CHAPTER 5

THE ROLE OF LEXICAL FACTORS IN SCOPE ASSIGNMENT

5.1 Introduction

Two factors readily come to mind as affecting scope assignment and scope preferences: syntactic structure and choice of quantifier. I have argued that the default scoping in a multiply-quantified sentence is computed from the required LF structure of the sentence, so that surface c-command relations generally determine scope preferences. This theory was supported by data from Experiment 1 on dative sentences (where the direct object and indirect object were quantified) and from my attempted replication of Kurtzman & MacDonald's (1993) experiment on active subject-object sentences. Corroborating evidence came from examining what is known about scope preferences in a number of other constructions.

One aspect of how the choice of quantifier affects scope assignment was revealed in Experiment 1 and the attempted replication. When an *every*-phrase takes scope over an *a*-phrase, the processor remains vague about how many entities the *a*-phrase represents (the Vagueness Principle). But this effect is due to the logical nature of what it means for a universal operator to have scope over an existential operator– multiple instantiation of the existential is possible but not required– not specifically to *every* and *a* per se. It should hold of other quantifiers as well, other things being equal.

In this chapter I will consider the role that the lexical biases and conditions of individual quantifiers play in determining scope preferences and how they interact with syntactic structure, concentrating on the quantifiers *each* and *every*.

It is widely assumed that *each* and *every* have a greater propensity than other quantifiers to scope over a second quantifier in their clause– *each* even more so than *every*. Generally, scant evidence is offered to support this assumption. Many researchers simply reference Ioup's work on scope preferences (Ioup 1975a,b).[1] As is well known, she proposed that quantifiers differ with respect to their preference to take wide scope and presented a hierarchy that reflected these built-in tendencies:

(1) Ioup's Quantifier Hierarchy

each > *every* > *all* > *most* > *many* > *several* > *some*$_{pl}$ > *a few*

Two points are to be made here. First, this hierarchy is built from a small number of examples, and it is unclear how accurate it is. In a study comparing the scope preferences of all but one of the quantifiers in the scale, Gillen (1991) found numeric support for the hierarchy (except for the relative position of *all* and *most*), but it is unclear how reliable the differences between quantifiers were since statistical tests on pairs of adjacent quantifiers were not performed. The scope preferences of individual quantifiers plainly need to be investigated further. While a number of researchers (Liu 1990; Diesing 1992; Ruys 1992; Beghelli 1993, 1997) have begun to do this for the indefinite quantifiers at the bottom of the scale, the top of the scale has for the most part been left alone.

Secondly, the question arises as to why the various quantifiers hold the positions in the hierarchy that they do. Simply adopting a quantifier hierarchy to account for the scope behavior of different quantifiers is not sufficient. Ruys (1992:130) discusses the drawbacks of this approach with respect to indefinites, saying:

> First of all, it leaves as a mystery why all weak quantifiers are located at the same end of the scale. … Furthermore, while it appears undeniable that quantificational specifiers are lexically marked for their propensity for taking wide or narrow scope, it is unclear in what way, or why they are so marked. This approach … does not provide us with any insight into [scope] behavior. In the absence of a grammatical theory of wide scope-propensity which refers to a lexically specified

[1]Two exceptions are Kroch (1974) and Beghelli & Stowell (1997), who consider a variety of examples containing different quantifiers.

feature, it does not appear very enlightening to take this course.

In other words, we want to know what is behind the hierarchy.

My goal is to provide a combined grammatical and processing theory of the wide scope tendencies of why *each* is said to have a stronger preference for wide scope than *every*, employing the lexical conditions proposed for these quantifiers in Chapter 4. I begin by reviewing these conditions, and then present a more detailed outline of the present chapter.

The principal thesis in Chapter 4 was that *every* is subject to the Event Distributivity Condition in (2), while *each* is subject to the stronger Differentiation Condition in (3).

(2) <u>The Event Distributivity Condition</u>

A sentence containing a quantified phrase headed by *every* can only be true of event structures which are at least partially distributive. At least two different subsets of the restrictor set of the quantified phrase must be associated with correspondingly different subevents, in which the predicate applies to that subset of objects.

(3) <u>The Differentiation Condition</u>

A sentence containing a quantified phrase headed by *each* can only be true of event structures which are totally distributive. Each individual object in the restrictor set of the quantified phrase must be associated with its own subevent, in which the predicate applies to that object, and which can be differentiated in some way from the other subevents.

For example, (4a) means that Jamie lifted all of the baskets, in at least two subgroups; perhaps baskets 1, 2, and 3 together, and baskets 4 and 5 together. Which baskets were lifted together is not particularly important. On the other hand, (4c) can only be used felicitously to describe a situation where no two baskets were lifted in the same subevent. As such, the (d) version, which denies total event distributivity, sounds quite odd. (Examples which are odd or infelicitous are marked with the symbol #.)[2]

(4) a. *Jamie lifted every basket.*

b. *Jamie lifted every basket, but not individually.*

c. *Jamie lifted each basket.*

d. #*Jamie lifted each basket, but not individually.*

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[2]Examples should be read without a strong pitch accent on any element in the sentence.

The Differentiation Condition requires that subevents be distinguished from each other on some dimension (e.g. time, manner, instrument). Moreover, the subevents must be differentiated in a meaningful or interesting way; what counts as "interesting" depends on context. Since delimiting events is a vague affair, differentiating subevents is as well, and the Differentiation Condition can be satisfied in a number of ways. In the appropriate context– as long as there is enough interest in the individual objects– the subevents can even be differentiated simply by having a different object in each one. When there is no interest in differentiation or individuation, the use of *each* is infelicitous.

These conditions create usage constraints for the quantifiers: *Each* is employed to stress differentiation and focus on the individuals in the set it quantifies over. *Every* is used to direct attention to the set as a whole. It is employed when distributivity obtains but is not critically of interest, and sometimes to emphasize, rather than just convey, universality and exhaustiveness.

Evidence that speakers utilize these constraints was provided in Experiment 2, where participants chose whether *each* or *every* fit best into the final sentence of a passage which described either how a set of objects or people differed or how they were the same. *Each* was chosen more often when the passage had been about the differences between the objects/people than when it had been about the similarities. These results are explained if the Differentiation Condition is part of the meaning of *each* and if language users are sensitive to such conditions in language production.

In this chapter I will investigate the hypothesis that the usage constraints of quantifiers also play a role in language comprehension. In particular, I will examine how the Event Distributivity Condition and the Differentiation Condition influence scope preferences in sentences containing *each* and *every*.

Much of the sense that *each* and *every* prefer wide scope more than other quantifiers likely comes from instances where they are in subject position. The general preference for forward scope in subject-object sentences is expected under the PSI. Cases which would offer more compelling evidence would be those where giving *each* or *every* wide scope involved changing the required LF structure, such as giving an object *each*- or *every*-phrase inverse wide scope over the subject. Accordingly, I concentrate on determining and explaining the extent to which inverse scope readings for *each* and *every* are preferred in subject-object sentences.

I will argue (i) that the sense that *each* prefers wide scope to a greater extent than *every* arises from examples where an *each*-phrase takes scope over an indefinite which c-commands it in the required LF structure in order to satisfy the Differentiation Condition, and (ii) that when the Differentiation Condition is fulfilled in some other way, the scope preferences of *each* and *every* are very similar. Furthermore, I will demonstrate that the Event Distributivity Condition, shared by *each* and *every*, has little effect on their scope behavior.

The great majority of examples to be discussed here involve the relative scoping of quantified phrases headed by *each* or *every* and phrases headed by the simple indefinite determiner *a*. At the end of the chapter, I will address how the choice of indefinite can influence the scope behavior of *each* and *every*. Such examples are important to consider because in a sentence where the preferred scope is *each/every* over an indefinite it could be either *each/every* or the indefinite which is responsible for the preference, or both (abstracting away from structural factors). *Each/every* could prefer to be in a position which gives it wide scope, and/or the indefinite could prefer to be in a position which gives it narrow scope.

The chapter proceeds as follows. The first examples demonstrating that the Differentiation Condition can influence scope assignment are presented in section 5.2, along with a detailed theory of how syntactic structure interacts with the lexical preferences of quantifiers in determining scope preferences: the Quantifier Satisfaction Hypothesis. Section 5.3 continues with examples in which the Differentiation Condition plays a role: examples which contain secondary predicates. Sections 5.4 and 5.5 present experimental evidence in support of the Quantifier Satisfaction Hypothesis, using the secondary predicate items. Other studies comparing the scope behavior of *each*t to that of another quantifier are reviewed in section 5.6. The effect of various types of indefinites on the scope behavior of *each* and *every* is examined in §5.7. Section 5.8 returns to Ioup's Quantifier Hierarchy, investigating the scopal tendencies of *most* and *all* in comparison to that of *each* and *every*. Open questions are laid out in §5.9. Section 5.10 contains concluding remarks.

5.2 Quantifier Satisfaction

The theory to be developed in this chapter of how the lexical conditions of quantifiers can influence scope preferences is built upon the theory proposed in Chapter 3 of how surface structure influences scope preferences. I therefore begin by restating the basic points of that theory.

5.2.1 Review of the Principle of Scope Interpretation

In terms of syntax, I assume that at S-structure in English both subjects and direct objects have moved out of VP into the specifier position of an agreement phrase (Runner 1995). The Mapping Hypothesis governs the translation of LF structures into a tripartite semantic representations (Diesing 1992). Material contained inside the VP gets mapped into the nuclear scope, and material in the rest of the tree gets mapped into the restrictor clause. Quantifier Raising (QR) applies only when necessary, such as to raise QPs headed by strong quantifiers (e.g. *every, most*) which are inside VP at S-structure. These QPs must be external to VP at LF, since they require a restrictive clause for interpretation and cannot form one from within VP.

With respect to syntactic processing, I assume that the processor builds a single S-structure for each input string and computes a single LF representation from this. The building of LF structure is guided by the General Processing Economy Principle, whereby the processor performs only those operations which are required by the grammar, unless the extra structure-building, movement, etc. is motivated in some way. When movement is required, the shortest possible movement that satisfies grammatical requirements is used. LF representations are interpreted into semantic and discourse structures, which include the construction of tripartite representations.

The relative scoping of two QPs depends on the c-command relation between them at LF.

The Principle of Scope Interpretation (PSI) in (5) determines the initial scope assignment. The PSI follows directly from Processing Economy.

(5) Principle of Scope Interpretation (PSI)

The default relative scoping in a multiply quantified sentence is computed from the required LF-structure of that sentence, where the required LF is determined by required grammatical operations acting on the S-structure. The default scoping is the preferred scoping unless there is evidence to go beyond it.

Generally, required syntactic operations do not change the c-command relations of QPs. Hence the descriptive C-command Principle, which states that the preferred scoping corresponds to the scoping determined by surface c-command relations, is a corollary of the PSI.

Scope preferences in various constructions were considered in Chapter 3. As a general rule, when there is no evidence to change the default scoping as established by the PSI, the preferred scoping in a doubly-quantified sentence is the forward scoping of QP_1 over QP_2. This corresponds to QP_1 c-commanding QP_2 at S-structure. One exception is so-called inverse-linking structures where one QP contains another at S-Structure. In those constructions, QP_2 c-commands QP_1 in the required LF, so that inverse scope is predicted to be preferred. Until §5.6.2, where these cases are discussed, I will speak of inverse scopings as if they are always the less economical scoping, the one not computed from the required LF structure.

5.2.2 The Quantifier Satisfaction Hypothesis

In this section, I expand the PSI-based theory to incorporate the influence that individual quantifiers may have in determining scope preferences. The central idea is that a quantifier's scope behavior is driven by the lexical condition(s) which are part of its meaning. These conditions, such as the Differentiation Condition of *each*, make no reference to scope themselves, but they may be satisfied by moving the QP headed by the quantifier at LF to a position which changes the scope relations in the sentence.

Such a change comes about in the following way: When the processor encounters a QP, it first assesses whether the quantifier's lexical conditions can be fulfilled in the required LF structure. This assessment cannot reasonably take place until enough material in the sentence has been processed with respect to which the conditions can be evaluated (such as the verb and perhaps some required verbal complements). For cases where the QP being assessed is the second QP in the sentence, the required LF structure will embody the default relative scoping of the QPs, according to the PSI. If the lexical conditions of the quantifier(s) can be satisfied in the required LF, then the scoping is left unchanged and the preferred scoping for the sentence is the default scoping. If not, then the processor tries to find a way to meet them. One option, expressed in (6) as the Quantifier Satisfaction Hypothesis (QSH), is to build the less economical inverse scoping:

(6) Quantifier Satisfaction Hypothesis (QSH)

If necessary, the processor may move a QP at LF to a position above or below its required LF position in order to satisfy the conditions of the quantifier which heads the QP.

The QSH can be derived from the general notion that the processor uses the grammar to build structure, which is also an underlying component to the PSI.

A prediction of the QSH is that in a sentence where the lexical conditions of the quantifiers are satisfied on the inverse scoping but not on the default forward scoping, the forward scoping should be less strongly preferred than in a sentence where the quantifiers' conditions are satisfied on the forward scoping– because the inverse scoping is motivated in the former case but not in the latter. An examination of scope preferences in various sentences containing *each* confirms this prediction.

Before taking up those examples, however, I would like to mention an alternative to fulfilling conditions on quantifiers through inverse scoping. If the conditions are not satisfied within the sentence on the default scoping of the QPs, then may be able to be fulfilled by using information from the discourse context or the common background of speaker and hearer. They may even be met only in a very general way. In a sentence containing *each*, for example, the hearer may simply come away with the sense that the speaker felt that differentiation is important, without determining the differentiating dimension. In other words, *each*'s Differentiation Condition is not as strict a condition as, e.g., that which governs the binding of reflexives. Rather, it can be satisfied in a number of ways and is more akin to presuppositions attached to lexical items, which can be satisfied through the process of accommodation. For example, definite DPs carry a presupposition that their referent is already known. But if someone says to you "I'm upset that the maid didn't come today" and you didn't know already she had a maid, you can understand her statement; you simply update your knowledge base to reflect this piece of information. The same may be true for conditions on other quantifiers, which have yet to be worked out.

Given this alternative way of satisfying conditions on quantifiers, one question that arises is how often inverse scoping is employed. On the one hand, the processor may prefer to fulfill the conditions within the sentence, despite the cost of building an inverse scoping structure. Or, it may prefer to avoid such structures when possible, since they are uneconomical even when they are motivated, and go with the accommodation alternative when possible. Foreshadowing a bit, the results of the experiments involving *each* sentences, to be reported below in sections 5.4 and 5.5, indicate that while the inverse scoping option is chosen some of the time to satisfy the Differentiation Condition, the accommodation alternative is employed more often. For now, I will put this issue aside and focus on examples where inverse scopings are predicted to be preferred according to the QSH.

5.2.3 Scope and the Differentiation Condition

As a first example of where the Quantifier Satisfaction Hypothesis comes into play, consider the case of *each* and the Differentiation Condition. Recall from Chapter 4 that I conducted a small informal survey of linguists to gather judgements about a few sentences containing *each* and *every*, including those in (7). Three of the six informants found (7a) odd/infelicitous (indicated by the symbol #), particularly as compared to (7b).[3]

[3]Of the three informants who accepted (7a), one found a way to distinguish the different takings and thus satisfy the Differentiation Condition (this is clear from his statement, "To the extent that I can come up with a bunch of individual events, [it is] fine." The other two seemed to be rating the sentences strictly on a grammaticality scale, which is not appropriate for violations of the Differentiation Condition. See the discussion in Chapter 4.

(7) a. #*Ricky took each apple.*

b. *Ricky weighed each apple.*

I argued that this oddity was due to the Differentiation Condition not being satisfied. The use of *each* indicates that distribution is important, yet in (7a) it is hard to see why it is significant whether the action was distributed or not. It is not difficult to carry more than one apple at a time; one does not need to be particularly careful with them (as opposed to, e.g., a crystal platter). What seems most important is that in the end all the apples are taken, no matter how it was done. In (7b), on the other hand, it does matter whether the apples were weighed one a time or not– the weight obtained is different. So *each* is felicitous in (7b).

Changing the subject in (7a) to an indefinite, as in (8) below, improves the sentence. The indefinite provides a way to meet the Differentiation Condition: if *each* takes scope over the subject, then there are multiple clerks involved in the overall taking event and the taking of one apple can be differentiated from the taking of another apple by the agent of taking in each case. In this way, specifying different agents thus adds more descriptive content to the subevents.

As applied to *each*, the Quantifier Satisfaction Hypothesis says (i) that *each* will take inverse wide scope over an indefinite subject in order to satisfy the Differentiation Condition, and (ii) that it will do so only if the Differentiation Condition is not satisfied when *each* is given narrow scope. This predicts that when an indefinite subject is added to a sentence where the Differentiation Condition fails, as in (7a), wide scope on *each* will be preferred. This prediction was confirmed by my informants. Those informants who found (7a) odd preferred wide scope *each* in (8).

(8) *A clerk took each apple.* preferred scope: *each>a*

Syntactic reanalysis is usually triggered by a real problem, such as ungrammaticality, with the first analysis. What induces the reanalysis of LF structure in (8) to produce the inverse scoping is not as concrete. The Differentiation Condition is not a syntactic condition, nor a feature that needs to be checked in order for the derivation to be valid. It is part of the meaning of *each* and must be supported by the sentence or the context. If it is not met, the result is not ungrammaticality, but infelicity or a feeling that something is missing. Upon hearing (8), the hearer wants to make sense of the fact that *each* was employed by the speaker. But it is hard (for some people) to imagine why attention is being directed to the taking of individual apples on the default *a>each* scoping. Re-scoping is triggered by the desire to justify why *each* was used and to fulfill *each*'s Differentiation Condition.[4]

In contrast to (8), when an indefinite subject is added to a sentence where the Differentiation Condition is met, such as (7b), the QSH predicts that narrow scope *each* will be preferred:

(9) *A clerk weighed each apple.* preferred scope: *a>each*

This prediction was also upheld by my informants. In contrast to their judgements on (8), here they either reported a preference for the *a>each* scoping or no preference at all.

Moreover, two of the informants who rated (7a) as perfectly fine– no violation of the Differentiation Condition– preferred wide scope on *a* in (8) (the third had no preference), further supporting the QSH. Giving *each* inverse wide scope was not motivated.

5.2.4 Scope and the Event Distributivity Condition

Having demonstrated that scope preferences can be influenced by the Differentiation Condition, I now consider whether they might also be affected by the Event Distributivity Condition.

While for many speakers there is difficulty satisfying *each*'s Differentiation Condition in (7a), all awkwardness disappears when *every* replaces *each*; see (10a). The Event Distributivity Condition is readily met. It is easy to imagine in (10a) that Ricky took the apples in two or three batches. Or, alternatively, if exhaustiveness is emphasized, to not care about distributivity; i.e. the Event Distributivity Condition is relaxed (see §4.4). The same can be said for (10b).

(10) a. *Ricky took every apple.*

b. *Ricky weighed every apple.*

According to the Quantifier Satisfaction Hypothesis, then, *every* should generally disprefer

[4]This relates to the more general question of how semantic interpretation can influence what kind of structures are built, cf. Fox (1995) who argued that QR is generally uneconomical but that it is licensed when it produces a reading that cannot be generated otherwise.

inverse wide scope because there is no lexical condition forcing it to raise above the subject and it is uneconomical to do so without reason. Thus, when an indefinite subject is added in (10), as in (11), the preferred scope should be *a>every* (cf. (8) and (9)):

(11) a. *A clerk took every apple.* preferred scope: *a>every*

b. *A clerk weighed every apple.* preferred scope: *a>every*

Again, the scope preferences of my informants were as expected, upholding the QSH. Five out of the six reported a preference for wide scope *a* or no preference at all. (The sixth preferred wide scope *every* in both (a) and (b).) See sections 5.7 and 5.8 for discussion of a few cases where the Event Distributivity Condition may helps to support inverse wide scope in combination with another factor.[5]

We now have a reason why *each* is said to want wide scope more than *every*. Under certain conditions *each* will raise over an indefinite subject to fulfill the Differentiation Condition, but *every* does not have a corresponding condition which motivates it to take inverse wide scope.

These findings in this section and the previous one support both the QSH and the Differentiation Condition. They are not captured either by other theories of scope preferences, since those theories do not specify how it is that particular quantifiers affect scope preferences, or by theories of the differences between *each* and *every*, such as that proposed by Beghelli & Stowell (1997).[6] Under my approach, this pattern of responses is not only understandable, it is precisely

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[5]In Chapter 4 sentences containing *each* or *every* and a predicate which is obligatorily collective, such as (i-a,b), were discussed:

(i) a. **Each/every student gathered in the hall/met for lunch.*

b. *?*Vic gathered each/every towel from the bathroom.*

These examples are not relevant to the present discussion. (i-b) is not ungrammatical because the Event Distributivity and Differentiation Conditions are violated but because the verb *gather* can only apply to an object which denotes a group and *each/every*-phrases can never denote a group. A QP headed by *each/every* always distributes down to the individuals in its restrictor set. This is true whether it scopes over an indefinite or not. Thus, the addition of an indefinite for *each/every* to scope over does not improve these sentences.

(ii) a. **Each/every student gathered in a hall/met for lunch at a cafe.*

b. *?*A maid gathered each/every towel from the bathroom.*

Furthermore, there is no sense that *each* or *every* scopes over the indefinite subject in (ii-b).

[6]Recall from Chapter 4 that Beghelli & Stowell (1997) offered a theory of some of the differences between *each* and *every*. They were concerned with the distributive nature of *each* and *every*, not with scope preferences per se. Yet they did claim that their syntax explicates why QPs

(footnote continued …)

what is expected.

5.2.5 Summary

To summarize so far, I have proposed a hypothesis, the Quantifier Satisfaction Hypothesis, about how the lexical conditions of quantifiers can affect scope assignment and a theory of how it interacts with the PSI. I have argued that the Event Distributivity Condition does not drive inverse scoping, but the Differentiation Condition does, thus providing an explanation for why *each* prefers wide scope more than *every*. In the following section, I present additional examples where the scope preferences of *each* and *every* differ because the Differentiation Condition drives *each* to take inverse wide scope over an indefinite.

5.3 Secondary Predicates and the Differentiation Condition

The PSI favors the subject scoping over the object in a simple subject-object sentence. Yet we have seen that lexical factors can sometimes override this preference. I have argued that when *each* is in object position it will take inverse scope over an indefinite subject in order to meet the Differentiation Condition, and have offered a number of examples and informant responses to support this claim. Those examples contrasted in whether they contained the verb *take* or the verb *weigh*. While I have attempted to elucidate why the Differentiation Condition is satisfied in *Ricky weighed each apple*, but is not satisfied in #*Ricky took each apple* for many speakers, the determining factors are still somewhat elusive. A more well-defined factor which yields the desired paradigm is the absence or presence of an adjectival secondary predicate. The addition of a secondary predicate ameliorates questionable *each* sentences, as noted in Chapter 4:

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headed by these quantifiers often receive wide scope: they raise at LF to a position which is relatively high in the tree. While they observed that the scope behavior of *each* and *every* is different in sentences containing negation, their account of those examples does not extend to the examples discussed in this chapter which show that in particular situations *each* takes inverse wide scope over an indefinite to a greater extent than *every*. There is nothing in their theory equivalent to the Differentiation Condition that could affect relative scopings in such cases.

(12) a. #*The painter bought each brush.*

b. *The painter bought each brush dirty.*

(13) a. #*Brook wiped each table.*

b. *Brook wiped each table clean.*

(14) a. #*Each person in the room left.*

b. *Each person in the room left tired.*

The (a) versions of these examples are degraded because the Differentiation Condition is not satisfied. In (12a), for example, there is no obvious reason to differentiate the buying of one brush from another, no reason to think the individual brushes are of interest (during the buying) or that the time or manner in which they were bought is important. The use of *each* is not supported. When *each* is replaced by *every*, the sentences are fine.

According to Halliday (1967:62), a secondary predicate is a kind of 'attribute,' "a characteristic ascribed to one of the participants in the clause; but it is one that relates specifically to the process in question." So a secondary predicate connects to both the event and the individuals described in the sentence. For instance, *dirty* and *tired* apply to individual objects and beings: a group of objects cannot be collectively dirty while its members are not dirty. Examples (12b) and (14b) are more acceptable than (12a) and (14a) because the secondary predicate directs attention to the individuals in the set it modifies (the *each*-phrase) and relays a property of those individuals that held during the event. This emphasis on individuals reinforces *each*, and the property adds content to the subevents, thus satisfying the Differentiation Condition without requiring differentiation on another dimension.

Now consider the examples in (12) with one modification: the indefinite determiner *a* rather than *the* in the subject DP, creating a scope ambiguity; in (15). Given the degraded status of (12a), the Quantifier Satisfaction Hypothesis predicts that there should be an increased preference for *each* to take inverse wide scope over the indefinite subject, in order to satisfy the Differentiation Condition. Furthermore, the QSH predicts that the preference for wide-scope *each* should go away when the secondary predicate is added. Since the secondary predicate can fulfill the

Differentiation Condition on its own, the uneconomical inverse scoping is not supported. These predictions are intuitively supported: in (15a), the preferred scoping is *each>a*, but in (15b), with the secondary predicate, there is no temptation towards inverse scope.

(15) a. *A painter bought each brush.* preferred scope: *each>a*

b. *A painter bought each brush dirty.* preferred scope: *a>each*

With *every* as the head of the object QP, the preferred scope is subject over object whether there is a secondary predicate present or not. There is no reason to override the PSI in either case.

(16) a. *A painter bought every brush.* preferred scope: *a>every*

b. *A painter bought every brush dirty.* preferred scope: *a>every*

To my knowledge, the effect of a secondary predicate on scope preferences has not been noted before.[7]

I will assume a syntactic structure in which the secondary predicate and the object NP do not form a constituent (e.g. they do not form a small clause). Even if they did, it would be hard to argue that this clause structure blocks the object from raising to scope over the subject. As was pointed out in Chapter 2, there are a number of examples which show that QR is not always clause-bounded, including sentences with full CP complements, which have more structure than a small clause. Moreover, when the quantifier in the subject QP is changed to one which has a lexical bias to be interpreted existentially/weakly (see §5.7) the preference for narrow scope *each* is not nearly as strong, indicating that object QP can take wide scope:

(17) a. *Fewer than three boys wiped each table clean.*

b. *More than three women stained each bookcase dusty.*

Similarly, when *a different* is employed the sentence is perfectly fine, showing that the *each*-phrase has raised over the subject:[8]

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[7]Though secondary predicates affect interpretation in various other ways, cf. Laca (1990) on the generic interpretation of objects and Percus (1996) on examples involving quantificational adverbs.

[8]The secondary predicate in (17a) and (18) is a 'resultative' secondary predicate, and the one in (17b) is a 'depictive' secondary predicate. A resultative conveys the state of its associated NP at the completion of the process described by the verb, while a depictive conveys the state of the NP (footnote continued …)

(18) *A different boy wiped each table clean.*

A different N must be within the scope of a *each* or *every* to be interpreted (Beghelli & Stowell 1997).[9] Together these observations demonstrate that the difference between (15a) and (b) should not be ascribed to syntax.

Because the factors in (15) and (16) are well-defined– a difference in quantifier (*each* or *every*) and the presence or absence of a secondary predicate which applies to individuals– they are easily manipulated experimentally. Thus they offer an advantageous setting in which to test the Quantifier Satisfaction Hypothesis. In the following sections I report on two questionnaire studies which were conducted to gather scope preferences on sentences such as these. The results provide strong support for the QSH.

5.4 Pilot Experiment 1 – Scope Preferences and the Differentiation Condition

The secondary predicate examples discussed in the previous section were first tested in a small pilot study.

5.4.1 Method

Nineteen volunteers from the MIT community participated. Eight items like those in (19) (from (15) and (16) above) were presented in a printed questionnaire, crossing quantifier (*each* or *every*) with presence/absence of a secondary predicate. The items were counterbalanced across four lists. See the Appendix for a full list of targets.

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during (or at least at the start of) the process. As (i-a) shows, depictive secondary predicates, unlike resultatives, are incompatible with *a different*. The source of the awkwardness of (i-a) is not the difficulty of giving *each* wide scope; rather, it seems related to interpretation. While (i-a) is degraded, so is (i-b), which approximates it's meaning:

(i) a. ??*A different woman stained each bookcase dusty.*
b. ??*A different woman stained each bookcase while it was dusty.*
cf. *More than three women stained each bookcase while it was dirty.*
OK: *each* > *more than three*

[9]This is true for cases where *a different N* marks the set to be distributed over within the sentence; the reading in which it picks out an N different from the N discussed earlier in the discourse is not relevant here.

(19) a. *A painter bought each brush.*

b. *A painter bought every brush.*

c. *A painter bought each brush dirty.*

d. *A painter bought every brush dirty.*

There were twelve potentially ambiguous filler sentences,[10] for a total of 20 items. At least one filler item intervened between target sentences.

Participants were told to read each sentence once and to fix in their mind the first impression of what the sentence meant, and then to turn the page and choose which of two paraphrases given there was closest to the meaning they had arrived at. The importance of determining the meaning of the target sentence before reading the paraphrases was stressed. The paraphrases for example (19) were as follows:

(20) a. The brushes were all bought by the same painter (and they were all dirty when bought).
[Forward Scope: *a > each, every*]

b. Each brush was bought by a possibly different painter. (Plus each one was dirty when it was bought.)
[Inverse Scope: *each, every > a*]

The parenthesized material was given only in conditions (c) and (d), where there was a secondary predicate. The “same” paraphrase, as in (20a) above, was listed first for half of the items and second for the other half.

According to the Quantifier Satisfaction Hypothesis, the inverse scoping will be preferred to a greater degree (i.e. the “possibly different painter” paraphrase will be chosen more often) in condition (a), when the quantifier is *each* and there is no secondary predicate, than in any other condition, since only in condition (a) is there a reason to violate the PSI. There should be little difference among conditions (b,c,d). Thus, an interaction of quantifier and ±predicate is predicted.

[10]Two of the lists contained one filler with *every*, and two lists contained four. No fillers included *each*.

5.4.2 Results and Discussion

Figure 5.1 gives the percentage of cases where the preferred scope was the inverse scoping of *each* or *every* over *a* (i.e. the "possibly different painter" paraphrase was chosen), by condition. As expected under the QSH, there were more inverse scopings in condition (a), *each*/–predicate, and the rest of the conditions differed little from one another.

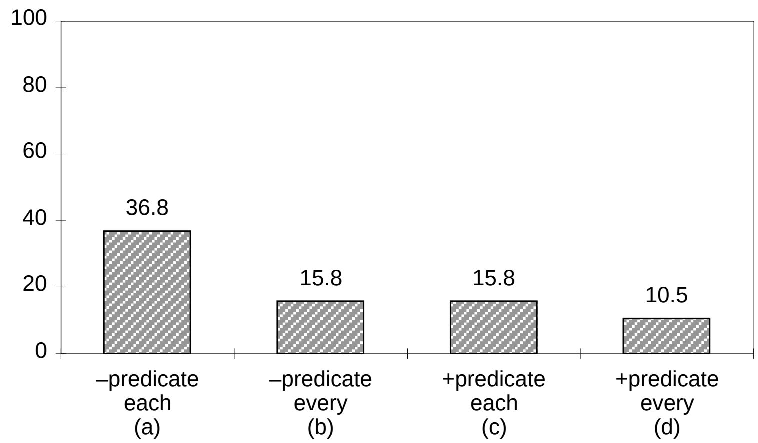

Figure 5.1 Percentage of cases where the preferred scope was *each, every* > *a* in Pilot Experiment 1

For the purposes of analysis, items in which *each* or *every* was given scope over *a* were coded with a '1' and items in which *a* was given scope over *each* or *every* were coded with a '0'. Planned contrasts of condition (a) compared to each of the other conditions were significant in the participants analysis, but very weak in the items analysis; for the effect of ±predicate on *each* (condition (a) vs. (c)), and the effect of quantifier when there was no secondary predicate ((a) vs. (b)), $F_1(1,18) = 5.03$, $p < .05$; $F_2(1,7) = 3.28$, $p < .15$; for each/–predicate vs. every/+predicate ((a) vs. (d)), $F_1(1,18) = 7.86$, $p = .012$; $F_2(1,7) = 4.78$, $p = .065$. No other contrasts approached significance, all *F*s < 1. Since the predicted pattern of effects was significant only in these analyses,[11] and even then only by participants, a larger and better controlled version of the pilot study was designed and conducted.

5.5 Experiment 3 – Scope Preferences and the Differentiation Condition

The main manipulations in Experiment 3 were as in Pilot 1. In addition, since the intuitions of some speakers suggested that different types of secondary predicate had different effects on scope judgements, two more conditions were added so that the effect of two kinds of secondary predicates– resultatives and depictives (see fn. 8)– could be compared. One reason to suspect that these kinds of secondary predicates might influence scope in different ways is that they are given distinct syntactic structures on most analyses.[12] Beyond this single change, the design for Experiment 3 was the same as for Pilot Study 1.

5.5.1 Method

Materials and Design. As in the pilot study, the materials were presented in a written questionnaire, with the experimental sentences printed on one side of a page and the paraphrases on the other side. Eighteen sets of sentences with the general form in (21) were constructed. An example sentence set and the corresponding paraphrases are given in (22) and (23).

(21) *a* N_1 V *each/every* N_2 (Pred)

(22)	a.	*A boy sliced each carrot.*	no predicate	*each*
	b.	*A boy sliced every carrot.*		*every*

[11]A two-factor ANOVA of ±secondary predicate x quantifier yielded a main effect of ±predicate, so that sentences without secondary predicates assigned wide scope on *each* or *every* more often than sentences with a secondary predicate, 26.3% vs. 13.2%, $F_1(1,18) = 10.84$, $p < .005$; $F_2(1,7) = 5.73$, $p < .05$. There was a very marginal effect of quantifier, with *each* being given wide scope more than *every*, 26.3% vs. 13.2%, $F_1(1,18) = 2.89$, $p = .106$; $F_2(1,7) = 3.99$, $p = .086$. The predicted interaction was not significant Fs < 2.

[12]For one proposal on the syntactic differences between predicate types and how they might affect the processing of these constructions, see Frazier & Clifton (1996).

c. *A boy sliced each carrot thin.* resultative predicate *each*

d. *A boy sliced every carrot thin.* *every*

e. *A boy sliced each carrot raw.* depictive predicate *each*

f. *A boy sliced every carrot raw.* *every*

(23) a. *All the carrots were sliced by the same boy { Ø / into thin pieces / when they were raw }.*
[Forward Scope: *a > every, each*]

b. *Each carrot was sliced by a possibly different boy { Ø / into thin pieces / when it was raw }.*
[Inverse Scope: *every, each > a*]

N_1 was always animate and N_2 was always inanimate. The "same" paraphrase, as in (23a) above, was listed first for half of the items and second for the other half (balanced across conditions).

The primary predictions for this experiment are the same as for Pilot 1. Following the Quantifier Satisfaction Hypothesis, inverse scope should be assigned more often in condition (a), when the quantifier is *each* and there is no secondary predicate, than in any of the other conditions, since the Differentiation Condition is not satisfied in (a). No effects of predicate are predicted for *every*, because its Event Distributivity Condition is fulfilled on the forward scoping whether a secondary predicate is present or not.

In addition to the target items, four control sentences were constructed which looked like the (a,b) target sentences but which were pragmatically biased towards a particular scoping: two towards the *each, every > a* scoping and two towards the *a > each, every* scoping. The control sentences and their intended scopings are given in (24). The paraphrases for these items were identical in form to the paraphrases for the target items.

(24) a. *A cat was sleeping on each chair.* *each>a*

b. *A pen lay on every book.* *every>a*

c. *A doctor checked each finger.* *a>each*

d. *An editor corrected every typo.* *a>every*

These sentences were included to make sure that participants were truly thinking about the items and not simply responding the same way every time they say an item of the form in (21). Since the strength of the bias was stronger in (24a,b) than in (c,d), it was decided that a participant would be excluded from analysis if he or she chose the wrong paraphrase for (24a), or for (24b), or for both (24c) and (d).

There were 24 filler sentences similar in length to or slightly longer than the targets, for a total of 46 items. Twenty of the fillers were ambiguous and 4 were unambiguous. As with the controls, the unambiguous fillers were included to assess whether participants were paying attention. A sample unambiguous filler and its paraphrases are given in (25):

(25) *The worker patiently explained how to load the truck.*

a. *The worker explained how to be patient while loading the truck.* [Incorrect]

b. *The worker was patient as s/he explained how to load the truck.* [Correct]

Of the 20 ambiguous fillers, 12 were part of another experiment on the interpretation of adjectives and 8 were of various other types, including ambiguities of PP attachment and the scope of negation. None of the fillers contained *each* or *every* or a secondary predicate.

Six lists were made up, counterbalanced so that each participant saw three target items in each condition and only one version from each sentence set. Some secondary predicates were used more than once in the materials, but the lists were constructed so that a given predicate occurred only once on each list. The lists were pseudo-randomized so that at least one filler followed each target or control item. The experimental sentences were printed on one side of the page and the paraphrases were printed on the other side. The survey was three pages (front and back) long. The order of the pages was shuffled for each subject. At least one control item occurred on each page.

Procedure. The procedure was the same as for Pilot Experiment 1. The survey took about 10-15 minutes to complete. It was given to participants after an unrelated 35-minute self-paced reading study.

Participants. Seventy-seven participants took part in the study. Thirty-one were undergraduates from the University of Massachusetts, Amherst, who received course credit in introductory psychology for their participation. Forty-six were from the MIT academic community (primarily undergraduates at MIT), who were paid for taking part. All were native speakers of English and were naive as to the purpose of the study. None of the participants took part Pilot 1.

5.5.2 Results

Participants' performance on the control items and unambiguous fillers was quite poor. Of the 77 participants, there were 9 who failed the criterion set up for the control items, 2 who got two of the unambiguous fillers wrong, and an additional 24 who got one unambiguous filler wrong. Nevertheless, the pattern of results and the strength of the effects is very similar whether all 35 of these poorly-performing participants are excluded, only the 11 worst ones are, or none are. The results reported below are based on the data from all 77 participants. There were no differences between the group of participants run at UMass and the group run at MIT.

The type of secondary predicate did not have any effect, so the resultative and depictive predicate conditions for each quantifier were collapsed for analysis (i.e. conditions (c) and (e) were combined, as were (d) and (f)), yielding two levels for the predicate factor (absent, present) rather than three (see Appendix B for the results broken down by predicate type).

For the purposes of analysis, items for which the "possibly different boy" paraphrase was chosen (indicating *each, every* > *a* scope) were coded with a '1' and items for which the "same boy" paraphrase was chosen (indicating *a* > *each, every* scope) were coded with a '0'. A 2x2 ANOVA of quantifier and predicate presence was performed. Across the whole experiment, there was a significant main effect of predicate presence, with –predicate items yielding more inverse scopings (*each, every* > *a*) than +predicate items, $F_1(1,76) = 17.19$, $p < .001$; $F_2(1,17) = 13.50$, $p < .005$. This result was numerically but not statistically bigger for *each* (21% *each*/–predicate; 17% *every*/–predicate; 9% +predicate, for both *each* and *every*). No other effects approached significance, Fs < 2.

Many participants reported noticing and disliking the secondary predicate items in the experiment.[13] In order to assess whether these observations had an effect on how participants responded to the target items, the data from each participant was split into two halves: the first nine items s/he saw vs. the second nine items s/he saw. Figure 5.2 (pg. 145) presents the percentage of cases where *each* or *every* was given wide scope in the combined predicate conditions and in the conditions without predicates, broken down by halves. As can been seen, the predicted pattern was obtained in the first-half items: there were more inverse scope readings for *each*/–predicate than for any other combination of factors. For the second-half items, there were no differences between *each* and *every*. It seems that part-way through the experiment, participants were bothered by the secondary predicate items enough that they began paying attention only to whether there was a secondary predicate or not, and were no longer noticing what the quantifier was.

2x2 ANOVAs of quantifier and predicate presence were performed separately for the first-half and second-half items.[14] Analysis of the first-half items yielded a significant main effect of predicate presence, $F_2(1,17) = 7.28$, $p = .015$; and a main effect of quantifier, $F_2(1,17) = 4.47$, $p = .05$. The interaction of quantifier and predicate presence was marginal, $F_2(1,17) = 3.30$, $p = .087$. Planned contrasts on the means showed the expected pattern. Critically, there was a significant effect of predicate presence when the quantifier was *each*, $F_2(1,17) = 8.00$, $p = .012$; but not when the quantifier was *every*, $F_2 < 1$. In addition, the effect of quantifier was marginal without a secondary predicate, $F_2(1,17) = 4.33$, $p = .053$; but unreliable with a secondary predicate, $Fs < 1$. Furthermore, one-factor ANOVAs on the effect of condition showed that the *each*/-predicate items differed significantly from all the other conditions, $F_2(1,17) = 8.56$, $p < .01$; and that the non-*each*/-predicate conditions did not differ from one another, $F_2 < 1$.

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[13]For instance, a number of subjects said that e.g. *A gardener pruned every bush frozen* should have been *A gardener pruned every frozen bush*, with the secondary predicate changed to a prenominal adjective.

[14]Only items-analyses were possible for most statistical tests reported here. In the participant analyses, there was not an equal number of participants for all combinations of factors. The lists had not been constructed with the intention of analyzing only the first (or second) half of the items a participant saw.

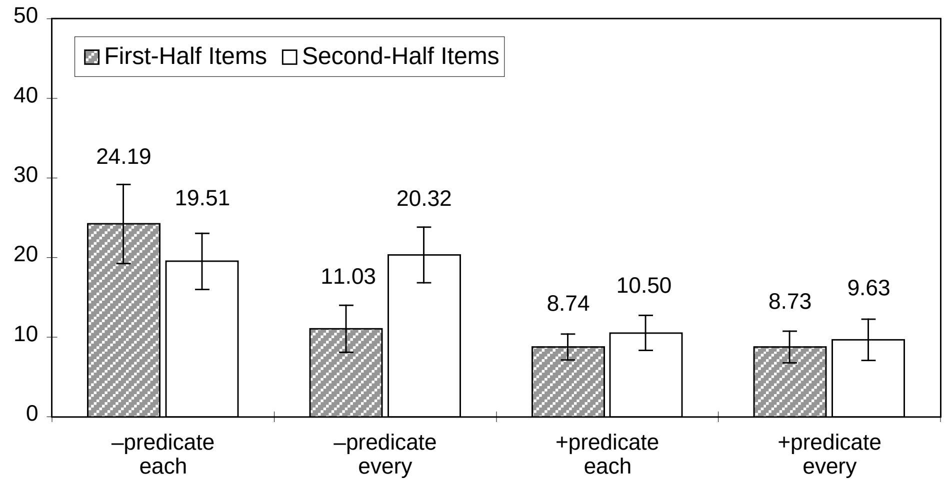


Figure 5.2 Percentage of cases where the preferred scope was *each, every* > *a* in Experiment 3, for the first nine items vs. the second nine items that a participant saw

For the second-half items, there was a reliable main effect of predicate presence, $F_2(1,17) = 7.08$, $p = .016$. The effect of quantifier and the interaction of quantifier and predicate presence were not reliable, Fs < 1. Planned contrasts on the means revealed significant effects of predicate presence for both *each*, $F_2(1,17) = 4.43$, $p = .05$, and *every*, $F_2(1,17) = 4.36$, $p = .052$. The effect of quantifier was nonsignificant with a secondary predicate, and without one, Fs < 1.

5.5.3 Discussion

The results from the first-half items in Experiment 3 replicate the findings of Pilot Experiment 1, with a different set of items and a different participant pool. Together the two experiments provide strong support for the Quantifier Satisfaction Hypothesis. As predicted, *each* had a stronger preference for inverse wide scope when there was no secondary predicate than it did when a secondary predicate was present, and there was no effect of predicate presence on *every*. These findings are explained as follows: The presence of a secondary predicate satisfies *each*'s Differentiation Condition by directing attention to the individuals involved in the event described by the verb (more on this point below). By the QSH, the uneconomical inverse scoping is therefore not supported, and the preferred scoping is the default scoping determined by the

PSI, where *each* has narrow scope. Without the secondary predicate, on the other hand, the Differentiation Condition is not easily met on the default forward scoping. One way to satisfy the condition in such cases is to give *each* wide scope over the subject indefinite, thus providing different agents for each subevent. This option is taken at least some of the time: the percentage of inverse scope readings is higher for *each* when there is no secondary predicate than when one is present. With *every*, forward scoping is always strongly preferred, whether of not there is a secondary predicate, because there is no reason to go beyond it. *Every* does not have a condition corresponding to *each*'s Differentiation Condition to drive it to take inverse wide scope.

Readers may be surprised that although there were significantly more inverse scope readings with *each*/–predicate than in any other condition the percentage was nevertheless fairly low, about 24%. That is, participants still preferred the forward scope reading for this condition. I believe this is primarily due to two related factors. First, as was discussed in Chapter 4, language users vary considerably as to how they fulfill the Differentiation Condition. While some people find the sentence *Ricky took each apple* (= 7a) odd because it is difficult to satisfy the condition using the default differentiating dimension of time, others find it acceptable because they go beyond time and find another way to differentiate or they invent scenarios that make differentiating based on time relevant. Some participants in the study may have been inclined to go beyond the overt content of the sentence, as just described, in order to meet the Differentiation Condition. This would help to explain the low percentage of inverse wide scope readings for the *each*/–predicate condition. According to the QSH, when the Differentiation Condition is fulfilled in another way, there is no need to give *each* wide scope over an indefinite subject (cf. the discussion of informant responses for examples (7a) and (8) in §5.2.3).

It seems unlikely, though, that the majority of participants fell into this category, especially given the experimental setting. No aspect of the task motivated participants to invent differentiating scenarios for the *each*/–predicate sentences they encountered. Giving *each* wide scope over the subject would be a conceivable way to differentiate, without having to go beyond the sentence and imagine a context. That this option was not taken more often suggests that the processor commonly avoids inverse scope readings– or, more exactly, readings not generated from the required LF structure– even when they satisfy the lexical conditions of the quantifiers. The picture that develops, then, is that the preferred scoping of a sentence is the default forward scoping which is consistent with the PSI, and that changing this scoping is quite difficult. Satisfying the lexical conditions of quantifiers provides a motivation for changing the default scope, yet it is not a strong enough motivation to produce inverse scopings all the time, since there are alternative ways of satisfying lexical conditions. Most participants in the present study probably simply read the sentences containing *each* and got the general sense that differentiation was important and felt this was enough to understand the sentence. As discussed in section 5.2.3, such an unspecific understanding of *each* is possible because how the Differentiation Condition is satisfied depends on context; an experimental setting is a kind of context.

I have been assuming a processing model in which a single LF is built from each S-structure. On such a model, only one reading is initially computed for a doubly quantified sentence, in accordance with Processing Economy and the PSI. Obtaining the other reading requires reanalysis. I have suggested that reanalysis only occurs under particular circumstances, such as when it is motivated by a desire to fulfill the Differentiation Condition. In Chapter 3 I argued that Experiment 1 did not distinguish between a single-LF system such as this and a ranked-parallel system in which multiple LFs are built, with Processing Economy determining the ranking. The results of Experiment 3 do not help to decide between these approaches either. In a ranked-parallel model, if the Differentiation Condition is not satisfied on the default forward scoping, the alternative, lower-ranked scoping would be assessed to see whether it fulfills the condition. If it does, its ranking would go up. Experiment 3 suggests that this alternative LF does not win out very often. In other words, its ranking does not seem to improve much even when it satisfies the Differentiation Condition. Perhaps this is because it is quite costly to compute and is therefore ranked quite low to being with.

<u>The Secondary Predicate Effect.</u> The results of Experiment 3 indicate that the presence of a secondary predicate satisfies *each*'s Differentiation Condition. But it is not precisely clear how it

does so. The explanation I have given so far is that the secondary predicate directs attention to the individuals involved in the event described by the verb. This explanation has a different flavor than the one given for how the condition is fulfilled by *each* scoping over an indefinite subject. The secondary predicate does not contribute to the **differentiation** of subevents or individuals per se. In fact, it specifies something which is the **same** about all of them.

It is possible that by identifying ways in which the subevents are the same, it becomes easier to pick out the dimension on which they differ. This may also account for why adding various adverbials helps questionable *each* sentences ((26c), pointed out by Tim Stowell, p.c.):

(26) a. ?? *Each person in the room left.*

b. *Each person in the room left tired.*

c. *Each person in the room left early / at five o'clock.*

A number of studies in psychology support this idea (e.g. Gentner & Markman 1994).

An alternative is that the use of *each* is more supported when more descriptive content about the subevents is given. The extra content, like the use of *each* itself, indicates that the subevents are considered important. This account better relates the secondary predicate cases to the scoping-over-an-indefinite cases. Scoping over an indefinite subject provides more content for the subevents as well, a different agent in each case.

I leave a more precise account of how secondary predicates satisfy the Differentiation Condition to future research.

5.5.4 Summary

The present study provides evidence for the claim that the scope behavior of *each* and *every* differs only under particular circumstances. *Each*'s Differentiation Condition can drive *each* to take inverse wide scope when it is not easily satisfied under the default forward scoping. Even in these cases, inverse scoping is adopted at a surprisingly low rate. When the Differentiation Condition is fulfilled *each* and *every* exhibit similar scope preferences, as predicted by the QSH. Furthermore, Experiment 3 offers additional support for the PSI. The preferred scoping in the target items was overwhelmingly subject > object.

5.6 The Scope Behavior of *Each* in Other Constructions

I am aware of two experiments which compared the scope behavior of *each* to that of another quantifier. First, *each* was compared to *all* in active and passive sentences. The results showed that *each* has a stronger preference for wide scope than *all*. Second, both *each* and *every* were employed in a study of sentences in which one QP is contained within another. No differences between *each* and *every* were found. These findings can be accounted for in the present theory if the materials used in the studies are considered.

5.6.1 *Each* vs. *All* in Actives and Passives

The scope behavior of *each* was compared to that of *all* in a study conducted by Brooks & Braine (1996, Experiment 2) as part of their research on children's understanding of these quantifiers. Data from adults was used as a point of comparison for the developmental data. Active and passive sentences likes those in (27) were used.

(27) *Each man is building a boat.*
All the men are building a boat.
A boat is being built by each man.
A boat is being built by all the men.

According to the PSI, forward scope should be preferred in both actives and passives, since the first QP c-commands the second QP in the required LF structure. What effect might quantifier choice have here? The QSH predicts that *each* should only take inverse wide scope if it is motivated to do so in order to satisfy the Differentiation Condition. *All*, on the other hand, may take inverse **narrow** scope in order to fulfill a condition of its own that favors collective readings.

The experiment proceeded as follows: Each item was read aloud and participants chose which of two pictures better represented the sentence they had just heard. The pictures were consistent either with a wide-scope indefinite interpretation of the sentence (in which all of the actors were shown acting collectively on an object) or a wide-scope universal interpretation of the sentence (in which each of the actors was shown acting separately on a different object; i.e. depicting a strictly distributive event). The universally quantified phrase was always the agent.

After a participant completed the picture-choice task for all items in the experiment, he or she was read a small number of target sentences again (one of each of the four types shown in (27)). Again, he or she was asked to choose the picture that went best with the sentence just heard. After the selection was made, the participant was asked whether the remaining picture could also go with the sentence.

The results of the main picture-choice task were as follows. *Each* was given wide scope more often than *all*, and there were more wide-scope universal readings for actives than for passives. Because the universal quantifier was the head of the first QP in the active sentences but of the second QP in the passives, the latter finding amounts to saying that there were more forward scope readings in the actives than there were inverse scope readings in the passives. This result is expected under my theory, since inverse scopings violate the PSI.

By quantifier, *each* received wide scope 99.2% of the time in actives, and 82.5% of the time in passives, while *all* received wide scope 16.7% of the time in actives and 1.7% of the time in passives. These findings are consistent with the idea that *all* is often used to indicate a collective event structure and *each* is used to indicate a distributive event structure. That the default forward scoping in the target sentence was sometimes overridden in order to satisfy these lexical conditions– giving *each* inverse wide scope, giving *all* inverse narrow scope– is predicted by the Quantifier Satisfaction Hypothesis.

What is surprising, however, is how frequently this occurred with *each*, around 83% of the time compared to 24% for inverse wide-scope *each* in my own Experiment 3. Given the small number of items in the study (18, with no fillers), it is possible that participants became aware of the quantifier manipulation, and that this heightened the influence of the quantifiers' lexical biases.[15] The nature of the pictures probably also contributed to this effect. In the collective picture, it is difficult to satisfy the Differentiation Condition, making it incompatible with *each*: all the men are shown working on the same boat at the same time, for example. Furthermore, although *all* can be used to express distributive action, it is not employed to **stress** distributivity–but that is what the distributive picture seemed to be doing, in that it depicted a strict distributive event.[16]

When participants were asked whether the target sentences could be used to describe each of the pictures, the picture showing collective action (scope: indefinite > universal) was accepted 100% of the time for *all*, and the picture showing distributive action (scope: universal > indefinite) was accepted nearly 100% of the time for *each*. These results held whether the sentence was in active or passive voice. More telling are the acceptance rates for the pictures depicting the reading which did not match the bias of the quantifiers. For *each*, the collective picture was accepted 25% of the time after an active sentence and 20% of the time after a passive sentence. According to the theory I have developed, these rates are low because, as mentioned above, the Differentiation Condition is not easily fulfilled in the collective picture. For *all*, the distributive picture was accepted 70% of the time after an active sentence but only 20% of the time after a passive. This difference is expected on my theory, since the active sentences supported the distributive event structure on the default forward scoping, but the passive sentences supported it only on the inverse scoping which violates the PSI. The relatively high rate of acceptance of the distributive picture for *all* in an active sentence suggests that *all*'s preference for a collective event structure is weaker than, and thus can be set aside more easily than, *each*'s Differentiation Condition.

[15]The participants in my Experiment 3 probably picked up the quantifier manipulation as well, but analyses of the first vs. second halves of the study indicated that they noticed the ±predicate manipulation more.

[16]These comments are not meant as criticisms of the study. Brooks & Braine's intention was to investigate *each* as a distributive quantifier and *all* as a collective quantifier. The pictures clearly served this purpose.

In sum, Brooks & Braine's findings provide further support for the current theory, showing effects of both syntactic structure and quantifier type predicted by the PSI and the QSH.

5.6.2 One QP Within Another: Inverse-Linking Structures

Intuitions suggest that the lower quantifier in sentences like (28) and (29), in which one quantified phrase is contained within another (called inverse-linking structures by May, 1977), generally takes wide scope over the higher quantifier. Many researchers go further and claim that only one scoping is available in these structures, as in the double object construction (though here it is the inverse scoping and with double objects it is the forward scoping). (Gabay & Moravcsik, 1974, are often cited as the first to have discussed examples like these.)

(28) $[_{QP_1}$ *All the gifts to* $[_{QP_2}$ *some girl*]] *were wrapped in red paper.*
(Reinhart 1983:196)

(29) a. *Everybody in some Italian city met John.*

b. *Some people from every walk of life like jazz.*

c. *Every senator on a key congressional committee voted for the amendment.*
(May 1977:62,102)

The results of two studies by Kurtzman & MacDonald (1993) on these structures support the intuitive preference for inverse wide scope. Their data is particularly interesting because they employed *each* and *every* in some of their items. I will begin by discussing the syntax of these structures, then turn to a review of the studies.

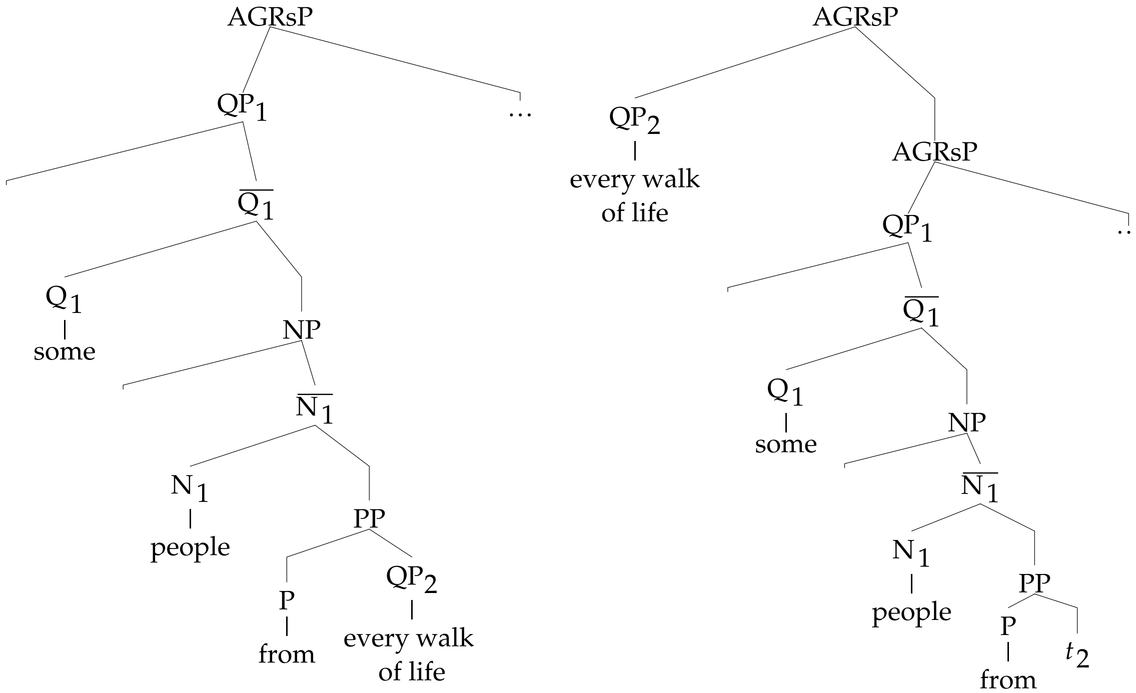
Inverse-linking examples have always posed a problem for theories of scope based on surface c-command relations, since although the first quantifier c-commands the second, it is the second which gets wide scope. But note that the C-command Principle is usually formulated as referring to the relation between the two whole QPs, not the quantifiers/determiners within them. On this formulation, it does not apply to inverse-linking structures, since one QP contains the other. The first Q and N do not form a constituent on their own. So QP_1 does not c-command and is not c-commanded by QP_2. Hence, on this formulation, the C-command Principle makes no prediction about the preferred scope in these structures. The Principle of Scope Interpretation that I have proposed, however, correctly predicts that inverse scope should be preferred. I will return to this point shortly.

The analysis usually given for why the forward scoping is difficult (or impossible) to get in these structures is in the same vein as that given for why the inverse scoping is difficult (or impossible) to get in double object structures: in both cases there is a trace that can only be properly bound in one configuration. The difference between the two constructions is the constituency of the QPs. In inverse-linking structures the quantifier and noun of the first QP (*some people*) do not form a constituent while in QP_2 they do (*every walk of life*). Thus, QP_2 can move on its own, but QP_1 cannot; it always drags along QP_2 or a trace of QP_2. In the double object construction, as analyzed by Runner (1995), the reverse is true (see Chapter 3, §3.3.2).

At S-structure, the entire phrase *some people from every walk of life* in (29b) is in [Spec,AGRsP], as shown in (30a). At LF, QP_2 (*every walk of life*) must raise because it cannot be interpreted as the complement of a preposition, since that is a type-*e* position. It adjoins to AGRsP (the PP, NP, and DP are not of the appropriate semantic type for the QP to adjoin to) and leaves behind a trace within QP_1. If QP_1 were to also raise, and adjoin to AGRsP above QP_2, then the trace of QP_2 would not be properly bound, violating the ECP. Thus QP_2 must scope over QP_1.

(30)

a. S-structure b. LF



May (1977) argues that the inverse scoping is the only one which the grammar can generate for sentences like (12) and (13). He admits, however, that a small number of examples, including (13c), also allow the forward scope reading. He calls this reading the ‘relative’ reading because it is interpreted like a relative clause. For instance, for (13c) this reading can be paraphrased as “Every senator who is on a key congressional committee….” May maintains that this interpretation is idiosyncratic, depending on the choice of preposition and the choice of quantifiers, whereas the inverse scope reading is always available. When *every* in (13c) is replaced by *each* or *all of the*, for example, the relative reading is no longer available. May suggests that the relative reading must be derived outside the sentence grammar.

Huang (1982:196-7) maintains that inverse-linking structures are ambiguous, but that some interpretations are harder to get because of pragmatic effects. It seems fairly clear that pragmatics and plausibility are indeed playing a role here. Consider (13b). Individual people come from one or two occupations, not **every** one; the *some>every* scoping is implausible. Similar comments can be made about the well-known example in (31) (from May 1977):

(31) *Some exits from every freeway are badly constructed.*

Though one can imagine exit ramps from two close freeways merging together to form one, it is impossible to extend this picture so that the exit is from **every** freeway. Numerous inverse-linking examples have this character. Reinhart (1983:195) offers a similar example, *The policeman found a bomb in every mailbox*. All the examples I have encountered of this type have an indefinite as the first quantifier and a universal as the second quantifier.

According to the theory of scope preferences that I have developed in this dissertation, the scoping based on surface c-command is generally preferred. Why is that not the case here? To be interpreted, QP_2 must raise and adjoin to a clausal projections; that's part of the required LF. QP_1 cannot raise above QP_2, because then QP_2's trace would not be bound. So in the required LF, QP_2 scopes over QP_1, and the PSI predicts this to be the preferred scoping. The forward scoping of $QP_1 > QP_2$ can be obtained, but only through employing an expensive operation of some kind: violating the ECP, building extra syntactic structure into the phrase such as adding a clausal node inside it, as May suggested, or employing high semantic types to interpret the QPs (see Heim & Kratzer, 1998, for discussion of these alternatives). Such expensive operations are dispreferred when not motivated.

Experiments on Inverse-Linking Structures. As mentioned above, Kurtzman & MacDonald (1993) conducted two studies on inverse-linking structures which supported the widespread intuition that inverse scope is preferred in them. Moreover, they employed both *each* and *every* as one of the quantifiers in the items, allowing a comparison of their scope behavior.

According to the QSH, *each* should generally pattern with *every*, unless it is motivated to override the PSI and take wide scope in order to satisfy the Differentiation Condition. Because the scoping computed from the required LF in inverse-linking sentences is $QP_2 > QP_1$, the place to look for quantifier effects is in items where the *each*- or *every*-phrase is QP_1.

K&MacD's inverse-linking experiments used a design very similar to their active and passive studies (reviewed in Chapter 2). In their Experiment 3 there were eight conditions: four "ambiguous" and four "lexically biased." I begin by describing the former, leaving the latter to be discussed prior to their Experiment 4, which further explored lexically biased items.

In the ambiguous conditions of Experiment 3, the quantifiers were *a* and *every*, and quantifier order crossed with continuation type. See (32) for sample items, along with the scoping the continuation sentence was intended to be consistent with. As in K&MacD's other experiments, participants judged whether the continuation was compatible with the quantified sentence. The items were constructed so that both scopings were plausible (unlike (31) discussed above).

(32) a. *George has a photograph of every admiral. The photograph was quite famous.* a>every

b. *George has a photograph of every admiral. The photographs were quite famous.* every>a

c. *George has every photograph of an admiral. The admiral was quite famous.* a>every

d. *George has every photograph of an admiral. The admirals were quite famous.* every>a

The results for these conditions indicated a weak preference for inverse scope in the *every-a* order (approximately 57% compatibility for inverse scope, condition (c), vs. 42% for forward scope (d), a difference of 15%) and a strong preference for inverse scope in the *a-every* order (about 90% compatibility for inverse scope (b) vs. 38% for forward scope (a), a difference of 52%). K&MacD do not present an ANOVA on just these four conditions, or relevant *t*-tests, so it is unclear whether there is a significant interaction here, i.e. whether the strength of the preference for inverse scope is significantly different for the two different quantifier orders. However, the data clearly point in that direction.

The lexical bias conditions of Experiment 3 contained either *each* or *the*, as quantifiers biased to take wide scope. *Each* was paired with *a* as the second quantifier, and *the* was paired with *every*. For both pairs, both quantifier orders were presented but only the continuation that was consistent with the lexical bias of the quantifiers was used. As shown in (33), for *each/a* the continuation was plural, consistent with *each* getting wide scope, and for *the/every* the continuation was singular, consistent with *the* getting wide scope.

(33) a. *George has the photograph of every admiral. The photograph was quite famous.* the>every

b. *George has a photograph of each admiral. The photographs were quite famous.* each>a

c. *George has every photograph of the admiral. The admiral was quite famous.* the>every

d. *George has each photograph of an admiral. The admirals were quite famous.* each>a

The compatibility rates for the lexically-biased conditions were very similar to those for the ambiguous *a-every* conditions, yielding high compatibility judgements in (b) and (c) where the continuation was consistent with wide scope on the second quantifier.

In Experiment 3 as a whole, the preference for inverse scoping was significant, and due to the weak preference for inverse scope with *every-a* vs. a strong preference for inverse scope elsewhere, there was a significant three-way interaction of ambiguity, continuation, and quantifier order.

In Experiment 4, K&MacD further examined lexically biases, using the quantifier pairs *each/a* and *every/the.* In contrast to Experiment 3, only one quantifier order was employed– the universal quantifier was always first– but the continuations varied, half the time being inconsistent with the lexical bias of the quantifiers. Conditions (33c) and (d) from Experiment 3 were re-run, along with those in (34):

(34) a. *George has each photograph of an admiral. The admiral was quite famous.* a>each

b. *George has every photograph of the admiral. The admirals were quite famous.* every>the

The *each-a* items in Experiment 4, (33d) and (34a), yielded a weak preference for inverse scope (about 58% compatibility for inverse scope vs. 44% for forward scope, a difference of 14%), marginally significant by a *t*-test. Hence the results for *each-a* items here matched those for the *every-a* items in Experiment 3, (32c,d). This finding is important to the question of how *each* and *every* differ with respect to scope preferences. I will return to it shortly.

For the *every-the* conditions in Experiment 4, (33c) and (34b), there was a strong inverse scope preference, matching the *a-every* pattern in Experiment 3, (32a,b): 78% for inverse scope vs. 30% for forward scope, a difference of 48%. There was a significant interaction between the strong preference in the *every-the* conditions and the weak preference in the *each-a* items.[17]

Kurtzman & MacDonald observed that none of the scope principles they were assessing can account for the preference for inverse scope that they found in these experiments. They stated that their findings indicate that the C-command and Linear Order Principles either are completely invalid or for some reason do not operate in inverse-linking structures, and that a new principle, yet to be composed, is needed to capture the preferences in these structures. I maintain that the PSI can handle the inverse scope preference in inverse-linking structures as well as it can account for scope preferences in other constructions. For inverse-linking sentences, inverse scope is assigned because it is this scoping which is computed from the required LF.

The fact that K&MacD found some support for forward scope readings in inverse-linking structures led them to state that ruling out this reading by grammatical principles seems "extreme" (p. 269). I concur. The forward scoping should not be considered impossible to generate, but rather less economical.

I turn now to a comparison of the *each-a* and *every-a* items. These items were the critical place to look for differences between *each* and *every*, since giving the *each*- or *every*-phrase wide scope would override the PSI. The results indicated that the *each-a* and *every-a* conditions were treated similarly by participants. K&MacD did not point out this similarity directly. Instead, they commented on finding a lower rate of compatibility judgements for wide-scope *each* than they had expected. They concluded (p. 267) that "the preference [for inverse scope in inverse-linking structures] is so strong that it can overcome the scope tendencies of particular quantifier terms." I take a different view. *Each* is not inherently biased to take wide scope more often than *every*, but it will do so, following the QSH, in order to meet the Differentiation Condition. That *each* did not take wide scope more than *every* here suggests that the Differentiation Condition is fulfilled in these items without *each* taking wide scope. For example, in *Jack photocopied each article about a*

[17]K&MacD suggested that the weaker inverse scope preference in items where the second quantifier was *a* may be due to some awkwardness in having an indefinite in a deeply embedded position.

hostage it is easy to differentiate articles even when they are about the same hostage, and in *The manager responded to each request from a worker* it is easy to differentiate requests even when they are from the same worker.

Thus, Kurtzman & MacDonald's experiments on inverse-linking structures had the potential of revealing differences between the scope behavior of *each* and *every*, but in the end exhibited none. These results are accounted for by the QSH, providing that the Differentiation Condition was satisfied in the items they tested. Furthermore, these studies provide additional support for the PSI, using a construction in which the C-command and Linear Order Principles at best yield no prediction about which scoping should be preferred.

5.6.3 Further Investigations of the Scope Behavior of *Each*

Clearly, more research should be done on comparing the scope behavior of *each* to that of other quantifiers. The studies reviewed above bring forward some issues that should be considered in designing such studies. First, *each* should be studied in a setting which does not amplify the Differentiation Condition the way it was in the strict distributive and strict collective pictures in the Brooks & Braine experiment. Offering a picture of an event with a partial distributive event structure might be a solution. Second, and more importantly, it would be best if the materials in the study were pretested to show whether they did or did not satisfy the Differentiation Condition without *each* scoping over an indefinite. Unfortunately, how to do such pretesting is unclear. A simple acceptability rating task allows for too many other factors to possibly influence participants' responses. A method is needed which gets at the differentiation question more directly. Using linguists as informants was helpful to me because they are trained to think about and discuss their judgements of sentences. Future work on investigating the scope behavior of *each* should begin with the question of how to have non-linguists evaluate whether the Differentiation Condition is fulfilled or not.

5.7 The Role of Different Kinds of Indefinites

In this section I will demonstrate that the tendency for *each* and *every* to take wide scope is, in at least some cases, affected by the lexical conditions of the indefinites they occur with.

Recall from Chapter 2 that in Diesing's system, indefinites are ambiguous between a weak/existential interpretation and a strong/presuppositional/quantificational interpretation. What has yet to be discussed is what determines which reading is obtained. Two factors play a role. First, the position of the indefinite: subjects are more apt to be interpreted presuppositionally than direct or indirect objects. This is likely due to the tendency to interpret the subject as given material, already established in the discourse. Second, the indefinite quantifier itself matters: certain quantifiers seem to prefer to be interpreted presuppositionally, while others prefer to be interpreted existentially.

For the present discussion I will concentrate on a particular set of QPs: those containing monotone decreasing quantifiers and modified numerals, such as *no one, fewer than three*, and *more than six*. There is general agreement that it is quite difficult, if not impossible, to get strong/presuppositional interpretations of these QPs, while QPs headed by *some, one, two, four*, etc., and perhaps to a lesser degree, *several*, are easily taken to be presuppositional (Ruys 1992; Beghelli 1993).[18] For example, (35a) allows a presuppositional interpretation, while (35b) does not (see Ruys for a pragmatic account of why this is so):

(35) a. *The boy has kissed three girls.*

= "there is a (particular) set of three or more girls that have been kissed by the boy" Strong reading

[18]The strong tendency for overt partitives, built with the addition of *of the*, to be interpreted strongly/presuppositionally is also fairly well accepted, though, as was pointed out in Chapter 2 (§2.3.2), there are dialects where they can receive weak readings. On the other side, bare plurals are widely thought to require existential interpretations. Researchers disagree, however, on how strongly *a N* prefers one reading or the other. It is likely that there are individual and/or dialect differences here as well.

b. *The boy has kissed less than three girls.*

≠ "there is a (particular) set of less than three girls, who are girls who have been kissed by the boy" Strong reading

= "the number of girls that the boy kissed is less than three (possibly none)" Weak reading

based on Ruys (1992:166)

Beghelli (1997) investigated the availability of different scope readings in various constructions involving two QPs (c.f. Liu 1990). He was not concerned with scope preferences, but with which QPs in which positions yield which readings. The following examples are based on the paradigm that Beghelli offered.

(36) a. { *Two of the women* / *several women* / *a woman* / *more than three women* } *visited every/each man.*

b. { *Two of the clerks* / *several clerks* / *a clerk* / *fewer than five clerks* } *weighed every/each package.*

(37) a. *John introduced* { *two of the professors* / *a professor* / *more than three professors* } *to every/each student.*

b. *Mary showed* { *two of the books* / *a book* / *fewer than five books* } *to every/each child.*

My intuitions are that it is possible to get a wide scope interpretation of the *every/each*-phrase in these sentences (the inverse scoping), but that this reading is only **preferred** when the indefinite is *more than three N* or *fewer than five N*, which prefer to be interpreted weakly/existentially (see (38) and (39)). With the other indefinites forward scoping is preferred.

(38) Inverse scoping of (36a)

"for every/each man, there is a (possibly different) set of more than three woman who visited him"

(39) Inverse scoping of (37a)

"for every/each student, there is a (possibly different) set of more than three professors whom John introduced her/him to"

The LF representations for the inverse scopings of (36a) and (37a) are given in (40) and (41), respectively. In Diesing's system indefinites must be internal to VP at LF to receive a weak/ existential interpretation (so that they are mapped into the nuclear scope of the tripartite semantic structure and captured by existential closure). Weak indefinite subjects and objects must therefore lower at LF from their surface [Spec,AGRP] positions into their base positions within VP.[19] In both (40) and (41), the QP *more than three women*, with its preference to be interpreted existentially, lowers into VP, placing it below the *every/each*-phrase. In (40), *every/each man* remains in its surface position, [Spec,AGRoP]. In (41), *every/each student* has raised and adjoined to VP because as a strong QP it can not remain inside the VP at LF.

(40) $[_{AGRsP}$ t_i *visited* $[_{AGRoP}$ *every/each man*$_i$ $[_{VP}$ [*more than three wome*n $]_k$ t_v t_i]]]

(41) $[_{AGRsP}$ *John*$_k$ [*introduced* $[_{AGRoP}$ t_i $[_{VP}$ *every/each student*$_j$ $[_{VP}$ t_k t_v
[*more than three professors* $]_i$ *to* t_j]]]]

The Quantifier Satisfaction Hypothesis explicates the effect of indefinite-type in (36) and (37): the lexical preference of *more than three N* and *fewer than five N* to be interpreted weakly/existentially motivates the violation of the PSI, while with the other indefinites there is no such motivation.

Although inverse wide scope of an object over a subject in a simple subject-object sentence is possible for *every* (though not preferred), it is much harder for presuppositional indefinites such as *three of the men*, as pointed out by Beghelli (1997). Compare:

(42) a. *More than one woman visited three of the(se) men.*

b. *More than one woman visited every man.* = (36a)

Inverse scope = "{ for each of these three men/for every man }, there is a (possibly different) set of more than one woman who visited him"

The contrast in (42) offers the first evidence that the Event Distributivity Condition is playing a role in determining the availability of inverse scope readings for *every*. The subject here is an indefinite with a lexical bias for being interpreted weakly/existentially, thus inverse scoping is obtained by lowering the subject into VP, below the object in [Spec,AGRoP]. It seems that the subject's bias is not enough to make the inverse scoping easy in (a), but the combination of this

[19] An alternative to syntactic lowering is 'semantic reconstruction' (see e.g. Bittner 1994; Cresti 1995; Rullmann 1995).

bias and *every*'s Event Distributivity Condition is sufficient to do so in (b). In essence, *every* says "I like distributing, so I will endorse a structure where I get to distribute over an indefinite."

A final note on (42): when the head of the object QP is *most*, the inverse scope reading is easier to obtain than with a presuppositional indefinite, as can be seen by comparing (43) to (42a):

(43) *More than one woman visited most of the men.*

The interpretation of a partitive such as *three of the men* in (42a) as strong/presuppositional is favored, but not absolute. *Most*, on the other hand, is like *every* and *each* in always receiving a strong/presuppositional interpretation. Perhaps it is this factor which somehow makes inverse scope more available in (43) than in (42a). The question remains whether there is a difference between the ease/difficulty of assigning *most* wide scope in (43) versus assigning *every* wide scope in (42b). My judgements are unstable. Such direct comparisons of *every* and *most* are not often made. I take up this issue now.

5.8 Residue of the Scope Hierarchy

I have argued that the sense that *each* has a stronger preference for wide scope than *every* comes from cases where *each* takes wide scope in order to satisfy the Differentiation Condition, and that *every*'s Event Distributivity Condition does not affect scope nearly as strongly. What about the other quantifiers on Ioup's hierarchy? Is the relative positioning valid? If so, what is behind it? There are two quantifiers in the hierarchy other than *each* and *every* which are strong quantifiers– which do not have the option of being interpreted within VP at LF, where they would be scoped over by QPs higher in the structure– *all* and *most*. How does their scope behavior compare to that of *each* and *every*?

The little data available on such comparisons are inconclusive. Gillen (1991) found slight differences in the scope behavior of *every*, *most*, and *all* in her Experiment 8, where participants judged whether a diagram depicting one of the scope readings was compatible with the quantified sentence they had read. Wide-scope universal diagrams were accepted at a slightly higher rate with *every* than with *most* (91% vs. 87%) and, correspondingly, wide-scope indefinite diagrams were accepted slightly more often with *most* than with *every* (68% vs. 65%). On both measures, *all* was not far behind *most* (83% acceptance for wide-scope universal diagrams; 70% for wide-scope indefinite diagrams). However, as already noted, statistical tests comparing pairs of quantifiers were not conducted, so it is unclear whether these small differences are reliable.

All is often used to convey a collective event structure, though it does not absolutely require one. (To unambiguously indicate and emphasize a collective event, a collectivizer like *together* is used in addition to *all*.) Consider the example in (44). For this sentence to be true of a collective event– all the girls worked together at the same time to pick up a piano– it must have been the same piano they were all trying to lift. So the relative scoping of the quantifiers must be *a>all*.

(44) *All the girls picked up a piano.*

Thus *all* likely takes inverse narrow scope (overriding the PSI) to the extent that it favors collective structures in the sentences in question. In §5.6.1, I noted that the results of Brooks & Braine's study comparing *each* and *all* suggested that *all*'s preference for a collective event structure is not as strong as *each*'s Differentiation Condition. It has yet to be determined how the strength of *all*'s lexical condition compares to that of *every*.

Unlike *each* and *every*, *most* does not require any amount of event distributivity, as (45) shows, though it does not bias towards a collective event structure the way that *all* does.

(45) *Jamie lifted most of the baskets together (and the rest one at a time).*

Consequently, if *every*'s Event Distributivity Condition has any effect on scope preferences, that effect might best show up when comparing *every* and *most*.

We have seen that obtaining inverse wide scope over a subject is often difficult. How does *most* fare in such sentences? Beghelli (1993:70), who maintains that QPs headed by *each* and *every* undergo QR but that QPs headed by other strong quantifiers do not, offers example (46a). He notes that it is very difficult to give *most* inverse wide scope over *a* here, despite the fact that the sentence is pragmatically biased towards an interpretation with multiple salesreps. In contrast, the latter interpretation is not only available with *each* and *every*, but preferred.

(46) a. *A salesrep convinced most customers at the convention.*

b. *A salesrep convinced every/each customer at the convention.*

Thus, *each* and *every* seem more amenable to pragmatic influence than does *most*. In (46b), as in (42b) at the end of the previous section, the Event Distributivity Condition and the Differentiation Condition have enough influence to, along with another factor– here plausibility, in (42b) the bias of the subject quantifier– make overriding the PSI easier. *Most* appears not have a corresponding lexical condition to help it out.

Certainly more experimental data should be gathered on the scope behavior of different types of quantifiers, especially within the same syntactic frame. The Quantifier Satisfaction Hypothesis allows for the lexical conditions of all quantifiers to play a role in determining scope preferences. We need to establish what those other lexical conditions are.

5.9 Open Questions

A number of open questions about the scope behavior of *each* and *every* remain. For one, recall from §4.7 that the domain of quantification for *every* must be specified in the context, while for *each* it can be accommodated much more easily. Whether this difference between *each* and *every* relates in any way to their scope behavior has yet to be determined.

Secondly, there is the question of whether the Differentiation Condition can be highlighted or backgrounded in certain contexts and, if so, how that would affect scope preferences. If the condition were highlighted, then it might be desirable to differentiate the subevents more than "normal," on more than one dimension. Hence, we might expect more inverse wide scope of *each* over an indefinite subject even when the Differentiation Condition is satisfied on the forward scoping. If the Differentiation Condition were backgrounded, there might be less inverse scoping, even when the condition is **not** fulfilled on the forward scoping. I leave to future research how highlighting or backgrounding could be achieved.

A third issue concerns whether *each* and *every* respond differently to the Vagueness Principle. There are two situations to consider: when *each* is given scope over an indefinite by default, following the PSI, and when *each* takes inverse wide scope[20] in order to satisfy the Differentiation Condition.

In regard to the first case, consider the examples in (47), based on Kurtzman & MacDonald's Experiment 1 materials. The preferred scoping is predicted to be *each*>*a* here. If the Vagueness Principle holds equally for *each* and *every*, then the (a) and (b) continuations should be read equally quickly, as was found with *every* in my attempted replication of K&MacD's experiment.

(47) *Each kid climbed a tree.*

a. *The tree was full of apples.*

b. *The trees were full of apples.*

But the Vagueness Principle may not apply to *each* here. *Each*'s Differentiation Condition may influence the processor to multiply instantiate *a tree*. If so, the plural continuation (b) would be predicted to be read significantly faster than the singular continuation (a).

For cases where *each* is in object position and it is given inverse wide scope, consider Experiment 3 once again. In order to satisfy the Differentiation Condition, *each carrot* can scope over *a boy* in (48), providing a different agent for each subevent. Since there must be different agents in order to fulfill the condition, I would expect the Vagueness Principle not to hold in such cases. Note that the Experiment 3 survey cannot help us determine whether this hypothesis is correct because subjects were forced to choose an interpretation. In a reading study, this hypothesis would predict continuation (b) to be read faster than (a):

(48) *A boy sliced each carrot.*

a. *The boy was careful with the knife.*

b. *The boys were careful with the knives.*

One caveat should be raised here. Although there were significantly more instances of inverse wide scope in these cases (*each*/–predicate) than in other the conditions in Experiment 3, the rate was still quite low (24%). If this result carries over to a reading experiment, then more often than

[20]For the remainder of this chapter I will use the term 'inverse wide scope' to mean the less economical scoping, achieved by changing the required LF structure.

not the scoping in (48) will be *a>each* and only the singular continuation will be appropriate, with (a) being read faster than (b). It is unclear how this effect would balance out against the predicted effect of (b) being read faster than (a) when *each* is given wide scope. A different experimental design may be needed.

Finally, I have argued that there is a contrast between the scope behavior of *each* and *every* in the examples discussed in §§5.2-5.5 because of the Differentiation Condition, but the question arises as to whether there is a contrast only in such directly contributable cases. It is beyond the scope of the chapter to consider this question in detail, but I sense that the answer is no. It may be that due to examples such as those discussed earlier, a more general contrast between *each* and *every* with respect to scope has been established. Language users may choose *each* when they want to indicate inverse wide scope, even in cases where the Differentiation Condition is satisfied. But I would be surprised if studies revealed more instances of such cases than of cases of inverse wide scope motivated by the Differentiation Condition. If this were to happen, I would suspect that *each* is subject to some other condition, yet to be determined, in addition to the Differentiation Condition. The QSH would apply to both of them.

5.10 Concluding Remarks

Various factors play a role in determining quantifier scope preferences. The focus of the present chapter has been on the role that individual quantifiers play in this process. I have proposed a detailed and motivated theory of how and why specific quantifiers can influence scope preferences.

Following the results from Chapter 3, I assume that the default scoping for a doubly quantified sentence is determined by the economy-based Principle of Scope Interpretation (PSI): it is computed from the required LF structure of the sentence. Generally, if QP_1 c-commands QP_2 at S-structure, then the default scoping is $QP_1 > QP_2$. The preferred scoping for the sentence is the default scoping, unless other factors operate to change it.

The central addition to this theory is the Quantifier Satisfaction Hypothesis, repeated in (49):

(49) Quantifier Satisfaction Hypothesis (QSH)

> If necessary, the processor may move a QP at LF to a position above or below its required LF position in order to satisfy the conditions of the quantifier which heads the QP.

This hypothesis essentially specifies circumstances under which the inverse scoping, where the surface c-command relations are reversed, can be assigned. (Inverse-linking structures are an exception to this generalization. Since inverse scoping is the default scoping in such cases, it is the forward scoping that the QSH generates.) According to the QSH, a quantifier's scope behavior is driven by the lexical condition(s) which are part of its meaning.

The QSH correctly predicts the differences in the scope behavior of the universal quantifiers *each* and *every*. *Each* has often been said to prefer wide scope more than *every*. I have provided evidence from informant responses and two questionnaire studies that a QP headed by *each* will take inverse scope in order to satisfy the Differentiation Condition, but that otherwise *each*- and *every*-phrases behave similarly, both taking narrow scope when they are c-commanded by another QP in the required LF structure. The Event Distributivity Condition does not seem to play much of a role in motivating inverse scoping for either *each* or *every*.

First, drawing on data from informants, I showed that sentences containing an *each*-phrase in object position which are awkward because the Differentiation Condition is difficult to satisfy, such as #*Ricky took each apple* , are improved by the addition of an indefinite subject and that the preferred scoping in the latter case is of the *each*-phrase over the indefinite. This phenomenon is accounted for by the QSH. The *each*-phrase takes wide scope in order to satisfy the Differentiation Condition: the subevents can be differentiated from one another by who did the taking in each one. Because the Differentiation Condition is fulfilled, the sentence loses its awkwardness. In contrast to that case, when an indefinite subject is added to a perfectly acceptable *each*-sentence, where the Differentiation Condition is already met, such as *Ricky weighed each apple*, the preferred scoping is the default, forward scoping where the *each*-phrase has narrow scope. This effect is predicted under the QSH, since there is no motivation for the *each*-phrase to scope over the subject here. Furthermore, when *each* was replaced by *every* in both of types of sentences, the preferred scoping was of the indefinite over the *every* phrase. This result is expected because *every* does not have a condition corresponding to *each*'s Differentiation Condition to drive it to take inverse wide scope.

The second set of evidence for the QSH came from two survey studies on scope preferences in sentences with an object quantified by *each* or *every* and an indefinite subject. Sentences with a secondary predicate were compared to those without one. The results indicated a stronger preference for inverse scoping when the quantifier was *each* and there was no secondary predicate than when there was one and than when the quantifier was *every*. That secondary predicates can influence scope preferences has not been observed before. The explanation for the secondary predicate effect on *each* is as follows. Without the secondary predicate, it is difficult to satisfy the Differentiation Condition, so, by the QSH, the *each*-phrase can take wide scope over the indefinite subject in order to fulfill it. When the secondary predicate is present, however, inverse scoping is not supported because the secondary predicate itself satisfies the Differentiation Condition. It does so by directing attention to the individuals members in the set quantified by *each* and by adding descriptive content to the subevents, without requiring differentiation on another dimension. Surprisingly, the percentage of inverse scope readings in the surveys was quite low, even for *each*/–predicate condition where inverse scope is motivated. This suggests that computing the inverse scoping is quite costly.

In sum, I have shown that, contrary to what is often assumed, *each* and *every* do not generally prefer to take wide scope over another quantifier. When taking wide scope would violate the PSI, it occurs at a very low rate. Moreover, I have presented evidence that *each* only wants wide scope more than *every* under very specific circumstances– in order to satisfy the Differentiation Condition, when it is not satisfied on the default scoping.

Such an approach is an improvement over simply adopting a hierarchy which specifies the inherent tendency to which a particular quantifier prefers wide scope as compared to other quantifiers, as Ioup (1975) did. It explains what is behind such tendencies. Future work should aim to further dismantle the scope hierarchy, examining the scope behavior of *all* and *most*.

The present approach also helps to provide insight into why there is variability in scope preferences across language users and sentences– scope preferences are determined in part by quantifier conditions and quantifier conditions can be satisfied in a number of ways, depending on the sentence and the language user. This property sets my theory apart from alternative theories of scope preferences.