can yield functional answers but the set of quantifiers that admit pair-list answers is restricted. For example, *every* and *each* allow for pair-list answers, *no* and *most* do not, while there is some debate about whether numerals like *two* or *three* do. What formal properties of quantifiers are relevant depends on what the core empirical facts are taken to be. I refer the reader to Chierchia (1993), Dayal (1996) and Szabolcsi (1997b) for detailed discussion of this point. For present purposes it suffices to note that taking the question to be formed out of sets extracted from the quantifier requires giving the quantifier scope outside C^0, the point at which the propositional core *p= IP* is determined but not necessarily over the wh-quantifier.

An important aspect of Chierchia's account of questions with quantifiers is that it focuses on the relationship between the wh and the quantifier in their base positions, rather than at their landing sites, to explain the contrast in judgment between sentences like (31a) and (32a). One advantage of doing so is that it can apply to pair-list answers to multiple wh-questions, which had been noted to have features in common with questions with quantifiers (Kiss 1993). Comorovski (1996) and Dayal (1996) both adopt the functional approach for multiple wh questions to explain subtle subject-object asymmetries that cannot be explained by theories like May's that depend on the structural divide between CP for wh-movement and IP for QR. Dayal modifies Chierchia's analysis, based on a closer examination of the types of pairings allowed in pair-list answers.

An alternative to Chierchia's account is Krifka (2001), who argues that pair-list answers to questions like (29a) involve wide scope over the wh and gives a semantics for them in terms of speech acts. He explains the restriction to universal terms as being due to the semantics of quantifying into question acts. Krifka's explanation for the asymmetry turns on the notion of topic-hood, but it is worth noting that he leaves unaddressed the correlation between the structures that allow pair-list answers and those that allow functional answers. It is also worth pointing out that the correlation with WCO configurations pointed out by Chierchia is not easily subsumed under Krifka's approach. Still, he makes a forceful argument for wide scope for the universal term in such cases, partially resurrecting May's approach as involving distinct scope relations between the

wh and the quantifier and providing a new perspective on its interpretation. It is not clear to what extent it could be extended to multiple wh-questions.

1.6 The Choice Function Account of Wh Expressions and Indefinites

We turn now to the role of choice functions in theories of scope. Reinhart (1997, 1998) argues that LF movement of *wh-in-situ* does not fit in with Minimalist assumptions about structure building. She proposes that they should be interpreted in their base positions via choice functions, which are functions from properties to individuals. If $\{a,b\}$ is the extension of a property, it is possible for a choice function $f_1\{a,b\}$ to pick out *a* and another choice function $f_2\{a,b\}$ to pick out *b*. Intuitively, f_1 and f_2 might correspond to descriptions like *the one on the left* or *the one most recently purchased.* Reinhart's use of choice functions can be illustrated with the following multiple wh-question in English:

33a. Which student read which book?
b. [which student$_i$ [t$_i$ read which book]]
c. $\lambda p\ \exists f\ \exists x[\text{student}(x) \wedge \text{CF}(f) \wedge p = x \text{ read } f(\text{book})]$

While the fronted wh quantifies over individual students in the standard way, the *wh-in-situ* is interpreted with a functional variable in argument position. The functional variable is bound from above C^0, where the propositional core of the question is determined. That is, from the position where normal wh-expressions take scope. The function takes the set of books as argument and returns an arbitrarily chosen member of that set. It thus delivers the same result as quantification over individuals, but without resorting to covert movement.

One immediate consequence of admitting two forms of scope taking for wh expressions is that it allows for a distinction in the scopal properties of moved wh and *wh-in-situ*. This makes it possible to maintain standard syntactic restrictions on movement because non-moved wh, which are associated with non standard scope effects, only *appear* to violate syntactic constraints. They are, in fact, interpreted by the alternative mechanism of choice functions. In (34a), for example, *which philosopher* can be interpreted inside the island, with the functional variable being bound by existential closure at the matrix level. This is shown in (34b):

34a. Which linguist will be offended if we invite which philosopher?
b. $\lambda p\ \exists x\ \exists f\ [\text{linguist}(x) \wedge p= [\text{invite}(\text{we}, f(\text{philosopher})) \rightarrow \text{be-offended}(x)]$
c. $\lambda p\ \exists x\ \exists y\ [\text{linguist}(x) \wedge p= [[\text{philosopher}(y) \wedge \text{invite}(\text{we}, y)] \rightarrow \text{be-offended}(x)]]$

Reinhart compares the choice function approach to the earlier attempt to preserve the integrity of LF movement by utilizing unselective binding in such cases (Pesetsky (1987) and Nishigauchi (1986)). She points out that the semantics of conditionals yields the wrong results for the unselective binding analysis of (34a). A proposition that picks a non-philosopher such as *Donald Duck* would count as a possible answer under this approach, as shown in (34c). Since *we invite Donald Duck* would make the antecedent false, the whole conditional would be true. The choice function approach, on the other

hand, because the choice is made from the common noun set, appropriately restricts answers to those that pair linguists with philosophers.

Dayal (2002) notes, however, that the answer to (34a) while it names two individuals, one for the fronted wh and one for the *wh-in-situ*, does not allow for the pair-list answer typical of multiple wh questions. Highlighting the fact that we have no direct intuitions about the scope of wh expressions and that we must rely almost entirely on the diagnostic of possible answers to determine their scope, she argues that such variations in the nature of possible answers must be carefully considered (see also Pesetsky (2000) and Bošković (2002) for more on this distinction; see also section 3.1).

The second application of choice functions, argued for by Reinhart, is in the domain of indefinites (see also Winter 1997). Choice functions provide a simple way of explaining an indefinite's propensity for unexpected wide scope readings. (35a), for example, has a natural interpretation in which the indefinite in the antecedent of the conditional refers to a specific individual. Fodor and Sag (1982), in their classic paper, had attributed this to a lexical ambiguity between a referential and a quantificational meaning. Among their primary arguments for the referential possibility was that indefinites either obey the same constraints as other quantifiers or they take widest scope. Crucially, they claimed that a sentence like (35b) does not have an intermediate scope reading, with *a student of mine* taking scope below *every professor* but above *the rumor*:

35a. If a relative of John's dies, he will inherit a fortune.
b. Every professor heard the rumor that a student of mine had been called before the dean.

Subsequent studies have shown that intermediate scope readings are, in fact, available (Farkas 1981, Partee and Rooth 1983, King 1988, among the earliest). In (36a), for example, the choice of topic can vary with students. Such intermediate scope readings have prompted the relativization of choice functions to c-commanding arguments, as shown in (36b). Here the variable over choice functions is parameterized to an individual. This is essentially the procedure of skolemization, discussed in connection with the functional approach to questions with quantifiers:

36a. Every Ph.D. student knows [most of the articles [that have been written on some topic]].
b. [Every Ph.D. student$_i$ [knows [$(f_i(\text{topic}))_j$ [most of the articles [written on t_j]]]]]

The use of choice functions in analyzing indefinites goes back to Hintikka (1986) and it continues to be of interest to semanticists (see Ruys 2005 and references cited there). Among the issues that are being debated is whether the variable over choice functions should be existentially bound at the matrix position or remain free, how the parameterization of the function should be calibrated, and how choice functions interact with other phenomena, such as distributivity, donkey anaphora, ACD etc.

An alternative position on the scope of specific indefinites is advocated by Schwarzschild (2001), who takes them to be existential quantifiers with distinguishing features. He proposes that their domain of quantification is a singleton. This aligns them with definites, the appearance of extraordinary wide scope being a case of scopelessness:

if there is only one (singular or plural) entity in a set, the reading remains unaffected whether it takes scope over or under some other scopal expression. Schwarzschild further suggests that the property responsible for turning the domain of an indefinite into a singleton is "private". Roughly speaking, the referent of a definite is familiar to both hearer and speaker, while that of a specific indefinite is familiar only to the speaker.

To sum up, the general consensus is that the unusual scope effects associated with indefinites do not warrant a relaxation of constraints on quantifier raising. This contrasts with *wh-in-situ* where there continues to be a range of views on their movement possibilities.

1.7. Section Wrap-up

In this section I have touched on the major developments in syntactic theories of scope, all of which include a notion of operator-variable chains of the type seen in predicate logic. In concluding this section, I would like to briefly mention approaches that do not share this commitment. Recall from the introduction that Montague's analysis of English does not force the creation of an operator-variable relation (cf. 3c). There are two major developments of this idea that have currency in present analyses of quantification.

The first approach abjures the creation of operator-variable chains in syntax, introducing such dependencies directly in the semantics. Cooper (1983) proposed a procedure for interpreting a quantificational expression in situ by positing a variable in argument position and storing the quantificational force for unpacking at a higher point in the derivation. This general procedure, which goes by the name of Cooper-storage, allows for distinct readings depending on the order in which quantifiers are brought out of storage to bind the variables they are associated with. The significance of this procedure is that it allows for a viable semantic account of scope and scopal ambiguities, without postulating an abstract level of syntax. Cooper storage is therefore of particular significance for theories of grammar that compute meaning directly on surface structure. Note, of course, that Cooper storage has to build in some syntactic sensitivity in order to account for locality-related effects. This somewhat reduces its distance from accounts that tie in such sensitivity with Logical Form.

The second approach represents a more radical departure from the accounts we have been looking at. It not only does away with operator-variable chains in syntax, it does not appeal to such dependencies even in the semantics. In a series of papers, Jacobson (1999, 2000 for example) has laid out a program showing how direct compositionality can be delivered by a "variable free" semantics, which dispenses with the task of interpreting variables and shifts the burden of explanation to principles of semantic combination.

I have kept the discussion of non-movement and/or variable-free accounts of quantifier scope brief because they have not had significant impact on the development of syntactic theory within the Chomskian tradition. In the rest of the survey we will continue to limit ourselves primarily to analyses of scope phenomena that assume movement and variable binding. It is worth keeping in mind, however, that there are no semantic imperatives forcing the creation of operator-variable chains and semantically viable alternatives are available in the literature.

2: Quantification at a Distance

In the previous section I gave an overview of the main developments in the theory of scope, focusing on quantified noun phrases that have their normal constituent structure. There are, however, constructions in which expressions that can plausibly be analyzed as parts of a single constituent appear at a distance from each other. One such case is *combien*-(sub)extraction, another is quantifier float. These two constructions are the focus of the present section.

2.1. Quantifier Higher than Restriction

The following data is illustrative of *combien*-(sub)extraction, which alternates with full DP fronting in French. What makes this construction theoretically interesting is that the alternation is not always available. An intervening adverb, for example, blocks *combien*-split:

37a. [Combien de livres]$_i$ as-tu (beaucoup) consulté t_i ?
How many of books have-you a lot consulted
b. Combien$_i$ as-tu (*beaucoup) consulté [t_i de livres] ?
How many have-you a lot consulted of books
"How many books have you consulted?"

On the basis of data such as these, Obenauer (1984) argued that the adverb had a blocking effect because of its similarity to the extracted element, an idea that proved central to the development of Relativized Minimality (Rizzi 1990; see also chapter 18).

Further striking effects are revealed when the extraction is over islands. There is a clear contrast between full DP and determiner sub-extraction, reminiscent of argument-adjunct asymmetries, in the case of wh and negative (or "inner") islands:

38a. ? [Combien de problemes]$_i$ sais-tu [comment [PRO resoudre t_i]]
How many of problems know-you how to-solve
b. * Combien$_i$ sais-tu [comment [PRO resoudre [t_i de problems]]]
How many know-you how to-solve of problems
"How many problems do you know how to solve?"

39a. [Combien de voitures]$_i$ n'a-t-il pas conduit t_i?
b. *Combien$_i$ n'a-t-il pas conduit [t_i de voitures]]?
How many not-he drive of cars
"How many cars didn't you drive?"

The unacceptability of (38b) and (39b), however, can be mitigated in D-linked contexts, in the sense of Pesetsky (1987). If there is a pre-established set of entities to which the relevant phrase refers, normal constraints on movement are relaxed. Thus referentiality has to be recognized as an independent factor in the licensing of chains. These insights about *combien*-split have proved critical in refining our understanding of islands and the nature of A-bar dependencies (Cinque 1990; see also chapter 18, sect. 4).

Combien-(sub)extraction has also been significant in advancing the theory of reconstruction. Consider in this connection (40a), which has full DP extraction with the predicates *composer* and *chanter*, and (40b) and (40c) which have sub-extraction with those predicates:

40a. Combien de chansons vas-tu composer/chanter?
How many of songs will-you compose sing
b. Combien vas-tu composer de chansons?
How many will-you compose of songs
c. Combien vas-tu chanter de chansons?
How many will-you sing of songs

There are two potential readings here: the referential reading (*how many songs are there that you will sing/compose them*) and the cardinal reading (*for what number x, will you sing/compose x-many songs*). Given the lexical semantics of the predicates, both readings are available with *chanter* but only the latter with *composer* in (40a). The sub-extraction versions, however, have only cardinal readings with both predicates, suggesting that cardinal readings generally involve interpreting the restriction in the base position (Dobrovie-Sorin 1995, Heycock 1995). We can infer from this that reconstruction is possible in (40a), and furthermore, that raising of the stranded element in (40b)-(40c) does not happen at LF.

These conclusions are corroborated by similar effects in English. (41b) represents the referential reading of (41a), where a particular set of books exists and Mary said "read them to me". (41c) represents the cardinal reading, where a particular number is such that that Mary said "read me x number of books", without insisting on particular books:

41a. How many books did Mary ask you to read?
b. How many books are there such that Mary asked you to read them?
c. For what number x, did Mary ask you to read x-(number of)-books?

The referential reading is obtained by interpreting *how many books* in Spec of matrix CP, the cardinal reading by reconstructing the NP to the base position and leaving the wh determiner in surface position (see Cresti 1995, Heycock 1995, Kroch 1989, among others, for further discussion).

Another interesting aspect of *combien*-subextraction, one that looks ahead to the topic of the next sub-section, is discussed by De Swart (1998):

42a. Combien de chansons les enfants ont-ils tous chanté(s)?
How many of songs the children have-they all sung
b. Combien les enfants ont-ils tous chanté de chansons ?
How many the children have-they all sung of songs

(42a) is ambiguous. On the wide reading the set of songs (and consequently the number of songs) is the same for all the children. On the narrow reading, the choice of songs can vary with the children, though not the number. (42b), under *combien*-split, has only the latter reading. De Swart's work also shows that *combien*-extraction over interveners is

acceptable if the intervener can get out of the way by taking scope over *combien* (see, however, Obenauer 1994 and Sportiche 2005 for a somewhat different take on these facts).

The *combien*-split construction, then, has been extremely important in the development of syntactic theories of movement and reconstruction, providing direct empirical evidence for them. It has also been important in the development of interpretive accounts for quantifiers that allow the quantifier to occur at a higher level in the structure than its restriction. It is worth highlighting that the conclusion we come to from the *combien*-split is that a restriction can be interpreted lower than the site at which it surfaces but it cannot be interpreted higher than its surface position, even if the quantificational element in it has moved to that site. That is, reconstruction can be of full DPs or just of the inner NP but QR is limited to full DPs, it cannot raise NPs to the site of their quantificational associate.

2.2. Restriction Higher than Quantifier

Floating quantifiers ostensibly present the opposite situation, with the restriction appearing in a structurally higher position than the quantifier. However, the aptness of this characterization depends on the approach one adopts. Consider the following paradigm, which shows the universal at a lower position than its associate DP. The variants in (43b) have essentially the same meaning as (43a):

43a. All the students / each of the students / both the students have read the book.
b. The students (all/each/both) have (all/each/both) read the book.
c. [The students$_i$ [([$_{DP}$ all/each/both t_i)] [have [$_{VP}$ [$_{DP}$ all/each/both [$_{DP}$ t_i]] read the book]]]]
d. [The students$_i$ [(all/each/both) [have [(all/each/both) [$_{VP}$ t_i read the book]]]]]

There are, broadly speaking, two approaches to this construction. One takes the universal to be a constituent of the subject DP which originates inside VP, as shown in (43c) (Sportiche 1988, Miyagawa 1989, Déprez 1989). If movement targets the large DP, we get the sentence in (43a). If it targets only the inner DP, we get the sentences in (43b), with stranding of the universal at the base or at intermediate positions in the movement chain. The alternative approach takes the floating quantifier to be an adverbial of a sort, as shown in (43d) (Dowty and Brody 1984, Bobaljik 1995, Doetjes 1997, Brisson 1998). In this approach, there is no direct syntactic connection between the sentence in (43a) and those in (43b). Specific analyses of these sentences, of course, often involve more nuanced positions within this spectrum.

Floating quantifiers are attested in a number of languages. An example from French, already foreshadowed in our discussion of *combien*-split, is given below:

44a. (toutes/*tous) les femmes sont (toutes/*tous) arrivées
All the women have all arrived
b. (*toutes/tous) les hommes sont (*toutes/tous) arrivés
All the men have all arrived
"All the women/men have arrived"

"The women/men have all arrived."

As we can see, the quantifier shows distinct agreement patterns, depending on whether the associate nominal is feminine or masculine. The point of note is that this remains so whether the quantifier appears as part of the associate DP, or as a floating quantifier. This follows straightforwardly from the movement approach to the phenomenon, while it appears, at least on the face of it, to be a problem for the adverbial approach.

To sum up, then, the advantages of the movement/stranding approach are the following: it can account straightforwardly for the positions at which floating quantifiers appear by tracking the path of DP movement, it predicts semantic uniformity for the members of the paradigm, and it explains the agreement patterns in languages where such distinctions are manifested.

The adverbial approach, on the other hand, can point to the fact that the correlation between the positions for floating quantifiers and DP movement is not absolute. There are positions through which DP movement is known to occur but floating quantifiers are disallowed there. Most significantly, the object in passive and unaccusative constructions cannot have a floating quantifier in its base position, as seen in (45) and (46). In fact, Bobaljik (1995) notes that the predictions of the movement/stranding approach also fail with unergatives.

45a. All / Each of / Both the suspects have been arrested.
b. The suspects$_i$ have (all/each/both) been arrested *all/*each/*both t_i.

46a. All / Each of / Both the children have arrived.
b. The children$_i$ have (all/each/both) arrived *all/*each/*both t_i.

In sentences with several auxiliaries, floating quantifiers are unacceptable at lower levels, suggesting that (45)-(46) may be part of a more general ban on occurrence lower down in the tree:

47. The vegetables (all) will (all) have (all) been (*all) being (*all) roasted for an hour by the time you arrive.

Furthermore, the adverbial approach can show that floated *all* interacts with adverbs (Fitzpatrick 2006). In (48a), *bravely* has both a subject-oriented and a manner reading. In (48b) it only has a subject-oriented reading. Fitzpatrick also notes the possibility of iteration of the kind shown in (49):

48a. The gladiators all bravely fought the lions.
b. The gladiators bravely all fought the lions.

49a. All/both of the students have each been asked to fill out the form in pencil.
b. Both of the teams have all been asked to turn in their projects tomorrow.

The question for the adverbial approach is how to capture the relation between the quantifier and the DP associate. One option, proposed by Doetjes (1997), is that the

quantifier has in its scope a null *pro* that is in a binding relation with the DP typically thought to be the associate. This points the way for solving potential problems for the approach, such as the agreement patterns seen in (44).

There is also the issue of finding a way to align the meanings of floating and non-floating versions. Brisson (1998), for example, treats the floating quantifiers *all/both* as subject-oriented adverbs that do not contribute to the truth conditions of the sentence but rather interact with a distributive operator to strengthen the meaning of a definite noun phrase. While a definite DP can countenance some exceptions in predication (that is, it is not a *strict* universal), modification by a floating quantifier ensures that every member of the associate's restriction participates in predication. Note that the distributive operator under this view does not enforce distributivity, but only regulates it so that statements with definites, with or without the modifier, can have collective, intermediate distributive, or total distributive readings.

As would be obvious, the phenomenon of floating quantifiers is theoretically as well as empirically intriguing and there is a substantial literature on the topic. Fitzpatrick (2005) points out that prior approaches force a choice between the two approaches. He argues, on the basis of the well-known facts as well as on novel cross-linguistic data, for a dichotomy in the class of floating quantifiers. According to him, floating quantifiers of the sort we have discussed are adverbial but there are floating quantifiers in languages that originate inside the associate. He takes the first kind to be distinguished by the fact that it is associated with A-chains, as noted by Déprez (1989). They get the analysis in (50), incorporating Doetjes' proposal of a null pronominal element:

50. $[_{DP}$ The students$]_1$ have $[_{VP}$ [[all pro$_1$] $[_{VP}$ t$_1$ had their lunch]]

Fitzpatrick claims that the second kind of floated quantifiers is associated with A′-chains, and can be illustrated by Japanese examples like (51a). (51b) shows an intermediate stage of the derivation where *hon-o san-satu* has been scrambled to the intermediate CP level, followed by stranding, as shown in (51c):

51a. $[_{CP}$ hon-o John-ga $[_{CP}$ san-satu Mary-ga $[_{CP}$ gakusei-ga yonda to] ita to]
book-ACC John-NOM 3-CL Mary-NOM student-NOM read C said C
omotteiru
thinks
" John thinks that Mary said the students read three books".

b. $[_{CP}$ John-ga $[_{CP}$ [[hon-o san-satu]$_i$ Mary-ga $[_{CP}$ gakusei-ga t$_i$ yonda to] itta to]
omotteiru]]

c. $[_{CP}$ hon-o$_j$ John-ga $[_{CP}$ [[t$_j$ san-satu]$_i$ Mary-ga $[_{CP}$ gakusei-ga t$_i$ yonda to] itta to]
omotteiru]]

Fitzpatrick provides independent semantic motivation for his proposal by showing differences between the two types with regard to exhaustivity. His account, as we can

see, expands the empirical coverage of theories of floating quantifiers but it remains to be seen if it will hold up to further scrutiny.

2.3. Section Wrap-up

Although the unselective binding and choice function approaches to quantification surveyed in Section 1 involve syntactic distance between the quantifier and the restriction, they cannot be characterized as quantification at a distance since the syntax of the noun phrase remains intact. It contributes the common noun denotation, a restriction on a variable or the argument to a function, while the quantificational force comes from elsewhere. Similarly, the type of quantification seen in Japanese where quantificational morphemes mark the scope site and regular indefinites the restriction, cannot be characterized as quantification at a distance since one morpheme simultaneously associates with more than one nominal phrase.

The constructions we have considered in section 2 are fundamentally different in that two expressions that could plausibly be thought of as forming a constituent, surface in different parts of the structure. They thus represent cases of quantification at a distance and, as we have seen, have the potential to track possibilities for movement and reconstruction. Whether analyses agree on the nature of the dependency involved, they all agree that these constructions are significant for syntactic theories of movement and scope.

3: Wh-Scope Marking and Wh-Copying Constructions

In this section, we turn to wh-scope marking and wh-copying constructions, constructions that exemplify two non-standard ways of forming long-distance wh-dependencies (see also chapter 25, sect. 4.2). Since background assumptions about standard long-distance extraction play a crucial role in analyses of both constructions, we will at various points allude to extraction; but I refer the reader to chapter 18 for a more focused discussion of it.

3.1. The Diagnostic of Specification in Answers

Wh-dependencies vary in interesting ways across and even within languages. In order to appreciate the issues surrounding the various strategies, it is important to note a fundamental difference between indicators of scope for regular quantificational DPs and those for wh-expressions. Natural languages typically do not show quantifier scope overtly (though there are some, such as Hungarian). It is much more common to find wh-scope being overtly represented. Thus in languages like English or Bulgarian, questions are distinguished from declarative statements by fronting of wh-expressions, which we take as marking the scope of that wh. As indicated in section 1.2, the issue of determining scope arises primarily in the case of *wh-in-situ*, in languages like Chinese or Hindi that do not have overt movement, or languages like English that allow fronting of only one wh-expression. In the case of quantifiers, the issue of scope is settled by probing intuitions about the truth conditions associated with particular structures. In the case of questions, however, this diagnostic does not apply. Instead, we must take recourse to indirect

means, using the possibility/requirement of specifying values for wh-expressions as the indicator of scope. As such, it is important to understand the diagnostic before applying it to constructions where syntactic position may appear less than transparent.

Consider (52a) and its possible answer in (52b). This can be derived in a Karttunen/Hamblin-style semantics for questions under a representation like (53a), where the wh is fronted at LF, leaving behind a trace in argument position. This is interpreted as in (53b), resulting in denotations naming books directly, as in (53c). Alternatively, it can be interpreted in situ, as in (54a), using the choice function analysis of Reinhart (1997, 1998), discussed in section 1.6. Here the *wh-in-situ* is bound by an existential quantifier over functions that gives it scope outside the propositional core. The resulting interpretation refers to books via functions, as shown in (54c). In either case, one can derive intuitively acceptable answers such as (52b):

52a. Which student bought which book?
b. Bill bought W&P, Sue bought Aspects.

53a. $[_{CP}$ which student$_i$ $[_{IP}$ t_i bought which book]]
LF$\rightarrow$ $[_{CP}$ which book$_j$ which student$_i$ $[_{IP}$ t_i bought t_j]]
b. $\lambda p\ \exists x\ \exists y$ [student(x) & book(y) & p = bought(x,y)]
c. {Bill bought W&P, Bill bought Aspects, Sue bought W&P, Sue bought Aspects}

54a. $[_{CP}$ which student$_i$ $[_{IP}$ t_i bought f(which book)]]
b. $\lambda p\ \exists x\ \exists f$ [student(x) & p = bought(x, f(book)]
c. {Bill bought f_1(book), Bill bought f_2(book), Sue bought f_1(book),
Sue bought f_2(book)}

Extrapolating from this, it seems reasonable enough to take the next step and claim that if an answer to a question specifies values for a wh-expression, that wh-expression must take scope outside the propositional core in C^0. However, this step is not valid. As noted originally by Kuno and Robinson (1972), both versions of (55a), the one with a wh-expression and the one with the definite, allow for a pair-list answer specifying values for individuals and books:

55a. Who knows where Mary bought these books/which book?
b. $[_{CP}$ which book$_j$ who$_i$ …$[_{CP}$ where$_k$ $[_{IP}$ …t_j…t_k…]]]
c. $[_{CP}$ these books$_j$ who$_i$ …$[_{CP}$ where$_k$ $[_{IP}$ …t_j…t_k…]]]

If one takes the pair-list answer as evidence of matrix scope for wh, as in (55b), one would have to take a similar stand on the definite (55c), a move most linguists would not want to make. There are, in fact, differences between possible answers to the two questions that have been discussed in subsequent literature (see Dayal 1996), which I will not delve into here. The point of relevance for us is that Kuno and Robinson's argument remains relevant and serves as a corrective against an unquestioning reliance on specification as evidence of scope for wh-expressions. It is particularly significant in framing our survey of the research on wh-scope marking.

3.2. Wh-Scope Marking

A wh-scope marking construction, also known as partial wh-movement, instantiates a wh-dependency of a particular kind. There is a fixed wh-expression, corresponding typically to *what* in the matrix, and one or more wh-expressions in an embedded clause (56a). Examples from German and Hindi are given in (56b) and (56c), respectively:

56a. […WHAT…([…WHAT…)[…wh_1…(wh_n)…]]]
b. was denkst du (was Peter glaubt) mit wem Maria gesprochen hat
what think you what Peter believes with who Maria spoken has
"Who do you think (Peter believes) Maria has spoken to?"
c. anu kyaa kahtii hai (ravi kyaa soctaa hai) uma kis-se baat kar rahii hai
Anu what says Ravi what thinks Uma who-with talk doing is
"Who does Anu say (Ravi thinks) Uma is talking to?"

If the embedding is deep, the matrix wh-expression is repeated in each of the intermediate clauses. In fronting languages the *what*-expression is in Spec of CP, otherwise it remains in situ. The embedded clause wh-expressions likewise obey the standard question formation strategies of the language. As one can see, even though every clause in the chain has a wh-expression but embedding predicates are not +wh selecting. That is, *ask* or *wonder* are not good embedding predicates, but *say*, *believe*, or *think* are. Embedding predicates also cannot be in the negative (see Fanselow 2005 for a recent survey).

In a variant of this construction, the clauses are independent as shown in (57a), with a prosodic contour that clubs them together. German (57b) is a variant of (56b) with V2 in every clause, a matrix clause feature. The English example in (57c) has inversion in all the clauses, again a feature of matrix clauses. Note that there is no acceptable embedded version for the English (57c):

57a. [[…WHAT…] ([…WHAT…]) […wh_1…(wh_n)…]]
b. Was denkst du? (Was glaubt Peter?) Mit wem hat Maria gesprochen
What think you What believes Peter with who has Maria spoken
c. What do you think? (What does Peter believe?) Who has Maria spoken to?

Unless otherwise specified, the discussion in this section applies to both versions of the strategy, embedded and sequential scope marking.

To complete the picture, the last clause in a wh-scope marking construction can be a multiple wh-question, assuming that the language allows multiple wh in simple questions:

58a. was denkst du wem Karl welches Buch gegeben hat
what think you who Karl which book given has
"Who do you think Karl has given which book to?"
b. anu kyaa kahtii hai kaun kis-se baat kar rahaa hai
Anu what says who who-with talk doing is

"Who does Anu say is talking to who?"

Now, coming to the diagnostic of specification, we find that an answer to a scope marking question specifies values for all and only the wh-expressions in the most deeply embedded clause /last question in the sequence, not for the preceding *what*-expression(s). If we take specification of values to be an indicator of scope, a plausible analysis for scope marking is one that gives the embedded wh-expression(s) scope at the level of the highest clause and makes the matrix (and intermediate) wh-expressions semantically irrelevant. This is what lies behind the first analyses of this construction, van Riemsdijk (1982) for dialects of German, Hiemstra (1986) for Frisian, and McDaniel (1989) for Romani. Hiemstra's approach gives an idea of the extent to which the diagnostic of answers has influenced the analysis of scope marking.

Hiemstra views *wh*-movement as movement of a *wh*-feature (see also Cheng 2000). Languages differ with respect to what is involved in this movement. If the whole feature matrix of the *wh*-phrase is moved, including the phonetic matrix, we get long-distance wh-movement of the English kind. If only the wh-feature moves, it needs to be spelled out at the landing site as the most unmarked *wh*-expression of the language: *was* in German, *wat* in Frisian, *mit* in Hungarian, *kyaa* in Hindi, etc. This is the scope marking construction. If person–number features of the *wh*-phrase are also moved, we get the copy construction to be discussed in the next section. In every case, the answer is predicted to specify values for the same wh-expression, the one that originates in the (most deeply) embedded clause and lands by LF in the highest Spec position.

The appeal of such an approach, dubbed the direct dependency approach in Dayal (1994), is undercut by the existence of scope marking in languages like Hindi in which covert wh-extraction out of finite clauses is not attested. It is also undercut by the discovery of sequential scope marking of the kind exemplified by (57) in English and German (Dayal 1996, Reis 2000). Rejecting the view that specification of values entails matrix scope, the indirect dependency approach (Dayal 1994, 1996, 2000) develops an account taking *what* to be a bona fide wh-quantifier over propositional variables. That is, the matrix question or the first question in the sequence, like any question, asks for information: *what does Bill think?* The next question provides the restriction on the variable: *where did Mary go?* Answers to the first question are constrained by the set of propositions denoted by the second question. Embedding has consequences for binding-theoretic effects but the basic computation regarding the role of successive clauses remains the same in embedded and sequential versions of the construction.

A hybrid analysis has been proposed by Mahajan (2000), Fanselow and Mahajan (2000), and independently by Horvath (1997). It shares with the indirect dependency approach the view that the embedded clause is the complement of the matrix wh-expression and posits an LF where this complement raises up to its base position. However, it shares with the direct dependency approach the view that the matrix wh is semantically an expletive and is replaced by the wh-expressions in the complement at interpretation. One might say that the syntax of this approach aligns with the indirect dependency approach but its semantic assumptions are those of the direct dependency approach.

The choice between these approaches to scope marking has been debated extensively since the mid-nineties. von Stechow (2000) and Beck and Berman (2000)

propose a cross-linguistic division among languages with respect to the nature of the dependency. They suggest that direct dependency is appropriate for languages like German and indirect dependency for languages like Hindi. In fact, Bruening (2004) argued on the basis of Passamaquoddy that the two types of dependencies could co-exist in a single language. A cross-linguistic divergence between direct and indirect dependency languages, however, no longer seems to be the prevalent view. Many of the arguments for it are countered in Dayal (2000), based partially on a more nuanced presentation of the German facts in Reis (2000). Fanselow (2005) notes a general shift in favor of indirect dependency in recent analyses of the phenomenon. Stepanov (2001), Klepp (2002), Legate (2002), Felser (2004) are some examples of this trend, as is Bruening (2006), who reverses his position on Passamaquoddy and comes out unequivocally in favor of the indirect dependency approach for scope marking.

3.3. The Wh-Copying Construction

The wh-copying construction, though it shares some similarity with wh-scope marking, differs from it in significant ways (see Felser 2004 for a detailed discussion):

59a. […wh_1…([…wh_1…)[…wh_1…]]]
b. wer denkst du (wer glaubt Peter) wer kommt
who think you who believes Peter who comes
"Who do you think (Peter believes) will come?"

There can be only one wh-expression in the most deeply embedded clause and it is this wh-expression that occurs in the higher clause(s). A non-embedded, sequential variant of this construction has not so far been reported. Furthermore, there is no wh-copying construction corollary of the scope marking structure in (60), due to Höhle (2000), with a conjoined question in embedded position:

60. Was meint er wann sie kommt und wen sie mitbringt?
What thinks he when she comes and who she brings
"What does he think when is she coming and who is she bringing?"

On the basis of such facts, Dayal (2000) suggests copying involves single chain formation under a direct dependency type of configuration, aligning it with extraction, while scope marking creates an indirect dependency between a wh-expression and a complement clause. More in depth analyses of the copying construction have been provided where the relationship with extraction has been explicitly articulated on the basis of morpho-syntactic differences between the two.

The most intriguing difference between the copying construction and extraction has to do with restrictions on the type of wh allowed in the former. It is generally assumed that only monomorphemic wh-expressions are acceptable. This is captured in Hiemstra's account, discussed in the previous section, by taking the copying construction to be the spell-out of a structure in which only the person-gender-number features of the wh-expression move. Rett (2006) provides an alternative account for this fact. According to her, wh-expressions can simply contribute a variable (as wh-pronominals)

or be generalized quantifiers (as wh-determiners). She shows that when a wh-quantifier only contributes a variable, iteration of wh's with a final existential binder is not problematic. When a wh-expression is a generalized quantifier, iteration leads to vacuous quantification. Thus, the copying construction that requires wh-expressions in intermediate positions is only compatible with wh-pronominals. This does not apply to extraction where the wh-quantifier leaves wh-traces in intermediate positions.

Hiemstra's and Rett's accounts do not predict the following paradigm from Van Kampen (1997, 2009), discussed in den Dikken (2010). While full DPs are barred from occurring in every Spec position, it is possible to have them in one of the Spec positions:

61a. welke jongen denk je wie ik gezien heb? *(colloquial & child Dutch)*
which boy think you who I seen have
b. wie denk je welke jongen ik gezien heb? *(colloquial Dutch)*
who think you which boy I seen have
c. *welke jongen denk je welke jongen ik gezien heb?
which boy think you which boy I seen have
"Which boy do you think I saw?"

Den Dikken's analysis of the paradigm in (61) rests on the view that long-distance dependencies of any kind do not result from movement but arise from a relationship of agreement between a scope marker in a higher clause and an actual wh in the lower clause. This is shown schematically in (62):

62a. SM ... [$_{vP}$ *v* [$_{VP}$ V [$_{CP}$ XP C ... ~~XP~~ ...]]]
b. SM ... [$_{vP}$ ~~SM~~ [$_{vP}$ *v* [$_{VP}$ V ~~SM~~ [$_{CP}$ XP C ... ~~XP~~ ...]]]]
c. SM$_i$ ... [$_{vP}$ ~~SM~~ [$_{vP}$ *v* [$_{VP}$ V ~~SM~~ [CP XP$_i$ C ... ~~XP~~ ...]]]]

(62a,b) represents scope marking while (62c) represents so-called extraction and *wh*-copying. The crucial difference is that only the latter shows concord. The relevant differences between extraction and copying construction depend on whether concord is partial or full. A full concordial relationship, where the matrix scope marker spells out all the features of the embedded wh (which remains silent), characterizes extraction. Partial concordial relationship characterizes the copying construction. Approaching the paradigm in (61) from this perspective, he analyzes (61b) as resulting from concord restricted to the N-features (number and animacy) but leaving out the quantificational D-features. (61c) is ruled out because full concord forces deletion of the lower wh-expression. Although den Dikken does not address (61a), his analysis of these structures presents a genuinely novel approach to the phenomena. While it successfully addresses the morpho-syntactic differences in chain formation between the three constructions, it needs to be ascertained if it can also successfully address the semantic differences that have been noted between scope marking, on the one hand, and extraction and the copying construction, on the other.

3.4. Section Wrap-up

Thornton and Crain (1994) report an acquisition study that provides interesting corroboration of the division between wh-scope marking and wh-copying constructions.

According to them, English-speaking children initially manifest both constructions, but with the acquisition of extraction, the copying construction is lost while the scope marking is retained. With the discovery of sequential scope marking, we now have reason to believe that scope marking is available in English and may well be available universally. It follows, then, that there is no reason to expect children to lose this construction. That the copying construction should be replaced by extraction is to be expected in a language where the adult grammar does not have the copying construction (see Dayal 2000). (For more discussion of acquisition, see chapter 25.)

While much of the work in the domain of long-distance wh-dependency has focused on the nature of quantification involved, closer attention to the discourse contexts that favor one strategy over another might prove useful in shedding further light on the variation between them. Similarly, a diachronic study might also be helpful in this regard. The studies surveyed here provide a solid theoretical and empirical foundation for approaching these constructions from pragmatic and/or historical perspectives.

4. Conclusion

There are several important aspects of grammar relevant to the topic of this survey that have not been adequately covered here. These include negation (see chapter 21), prosody (see chapter 23), scope-taking adjuncts (see chapter 13), and tense, aspect and modality (see chapter 20). This survey has focused on significant developments in the theory of quantification and scope since Frege's original insight about the logic of quantification and Montague's demonstration of the compositional relationship between natural language syntax and logical representation. There have been many innovations in the theory geared towards restricting the overgeneralization inherent in the system of scope taking, either by constraining movement of quantified phrases and/or by positing alternatives to treatment of noun phrases as generalized quantifiers over properties of individuals. These innovations have sometimes been driven by theoretical imperatives but their evaluation ultimately rests on empirical considerations. There is now a wealth of information from a wide variety of languages available in the literature, and this continues to motivate and regulate theoretical developments. While it cannot be said that the phenomenon of scope and quantification has been nailed down, it is clear that considerable strides have been made in our attempt to do so.

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