Chapter 3
Preview of the Arguments: Data and Methodology

3.1 Data

In chapter 1, we evaluated the following sentences:

(77) Ray and Tess wrote poems.
(78) Ray and the boys wrote poems.
(79) Ray and Tess and Jess wrote poems.

and concluded that our two theories part ways when it comes to the interpretation of a conjoined noun phrase one of whose conjuncts is itself plural (formed by conjunction or common noun pluralization), as in (78) and (79). As a result of the fact that set formation is a non-associative operation[10], on the sets approach syntactic complexity is mapped into semantic complexity, while such is not the case on the union approach and this difference starts to have effects when a conjunct is plural. The sets approach requires many more types (in the logical sense) of entities in the domain of discourse than does the union approach. This difference is recorded in the relationship between D and D^* on the two approaches:

(80) Union theory: D^* is the set of all non-empty subsets of D.

[10] O is an associative operation iff for *any* a,b,c in the domain of O: (a O b) O c = a O (b O c). By set-formation we mean the operation * such that a*b = {a,b}. (a*b)*c ≠ a*(b*c).

(81) Sets theory[11]:

$$D_0 = D$$

$$D_{n+1} = D_n \cup POW_{\geq 2}(D_n)$$

$$D^* = \bigcup_{n < \omega} D_n$$

If it can be shown that the "extra" entities of the sets approach are required of a model that interprets plural expressions, then the sets theory is to be preferred over the union theory. The purpose of chapters 4-9 is to examine various arguments supporting the need for the sets domain. This chapter is meant as a preview of the different kinds of arguments to be discussed.

Assuming a sets model and a union model that agree on the domain of singularities, it is possible to find a pair of noun phrases that have identical denotations on a union interpretation but different denotations under a sets interpretation. For example, if D, the domain of singularities, contains exactly one boy and exactly three girls, then the noun phrases *the boy* and *the girls* and the noun phrase *the children* will (assuming they are felicitous) have the same denotation for the union theory but not for the sets theory (cf. chapter 1, page 7). One line of attack on the union theory has been to identify predicates that are sensitive to these differences. I will argue that predicates of the required type are not in fact found in English. In chapter 4, I will give a general account of the obstacles to any argument in favor of the sets theory which capitalizes on differences in denotation between plural noun phrases that emerge on that theory but not on the union theory.

In chapter 5, I will take up a specific subcase of the type of argument discussed in chapter 4. This subcase involves examples of sentences which, on their distributive readings, argue for the sets theory. For example, consider a context in which the following statements are true:

(82) Every woman is either an author or an athlete and all authors and athletes are women.

(83) a. The authors are outnumbered by the men.
b. The athletes are outnumbered by the men.
c. But, the women, altogether, outnumber the men.

[11] $POW_{\geq 2}(X)$ is the set of all the non-empty non-singleton subsets of X. This inductive definition is taken from Hoeksema (1983:81), where it is credited to Johan van Benthem.

There are those who would say that in such a context (84) below is ambiguous, having one true reading. That true reading would be described as one in which there is distributivity on the subject argument. It is captured in the unambiguous (85).

(84) The authors and the athletes are outnumbered by the men.

(85) The authors are outnumbered by the men and the athletes are outnumbered by the men.

Now, on the union theory alone, given (82), the subject noun phrase of (84) has the same denotation as the subject noun phrase of (86):

(86) The women are outnumbered by the men.

hence presumably (84) and (86) should have the same truth value in this context. However, given (83c), (86) is false. This is a specific example of the type of anti-union argument identified above. A predicate is isolated which distinguishes noun phrases that are co-referent on the union theory. One of the reasons for treating it separately is that distributivity holds a unique place in the literature on plurals. Moreover, the anti-union arguments of chapter 4 rely on finding **specific** predicates of English that are sensitive to semantic differences that emerge only on the sets theory. In contrast to this, all predicates can have distributive readings.

In chapter 5, I will take issue with specific assumptions underlying analyses of distributivity. I will argue that even without the results of chapter 4 it is not clear that distributivity offers any hope for distinguishing our two theories. In particular note that the argument outlined with the help of examples (82)-(86)crucially relies on having a truly ambiguous VP in (84). By this I mean, that the VP in (84) is said to have two distinct denotations. It is the "distributive denotation" of that VP which is being used here to argue against the union theory. I will argue against some of the assumptions underlying this analysis, in particular its failure to recognize the context-dependent aspects of distributivity. The anti-union argument outlined here will not survive the analysis of distributivity that I will propose.

As Lønning (1989) has argued, probably the most convincing arguments for the sets theory have been made using predicates with reciprocals such as *infuriate each other*. So in the first part of chapter 6, I discuss reciprocals focussing on what they have to tell us about the union-sets debate. In the second half of the chapter, I give an analysis of reciprocals drawing on the context dependent analysis of distributivity from chapter 5 and the work of Heim, Lasnik and May (1991a,b) and Sauerland

(1994).

Chapter 7 is devoted to remarks concerning floated quantifiers. Floated quantifiers have been used as a starting point in the development of theories of distributivity including the one in chapter 5. In chapter 7, we return to compare the resulting theory of distributivity with the behavior of floated quantifiers. Another issue briefly discussed is the relation between floated quantifiers and their non-floated counterparts. In the second part of the chapter, attention is turned to the floated quantifier both, said to involve a notion of duality. A speaker who uses the expression both camels presupposes that there are two and only two camels under discussion. Peter Lasersohn has used this duality presupposition of both to probe the semantics of plural noun phrases using the example in (87):

(87) both Awbery and Jones and Thomas.

He concludes that the sets theory is correct on the basis of this evidence. In chapter 7, I respond to his argument claiming that in examples like (87), both is part of a complex conjunction and in fact has no semantic duality requirement.

At the heart of chapter 8 is a potential argument in favor of the sets theory based on the richness of the domain of discourse, D^*, on that theory as compared with D^* for the union theory, again assuming the two start off with the same domain of singularities, D. Recall from (81) above, the elements of D" in the sets theory come in an infinite variety of (logical) types. If this theory is correct, you might expect the richness of the domain of discourse to be exploited by the language. One place predicates of English, denoting subsets of D", might very well be organized type-theoretically. Particular predicates might be defined only for pluralities of a certain order. Imagine that you had a verb like that, say V_2 of type 2. If that were the case then the truth or well-formedness of sentences of the form NP V_2 would depend in part on the syntactic complexity of the subject NP. For example, the children V_2 could but the boys and the girls V_2 couldn't be true. Such verbs would constitute strong evidence in favor of the sets theory. On the other hand, if it turns out that there are no such verbs, then all else being equal we should opt for the simpler union theory.

Chapter 9 is devoted to the semantics of collective nouns. Collective nouns are characterized in Jespersen (§4.8) as follows:

> A **collective** noun is defined in the NED [New English Dictionary by Murray, Bradley, Craigie. Oxf. 1884] as 'a substantive which (in the singular) denotes a collection or number of individuals.' We may accept this definition (though it does not always agree with practice followed in that dictionary), and give as examples a *library* = 'collection of books', a train (railway-carriages), a forest (trees), a nation (men and women), an army (soldiers). All of these may be used with such words as one (one library) or that; and we may use them in the plural: libraries, trains, etc.
>
> According as the idea of plurality is more or less prominent in the mind of the speaker, there is in all languages and at all times a tendency to forget the fact that collectives are grammatically singular, and we often find plural constructions, partial or total. ... It should, however, be noticed that it is only with collectives denoting living beings that the plural construction is found: words like *library* or train never take the verb in the plural.

This view of collective nouns suggests that rule [7] from chapter 1:

[7] If a is a singular common noun, then $\| \alpha \|_M = V(\alpha)$ and $V(\alpha) \subseteq D$.

is not fully general. Rather, it appears that collective nouns, at least the animate ones, denote subsets of D^*. In more recent times collective nouns have been treated this way in formal accounts of the semantics of English[12]. These accounts give formal expression to the synonymy of pairs such as the following:

(88) a. The committee voted.
b. The members of the committee voted.

(89) a. The members of the group gathered in the park.
b. The group gathered in the park.

To see why this is relevant to the choice of the sets or the union theory we need to consider examples in which a collective noun forms part of a (syntactically) plural noun phrase, for recall, the two theories part ways once pluralization is iterated. If one maintains that in the extension of committee there are (non-singleton) sets, pluralities, then given a domain in which the noun phrase the committees is felicitous, it will denote (assuming rules [6] and [8] of chapter 1) the set of all committees, each of which is a set, hence a set of sets. This is troublesome for the union theorist because

[12] In the formal semantics tradition, this practice goes back at least to R. Montague (cf. Bartsch 1973:79).

his domain of discourse has to be enlarged to accommodate these entities. He must now adopt a domain more like that we've come to associate with the sets theory. Moreover, having accepted this analysis for collective nouns, the attack on the union theory can be mounted even with respect to the interpretation of conjunction as follows. A context is chosen in which there are exactly two committees, A and B, and then the referents of the subjects of the following pair are identified:

(90) The committees voted.
(91) The members of committee A and the members of committee B voted.

This identification forces us into a denotation for the subject of (91) that is predicted by the union theory to be impossible (assuming *member of committee A* denotes a subset of D).

This constitutes a serious blow to the union theory, if the position outlined so far is tenable. However, we should not be too quick to identify the denotation of a noun phrase such as *the committee* with the denotation of *the members of the committee,* since there are predicates that distinguish them. As an illustration consider that if a normally seven-membered committee loses five of its members and the remaining members are both seven feet tall then:

(92) The committee is small.

but:

(93) The members of the committee are not small.

Furthermore, while we can say:

(94) The members of the committee are tall.

we cannot, as Bennett (1974:223) pointed out, say:

(95) "The committee is tall.

In fact then, pairs of noun phrases such as *the committee / the members of the committee* or *the team / the players* seem not to be extensionally equivalent. In chapter 9, we will consider the conflicting data of (88)-(91) and (92)-(95). Further, we will follow the lead of Jespersen and Dougherty (1970) in devising plausible tests for semantic plurality in an attempt to

decide when and whether collective noun phrases denote pluralities.

3.2 Methodology

I would like now to end with a somewhat lengthy methodological note. Much of the argumentation in this book turns on a comparison of pairs of noun phrases in contexts in which they are assigned the same denotation in one theory and different denotations in the other. For example *the boy and the girls* and *the children,* if felicitous, are co-referent according to the union theory, but not according to the sets theory. Let us say that two or more noun phrases **share** a predicate if applying the predicate to both of them yields the same truth value. Generally, arguments for or against coreference of noun phrases turn on predicate sharing. For example, the sets theorist might argue for the non-coreference of the noun phrases *the boy* and *the girls* and *the children* by isolating predicates that are not shared by the two. This method of argumentation is fairly straightforward so long as we stick to the two extremes: either the noun phrases share all predicates of the language or they don't share any. Consider first two noun phrases that share all (appropriate) predicates of the language. In this case, coreference is plausible even if not inevitable. A diehard multiplier of entities could still maintain that the two noun phrases denote distinct entities differing with respect to properties that are not expressible in the language.[13] Nonetheless, in this case one normally chooses the more intuitive option of inferring coreference from the sharing of all predicates of the language. Assigning the two noun phrases the same denotation, that is treating them as coreferent, is in a sense a way of capturing in our semantics the fact that all predicates are shared by the noun phrases in question. At the other extreme we have noun phrases that do not share any predicates. In this case, it is hard to see any basis for assuming coreference. In sum then, the sharing of all predicates is associated with coreference while the sharing of no predicates is associated

[13] This connection between predicate sharing and coreference is similar to Leibniz's principle of the Identity of Indiscernibles, though it differs in its reference to language. We connect predicate sharing and noun phrase coreference whereas Leibniz's principle is about property sharing and identity of objects. An earlier example of a linguistic interpretation of Leibniz's principle is found in Wilson (1953) who writes "The principle of the identity of indiscernibles may be taken to mean that if two objects O_1 and O_2 are numerically different then they are qualitatively different, they differ in some mentionable respect."

with non-coreference. Expressing approximately this idea, Link (1983:304) writes:

> Our guide in ontological matters has to be language itself, it seems to me. So if we have, for instance, two expressions a and b that refer to entities occupying the same place at the same time but have different sets of predicates applying to them, then the entities referred to are simply not the same.

Unfortunately, neither of the extremes examined so far is representative. Rarely, if ever, do two noun phrases share all predicates. The unintuitive conclusion drawn in (96) based on Link's dictum illustrates this:

(96) a = 'George and Mike'
b = 'Mike and George'
P = 'are running with Dan and Lloyd respectively.'
P(a) A not P(b).
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a and b do not refer to the same entity.

This means that "total predicate sharing" is hopeless as a criterion for coreference. Total non-sharing of predicates fares even worse as a criterion for non-coreference. Quite often, two intuitively non-coreferent noun phrases share some predicates. Think of all the predicates that hold both of *the number two* and of *the number four* or of *Joe* and *Joe's brain*. Thus, the observation that a pair of noun phrases share some predicates is not sufficient grounds to identify their referents. The key then in making sense of the connection between coreference and predicate sharing is to develop theories rich enough to allow the definition of a subset of predicates all of which must be shared by coreferent noun phrases. The most well-known example of this is the distinction between extensional and intensional contexts. Noun phrases that are found to share all predicates classified as extensional can safely be counted as coreferent even though they may differ in the sense they express and hence not share some intensional predicates. Theories concerned with discourse afford another distinction which can be appealed to here. These theories make reference to the potential of an expression to change the discourse context. A noun phrase's context change potential is a function of but not identical to its reference. Two noun phrases may have different context change potentials while remaining coreferent. Predicates whose interpretation makes crucial use of discourse properties of noun phrases will not be counted in deciding coreference. An example of such a predicate, I would argue, is the verb phrase in (96) above

containing the adverb *respectively*. This adverb relies for its interpretation on the linear order in which discourse referents are introduced. Some have used this property of *respectively* in determining the kind of things noun phrase conjunctions denote (cf. section 2.10 of Link to-appear; Lasersohn 1988:139). However, I would argue that linear order is a property of the discourse itself and not of the entities referred to. Evidence for this claim derives from examples in which this ordering information is not contributed by a conjoined noun phrase subject but rather enters the discourse from outside the sentence containing *respectively*. Here are two such examples; the first is from the text of Jackendoff (1972:325, italics are mine):

(97) ... there are the ambiguous readings of (8.22) and (8.23).
(8.22) They're fighting about nothing.
(8.23) I will force you to marry no one.
One reading of these sentences is Synonymous with (8.24) and (8.25), respectively.
(8.24) It is not so that they're fighting about anything.
(8.25) It is not so that I will force you to marry anyone.

(98) The first book is 2,000 pages long and it barely fits in the book bag. The second one is only 20 pages long, you can put it in your pocket. I refer to these books as the fat book and the skinny book, respectively.

Other expressions that behave like *respectively* are *correspondingly, analogously, equivalently* and *in that order* (for examples cf. Dougherty 1970:896). Comparisons in general often depend on linear order for their interpretation.

Verb phrases containing pronouns provide another clear class of predicates whose failure to justify non-coreference claims is explained with the help of a theory of discourse. One such example occur; in (99) and (100) below:

(99) Ray and the women relate that by late August each person was aware that he had only six months to live.
(100) The authors relate that by late August each person was aware that he had only six months to live.

Assume that both (99) and (100) are initial utterances in a discourse between two speakers who are aware of who Ray, the women and the authors are and that Ray and the women are the authors. (99) has a reading in which

he is interpreted as referring to Ray. (100) lacks this reading. One might argue that this difference arises from the fact that the subjects of (99) and (100) are non-coreferent. This would constitute an argument against the union theory and for the sets theory which predicts non-coreference here. However, I would argue that an adequate theory of discourse would assign these noun phrases different context change potentials, though not necessarily different referents. Note that the verb phrase in question distinguishes as well between the noun phrases Ray and Tess and the authors which, assuming now that the authors were just Ray and Tess, even the sets theory counts as coreferent.

A debate about the coreference of definite noun phrases is a debate about predicate sharing but in a trickier way than at first envisioned. It is a two stepped affair. First one needs to determine whether predicates are shared or not. If certain predicates are found that are not shared then we must wonder whether there is some explanation for this other than the referential properties of the noun phrases. Clearly, what drives the discussion to begin with is some initial intuition that the noun phrases in question are coreferent. These intuitions are very much in the background of the debate in this book. They have cropped up already in the form of identity statements such as:

(101) a. The children are just the boy and the girls.
b. The players are the team.

In the following chapters we try to determine whether the **relevant** predicate sharing is found to accord with these intuitions.

Chapter 4
General Arguments from VP Denotations

In this section, our focus will be on arguments in favor of the sets theory based on possible VP denotations. The discussion will run as follows. First I will make some preliminary adjustments to our theories in order to accommodate the kinds of examples we need to consider. Next I will present a number of examples from work by Hoehsema, Link and Landman which argue for the sets approach. I will temporarily adopt this theory. Then I will argue for the introduction of two shifting operations which can apply to predicates to allow them to apply to entities of different types. Next, I will show that once these operations are in place, the motivation for the sets approach is eroded. I end this section by returning to the simpler union approach.

Let us assume for the remainder of our discussion that we have some male and female cows and some male and female pigs, that the cows and the pigs comprise all the animals there are, and that the males are young and old and so are the females. In order to talk about these various cows and pigs we add to our theories the category IADJ (intersective adjective) whose members include young, old, male and *female*. We also add the following rules to both theories:

[9] If α is an IADJ then $\| \alpha \|^M = V(\alpha)$ and $V(\alpha) \subseteq D$.
[10] If α is an IADJ and β is a CN then $\alpha\beta$ is a CN and $\| \alpha\beta \| = \| \alpha \| \cap \| \beta \|$.

and we assume for a noun phrase like the young pigs that young pigs is the plural of young ***pig.***

The noun phrase the cows denotes the set of all the cows. The noun phrase *the* ***pigs*** likewise denotes the set of all the pigs and the noun phrase the ***animals*** will denote the set of all the animals. So far we have three distinct noun phrases and three distinct entities. Now we come to the noun phrase the cows and the pigs. On the union approach we get the

union of the cows and the pigs which is the set of all the cows and pigs which is just the set of all the animals. So the cows and the pigs are just the animals on this approach and we still have only three entities. On the sets approach, the noun phrase *the* cows and *the* pigs denotes a set of two sets, a cow set and a pig set. This is different from the noun phrase *the* animals which denotes a set of individuals, not a set of sets. So now, on the sets approach, we have four entities: a purely bovine plurality, a purely porcine plurality, an animal plurality, and finally a plurality composed of two pluralities. Of course, this last one is not the only new animal entity that the sets approach has but that the union approach lacks. For there is also the denotation of *the* young animals and *the* old animals, another set of two sets and there is the male animals and the female animals, yet another distinct entity. And so on. All we want now is some linguistic evidence to show that we need these extra entities.

The list in (102)-(104) below, inspired by examples in Link (1984) and Landman (1989a), contains the evidence we need for the extra higher order entities of the sets approach. Let me note that I will be ignoring distributive readings throughout. The issue of distributivity will be taken up in chapter 5.

(102) a. The cows and the pigs were separated.
b. The young animals and the old animals were separated.
(103) a. The cows and the pigs talked to each other.
b. The young animals and the old animals talked to each other.
(104) a. The cows and the pigs were given different foods.
b. The young animals and the old animals were given different foods.

Each example consists of an a. and b. pair which seem, in the context we're assuming here, to be independent in the sense that one could be true while the other is false. Consider the pair in (102). It has been claimed that we do not want it to follow necessarily from the fact that the cows and the pigs were separated that the young animals and the old animals were separated, even with our assumption that the animals are just the cows and the pigs. On the union approach the noun phrase subjects of the a. and b. sentences would have the same denotation, namely something corresponding to the set of all the animals. This would mean that if any of the a. sentences was true the corresponding b. sentence would also have to be true. In order to avoid this undesirable consequence, we adopt the sets theory, under which the noun phrase *the* cows and *the pigs* and the noun phrase *the* young animals and *the* old animals have different denotations, and hence the a. and b. sentences remain independent.

We have just considered examples the main predicates of which appear to distinguish sets of higher than first order. Since such sets are not found in the domain of the union approach, we had cause to adopt the sets approach. But, of course, not all predicates are like the ones in (102)-(104). Some predicates, such as *fill the* room and *are* asleep, intuitively appear to hold of first order sets. This fact, by itself, is not a problem for the sets-approach whose domain includes all the elements in the domain of the union approach, including first order sets. However, these intuitively first-order predicates have a property that is somewhat surprising, given the assumptions of the sets approach. Consider the following:

(105) a. The animals filled the barn to capacity.
b. The cows and the pigs filled the barn to capacity.
c. The young animals and the old animals filled the barn to capacity.
(106) a. The animals were sleeping in the barn.
b. The cows and the pigs were sleeping in the barn.
c. The young animals and the old animals were sleeping in the barn.

If (105a) is true then in the context we are assuming, (105b) and (105c) will follow. On the sets approach which we have just adopted, nothing guarantees this since the subject noun phrases in (105a)-(105c) are not coreferent. The inference from (105a) to (105b) and (105c) is an example of what I call the Upward Closure Phenomenon, whereby

(107) Upward Closure Phenomenon
An English predicate that is true of a first order plurality G (non-singleton set of individuals), is true as well of all higher order pluralities formed using all the members of G.

We need to add something to our sets theory now which will guarantee that the Upward Closure Phenomenon holds for the sentences generated and interpreted by this theory. We do this by constraining the interpretation function, $\| \cdot \|$, so as to eliminate any predicates that do not have the Upward Closure property:

(108) LIFT constraint on $\| \cdot \|$.
For any predicate of English, δ, and $Y \in D^*$:
if $\{x \in D \mid x \in^* Y\} \in \| \delta \|$ then $Y \in \| \delta \|$

$\in^*$ is meant to indicate the transitive closure of $\in$ defined as follows:

$$\forall x,z[x \in^* z \leftrightarrow (x \in z \ \vee \ \exists y[x \in^* y \wedge y \in z \ \wedge y \neq z])]$$

According to (108), if δ is true of some first order plurality A, δ will be true of a plurality of any order if the individuals involved are just the members of A. For example:

$$\{a,b,c,d\} \in \| \delta \| \ \rightarrow \{\{a,b\},\{c,d\}\} \in \| \delta \|$$

To see how this works, reconsider the example in (105). Assume that (105a) is true. If that is the case, then the plurality composed of all the individual animals is in ‖ fill the room to capacity ‖ . The LIFT constraint now guarantees that any set of any order whose urelements are the animals will be in ‖ fill the room to capacity ‖ . The subject noun phrases of (105b) and (105c) both denote such sets, hence these sentences would also come out true.[14]

It is worth noting here that the problem surrounding (105)-(106) would not have arisen had we chosen the union theory instead of the sets theory. This is so because according to that theory all the subject NPs in (105)-(106) have the same denotation provided the domain of discourse is as assumed here where the animals are just young and old cows and pigs.

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[14]This LIFT constraint is written in such a way that it will apply to all predicates, not just verbal predicates. This generality is desirable since the Upward Closure phenomenon shows up not only with verbs, but also for example with nouns:

i. The cows are mammals.

entails that:

ii. The young cows and the old cows are mammals.

However, this causes a problem for our interpretation of definite plural noun phrases. A plural noun can no longer be taken to denote the power set of the denotation of its singular counterpart minus the empty set, but must now denote the "lifted" version of this set, that is one that conforms to the LIFT constraint. Furthermore, we can no longer be content with saying that the denotation of the definite article is a function that takes a set of sets and returns the largest one. Rather, we must say that it returns the largest first order set. This will still work for the singular case, since singletons are first order.

One might be tempted therefore to suggest that the conjunction and is ambiguous with a union interpretation associated with the examples in (105)-(106) and a sets interpretation associated with the noun phrases in (102)-(104). This will not work however, because, as pointed out in Landman (1989a:§2.4), there are examples such as (109) in which predicates of the (105)-(106) type are conjoined with predicates of the (102)-(104) type:

(109) The Cows and the Pigs account for more than half the population of New Blinks but hate each other intensely.

(110) a. The Cows and the Pigs account for more than half the population of New Blinks.
b. The Cows and the Pigs hate each other intensely.

To see the problem here, let us assume for the moment that and is ambiguous between a union and a sets interpretation and that we do not have something like the LIFT constraint. The first VP conjunct in (109) is one that would be true in virtue of some fact about a first order set of individuals; it is like fill to capacity. The denotation of the subject NP could be in the extension of such a VP if we interpreted it using the union interpretation of and. The second VP is of the type that was used by Link (1984) to argue for a higher order theory like our sets theory (cf. (103) above). The denotation of the subject NP could be in the extension of such a VP if we interpreted it using the sets interpretation of and (assuming a reading in which Cows love Cows and Pigs love Pigs but Cows hate Pigs and vice versa). We assume that VP conjunction with but has the same truth conditions as with and, and so it is interpreted as set intersection. The problem is that nothing guarantees that the intersection of the denotations of these two VPs will contain either type of NP denotation even if the sentences in (110) were true and this is counterintuitive. The reader may recognize this argument as a higher order version of the one given at the end of section 1.3 against an ambiguous interpretation for and.

Because of examples like (109), we stick to the sets theory and introduce the LIFT constraint. This then guarantees that we can safely use the sets interpretation of and in (109), and assuming the sentences in (110) are true, (109) will be true as well. This way of doing things is essentially an adaptation of the type-shifting operations introduced in Landman (1989a:§2.4) or the meaning postulates of Hoeksema (1987a:28-29).

Reviewing briefly, because of the examples in (102)-(104) repeated below:

(102) a. The cows and the pigs were separated.
b. The young animals and the old animals were separated.
(103) a. The cows and the pigs talked to each other.
b. The young animals and the old animals talked to each other.
(104) a. The cows and the pigs were given different foods.
b. The young animals and the old animals were given different foods.

we adopted the sets theory. In order to prevent the inference from the truth of an a. sentence to the corresponding b. sentence, we interpret conjunction as set-formation and this insures that the noun phrases *the* cows *and the pigs* and *the young animals and the old animals* will have different denotations. Next, we saw that certain predicates which are true of first order pluralities seem to be true as well of all higher order pluralities formed from the same individuals, thus blurring the distinctions introduced with the adoption of the sets theory. To handle this Upward Closure Phenomenon, we constrain $\| \cdot \|$ in such a way that a predicate of English will be true of a higher order plurality in D^* if it is true of the set of individuals which are the urelements of that higher order plurality.

The LIFT constraint is worded in such a way that it applies to any predicate of English. As far as intuitively first order predicates like the ones of (105)-(106) are concerned, I think this is correct. As far as non-first order predicates like those in (102)-(104) are concerned, the constraint would appear to be irrelevant, since its application is limited to predicates having first order sets in their extension to begin with. But this last statement, relies on an assumption which I would like now to challenge. I would like to claim that not only is there an upward closure phenomenon in English but there is a downward closure phenomenon as well. I claim that:

(111) Downward Closure Phenomenon
1° There are no predicates of English that have higher order pluralities in their extension but that cannot also have first order pluralities in their extension.
2° If a predicate of English is true of a plurality G of any order, it will also be true of that first order plurality G' which is composed of the individuals used to generate G.

The first part says that there are no predicates of English that have exclusively higher order pluralities in their extension. In other words, there are no predicates that are strictly typed for higher order groups. Support for this claim comes from the fact that the predicates used in (102)-(104) to

argue for adopting the sets theory can be applied to noun phrases denoting first order sets. Examples of this appear in (112).

(112) a. The boys were separated.
b. The boys talked to each other.
c. The boys were given different foods.

We return to this conjecture in chapter 8.

The second part of (111) says that if a predicate of English is true of a plurality G of any order, it will also be true of that first order plurality G' which is composed of the individuals used to generate G. This is, in a sense, a stronger version of the first part. It speaks not about the kinds of things that can be in a predicate's extension, but about specific entities that we find there. Evidence for this claim follows in examples (113)-(115). Recall that distributive readings are ignored here and that we are assuming that the animals are just the cows and the pigs. I claim that in each example the b. sentence follows from the a. sentence.

(113) a. The cows and the pigs were separated.
b. The animals were separated.
(114) a. The cows and the pigs talked to each other.
b. The animals talked to each other.
(115) a. The cows and the pigs were given different foods.
b. The animals were given different foods.

An appropriate context for these sentences might be one where a speaker says a. and his hearer replies with b. adding that he is not interested in how it was done, just that it was done. Another context for these examples might be one in which the a. sentence is true, but the speaker didn't have enough information to say that, either because he didn't realize that there were only cows and pigs or he simply could not distinguish a cow from a pig.

So far, there is nothing in the system we are working with that will guarantee the types of inferences exemplified in (113)-(115) since the sets theory assigns the noun phrase *the animals* a different denotation from that assigned to the noun phrase *the cows* and *the pigs*. We need to add something to our sets theory which will guarantee that the Downward Closure Phenomenon holds for the sentences generated and interpreted by that theory. Again we do this by constraining the interpretation function, $\| \cdot \|$, so as to eliminate **any** predicates that would falsify the generalization:

(116) LOWER constraint on $\| \cdot \|$.
For any predicate of English, 6, and $K \in D^*$:
if $K \in \| \delta \|$ then $\{x \in D \mid x \in^* K\} \in \| \delta \|$
[E^* is the transitive closure of $\in$]

According to (116), if δ is true of a plurality G of any order, then 6 will be true of that first order plurality G' which is composed of the individuals used to form G, for example:

$$\{\{a,b\},\{c,d\}\} \in \| \delta \| \rightarrow \{a,b,c,d\} \in \| \delta \|$$

To see how this works, reconsider the example in (113). Assume that (113a) is true. If that is the case, then ‖ were separated ‖ will contain, among other things, a two membered set consisting of the set of all the cows and the set of all the pigs. Since ‖ were separated ‖ contains this set, it will also have to contain the first order set containing all the cows and pigs; that is what the LOWER constraint requires. Since the animals are just the cows and the pigs, it follows then that (113b) is true.

Reviewing again, because of the examples in (102)-(104)we assume the domain of discourse D' given by the sets theory and we interpret conjunction as set-formation. This means that the noun phrases *the animals* and *the cows* and *the pigs* cannot be coreferent. But then we come to find out that English does not want to cooperate. Predicates of English are just not fine-grained enough. So the next thing we need to do is introduce two constraints on the interpretation function that serve to blur the distinctions. At this point I want to give some thought to the interaction of these two constraints.

For our first example, I want to return to (105) repeated below:

(105) a. The animals filled the barn to capacity.
b. The cows and the pigs filled the barn to capacity.
c. The young animals and the old animals filled the barn to capacity.

I claimed above that (105a) implies (105b) and (105c). That intuition was incorporated into our theory in the form of the LIFT constraint. In fact, the entailment goes the other way as well. Namely, (105b) and (105c) (on their non-distributive readings) entail (105a). This entailment is not covered by the LIFT constraint. However, it is covered by the LOWER constraint. In effect then, the combination of the LIFT and the LOWER constraints guarantee that as long as the animals are just the cows and the pigs, (105a)-(105c) are truth conditionally equivalent.

Now we go the other way, reexamining the examples that motivated LOWER to see what effect LIFT has on them. I will do this by way of a piece of reasoning given in (117) which is explained by appeal to these constraints.

(117) Given:
a. The young animals and the old animals are just the cows and the pigs.
Assume:
b. The young animals and the old animals were separated.
Then:
c. The animals were separated. (by LOWER)
d. The animals were separated by age.
e. The cows and the pigs were separated by age.(LIFT)
f. The cows and the pigs were separated.

The intuition that c. follows from b. is explained by the LOWER constraint. (117d) seems to follow from (117b) and (117c) and the meaning of by *age*. Now from (117d) I think we can conclude (117e). This step is more evidence for the LIFT constraint. If ‖ separated-by-age ‖ contains the set of all animals, then it must, by the LIFT constraint, contain all sets whose urelements are the animals. In particular, it must contain the two membered set denoted by the subject of e. Finally, the step from e. to f. comes about because by *age* is a standard modifier, that is, it obeys the following schema:

(118) *NP VP by age* --> NP VP. (NP is monotonically increasing)

If some things are separated by age then they are separated. I take the inferences traced out in (117) to be intuitively correct, and yet they have allowed us to go from (117b) to (117f). Now I do not deny that (117f) is a misleading thing to say, if you could have said (117b). It is misleading, but not false. (117f) follows from (117b) because English does not respect the distinctions that the sets theory makes. Here is another example of reasoning in which LOWER and LIFT appear to interact:

(119) Scene: four lawyers: Robert (defense), John (defense), Marcia (prosecution), Hank (prosecution).

Given:

a. The defense lawyers and the prosecution lawyers used to fight each other in court every day.

Then:

b. The lawyers used to fight each other in court every day. (LOWER)

c. That woman and those three men used to fight each other in court every day. (LIFT)

Here again the steps from premise to conclusion seem intuitively correct. And again the subject NP of our premise and the subject NP of the conclusion have in common that they denote sets built from the same urelements. A tendentious way to put this would be that what they have in common is that they are assigned the same denotation by the union theory. We can summarize this pattern by combining our two constraints as follows: -

(120) LIFT and LOWER constraints combined.
if $K \in \| P \|$ then $\{x \in D \mid x \in^* K\} \in \| P \|$
if $\{x \in D \mid x \in^* Y\} \in \| P \|$ then $Y \in \| P \|$
(K,Y are variables over elements of D^*)

It follows from (120) that:

(121) if $K \in \| P \|$
and $\{x \in D \mid x \in^* K\} = \{x \in D \mid x \in^* Y\}$
then $Y \in \| P \|$

What (121) says is that we can go directly from (122) to (123):

(122) The cows and the pigs were separated.
(123) The young animals and the old animals were separated.

But now if LOWER and LIFT can conspire like this our original motivation for moving from the sparse universe of the union theory to the more complicated world of the sets theory is undercut.

Recall, our original motivation was to achieve a logic that would allow a sentence like (122) to be true, without it following, in the relevant context, that (123) was true. Having accommodated the Upward Closure Phenomenon and the Downward Closure Phenomenon, we now have a system that precisely allows us to go from (122) to (123).

I elaborate. (122) and (123) differ in meaning. No question about that. The issue here is that the argument based on these examples in favor of the sets theory rests on the belief that the difference between (122) and (123) can be captured in a semantics which takes predicates to denote sets of objects which are themselves distinguished by a set-theoretic principle of extensionality. In particular, given two different sets formed from the same urelements, for example {{a,b}, c} and {a,{b,c}}, this account rests on the possibility of having a predicate of English whose denotation includes one of these sets but not the other. It is this belief that I am challenging here.

In order to argue for a sets theory we need to have predicates that distinguish plural entities which differ only by the way they are grouped. We thought we had this. However, English has two properties that conspire against us. The Downward Closure Phenomenon guarantees that a predicate of English that is true of a particular grouping of a set of singularities will be true of that set itself. On the other hand, the Upward Closure Phenomenon guarantees that predicates of English that are true of a set of singularities to be true of those individuals on any grouping. Putting these two together, it turns out that a predicate of English that is true of a set of singularities on some complicated grouping will be true of the set itself, and hence true of those singularities on any grouping, so groupings cannot matter.

Of course, (122) and (123) differ in meaning. Both say more than (124).

(124) The animals were separated.

In (122) we understand the animals to be separated by species, in (123) by age. I also grant that this added information is coming from the NP subjects. So I do not dispute that (122) and (123) differ and that that difference has to do with the meaning of the subject NPs. What I do dispute is that the difference can be handled by an account that rests on having predicate denotations be sets of entities that are as fine grained as the sets theorist needs to support his theory. Extensions of predicates of English do not have this kind of structure.

The differences here do have to do with NP meanings, but not with the objects that NPs refer to. In the terminology introduced in section 3.2 we may say that those predicates not shared by our putatively non-coreferent noun phrases are not relevant here.

For completeness I would like to turn now to a slightly different version of the argument made here for the sets theory, due to J. Hoeksema. Consider (125) from Hoeksema (1983):

(125) [[Bliicher and Wellington] and Napoleon] fought against each other near Waterloo. ≠ [Bliicher and [Wellington and Napoleon]] fought against each other near Waterloo.

Hoeksema argues on the basis of the example in (125) that the interpretation of *and* must not be associative otherwise the bracketing on the conjunction would not affect the denotation of the noun phrase subject. The problem with this argument is that, as with the examples used above, it relies on having predicates that are sensitive to these groupings. In this particular example, the extension of the predicate *fight against each other* would have to encode information not only about who was fighting but also about who was allied with whom in the battle. However as I have argued up to now, English predicates do not seem to be as fine grained as the sets theorist requires. As above, the first thing to note is that the Downward Closure Phenomenon crops up with the predicate in this example. Were I embarrassed about the fact that I couldn't pronounce *Bliicher* correctly, I might report the events of (125) as:

(126) Those famous European generals fought each other at Waterloo.

(126) follows from (125). If a higher order plurality built from those three generals is in ||fought each other at Waterloo||, then so is the first order plurality having each of them as a member.

The example in (127) makes the case even stronger:

(127) Despite their current membership in a common market, only 50 years ago, *Germany, England, France and Italy were battling each other* in one of the worst wars in history.

I take (127) to be true. If Hoeksema is correct and the alignment of the forces is encoded in the extension of the predicate *were battling each other* then (127) should only be true if the subject noun phrase denotes a set of two sets, one containing Germany and Italy and the other France and England. But even the sets theory doesn't assign this denotation to the subject of (127). (128) below is yet another example of this type:

(128) John and Mary and Bill and Sue played tennis with each other. In the first match, the men played the women, and in the second match John and Mary played Bill and Sue.

A non-associative and might seem attractive on the basis of the second match, but must be abandoned on the basis of the first match.

Finally one bit of circumstantial evidence in favor of the position taken here comes from pairs of the following sort:

(129) a. The women from the two communities hated each other.
b. The women who belonged to the two organizations hated each other.

Consider a context in which the women from the two communities are just the women from the two organizations, the memberships of the two organizations are totally non-overlapping and each organization has members from both communities. The examples in (129) differ in way that is reminiscent of our earlier Linkian examples, repeated here:

(103) a. The cows and the pigs talked to each other.
b. The young animals and the old animals talked to each other.

In (103a) and (103b) the individuals doing the talking are the same while the grouping of the conversationalists differ. In (129a) and (129b), the individuals doing the hating are the same; the battle lines are drawn differently. The sets theorist attempts to account for the differences in (103) by incorporating the groupings in the denotations of the noun phrases. This is achieved through a judicious choice of interpretation for *and*. What (129) purports to show is that the phenomenon is not limited to noun phrases involving conjunction. To convince us that he is correct, the sets theorist will have to show how the correctly "grouped" denotations are arrived at for the subjects of (129). A similar point is made with (130) below, reminiscent of (102):

(130) The delegates from each of the countries were separated.
(102) The cows and the pigs were separated.

The verdict based on this section is in favor the union theory. The data that I used to demonstrate the Upward Closure Phenomenon and the Downward Closure Phenomenon now have a simpler explanation. The examples in (131) below all have the same truth conditions because all the subject NP's have the same denotation in the context we are assuming.

(131) a. The animals filled the barn to capacity.
b. The cows and the pigs filled the barn to capacity.
c. The young animals and the old animals filled the barn to capacity.

If the sentence in (122) is true,

(122) The cows and the pigs were separated.

then (124),

(124) The animals were separated.

can be uttered truthfully in the context we've assumed up to now, since the subjects of (122) and (124) are assigned the same denotation in the union theory and the predicates are identical.

While a case has been made here for the union approach, there is something that still remains unexplained. On the sets approach, (122) and (124) are truth-conditionally distinct and furthermore that difference depends on a difference in the reference of the subjects of those sentences. I have just argued against these two claims. Nevertheless, the fact remains that (122) and (124) do differ in some way and one would like to know why that is so according to the union theorist. In the following chapter, five, we will take up a different sort of argument for the sets approach, this will involve the phenomenon of distributivity, ignored to this point. The approach we take there to distributivity will, I believe, shed some light on the data examined in this section, so in chapter 6 we return to the questions left open here.

Chapter 5
Distributivity

5.1 A Challenge to the Union Approach

As noted in chapter 3, sentences of the following type:

(84) The authors and the athletes are outnumbered by the men.

have been used to argue for a more complex theory of plural reference (cf. Landman 1989a; Scha and Stallard 1988). (84) is claimed to have a distributive reading that (86) lacks:

(86) The women are outnumbered by the men.

even in a context in which the authors and the athletes are just the women. It is argued that this difference must be captured in part by distinguishing the possible denotations assigned to the subjects of (84) and (86). This constitutes a challenge to the union theory, which, in the context assumed here, assigns these noun phrases the same denotation.

This challenge to the union theory relies on the view that the denotation of a distributively read verb phrase differs from that of its non-distributive counterpart (see Lasersohn 1995 for extensive discussion of that view and alternatives). Even for those who accept that view, as we shall here, the source of that difference in denotation remains open and that turns out to be a crucial issue for the debate between the union and the sets theory. It is usually assumed that distributivity is a purely semantic matter: a plural predicate has one meaning on its distributive reading and a different meaning on it non-distributive reading, and these meanings differ in such a way that in some situations the two readings lead to different extensions. However, there is another possibility. It could be that a plural predicate has a single meaning, but that that meaning is context-dependent, and will lead to different 'readings' in different contexts. On the purely semantic view, it makes sense to trace the differences between (84) and (86) to differences in the referents of their subjects. However, if this latter,

context-dependent alternative is correct, then a difference in the context-change potentials of the subjects in (84) and (86) may account for the fact that they do not share (in the sense of section 3.2) the distributively read verb phrase common to (84) and (86).

In this section I will, through successive attempts, arrive at an account of distributivity that has a context-dependent element to it. The data in (84) and (86) when analyzed on that account no longer pose a threat to the union theory.

My presentation here will depart slightly from the practice of chapter 1. The account will be cast, at least initially, in a framework in which English is translated into a semantically interpreted language. The purpose of this departure is to remain somewhat closer to existing accounts of distributivity upon which mine is based.

5.2 A Quantificational Account

5.2.1 Cumulativity

Our story begins with the oft cited connection between distributivity and cumulativity. For example, while (133) is gotten from (132) by cumulativity:

(132) John moved the car and Mary moved the car.
(133) John and Mary moved the car.

(132) follows from a distributive construal of (133). Our first guess then, is that by accounting for cumulativity we thereby account for distributivity. This leads to what Lasersohn (1988) calls a closure-condition account. By this we mean that all predicates of the language have a simple translation as well as a translation which is interpreted as the closure under union of the simple translation. Letting α represent a metavariable over predicates of English we have:

(134) α translates as: α' and as $*(\alpha')$
$\| *(\alpha') \|$ = the closure under union of $\| \alpha' \|$.

We have employed here the "*" operator familiar from the work of G. Link, though with a slightly different semantics in terms of set union rather than lattice theoretical sum (see Appendix on closure under union of a set of individuals). The cumulative inference of (132)-(133) is now mapped as follows:

(135) $[\text{moved-the-car}'(J) \wedge \text{moved-the-car}'(M)] \rightarrow {}''(\text{moved-the-car}')(J+M)$

Assuming that J+M is interpreted as the union of John and Mary (this is just the set of John and Mary, see the Appendix), the interpretation of the star-operator in (134) guarantees the inference in (135).

Turning now to distributivity, this setup allows us two translations, one with and one without a star, corresponding respectively to the distributive and the non-distributive or collective construals of a given predicate. Presumably, the inference from (133) (on its distributive construal) to (132) would be mapped as in (136):

(133) John and Mary moved the car.
(132) John moved the car and Mary moved the car.
(136) $*(\text{moved-the-car}')(J+M) \rightarrow [\text{moved-the-car}'(J) \wedge \text{moved-the-car}'(M)]$

Unfortunately, (136) is not guaranteed by (134) the way (135) was. To see this, consider a situation in which John and Mary moved the car together but neither John nor Mary moved the car individually. Since (133) is true, the set of John and Mary must be in the extension of either *(moved-the-car') or moved-the-car'. Since it is false that John moved the car, John is not in the extension of either *(moved-the-car') or moved-the-car' and likewise for Mary. This means that the set of John and Mary can't have gotten into the extension of ''(moved-the-car') by closure under union, hence it must be in the extension of moved-the-car' and then by definition it must also be in *(moved-the-car'). This means that in the situation described, the antecedent of (136) is true and the consequent is false.[15] In other words, the arrow of (136) is not justified by adding (134) to our system.

The upshot of this result is that in a grammar where distributivity

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[15]One might think that the star-operator should be redefined as follows:

$\| *(\alpha') \|$ = the closure under union of $\| \alpha' \|$ excluding the elements of $\| \alpha' \|$ itself.

The problem is that this would incorrectly make:

i. John **and** Mary moved the car.

false on its distributive reading if they moved the car together, even if they also moved it individually.

is accounted for with a rule like (134), there is no translation of (133) from which (132) follows:

(133) John and Mary moved the car.
(132) John moved the car and Mary moved the car.

The prevailing view seems to be that (132) should follow from (133) on some reading (cf. Gillon 1987 and Lasersohn 1988:§2.1). In fact, it is only under this view that the argument presented at the outset against the union theory holds weight, since that argument relied on an entailment of this sort: *The authors and the athletes are outnumbered by the men* entails *The authors are outnumbered by the men and the athletes are outnumbered by the men.* While *I* am not entirely convinced that the prevailing view is correct, I will adopt it here and with it abandon our first attempt at an analysis of distributivity within the union theory.

Before moving on to the next attempt, let me note one more possible flaw in the current system, which was mentioned chapter 1. Theories which include something like (134) seem to overgenerate. They predict that cumulativity is independent of the predicates involved. However, I am uneasy with the following entailments:

(137) The boys look alike and the girls look alike → The boys and the girls look alike.
(138) The students left as a group and the teachers left as a group → The students and the teachers left as a group.

Lønning (1989:125) makes a similar point concerning this example:

(139) a. The black children played with each other and the white children played with each other.
b. The (black and the white) children played with each other.

5.2.2 The D-operator

The next attempt starts with the observation that distributivity can be overtly marked with the floated adverb *each:*

(140) John and Mary each moved the car.

(140) unambiguously entails that John moved the car and Mary did too. On the basis of this observation, one posits an adverbial D-operator in the translation language with the following semantics, where x,y are variables

over elements in the domain of discourse:

(141) $x \in \| D(\alpha) \|$ iff $\forall y[(\text{singularity}(y) \wedge y \in x) \rightarrow y \in \| \alpha \|]$

An operator of this type is found in Link's work as well as in Lønning (1987), Roberts (1987) and elsewhere.

The ambiguity of (133) is now captured by allowing the predicate to be translated either as in (142a) or as in (142b).

(133) John and Mary moved the car.
(142) a. moved-the-car'
b. D(moved-the-car')

The distributive entailment from (133) to (132):

(132) John moved the car and Mary moved the car.

is mapped as in (143):

(143) $D(\text{moved-the-car'})(J+M) \rightarrow [\text{moved-the-car'}(J) \wedge \text{moved-the-car'}(M)]$

This entailment is guaranteed by the semantics given in (141). Here I've assumed that the simple translation moved-the-car' denotes a set containing singularities and pluralities. Each member of the set is responsible for a moving of the car.

The introduction of a quantifier into the logical form of distributive predicates is further justified by evidence of scope interaction between it and other quantifiers. One example of this concerns the interaction between the D-operator and indefinite noun phrases as analyzed in Roberts (1987). To see this effect, consider first the simple example in (144) in a context where there is more than one boy:

(144) Every boy lulled a dog.

This example has a plausible reading in which the existential has narrow scope with respect to the universal and **an** implausible reading involving multiple lullings of a single dog. As is well-known, the singular indefinite can serve as the antecedent for a singular pronoun later in the discourse only if it has wide scope. Thus we get only the implausible reading when (144) is embedded in a discourse having such a pronoun, as in (145):

(145) Every boy killed a dog. It turned out to have nine lives.

Now consider the example in (146):

(146) John and Mary lulled a dog.

This example has two distributive readings. On one reading, (146) is true if John lulled a dog and Mary killed a dog. On the other, implausible, distributive reading, (146) is true if there is a dog and John lulled it and Mary lulled it. The presence of the two distributive readings is explained by talung the indefinite to have narrow or wide scope with respect to the D-operator. Once again, the implausible wide scope reading is the only one possible in a discourse where the indefinite serves as the antecedent for a subsequent singular pronoun:

(147) John and Mary killed a dog. It was buried in the parking lot.

((147)also has a collective reading, involving a single collaborative murder). Another example of scope interaction involving the D-operator was pointed out to me by Angelika Kratzer. In this case, the interaction is with the modal predicate likely:

(148) John and Mary are likely to win the lottery.

(148) has the following two distributive readings:

a. there is a good chance that John will win the lottery and that Mary will win the lottery.
b. John and Mary each have a good chance of winning the lottery.

This difference is explained by taking the D-operator to have scope under the modal in the (a) reading (attached to the lower verb) and over the modal in the (b) reading.

Reviewing so far, we have now helped ourselves to an account that fulfills the basic requirement of guaranteeing the distributive entailments and which analyzes the distributive-collective distinction as one of ambiguity. Furthermore, essential use of a quantifier in the translation of distributive predicates is independently confirmed by its participation in scope interactions.

One might wonder at this point whether or why this approach is an improvement on the approach taken for example by Bennett (1974:193,229) in which definite noun phrases were optionally translated with a universal quantifier, essentially giving a definite plural the meaning

of a universal noun phrase. The present approach has an advantage. As noted in section 1.3, conjoined verb phrases need not be understood both collectively or both distributively even when they combine with a single subject. This is unexpected on an account in which the ambiguity is located in the noun phrase.

5.2.3 Intermediate Readings: Contexr Sensitivity

With all that is positive about the D-operator account of distributivity, one significant problem remains. By employing the D-operator, we envision two kinds of situations in which a verb phrase will hold true of a plurality: either the property expressed by that predicate holds of each of the singularities that are parts of the plurality, this is the distributive case, or the property holds of the plurality itself, this is the collective case. Research on plural constructions has uncovered a third case, however. In their work on reciprocals, Fiengo and Lasnik (1973) observed that whereas for simple cases like (149),

(149) John and Bill were hitting each other.

we can say that a reciprocal VP of the form V-each other is true of a plurality if, and only if, the relation expressed by V holds between any two members of the plurality reciprocally, such is not the case with an example like:

(150) The men were hitting each other.

when there are more than two men. If the men are divided into groups, and there is reciprocal hitting between any two members of each group, Fiengo and Lasnik say that (150) might be considered true even if there is no hitting between members of different groups. In other words, reciprocity holds within subpluralities of the plurality denoted by the men. Langendoen (1978) extended this idea of distributing down to sub-pluralities in an analysis of non-reciprocal sentences.[16] Within this tradition,

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[16] A reviewer pointed out that Katz (1977:127) expresses a similar sentiment:

> "the units of attribution can be individuals, pairs, triplets, and so on, up to the entire membership of the set $DES(t_i)$ [roughly, the denotation of the relevant argument of the attributed predicate RSS]. The frequently discussed notions

Higginbotham (1981:100) adopts the following interpretive principle:

(151) [S NP_{plural} VP] is true iff there is a partition C of the plurality P denoted by NP such that VP is true for every element in C.

A partition is a kind of cover, where:

(152) C is a cover of P if and only if:
1. C is a set of subsets of P
2. Every member of P belongs to some set in C.
3. **O** is not in C

C is a partition of P if, and only if, C covers P and no two members of C overlap. In fact, there is some question whether (151) shouldn't make reference to covers of all types rather than just to partitions. Gillon (1987:212) provides the following example in support of this change:

(153) The men wrote musicals.

> Suppose *the men* denotes Rodgers, Hammerstein, and Hart. (153) is true, on at least one reading, when they are the denotation of the subject noun phrase. However, there is no partition of the set containing those three men in which *wrote* musicals is true of each member. Rather, the sentence is true because Rodgers and Hammerstein collaborated to write musicals and Rodgers and Hart also collaborated to write musicals.

On the strength of this example, we make the recommended change in (151):

(154) [S NP_{plural} VP] is true iff there is a cover C of the plurality P denoted by NP such that VP is true for every element in C.

If the claim in (154) is correct, then surely something is lacking in our analysis in terms of a collective reading and a D-operator based distributive

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> of the *distributive* and *collective* features of quantifiers represent two extremes of this range of possible units."

Incidentally, Katz rejects the notion that there is a genuine ambiguity here, a question to which we return below.

reading, where the distribution is to singularities only. But is the claim correct? Lasersohn (1989) doesn't think so. He asks us to consider a situation in which a department pays each of its three TAs (teaching assistants) $7,000. In such a case (155) is true on a distributive reading, (156) is true on a collective reading and (157) is false:

(155) The TAs were paid exactly $7,000 last year.
(156) The TAs were paid exactly $21,000 last year.
(157) The TAs were paid exactly $14,000 last year.

However, according to (154), (157) should be true as well since the VP in that sentence is true of any set of two TAs and hence will be true of each member of a cover of the TAs containing two two-membered sets. Lasersohn proposes instead that we remain with the simple two-way collective-distributive distinction. He reanalyzes Gillon's (153) by adopting a meaning postulate that guarantees the following:

(158) $\| \text{write} \| (w,y) \wedge \| \text{write} \| (x,z) \rightarrow \| \text{write} \| (w \cup x, y \cup z)$

Since the union of the set of Rodgers and Hammerstein and the set of Rodgers and Hart is just the set denoted by *the men* in (153), that sentence is guaranteed to be true on the construal Gillon is after.

Lasersohn's use of a meaning postulate to handle an "intermediate" distributive reading is in the spirit of Scha (1984) and Scha & Stallard (1988), to be discussed below. While I believe that the statement about the meaning of *write* made in (158) is likely correct, I think it is misleading to capture this information with a meaning postulate and, more importantly, it is incorrect to account for distributivity in strictly semantic terms. Both of these points deserve elaboration.

Accounting for the difference between (153) and (157) in terms of a meaning postulate amounts to claiming that the presence of the intermediate reading in (153) is a direct result of the presence of *write* as the main verb and that (157) lacks the intermediate reading because the verb *write* has been avoided. Observe, however, that (153) can be continued with:

(159) They were paid exactly $2,000 per musical/for their musicals.

If, in fact, the musicals went for $2,000 apiece (159) is true on the same intermediate reading, that is the one corresponding to the same cover as in (153). The main verb of (159) is similar to the one that was used to deny the presence in general of intermediate readings. This indicates that the

presence of the intermediate reading in (153) is not intimately connected with choice of main verb.

Now, regardless of how we capture facts about the extensions of plural predicates like that in (158), we will not achieve a complete analysis of distributivity. This is because there is a pragmatic element to distributivity which is nicely illustrated in Gillon's reply to Lasersohn. Gillon guessed that the adverb exactly was responsible for the possible lack of the relevant reading in Lasersohn's (157) and suggested we consider his (160) as well:

(160) The T.A.'s were paid their $14,000 last year.

in a context which he describes as follows:

> A chemistry department has two teaching assistants for each of its courses, one for the recitation section and one for the lab section. The department has more than two teaching assistants and it has set aside $14,000 for each course with teaching assistants. The total amount of money disbursed for them, then, is greater than $14,000. At the same time, since the workload for teaching a course's section can vary from one section to another, the department permits each team of assistants for a course to decide for itself how to divide the $14,000 the team is to receive. Suppose that it turns out, as it very well could under such circumstances, that no teaching assistant is paid exactly $14,000 . Yet it seems to me that either of the sentences in (157) or (160) could be truly affirmed, though neither sentence, by hypothesis, is true in virtue of either a collective or a distributive reading.

What Gillon has done here is to change the context in which Lasersohn's example is uttered. In other words, whether or not a certain intermediate reading is available seems to have to do with the context not with the semantics of particular lexical items. The phenomenon we are looking at is pragmatic, not semantic. The claim I am making can be cast in terms of a revision of the generalization made in (154) above repeated here:

(154) $[_S\ NP_{plural}\ VP]$ is true iff there is a cover C of the plurality P denoted by NP such that VP is true for every element in C.

(154) makes reference to covers of a plurality. Now, in different contexts, different covers may be salient, that is, a given plurality may have parts that are relevant in one conversation but not in another. So (154) should be modified to:

(161) $[_S\ NP_{plural}\ VP]$ is true in some context Q iff there is a cover C of the plurality P denoted by NP which is salient in Q and VP is true for every element in C.

The examples we've seen so far in which an intermediate reading was claimed to have arisen have all involved transitive verbs with bare plural or amount denoting object noun phrases. Before turning to an analysis which captures the generalization in (161), I would like to provide an example of a different form in which an intermediate reading arises.

Imagine a situation in which two merchants are attempting to price some vegetables. The vegetables are sitting before the merchant, piled up in several baskets. To determine their price, the vegetables need to be weighed. Unfortunately, our merchants do not have an appropriate scale. Their grey retail scale is very fine and is meant to weigh only a few vegetables at a time. Their black wholesale scale is coarse, meant to weigh small truckloads. Realizing this, one of the merchants truthfully says:

(162) The vegetables are too heavy for the grey scale and too light for the black scale.

In order to save space in our explanation, let us reword his utterance:

(163) a. The vegetables are too heavy for the grey scale.
b. The vegetables are too light for the black scale.

(163a) is false on its distributive reading, the one corresponding to a translation employing the D-operator of (141). It is true on its collective reading but that is not what the merchant intended. (163b) is false on the collective reading, the one corresponding to a translation without the D-operator. It is true on its distributive reading, but again that is not what the merchant intended to say. The physical arrangement of the vegetables in baskets suggests a cover of the vegetables with cells of the cover corresponding to baskets of vegetables. (162) is true and informative on the intended intermediate reading because the verb phrase is true of every member of that cover.

Reviewing now, our discussion began with the acceptance of those theories which model collective-distributive distinction with the help of the D-operator interpreted as in (141):

(141) $x \in \| D(\alpha) \|$ iff $\forall y[(\text{singularity}(y) \wedge y \in x) \rightarrow y \in \| \alpha \|]$

This approach has two advantages. It delivers a clear distributive and collective reading and it accounts for certain ambiguities in terms of a scope interaction between the D-operator and modals and between the D-operator and indefinite noun phrases. The trouble with this approach is that it fails to make enough distinctions. In certain contexts, sentences with definite plural noun phrase arguments are found to have intermediate readings that are not predicted on this approach. We need a new account that will allow for more readings. This account must do justice to the pragmatic aspect of these readings, referred to in the generalization in (161).

5.2.4 A Generalization of the D-operator

Our current defective proposal involves the following semantic rule for the D-operator:

(141) $x \in \| D(\alpha) \|$ iff $\forall y[(\text{singularity}(y) \text{ A } y \text{ E } x) \rightarrow y \in \| \alpha \|]$

We are happy with the universal quantifier attached to y and would like to retain it. The problem lies in the restriction to singularities. In the intermediate readings there is universal quantification, that is distribution, but not necessarily down to singularities. What would happen if we simply dropped this restriction:

(164) $x \in \| D(\alpha) \|$ iff $\forall y[y \in x \rightarrow y \in \| \alpha \|]$

This doesn't do very much given the kind of model we are assuming (that of the union theory). Being on the left side of the membership sign, y is effectively restricted to singularities since our domain has in it only singularities and sets of singularities. So we need to change the membership sign to subset:

(165) $x \in \| D(\alpha) \|$ iff $\forall y[y \subseteq x \rightarrow y \in \| \alpha \|]$

We don't lose any values for y in this process, since Quine's Innovation (see the Appendix) guarantees that:

(166) $\forall y \forall x([\text{singularity}(y) \wedge y \in x] \rightarrow y \subseteq x)$

The problem with (165) however is that it now requires too much for a distributive reading. To see this consider a situation in which the sentence:

(167) The bottles are light enough to carry.

is true but *only* on its distributive reading and that even two or three bottles would be too heavy to carry. If we go to map the true distributive reading with the operator defined in (165), we end up requiring that every set of bottles be in the extension of *be light enough to carry*. But then the translation of (167) with the D-operator is false, when in fact (167) is true on its distributive reading.

Getting rid of the singularity restriction was fine but we need some new restriction to replace it. The claim in (154) above, suggests the following:

(168) $x \text{ E } \| D(\alpha) \|$ if and only if
There is a cover C of x: $\forall y[y \in C \rightarrow y \in \| \alpha \|]$

Reconsider (167) in a situation in which each bottle by itself is light enough to carry though two or more bottles together would be too heavy to carry. The set of all the bottles is a cover of itself. This follows from the definition of cover:

(152) C covers A if:
1. C is a set of subsets of A
2. Every member of A belongs to some set in C.
3. **O** is not in C

along with our adoption of Quine's Innovation, according to which each bottle is a subset of the set of all the bottles. The predicate of (167) is true of every member of this cover. Translating (167) with a D-operator interpreted as in (168) yields a formula that is true in this situation. In addition, notice that if we left the D out we would get the collective reading and hence a formula that is false.

(168) represents progress. It retains the quantificational analysis of distributivity, and though it still allows for situations in which there is distributivity to singularities it is flexible enough to allow for intermediate distributive situations. Nonetheless it is flawed in two ways. First, we no longer have a true distributive (to singularities) reading, much as in the case of our original cumulativity-based analysis ((134), page 58). That is, distributive entailments no longer hold in our system. For example, if *the bottles* refer to three bottles named A, B and C, the entailment mapped as:

(169) $D(\text{are-heavy}')(A+B+C) \rightarrow \text{are-heavy}'(A) \wedge \text{are-heavy}'(B) \wedge \text{are-heavy}'(C)$.

is not **guaranteed** by (168). This is because there may be another cover, say the one in which all the bottles occupy one cell, such that each member of that cover is in the extension of be heavy. The other problem with (168) is that it makes no reference to context. But we learned in the previous section that the availability of certain readings was dependent on context; not all covers are equal.

The source of both of these problems is the existential quantifier in the phrase "there is a cover C" in (168). The semantics should make reference to a specific cover, the choice of which is a matter for the pragmatics. This can be done by leaving the variable C free. In this case, the actual truth conditions which a sentence receives on a particular occasion of utterance are determined not by its translation alone, but by the translation interpreted with respect to a certain value assignment to its free variables, which is determined by pragmatic factors. There is some leeway in how we change (168). Here is one possibility:

(170) $x \in \| D(Cov)(\alpha) \|$ if and only if
$\| Cov \|$ is a cover of x $\wedge \forall y[y \in \| Cov \| \rightarrow y \in \| a \|]$

Cov is a free variable over sets of sets. The value of Cov is determined by the linguistic and non-linguistic context. For example, in our vegetable example (163), the non-linguistic context provided a partition of the vegetables corresponding to their physical arrangement. This partition would have been assigned to Cov in the evaluation of (163). A slightly different way to amend (168) is as follows:

(171) $x \in \| D(Cov)(\alpha) \|$ iff $\forall y[(y \in \| Cov \| \wedge y \subseteq x) \rightarrow y \in \| \alpha \|]$

In this version Cov is variable over covers of the whole domain of quantification. In future discussion we will assume this alternative, briefly returning to the choice between the two at the end of section 5.3.

In all versions of the semantics of the D-operator there is implicit restriction to the domain of quantification, as with all natural language quantifiers. The change then from (165) repeated here:

(165) $x \in \| D(\alpha) \|$ iff $\forall y[y \subseteq x \rightarrow y \in \| \alpha \|]$

to (171) is simply that we have quantification restricted to contextually specified covers over the domain rather than to the domain itself.

I would like to end this discussion by showing how we have regained the distributive (to singularities) **reading** of (167). Before doing

that I want to make a notational modification. From now on, let us leave the one place D-operator familiar from the literature with exclusive rights to that name and rename our operator "Part" :

(172) $x \in \| Part(Cov)(\alpha) \|$ if and only if
$\forall y[(y \in \| Cov \| \wedge y \subseteq x) \rightarrow y \in \| \alpha \|]$

Turning now to the distributive (to singularities) reading, recall our earlier example:

(167) The bottles are light enough to carry.

which on its non-collective readings would get translated as:

(173) (Part(Cov)(are-light-enough-to-carry')) (the-bottles')

To simplify, let's assume that the domain of discourse doesn't include non-bottle entities. In that case, the reading we are after is the one in which Cov is assigned a set containing each of the bottles. This cover is salient in the discourse (it has been mentioned as the subject of the sentence) so its assignment to Cov is plausible. On this reading, (167) entails that each of the bottles is light enough to carry. This is what we have come to call the distributivity entailment.

This example points to a possible misunderstanding in the use of the term "reading". Throughout this discussion, I use the term "reading" to mean particular interpretation, including the choice of a meaning for ambiguous lexical items as well as the factoring in of specific aspects of context that affect interpretation. In this sense, there is a reading of (167) involving distribution to singularities. Some would limit the terms "reading' and "ambiguity" to differences in meaning deriving from lexical or syntactic ambiguity. On that view, according to the grammar envisioned here (to be modified below), (167) might be said to have two readings: one collective (translated without the Part operator) and one distributive, not necessarily to singularities.

5.3 Incorporating the Account into the Grammar

In this section, I would like to take a closer look at how the grammar needs to change in light of the analysis sketched in (172) below from the previous section:

(172) $x \in \| Part(Cov)(a) \|$ if and only if

$$\forall y[(y \in \| \text{Cov} \| \wedge y \subseteq x) \rightarrow y \in \| \alpha \|]$$

To begin with, we need a new translation rule, something like the following:[17]

(174) Distributive VP rule:
If α is a plural VP with translation α', then Part(Cov)(α') is also a translation for α.

Next, a semantic rule is needed to interpret these translations. We take e-type expressions to denote elements of D', and type <e,t> expressions to denote subsets of D'^{*}. The cover variable is of type <e,t> and the Part operator is interpreted as follows:

(175) Let α and β be variables whose values are object language expressions of type <e,t> and let u,v be variables whose values are entities in D'. For all α,β,u:

$$u \in \| \text{Part}(\beta)(\alpha) \| \text{ if and only if}$$
$$\forall v[(v \in \| \beta \| \wedge v \subseteq u) \rightarrow v \in \| \alpha \|]$$

Finally, a word about the pragmatics. In the introduction I said that interpretation would be with respect to a model and that I would write simply $\| \cdot \|$ instead of $\| \cdot \|^{M}$, omitting the superscripted M. Since we now have free variables in the translations, we need a mechanism by which they get interpreted. For concreteness, let's assume the pre-DRT view of things, where interpretation is carried out with respect to an assignment function and where the particular function chosen is somehow pragmatically determined (Cooper 1979, for example, discusses this method and attributes it to Montague). This means that from now on, $\| \cdot \|$ is an abbreviation for $\| \cdot \|^{M,g}$ where the superscripted M and g have been omitted.

Returning to the translation rule (174), we see that it allows for plural VPs to have two different translations. This is the source of the distributive-collective ambiguity mentioned at the end of the previous section. It also makes it apparent that the way that the **range** of distributive readings is handled, namely in pragmatic terms, differs from the way the distributive-collective ambiguity is handled. This conflicts with the

[17] This rule will produce translations containing multiple Part-operators. I suspect that this is harmless and will ignore this possibility.

intuition discussed earlier according to which the distributive (to singularity) and the collective readings are just extremes on a scale which includes distribution to subpluralities of various 'sizes'. What I would like to explore then, is a way to modify our grammar to reflect this intuition.

Recall, above, a distributive reading of:

(167) The bottles are light enough to carry.

was analyzed with the following translation:

(173) (Part(Cov)(are-light-enough-to-carry')) (the-bottles')

by taking the assignment to Cov to be a set containing each of the bottles. It is reasonable to assume that by collecting the bottles together under one noun phrase, the speaker makes salient in the discourse another cover of the domain: one in which the bottles occupy a single cell. Assigning this cover to the variable Cov leads to the collective reading. In other words, we now have two sources for the collective reading, one with and one without the Part operator. Since we don't in fact need the translation without the Part operator for anything else, we can simplify the translation rule (174) as follows:

(176) Plural VP rule:
If α is a singular VP with translation a', then the corresponding plural VP is translated as Part(Cov)(α').

On this way of doing things, the Part-operator simply reflects the plural marking on the verb and the collective reading is now just one among many that the semantics and context could potentially yield.[18] Support for this move, comes from the use of the phrase in *a* sense, which occurs when a speaker attempts to bring the so-called distributive-collective ambiguity into focus. For example, if John and Mary each made $1,000, one might at first reject (177), but then upon reflection utter (178):

(177) John and Mary made $1,000.
(178) Well, in a sense they did and in a sense they didn't.

[18] It might be harmless to incorporate the Part-operator in singular VPs as well. This would require a different kind of translation mechanism.

Lewis (1970:229) and Kamp (1975:150) have analyzed this phrase in its use with vague adjectives as in *John is clever, in a sense*. The role of in a *sense* according to these authors is to select a context or set of contexts with respect to which the adjective's vagueness is resolved. We might do something similar here. Assume that the predicate of (177) is interpreted with a Part(Cov) operator. In a "collective-context," Cov is assigned a cover in which John and Mary occupy the same cell. In a "distributive context," it is assigned a cover in which John and Mary occupy different cells. In an ambiguous context either assignment is possible. The role of *in* a *sense* in (178) is to restrict the interpretation now to a collective context, now to a distributive context. On this account then, we say that in the ambiguous context the plural noun phrase makes salient two different covers of the domain, one collective and the other distributive.

While I think this essentially pragmatic view of the distributive-collective ambiguity is correct, there is an apparent problem with the way we've set things up. Earlier (page 63), we argued for the D-operator analysis in part because it could handle the fact that conjoined verb phrases need not be understood both collectively or both distributively even though their conjunction combines with a single subject. On the current view, this type of data becomes a problem. To see this, consider the following example:

(179) These cars were put together in Malaysia and sent to different countries in Europe.

Here I am interested in a construal of the sentence in which the first verb phrase conjunct is understood distributively while the second is understood non-distributively. In other words, the cars were not attached to one another, but rather each car was assembled in Malaysia and each car didn't go to different countries, rather the shipment of cars was dispersed in Europe. Now consider the kind of translation the conjoined VP would receive (assume $\|A \text{ and } B\|$ is interpreted as $\|A\| \cap \|B\|$):

(180) Part(Cov)(p.t.i.Malaysia') $\wedge$ Part(Cov)(s.t.d.c.i.Europe')

For simplicity, let's assume the domain includes only the cars in question. Following the recently adopted view of the distributive-collective ambiguity, the cover variable in (180) is either assigned a set containing each of the cars, in which case we get the distributive reading of both conjuncts or it is assigned a set containing the set of all the cars in which case we get the collective reading of both conjuncts. Unfortunately, neither of these possibilities corresponds to the desired reading of the sentence.

I think the source of this problem is that we are not yet used to thinking of the distributive-collective ambiguity as pragmatic. On that view, a distributive-to-singularities reading arises because, in some sense, the conversants are thinking of the plurality in question in terms of its singular parts, while the collective reading arises when the conversants think of the plurality in question as a whole. But nothing prevents us from thinking of the same plurality in two ways. The problem in (180) is not the pragmatic view of collectivity, but rather that that representation doesn't allow for this third possibility. In fact, the culprit here too is our translation rule, which forces us into assuming one way of thinking of the given plurality per conversation. The following modification should rectify this:

(181) Plural VP rule:
If α is a singular VP with translation α', then for any index i, $\text{Part}(\text{Cov}_i)(\alpha')$ is a translation for the corresponding plural VP.[19]

Now, a possible translation for (179) would be:

(182) $\text{Part}(\text{Cov}_1)$(p.t.i.Malaysia') $\wedge$ $\text{Part}(\text{Cov}_2)$(s.t.d.c.i.Europe

And, on the intended reading, Cov_1 is assigned the set containing each of the cars, while Cov_2 is assigned the set containing the set of all the cars.

Although the rule in (181) grew out of a consideration of how language users think about pluralities, one could have arrived at this result from a different route beginning with an argument presented earlier for the D-operator (section 5.2.2). It had been noticed that plural predicates display scope interactions, behaving as if they contained a quantifier. The D-operator was a spelling out of that quantifier, as is our Part operator. Later, after having introduced the cover variable, I remarked that quantification in natural language always or almost always involves some sort of discourse restriction of the domain of quantification. The cover variable is a way of formalizing that restriction for the quantifier associated with plural predicates. Continuing this line of reasoning, we note that although domain restriction may be a restriction of the entire domain of quantification, it is something that is done on a per-quantifier basis, as pointed out in Westerstahl (1985). Here too, we should allow for each quantifier associated with plural predication to have its own domain

[19] One might want here a set of rules, one for each index, as Montague (1974) does with Quantifying-In. In that case, each rule provides a unique translation.

restriction. This is what rule (181) does.

I want to end this section with one more piece of evidence in favor of the grammar set up here and in particular the view it takes on the distributive-collective ambiguity. Consider the following incident. Apparently, in the last five years, an unsavory Mr. Slime has made several purchases from a computer store: 4 computers and 1 cartonful of diskettes. These purchases were made over the course of a few years and each time, Mr. Slime paid an initial amount in counterfeit currency and the remainder he paid for with a valid credit card. The following remark is entered in the police report:

(183) The computers were paid for in two installments and the diskettes were too.

First note, that the intention here is a distributive reading of the first verb phrase and a collective reading of the second, elided, VP. An analysis in which distributive and collective readings correspond to different underlying forms would have to explain how the second VP was elided when in fact it was non-identical to the first. What should we say about this example? We will assume the following formula represents the meanings of the conjuncts of (183) with c denoting the computer-plurality and d, the diskette plurality:

(184) $c \in \text{Part}(\text{Cov}_0)(\text{p.f.i.t.installments'})$
$d \in \text{Part}(\text{Cov}_0)(\text{p.f.i.t.installments'})$

Notice, here we cannot explain the different readings of the VP in terms of assignments to different cover variables, since here we are assuming identity of the VPs.[20] In fact, we don't need to assume different cover

[20]It is interesting to compare the reasoning here with that of Klein (1980:15-16). Klein was looking at the contextual evaluation parameters that determine the comparison class for adjectives like *tall* and those that determine the domain of quantification for quantificational noun phrases. Klein observed that an elided VP and its antecedent can differ with respect to the settings of these parameters for material inside the VPs. In contrast, the referent of an indexical pronoun in an elided VP must be identical to the referent of the corresponding pronoun in the antecedent VP. Klein concluded from this that the contextual parameters should not be incorporated like pronouns into the representation. We are not driven to a similar conclusion in the present case, as the reader will shortly see.

variables in this case, since the subjects of the two VPs are not identical. Rather we need to consider how the writer of (183) was thinking about things. As far as the facts of the case were concerned, the purchased items divide up into purchase-parts: one for each computer and one for the set of diskettes. When this cover of the domain (or some extension of it to cover things other than the stolen merchandise) is assigned to the variable $\text{Cov}_{,}$, the intended reading of (183) results.

It should be pointed out that the analysis just provided rides on the assumption that Cov gets assigned a cover of the whole domain and not just a cover of the plurality that the VP is predicated of, as suggested earlier (section 5.2.4, (170-171)). Lasersohn (1995) and an anonymous reviewer have pointed out that the decision to assign covers of the whole domain allows for cover choices that would effectively eliminate dependence of the truth of a sentence like John and *Mary left* on whether or not John left. This would happen, for example, if the cover puts John in only one cell, with someone other than Mary. While such a cell is in the cover, it is not a subset of the set of John and Mary, hence the truth value assigned to the sentence will incorrectly not depend on John's having left or not, given the rule in (172) above. The following variation on the semantics of the Part operator would take care of this.

Alternative Semantics for the Part operator:

(a) For any Y, a set of sets of individuals, and any y, a set of individuals, Y/x is the largest subset of Y that covers x, if there is one, otherwise it is undefined.

(b) $x \in \| \text{Part}(\text{Cov})(\alpha) \|$ if and only if
$\forall y[(y \in \| \text{Cov} \| /x) \rightarrow y \in \| \alpha \|]$

I refrain from adopting this formulation because I believe that pathological values for domain of quantification variables should be ruled-out pragmatically and not semantically. 'This point is elaborated in Schwarzschild (1994:228-233).

5.4 Excursus on Plural Quantification: Partitions

In the previous section we replaced the D-operator which was interpreted with a quantifier (implicitly) restricted simply to the domain of quantification with the Part-operator which involved quantification restricted to a cover of the domain of quantification. Let us call this kind of restricted quantification, partitioned quantification. I use the verb "partition" loosely referring to something that results in a cover of any sort,

even one that is not technically a partition. Our discussion gave the impression that partitioned quantification was something unique to the Part-operator. The point of this excursus is to indicate that partitioned quantification is pervasive. To show this, I will briefly review a number of examples whose interpretation is sensible only in case quantification of this sort is assumed. I will not endeavor to analyze these examples in any serious way.

Our first example is of a type common in statistical reports:

(185) One out of every three handguns in America is made by Smith and Wesson.

(185) is not falsified by the fact that three handguns can be found in America all of which are not made by Smith and Wesson. This is because (185) is considered true if there is a partitioning of handguns into threes such that each triplet contains a Smith and Wesson. Interestingly, replacing ***every*** with *each* or *any* changes the meaning in a way that seems to be related to partitioning:

(186) ? One out of any/each three handguns in America is made by Smith and Wesson.

If (186) means anything at all, it is that for any partitioning of handguns into threes, each triplet contains a Smith and Wesson. This is a roundabout way of saying that with the exception of at most two, all American handguns are Smith and Wessons. The difference noted here between *every* and *any* is especially clear in a situation in which the context provides an obvious partitioning of the domain. Observing a suburban neighborhood in which houses are built in blocks of three, each block in a different style, one may say:

(187) I observed that every three houses (formed a block / were built in the same style).

but it would be false to say:

(188) I observed that any three houses {formed a block / were built in the same style).

If the difference between *any* and *every* has been correctly analyzed, then I do believe there is a lesson here for our move from the D to the Part operator. The D-operator was modeled on *each* and for many speakers,

floated *each* quantifies over singularities only. For this reason it seemed natural that a covert distributivity operator should also quantify over singularities. However, the comparison between *every* and *any* shows that quantifiers can differ with respect to the partitioning of the domain of quantification. Floated *each* requires a partition into singularities while the Part operator does not.

Our next example comes from the discussion in Lasersohn (1988:Ch.IV) of quantifiers and group-level properties. He distinguishes between three different types of situation in which the sentence:

(189) John and Mary made $10,000.

is true. Either John and Mary each made $10,000 or in the "pure collective" case they made $10,000 in a joint enterprise or in the "cumulative" case, the combination of their individual incomes amounts to $10,000. Lasersohn points out however that these three situations are not equally relevant for the negative quantifiers no and *only*. To see this, assume that in fact (189) is true and that in addition it is true that:

(190) Bill made $10,000.

If no other individuals besides those mentioned so far made any money, is (191) below true?

(191) Only Bill made $10,000.

Lasersohn contends that the answer depends on which of the situations described above make (189) true. If John and Mary each made $10,000 or if they made $10,000 in a joint enterprise then (191) is false. But if $10,000 represents the combination of their individual incomes (and no other money was made by them) then (191) is true. In short, negative quantifiers do not pay attention to the cumulative case.

Lasersohn (1988:190) discusses the following putative counterexample to this last claim:

> Consider the budget of a small city. The payroll for the police department totals $1,000,000, the payroll for the fire department also totals $1,000,000, and the payroll for the sanitation department totals $500,000. In this situation, sentence (192) seems false:

(192) Only the police officers get paid $1,000,000.

The sentence is false because the firefighters also get paid $1,000,000. Since it is the combined income of the firefighters that is in question, this appears to be a case where *only* excludes a group from having a property even if it has that property only by virtue of a totaling operation on the properties of the group's members.

Compare another example, however. Suppose now that the fire department payroll is only $500,000. In this case, (192) is true -- despite the fact that the combined income of the firefighters and the sanitation workers is $1,000,000. What is different about this case? It seems clear that the reason why (192) was false in the original situation but true in this one is that in the original situation there were two distinct payrolls which (each) totaled $1,000,000, while in the new situation there is only one. To calculate the truth value of the sentence, one compares the lump sums allocated to single entries in the overall budget.

Elaborating on this explanation we might say that the context naturally partitions the workers into three sets of workers and *only* is sensitive to this partition.[21] In the first case there is another member of the partition besides the police officers that gets paid one million dollars, while in the second case there isn't. Reference to a partition is important here. We cannot simply say that the domain includes only three entities that get paid. The following could be felicitously uttered in a conversation including (192) without affecting the facts outlined above:

(193) Every worker receives his paycheck on the same day so the city estimates it must have at least $50,000 in the bank at all times.

In other words the domain must include individual workers as well.

Another case of partitioned quantification occurs in the use of the word *majority*. Consider first the indefinite term *a majority*. According to (194),

(194) If a majority votes for this proposal, we are doomed.

[21]It could be that the partitioning observed here comes in not from the meaning of *only* but rather from a Pan operator on the verb phrase.

any group containing most of the voters could spell disaster. Imagine now that a secret ballot is taken, 40 out of 50 voters are in favor and it is now truly announced that,

(195) The majority voted for the proposal.

Who or what does *the majority* refer to? There is no unique group containing most of the voters, unless we have partitioned the domain. Further, not just any partition will do. A group containing all those who were against plus 20 of those who voted in favor constitutes a majority. That majority in fact did not (all) vote for the proposal. Rather, what is assumed here is a partition into voting blocks.

Partitioning as a prerequisite for quantification is not limited to pluralities. Various people have noted that partitions are assumed in the counting of kinds (Carlson 1977:346ff)[22], facts (Kratzer 1989:608ff) and events.

The omnipresence of partitioned quantification suggests the following open question. If partitioning is a prerequisite for quantification then isn't a generalization missed by including this as a part of the Part operator? Shouldn't it simply fall out of a general mechanism in the grammar for interpreting quantifiers?

5.5 Two Place Predicates and Distributivity

Various people have discussed the phenomenon of distributivity as it relates to two or more arguments of a verb at a time. The purpose of this section is to consider some examples, particularly those of Scha (1984)

[22]Carlson requires that in order to count members of a set of kinds, that set must form a partition, not just a cover. That is, the set of kinds counted must be such that no two kinds have the same realization. His reason is that we cannot say *three kinds of dogs are in this room* if just one dog is in the room even if that dog instantiates three kinds, e.g. collies, females, loving dogs. Carlson's requirement is probably too strong. I think it is fine to say:

(i) Three kinds of professionals will attend this conference--- doctors, lawyers and college professors.

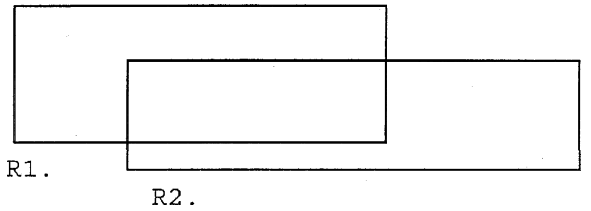
despite the fact that there may be an individual who is both a doctor and a lawyer.

and Scha and Stallard (1988), which have been used to identify special distributional readings associated with two place predicates and to extend the ideas on distributivity presented above to these cases.

Scha considers the following sentence in connection with the figure in (197):

(196) The sides of R1 run parallel to the sides of R2.

(197)



He claims that (196) has the reading given in (198):[23]

(198) $\forall x \in SR1 : \exists y \in SR2 : PAR[x,y] \wedge$
$\forall x \in SR2 : \exists y \in SR1 : PAR[x,y]$
[SR1 = the set of sides of R1]
[SR2 = the set of sides of R2]

Scha analyzes (196) with the following formula:

(199) PAR[SR1, SR2]

Following the method of Bartsch (1973), the reading in (198) is derived by adding the following meaning postulate to the grammar:

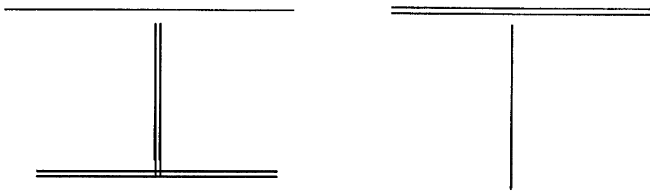
(200) $PAR[u,v] \leftrightarrow \forall x \in u : \exists y \in v : PAR[x,y] \wedge \forall y \in v : \exists x \in u : PAR[x,y]$

[23]Scha also includes as part of the reading that sets SR1 and SR2 are non-empty. We leave this out here and in the meaning postulate to be given in (200). Also, Scha maps individuals as singleton sets which are always distinguished from their members. I have adapted his formulae to the approach taken here, as discussed in the Appendix. In this adaptation, x,y are variables over singularities, while u,v are variables over pluralities and singularities.

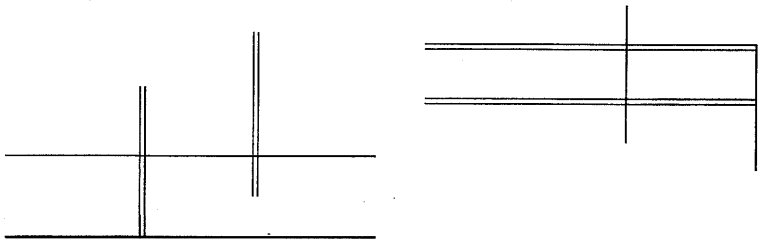
This analysis is similar to Lasersohn's approach to Gillon's examples discussed above. As in that case, I would like again to show that the meaning postulate approach cannot account for the effects of varying context. To that end consider the following sentence in connection with either of the diagrams in (202) or (203):

(201) The double lines run parallel to the single lines.

(202)



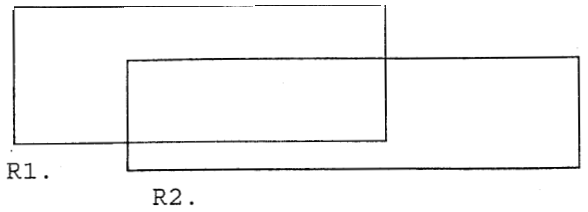
(203)



I find the sentence false in both situations or maybe difficult to judge. But the meaning postulate in (200) would have it otherwise. Letting SR1 now be the set of the double lines and SR2 the set of the single lines, the formula in (198) is true. This means that if the meaning postulate is correct, (201) should be true. My feeling is that again factors that arise in the interpretation of a sentence in a specific context (197) are mistakenly identified as part of the lexical meaning of the predicate in question. Pursuing the program begun above, I would like to find a way to have the relevant contextual information enter into the interpretation without incorporating it once and for all in the meaning of lexical items.

In order to develop a plan for using necessary contextual information in the interpretation, we first need to decide what the relevant information is. Let's look again at the diagram in (197) repeated below, to determine why it is that we agree the sides of the first rectangle run parallel to those of the second.

(197)



It appears that we compare the horizontal sides of the rectangles and the vertical sides of the rectangles independently or perhaps we compare the top horizontals, the bottom horizontals and left and right verticals. This diagram differs from those in (202) and (203) in that it provides us with an intuitive partition of the lines in question. Whereas in previous discussion we relied on the partitioning of sets of elements, here we need to partition sets of pairs. Building on our earlier analysis, we need an operator like Part and a variable like Cov that work on pairs. To do that, we need to extend the notion "cover" to pairs:

(204) T is a paired-cover of $<A,B>$ iff:
there is a cover of A, C(A), and there is a cover of B, C(B), such that:
i. T is a subset of C(A) X C(B).
ii. $\forall x \in C(A)\ \exists y \in C(B)$: $<x,y> \in T$
iii. $\forall y \in C(B)\ \exists x \in C(A)$: $<x,y> \in T$

If T is a paired-cover of $<A,A>$
then T is a paired-cover of A

Now we introduce a two-place version of the Part operator, PPart (short for paired Part). We let X,Y be variables whose values are pairs of elements in the domain and we use the symbol $\subseteq_2$ to combine two pair denoting terms where $<a,b> \subseteq_2 <c,d>$ iff $a \subseteq c$ A $b \subseteq d$. We call this relation pair-subset. We assume now that some contexts provide a value for the variable PCov and that that value is a paired cover of the domain. Our semantics for PPart is given as:

(205) $X \in \| PPart(PCov)(\alpha) \|$ if and only if
$\forall Y[\ (Y \in \| PCov \|\ \text{A}\ Y \subseteq_2 X) \rightarrow Y \in \| \alpha \|\ ]$

Let us see how this works in our test case. The paired cover assigned to PCov in the context of Scha's diagram consists of pairs whose members are

both horizontal or both vertical and it will not contain mixed pairs. Let (SR1,SR2) denote that pair of sets whose first element is the set of sides of rectangle 1, and whose second element is the set of sides of rectangle 2. Take an arbitrary element Y of PCov. If its first element is a subset of SR1 and its second element is a subset of SR2, then $Y \subseteq_2$ (SR1,SR2). Furthermore, $Y \in \|$ run-parallel' $\|$ because of the way PCov was set up. That is, in (197), any two lines that are both horizontal or both vertical are parallel. So the following holds:

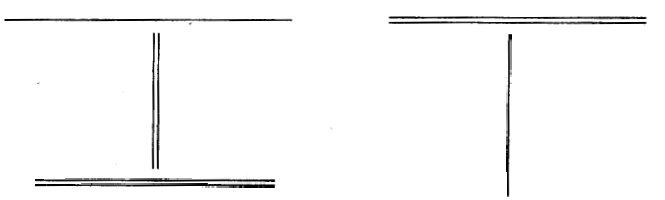
$\forall Y[(Y \in \| PCov \|\ \text{A}\ Y \subseteq_2 \| (SR1,SR2) \|) \rightarrow Y \in \|$ run-parallel' $\|]$

Assuming *run parallel* is translated PPart(PCov)(run-parallel') and the usual rules for assigning meaning to transitive clauses are employed, the semantics given in (205) guarantees that *the sides of R1 run parallel to the sides of R2* is true for Scha's diagram, (197). The required translation entails a rule of the following sort:

(206) Plural TVP rule:
If α is a singular transitive verb phrase with translation α', then for any index i, $PPart(PCov_i)(\alpha')$ is a translation for the corresponding plural transitive verb phrase.

In order to further justify the PPart operator, I would like to present some more examples whose interpretation seems crucially to rely on a pair-partitioning of the domain. Before doing that we might ask why (201) is not true of (202):

(201) The double lines run parallel to the single lines.
(202)



Our answer will be somewhat tentative, for reasons to be explained in the next section. It may be the case that mention of the double and single lines introduces a paired partition into the discourse consisting of all pairs of a double line and a single line and that this is the only value assignable to PCov. Now there are pairs of non-parallel lines in this cover that are pair-

subsets of the pair whose first element is the double lines and whose second element is the single lines. It would follow then that (201) with run *parallel* translated as PPart(PCov)(run-parallel') is false.

We move now to other instances of the paradigm examined so far. The first is based on an example that I have discussed elsewhere (Schwarzschild 1990). Imagine you arrive on the first day for a literature class on the relation between fiction and non-fiction. While introducing the course requirements, the lecturer directs your attention to the chart below and says that:

(207) The fiction books in the chart complement the non-fiction books.

Fiction	Non-fiction
Alice in Wonderland	Aspects of Language(Bloomfield)
Fantastic Voyage	Gray's Anatomy
David Copperfield, Hard Times	Das Kapital, The Wealth of Nations
Oedipus Rex, Agamemnon	Freud's Intro. to Psychology
Richard III	Machiavelli's The Prince

You are required to read three fiction books and their non-fiction complements. It hardly needs saying that the truth of (207) depends on a comparison of adjacent pairs of books. Note a number of things. The domain is partitioned into pairs of adjacent entries. Some of the pairs have non-singleton sets as members. (207) is true if for every pair in the pair-partition, if it is a pair-subset of (‖ the fiction books ‖ , ‖ the non-fiction books ‖) then the first element complements the second element. Crucially, non-adjacent pairs are irrelevant here.

In the two examples we have seen so far the value assigned by the context to PCov was determined by non-linguistic, graphic information. For balance I mention a few other kinds of cases. Scha and Stallard (1988), whose work was intended for use in accessing information about the capabilities and readiness conditions of the ships in the Pacific Fleet of the US Navy, discuss the following example:

(208) The frigates are faster than the carriers.

They speak of two translations for this sentence. The first, called a universal-universal translation, leads to a reading where every frigate is faster than every carrier. The other translation, which I will call universal-existential, requires that every frigate is faster than some carrier and that for every carrier there is a frigate faster than it. It is not very hard, however, to envision a situation in which neither of these represents the correct reading of the sentence. We just need to think partitionally. Imagine for example, that (208) is uttered in a context in which it is clear that these ships are sent out in teams to different areas of the globe with each team consisting of frigates and carriers. It may be that one area calls for very fast action while another will tolerate a sluggish response. If that were the case; I would judge (208) true just in case the frigates in a given area were faster than the carriers of that area, regardless of what speed relations obtained between ships of different areas. In this situation the universal-universal reading is too strong and the other reading is too weak. A semantics that incorporates the notion of a contextually determined partition accounts for these facts without having to drum up new translations.

Consider finally an example where the value for PCov is determined linguistically within the sentence containing PCov:

(209) Even though the couples in our study were not married, the men did display aggressive behavior towards the women.

Here the concessive clause raises the salience of a paired-cover in which men and women are paired into couples. (209) seems to be about aggressive behavior within pairs. The point is strengthened if *all* is added:

(210) Even though the couples in our study were not married, the men all displayed aggressive behavior towards the women.

In this case every man would have had to display aggressive behavior towards his female pair-mate, but crucially he would not have had to be aggressive to non-pair-mate women for (210) to be true.

I would like to end this section by briefly mentioning directions in which the present account could be further pursued. The two operators introduced so far are covert. The floated quantifier *each* could now *be* thought of as an overt counterpart of Part with a particular assignment to Cov, namely one where the cells are singularities. The adverb *respectively* might similarly correspond to the PPart operator. It has the effect of a PPart operator with a particular assignment to PCov. Other phrases that

seem to restrict the values of Cov and PCov are *together*, especially in its sentence initial position as well as phrases such as *one by one* and *in groups of three*. In each of these cases, the lexical item puts restrictions on the value that can be assigned to a free variable. This is similar to analyses of temporal adverbials where they are said to restrict the possible values assigned to a contextual variable over times.

The Part operator is for one-place predicates and the PPart operator is for two places. It is natural then to consider 3 and more place predicates. The following alternative formulation of the semantics of two-place distributivity in terms of functions should suffice to show how things could be extended for more places.

(211) Alternative Semantic Rule for PPart:

Let ß be a variable of type $<<e,t>,t>$, a' an expression of type $<<e,t>,t>$ and a,b,u,v, variables over elements of the domain, D^*, then:

$$\| \text{PPart}(ß)(\alpha') \|^{M,g}(a)(b) = 1 \text{ iff}$$
$$\forall u \forall v[(g(ß)(u)(v) \text{ A } u \subset a \text{ A } v \subset b) \rightarrow \| \alpha' \|^{M,g}(u)(v)]$$

5.6 On **Collective Readings**

The approach that I have outlined here in terms of contextual paired-coverings has been offered as an alternative to Scha's analysis based on meaning postulates. I think that the comparison between the approaches is worth pursuing particularly in light of the elaboration and modifications that are presented in Scha and Stallard's article. My original motivation for employing the PPart operator was simply that the meaning postulate in (200) fails in certain situations. Roberts (1987:133-4) lodges another objection to Scha's program. She points out that certain verbs are ambiguous, having distributive and collective readings and so if the source of distributivity is a meaning postulate one is forced to claim that meaning postulates can be optional. This, Roberts claims, is incoherent and she goes on to propose an analysis in terms of a distributivity operator. But Scha and Stallard have found a solution to this problem. Essentially, they give multiple translations to English expressions and these translations are associated with the various readings.[24] For example, the English verb *eat*

[24]Scha and Stallard's system actually involves double translation. English is translated into a language which itself gets translated.

has at least these two translations:

(212) $\lambda u,v: \forall y \in v : \exists x \in u : \text{EAT'}[x,y]$

(213) $\lambda u,v: [[\forall y \in v : \exists x \in u : \text{EAT'}[x,y]] \text{ A } [\forall y \text{ E } u : \exists x \text{ E } v : \text{EAT'}[y,x]]]$

These particular translations are motivated by Scha and Stallard's belief that the sentence *the children ate thepizzas* has different quantificational readings which differ in whether or not each child has to have eaten a pizza or not. Scha and Stallard allow that different readings are imposed by context, though they do not elaborate on this claim.

Given this new way of incorporating various readings in the grammar, there may now be an answer to my charge that the meaning postulate in (200) leads to incorrect predictions in some situations, since that meaning postulate is now attached only to one particular translation of the phrase *run parallel*. That translation is salient, so the story would go, in the context of Scha's original diagram but not with the figures I presented as counterexamples (202) and (203).

To me this approach is misguided in the role that it attributes to the context. In the examples we have seen so far the context is not providing information about which quantificational formula is appropriate, but rather about specific groupings. It tells us which elements are to be compared, which elements are to be checked and how, in order to verify the sentence. It does not determine a quantity of elements to check nor how many of this type must bear the relation in question for every one of that type.

There is, I think, another more fundamental flaw implicit in Scha and Stallard's agenda. The driving force of that analysis seems to be to translate away plural predications into quantification over and predication of singularities, whenever the predicate in question is applicable to singularities. It is doubtful whether this goal is ultimately attainable. Lonning (1987:124)'s discussion of the sentence *the boys ate the cakes* illustrates the difficulties one encounters in pursuing this goal. He points out that this sentence is true in a situation in which two boys jointly partake of each of two cakes. Notice first that the Scha and Stallard translations for *eat* given in (212) and (213) will not work here. In fact, without moving to quantificatior. over sub-singularities (parts of cakes), it seems well nigh impossible to formalize this as a reading in any meaningful way. Matters get even worse once you consider what Lasersohn (1988,1990) terms "team-credit extensions." These are examples in which a team gets credit for the actions of one of its members. For example, if John and Mary are a couple we may report that John and Mary made

$20,000 last year, even if in fact, only one of them actually worked. Expanding on the discussion in Carlson (1977:102ff), Roberts (1987:147) notes that

(214) The Marines invaded Grenada.

is true, in one sense, even though not all members of the U.S. Marine Corps went to Grenada.[25] The problem these examples pose for the agenda I have attributed to Scha and Stallard is as follows. Team credit extensions have a non-logical aspect to them. They cannot be analyzed simply by providing a translation for the verb phrase that has an existential quantifier in it, (e.g. Xu: ∃y ∈ u: invaded-Grenada[y]). Thus for example, it cannot be said that Mozart and Einstein won the Nobel Prize even though one of them did, because Einstein and Mozart were not a team in any sense.

The conclusion that many have reached based on the foregoing examples, and with which I concur, is that even predicates applicable to individuals can have a simple collective reading. On this reading, we should not, indeed can not, specify in the grammar how many of the singularities that make up a plurality must satisfy the predicate in order for that plurality to satisfy it. In the system I sketched here, this reading arises when the cover does not partition the plurality in question into more than one part. In this case, the Part and PPart operators don't do any real work. And they shouldn't, for they are not present in the grammar in order to specify quantificational refinements of the collective reading; this we have just said is fruitless.

Some of the examples mentioned above might be useful in demonstrating the distinction I am making here. Recall the sentence *the frigates are faster than the carriers* uttered in a context where the ships are sent out in crews to different areas. If all of the carriers in some high-speed area are faster than all of the frigates in some low-speed area, the sentence isn't false. The construal we are after which employs the PPart operator tells us not to compare ships across areas. On the other hand, exactly how many frigates have to be faster than how many carriers in a given area is left unspecified. There may be exceptional quick carriers. Next we have

[25]Similarly, Gillon (1984) notes that if the soldiers in F-Troop are chasing a band of Indians and the soldier in front sees them we can say the soldiers of F-Troop spotted the Indians. However, if a member of F-Troop sees an Indian while on vacation, we do not say the soldiers of F-Troop spotted the Indians.

the book chart example from (207) in which the PPart operator tells us which particular entries are complementary. It does not tell us how many are complementary. Notice, that if the list was twice as long as it is, we still would not expect complementarity within the fiction or non-fiction column. And again, although the context determines which entities are related to which, there are singularities about which it says nothing. Consider one particular pair of adjacent books, say Oedipus Rex and Agamemnon on the one hand and Freud's Introduction to Psychology on the other. The sentence in (207) asserts that the former two complement the book by Freud. No relation is claimed to hold here between individual books.

It is important to stress that the distinction I am making here is not simply one of 'quantity' versus 'quality'. The important distinction is that between pragmatics and semantics. Consider again the point made in connection with the Granada example, (214). Here the question is how many and perhaps even which individuals in a group have to possess a property in order for us to say that the group possesses the property. The answer here will depend on the makeup of the group as well as the kind of property ascribed. These are semantic facts, or extralinguistic facts, that I, as a speaker, do not control in uttering (214). Compare this to the point made with the chart example (207). Here the question is what exactly is being said, which proposition is expressed. If the speaker has in mind the context illustrated by the chart, he is simply not claiming anything about non-adjacent book pairs. Think of what happens if the chart is rearranged and the context is changed. In this case, the speaker says something different about these very same books. The facts of the world will nor have changed, the speaker is talking about the same books and the same relation of complementarity, yet the proposition expressed will be different.

I would like to end this subsection with an example discussed in the literature. Dowty (1987) expresses the view that it would be appropriate to use (215) to describe a news conference at which only a small number of the reporters present asked questions:

(215) At the end of the press conference, the reporters asked the President questions.

This is so despite the fact that some (or even many) reporters may not have asked questions. Compare this to:

(216) At the end of the press conference, the reporters remained silent.

Here one feels that all of the reporters must have remained silent for the

sentence to be true. In both cases, a group is said to possess a property, but this entails different quantities of individual group members possessing the property in the two cases.[26] Whatever the explanation, it will have to do with facts about groups of reporters and about the properties being ascribed.

Now consider the following variation on (215):

(217) At the end of the press conference, the reporters from NBC, CBS and ABC asked the President questions.

Here again some but not all of the reporters would have to have asked questions for the sentence to be true. However, there is a difference. Even if the reporters mentioned in (215) are also from the major networks, indeed the same exact reporters, (215) doesn't seem to require that every network got a question in. On the other hand, (217) in at least some contexts, implies that questions came from one or more members of each of NBC, CBS, and ABC. Mention of these networks introduces a partition of the reporters in the discourse and, on the pertinent reading, this partition is assigned as the value of the variable that provides the domain of quantification for a distributivity operator.

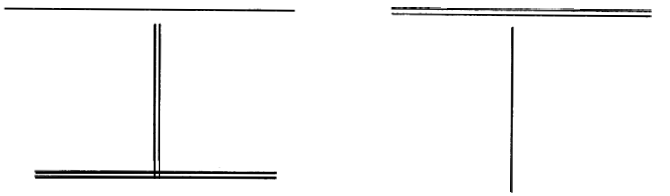
5.7 Plurals in Discourse: The Pragmatics of Distributivity

On the view espoused here, the truth conditions for sentences with plural arguments are often determined in part by the assignment to a free variable over coverings or paired coverings of the domain. We have said that the source of this assignment is pragmatic. Can we say more?

The question of what makes a partitioning of the domain salient in the discourse bears some resemblance to the question of what makes the antecedent for a pronoun salient. In many instances there are linguistic clues, some of which will be discussed below, but arriving at a complete answer surely involves other branches of cognitive science. Such is the case for domain partitioning as well. How we divide up our visual space for example is relevant here and yet that is a question which is properly a matter yet to be settled by experts on vision. Recall above we tried to explain why, in contrast to the diagram Scha used, *the double lines run parallel to the single lines* might be judged false for the diagram in (202):

[26] I have recently learned from Manfred Krifka that differences like these are discussed in Kang (1994).

(202)



A tentative answer was given to this question. A complete explanation of this difference demands an account of why there is no salient paired-cover here like there was in Scha's example. Such an account lies beyond linguistic theory.

So, while non-linguistic sources for partitioning are important to demonstrate that there is a pragmatic element to distributivity, we shouldn't expect to say much within linguistic theory about why a particular partition gets chosen in these cases. On the other hand, just as with pronominal anaphora, there are contexts in which the source of a domain partition or cover is linguistic and presumably these should be covered by some part of linguistic theory. What I therefore want to do now is to discuss aspects of anaphora resolution that appear to shed some light in the area of domain partitioning. Before turning to those parallels, I would like to remark on the status of the discussion to follow. I will be comparing the assignment of a value for a cover variable to the choice of antecedent for a pronoun. Pronominal anaphora is a much-studied case in which the semantics underdetermines meaning leaving conversants to resolve things further. But there are many other instances of this, including for example the choice of comparison class for some adjectives and the choice of domain of quantification for quantifiers. Recent research in this last area, especially as it pertains to adverbs of quantification, has shown how complex and difficult things can get. Although I suspect that these last mentioned cases are more closely related to domain partitioning, I will be focussing here on a comparison with pronominal anaphora resolution because of its relative transparency.

In general, to make the referent of a pronoun salient by linguistic means, one has to mention it explicitly. It is not enough to have mentioned a group containing the individual, as the infelicity of the following example (out of the blue) shows:

(218) The boys think that he will win.

Intuitively, a hearer would have no way of determining which member of the group referred to by the subject of (218) is the intended referent of the

pronoun. Apparently this is enough to disqualify members of that group as choices for the pronoun's reference. This is reasonable enough. Somewhat surprising though, are contrasts like the ones in (219) and (220) from Partee (1989:footnote 13) and Carlson (1984:320) respectively, showing just how strong the effect is:

(219) a. One of the ten balls is missing from the bag. It's under the couch.
b. Nine of the ten balls are in the bag. It's under the couch.

(220) a. I did not catch all of the words. They were spoken too indistinctly.
b. I missed some of the words. They were spoken too indistinctly.

In (219a), as opposed to (219b), the remaining missing ball is not explicitly mentioned and hence is an unlikely candidate for reference by the pronoun it. In (220b), *they* is likely to refer to just the words missed but this is not possible in (220a) where that group of words is not explicitly mentioned.

The same kind of effect, I would claim, is found when one looks at potential choices for the value of a cover variable. An intermediate distributive reading is pretty much unavailable for an utterance in which the particular intermediate covering is not explicitly mentioned (or salient in the non-linguistic discourse). Consider the following:

(221) The children earned seven dollars.

Even though the children could be partitioned into two groups, say one male and one female, it is difficult, if not impossible to interpret (221) as involving distribution to these two groups. If I have that cover in mind, I must explicitly mention it as in:

(222) The boys and the girls earned seven dollars.

I have assumed here that to mention a particular covering is to name the cells comprising it. For the time being I will stick with that assumption, though other possibilities will be considered later on. Comparing (221) and (222), as in the pronoun case, intuitively, there are many intermediate coverings of the children, since the hearer of (221) has no way of knowing which the speaker might have in mind, none is available to serve as the value of the cover variable.

Now, although the mention of a particular entity is necessary to make it salient, we know that this is not always sufficient. The following is a simple example of this aspect of anaphora:

(223) [The boys and the girls] entered the room (separately). They were wearing hats and they were wearing skirts.

The subject of the first sentence contains three noun phrases, referring, on all accounts, to three entities: the boys, the girls and the children. Nevertheless, the plural pronouns that follow cannot be used, in the absence of other contextual clues, to refer to the boys or to the girls. Exactly why this should be the case, I don't know. Comparison of this example with the following example in which the pronoun can refer to the boys:

(224) The boys told the girls that Mary took their hats.

suggests that one way or another, the correct story for (223) will have to take into account the syntactic relationships among the three noun phrases (cf. Smaby (1979) for an attempt at such a theory). Whatever one says about (223), it shows that simply mentioning something doesn't necessarily make it available for anaphoric reference with a pronoun.

So far, we have seen some examples where entities discussed are not likely referents for a following pronoun. Perhaps the more common situation is for a pronoun to have more than one possible antecedent. In this case, a host of factors come in to play in determining which is most likely to be chosen. These factors include appeal to extra linguistic knowledge as well as properties of the text or conversation itself, such as the relative proximity of the antecedent to the anaphor and general notions of textual coherence. In this last category, are cases in which a referent is chosen to reconcile implied or asserted contrast between utterances. This effect is seen in the following pair:

(225) a. Bill is coming for dinner. John is coming too and will bring his book along.
b. Bill thinks Sam will arrive at 8:00, but John thinks he will arrive at 9:00.

In a., one tends to choose John as the referent for the possessive pronoun, for he is last mentioned and is the subject of the predicate containing the pronoun. In b., John is not the most likely referent of the pronoun, but rather Sam is. In b., John's thought is being contrasted with Bill's. The two thoughts are analogous and hence contrastable if one takes the

pronoun to refer to Sam here.

In light of the foregoing observations, we now turn to some parallel considerations affecting the relative availability of various distributive interpretations. First, consider the following pair, based on the examples at the very beginning of our discussion of distributivity, about a group of women athletes and authors:

(226) a. The authors and the athletes outnumbered the politicians.
b. The authors and the athletes entered the room through different doors. We realized at once that they outnumbered the politicians.

(226a) is interpretable as meaning that the authors outnumbered the politicians as did the athletes. The cells of a cover of the women are explicitly mentioned, and this cover is then assigned as the value for the cover variable. This interpretation is not readily available in (226b). Paralleling what we said above, it appears that while mentioning a cover is necessary, it is not sufficient. In b. the noun phrase in which the cover is mentioned is further away from the verb phrase *outnumbered the politicians* than is the noun phrase *they*. Presumably, this works against the assignment of that cover to the variable in the verb phrase.

The following example, based on one from Barry Schein (pc), is a particularly surprising case in which a mentioned cover is nevertheless unlikely to produce the relevant reading:

(227) The vegetables, which are the beets and the carrots, weigh 5 lbs.

Even though the partition into beets and carrots is mentioned, Schein would find the intermediate distributive interpretation impossible. Here, the fact that the covering is mentioned parenthetically and perhaps 'outside' the clause containing the cover variable (cf. McCawley 1982) seems reduce its saliency.[27]

[27] If I understood him correctly, the source of the problem in Schein's view is that explicit mention of a covering is insufficient and what is needed are individuating **events.** Schein's actual example was:

(i) "The integers which are odd numbers and even numbers are (all) equinumerous.

which he claims cannot mean:

Now just as anaphora resolution is amenable to extra linguistic reasoning and textual clues, so too is the choice of cover values. Compare, the example in (227), with the syntactically similar one below:

(228) The visiting players, who were Italians and Brazilians, outnumbered their opponents.

Here too the relevant covering is mentioned parenthetically, however here, the sentence does seem amenable to the intermediate distributive interpretation according to which the Italian players outnumbered their opponents as did the Brazilian players. Knowledge of what players and opponents do enters in in this case: the cells of the cover correspond directly to games played.

Besides extra linguistic factors, textual clues also have a role to play in the interpretation of plural discourse. Above, concerning (226), we observed that even when a particular intermediate covering is mentioned it may remain unavailable as a value for a cover variable if another cover is mentioned in an intervening noun phrase. However, this effect can be overturned in an effort to understand implied or asserted contrast among utterances in the discourse. The following examples are all cases where this seems to happen (here and there I have used capitalization to indicate contrastive stress):

(229) A: The beets, the potatoes and the carrots (all) cost less than the meat.
B: No, the vegetables (all) cost less than the BEEF, but not less than the chicken.

B's reply is readily interpreted with distribution to the kinds of vegetables mentioned in A's comment. This interpretation would be unlikely out of context. Similarly, in the following:

(ii) The odd integers and the even integers are equinumerous

These examples do not involve (simple) distributivity, ((ii) doesn't say that the odd integers are equinumerous and the even integers are equinumerous) hence I used a different example in the text. However, (i-ii) do involve reciprocity and are therefore relevant to the discussion in the next chapter.

(230) The administration thinks that the physics instructors AND the math instructors cover five courses. In fact, THOSE instructors cover only TWO courses. Only the English teachers cover five courses.

In the next example, a contrastive statement receives a paired-covering interpretation which would otherwise, in the absence of contrast, be unlikely:

(231) We expected the male pigs and the male goats to be more numerous than the female pigs and the female goats. In fact, the males were LESS numerous than the females.

On the relevant interpretation of the second statement in (231), the sentence is false, if, for example, there are more male goats than female goats, even if the total number of male animals is less than the total number of female animals. The paired-cover introduced in the first utterance, is carried over into the second. Although these effects may be related to the process of quantifier domain restriction encountered in the interpretation of a noun phrase, they cannot be reduced to that process. The particular interpretation arrived at here could not be achieved by narrowing or widening the set of males considered or the set of females considered.

This completes our comparison of pronominal anaphora and distributivity effects. The purpose here was not to develop an explicit theory of discourse that assigns a saliency ranking to potential pronoun or cover-variable interpretations. Rather, the goal was simply to further demonstrate that distributivity indeed behaves like a pragmatic phenomenon. As such, the presence or absence of a particular distributive interpretation is to some extent dependent on the kinds of things that more familiar cases of pragmatic phenomenon depend on.

5.8 Conclusion: The Union and Sets Theories Reconsidered

In the preceding pages, I have developed an analysis of distributivity within the context of the union theory.. It is now time to return to our main theme, the choice between the sets and the union theories. Recall, distributivity was raised as an issue for us, with the following pair of examples:

(232) The authors and the athletes outnumbered the men.

(233) The women outnumbered the men.

It was observed that even in a situation where the women just are the authors and the athletes, for (232) but not for (233), there is a distributive interpretation according to which the authors as well as the athletes outnumbered the men. This difference is explained on the sets theory by the fact that the subject of (232) but not of (233), denotes, or may denote, a set of two entities. We need only assume that a sentence is true on a distributive reading of the subject, just in case the verb phrase truthfully applies to each of the entities making up the referent of the subject and this assumption is needed anyway for simpler cases of distributivity. Since on the union theory the subjects in the pair above are coreferent in the situation described, the union theory appeared initially to be counterexemplified. This of course depended on a purely semantic analysis for distributivity, something that we now claim is incorrect. There is a pragmatic explanation available to the union theorist for the difference in the pair above. According to this explanation, as we have recently said, the relevant distributive interpretation requires the assignment to a variable in the VP of a cover that is salient in (232) but not in (233).

At this point, a proponent of the sets theory might argue as follows. Leaving aside the question of whether there is some pragmatic element to distributivity, at least in cases like (232-233), the sets theory is more desirable, since it makes very clear predictions, commensurate with the clarity of the data. The union theorist has to some extent avoided responsibility for the data here, by passing the problem off to some other part of the grammar or out of the grammar altogether.

To begin with the argumentation itself is a bit shaky. Sure, if we leave aside the evidence for a pragmatic analysis, then the union theorist appears to be avoiding responsibility. However, if we take that evidence into consideration, then the proponent of the sets theory needs to explain why the explanation here is semantic. But even if we grant the sets theorist a limited view of the data, things are not as smooth as might be suspected for that analysis. Trouble arises upon reconsideration of some of the examples provided in the last section, this time in terms of the sets theory. Recall, the modified version of (232-233), discussed above:

(226) a. The authors and the athletes outnumbered the politicians.
b. The authors and the athletes entered the room through different doors. We realized at once that they outnumbered the politicians.

(226a) and the last clause in (226b) differ in just the way (232) and (233) do.[28] But notice, first, that the most natural interpretation of the first clause of (226b) is one where the authors came in through a different door than the one used by the athletes. On the sets theory, that interpretation arises because the subject denotes a set of two sets, one of athletes, the other of authors. Since the pronoun *they* in the second clause is anaphoric to the subject of the first clause, it will also denote this set of sets. But this is exactly the denotation that gives rise to the intermediate distributive reading in (233), yet the intermediate reading is missing here. In other words, like with (232-233), (226a) and the last clause of (226b) differ in interpretation, but unlike with (232-233) their subjects are coreferent. The only possible way out here is to assume that the pronoun cannot refer to a set of sets, but just to a set of individuals, in effect, making the pronoun here coreferent with subject of (233), *the women.* Besides being ad hoc, this cap on the space of pronoun denotations won't work, as the following shows:

(234) The authors and the athletes arrived simultaneously but they left at different times.

According to the sets theory, the pronoun in this case would again have to denote a set of sets.

The examples in (226) show that the sets approach presents little advantage over the union approach for explaining examples where the intermediate distributive reading is lacking. No less troublesome are cases discussed earlier where these readings are available, even though the relevant noun phrases lacked any conjunction. The chart example, repeated here:

(207) The fiction books in the chart complement the non-fiction books.

involved an interpretation where there was distribution over parts of the fiction books and parts of the non-fiction books. Aside from the technical

[28] I rely here on the judgment of a reviewer of.the manuscript for this book, who cited an example like this one as a problem for the pragmatic analysis of distributivity. The claim there was that intermediate readings do not arise if the most recently mentioned NP does not describe the intermediate partition. Note, if the cases differ and the intermediate reading is in fact available in (226b), then the discussion of this example in the previous section would require revision as well, and the reviewers initial point would not go through.

problem of extending the sets approach to the two-place case, if this interpretation was to be achieved purely in the semantics, then the noun phrases here would have to denote higher than first order sets, but nothing in the syntax justifies this. A similar point holds for (230), from our discussion of contrast in the previous section:

(230) The administration thinks that the physics instructors AND the math instructors cover five courses. In fact, THOSE instructors cover only TWO courses. Only the English teachers cover five courses.

(230) is interpretable as entailing that the physics instructors cover two courses as do their colleagues in math. A sets analysis for this would require the semantics to assign to the simple noun phrase *those instructors* a set containing two sets, one with the math instructors and one with the physics instructors. Such a semantics would undermine the claims made for the differences between (232) and (233), for it would allow *the women* to corefer with *the athletes and the authors.*

Initially, distributivity was presented as a semantic phenomenon with respect to which the sets approach appeared to have an advantage. What we have lately seen is that a semantic account within the sets approach fairs poorly overall. On the other hand, a case has been made for viewing distributivity as a pragmatic or semantico-pragmatic phenomenon. In particular, the work that is done by the richer ontology of the sets approach in fact should not be handled semantically at all. This leaves us with the simpler union approach, and a pragmatic theory of distributivity, which, along with other pragmatic phenomena, requires further analysis both in and outside of linguistics.