4 Coordination and Scope

We have seen in the previous chapter that the interaction between the directional and nondirectional slashes in Hybrid TLCG is the key for the simple analysis of Gapping that captures the core properties of this construction, including the apparently anomalous scoping patterns of modal auxiliaries as they interact with Gapping. The advantage of the flexible yet systematic architecture of our framework is not limited to this particular type of noncanonical coordination construction. In fact, Hybrid TLCG allows for a systematic analysis of complex interactions between coordination (including both ordinary constituent coordination and the so-called nonconstituent coordination phenomena) and various types of scopal operators that have posed considerable difficulties for previous approaches to coordination in generative syntax (including both transformational and nontransformational approaches). The present chapter and the next chapter offer a detailed analysis of interactions between coordination and scopal operators, comparing the analysis in Hybrid TLCG with competing and/or related approaches in the current literature. We argue that the flexible syntax-semantics interface of Hybrid TLCG offers a general framework for formulating a simple analysis of apparently quite complex empirical patterns that the data in this domain exhibit.

4.1 The Coordination Problem in Modern Grammatical Theory

Coordination phenomena were one of the first syntactic patterns invoked to showcase the superiority of the generative transformational framework (see Chomsky 1957) but have emerged as one of the most problematic empirical domains in syntax, particularly in the interface with semantic interpretation. In the same year in which the grammar of coordination appeared to have finally received definitive treatment in Dougherty (1970) and Dougherty (1971) in the transformationalist paradigm, a short paper by Barbara Hall Partee (1970) appeared which made clear how problematic the relationship was between syntactic form and semantic interpretation involving coordination, scopal operators, and negation. Partee displayed data such as (90) to demonstrate that the

standard approach to deriving the conjunction of non-clausal constituents by eliminating their apparently shared material via *Conjunction Reduction* was deeply misguided:

(90) a. Few rules are explicit and easy to read.
b. Few rules are explicit and few rules are easy to read.

(90a) can be true even when (90b) is false, so that deriving the first from the structure giving rise to the second would, as Partee convincingly demonstrates, require distinctly ad hoc restrictions on the operations of the Conjunction Reduction transformation. Partee concluded her study with the observation that "[t]hose aspects of semantic interpretation which have been under consideration here appear to be explainable quite naturally on the basis of surface structure." In fact, however, data such as (90) proved to be only the easiest case of the problems posed by the interaction of scopal expressions under coordination.

In particular, in all of Partee's examples, the "surface" approach she argues for would simply combine a subject with a conjunction of VPs, with a transparent syntax-semantics mapping—an analysis which would combine two VP constituents into one, with the quantifier subject applying as an operator, with simple Montagovian semantics, to the intersection of properties corresponding to the conjunction. But consider what would be entailed by an analogous "surface" treatment in (91):

(91) John told a joke to Bill on Monday and Mary on Thursday.

A "surface" approach would be even less successful than an analysis based on Conjunction Reduction, since the operator denoted by *a joke* would have to scope over two nonconstituents—*Bill on Monday* and *Mary on Thursday*—which, under standard phrase structure assumptions, do not denote properties at all or indeed have any coherent semantic interpretations of their own. Thus, the fundamental question was not really that of "underlying structure" vs. "surface" interpretation, but rather the possibility of a syntax-semantics relationship based on the composition of material possibly lacking constituent status under phrase structure–based criteria.

Generalized Phrase Structure Grammar (GPSG) is an apt case in point. One of the earliest talking points in GPSG's rhetorical arsenal was the simplicity the framework made possible for analyses of coordination phenomena; indeed, coordination was in a sense the showpiece analysis in Gazdar's (1981) watershed paper, which, almost on its own, established the framework as a major competitor to the dominant tranformationalist consensus. The stipulativeness inherent in transformational rules such as Conjunction Reduction—purpose-built for syntactic conjunction and hence, in effect, simply an encoding of a specific construction—could be completely eliminated in favor of a few simple templates allowing various kinds of coordinations of like categories—and unlike categories as well—via GPSG's use of category underspecification. But things

were quite different when the theorists working in GPSG attempted to confront data of the sort given in (92).

(92) a. John offered Mary, and Sue promised Bill, a lift home from the conference.
b. John gave Mary a book and Bill a CD.
c. John ate a pizza, and Mary, some tacos.

Each of these examples appears to display a coordination involving at least one nonconstituent. (92a) conjoins two partial clauses, each of which is missing a final NP required by its valence specifications, whereas (92b) seems to have coordinated two sequences of NPs, where each NP sequence is combinable with the partial clause *John gave*. Strangest of all is (92c), an apparent coordination of a full sentence on the left with an NP sequence on the right. Nor are these the most extreme examples of such noncanonical coordinations, as (93) makes clear.

(93) a. John offered, and Mary presented, a book to Sue and a CD to Bill.
b. John offered a book to Sue on Thursday and a CD to Bill on Saturday.

In (93a), illustrating *Right-Node Raising* (RNR), neither the partial clauses *John offered*, *Mary presented* nor the NP PP sequences *a book to Sue*, *a CD to Bill* have phrasal status within the theory. Similarly, in the Dependent Cluster Coordination (DCC) in (93b), *a book to Sue on Thursday* and *a CD to Bill on Saturday* do not count as constituents.

Moreover, these phenomena interact with one another in a fairly systematic manner:

(94) a. John offered a book, and Mary a CD, to Bill. (Gapping + RNR)
b. John offered a book to Sue on Thursday and a CD to Bill on Saturday, and Mary, a chess set to Ann on Wednesday and a decanter to Steve yesterday. (Gapping + DCC)
c. John told Mary that Bill wanted, and Sue that Ann had bought, a red Lambourghini Centenario. (DCC + RNR)

The theory of coordination given in Gazdar et al. (1985) does not come close to licensing any of these noncanonical coordinations, let alone provide an explicit compositional semantics for them. A more detailed treatment of coordination in GPSG appear in Sag et al. (1985), but the sketch of an account of Gapping in that work involved a completely ad hoc (and, compared to the rest of the framework, altogether inexplicit) mechanism that essentially jettisoned the otherwise strictly local nature of GPSG's syntax-semantics interface, as discussed in section 3.1.

As we argue below, at the heart of phrase structure–based frameworks' problems with noncanonical coordination—whether transformational or monostratal—is the unavailability of a simple treatment of seemingly partial and/or discontinuous constituents, allowing them full constituent status with a unitary semantic interpretation. But before

we draw any theoretical conclusions, the empirical landscape needs to be clarified. For this purpose, we first make a systematic survey of the interactions between coordination and quantifier scope in section 4.2. We focus on (generalized) quantifiers in this chapter for the following two reasons. First, quantifiers are the most basic type of scope-taking expressions and for this reason illustrate the scopal interactions that coordination exhibits with other scopal expressions in the simplest form possible. Our discussion of the more complex types of scope-taking expressions in chapter 5 will be based on the analysis of the quantifier scope case in the present chapter. Second, the specific issue of how to account for coordination/scope interaction has been a central issue in the debate on the adequacy of a certain line of analysis developed in the HPSG literature we review in section 4.3.2 (see, e.g., Yatabe 2001; Beavers and Sag 2004; Chaves 2007; Levine 2011; Yatabe 2012; Yatabe 2013; Kubota and Levine 2015; Yatabe and Tam 2019). Moreover, the relevant issue has implications for other variants of phrase structure–based approaches (in the broader sense encompassing movement-based approaches as well), as should become clear in our critique of previous approaches in section 4.3. For this reason too, reviewing the empirical facts and their theoretical consequences in some detail is important. The empirical survey is followed by a critique of representative analyses of NCC in three major contemporary syntactic theories—the Minimalist framework, HPSG, and LFG in section 4.3. We then formulate our analyses of NCC in Hybrid TLCG in section 4.4 and compare it with these previous alternatives.

4.2 Coordination Scope Generalization

Though the implications of quantifier scope data for the analysis of coordination has often been noted in the literature (cf., e.g., the seminal work by Partee 1970, discussed above, Crysmann 2003, Beavers and Sag 2004, and Steedman 2012), a clear characterization of the empirical generalizations in this domain has remained rather elusive. Our first objective in this section is laying out what we take to be the full range of data bearing on this question and identifying the key descriptive generalization which emerges. Though our ultimate goal is to consider the theoretical implications of the relevant data, the empirical study itself should be of general interest, especially given the lack of a systematic investigation in this domain in the literature. We manipulate three parameters that potentially affect the available interpretations: downward entailing (DE) vs. non-DE quantifiers,[1] conjunction vs. disjunction, and constituent coordination vs. DCC vs. RNR. In sentences in which quantifiers appear outside of coordinate structure, there are in principle two scopal relations between the quantifier and the coordinate struc-

1. Here only the right argument of the quantificational determiner is relevant, since we are interested in the properties of quantificational NPs as a whole. Readers who are confused with our terminology should replace our *downward entailing* with *right downward entailing/monotone decreasing*.

ture: the quantifier either scopes over the whole coordinate structure (we call this the *non-distributive reading*) or its meaning is distributed to each conjunct (*distributive reading*).

As we show below, the generalization that emerges is simple and straightforward:

(95) Both the distributive and non-distributive readings are in principle available for both DE and non-DE quantifiers, regardless of the type of conjunction word (disjunction/conjunction) and regardless of the type of coordination (constituent coordination/DCC/RNR).

This generalization turns out to be crucial in the comparison of ellipsis-based and direct coordination analyses of NCC below.

There are, however, several (sometimes quite subtle) pragmatic factors that seem to affect the available interpretations in specific examples (in particular, the distributive reading turns out to be much harder to obtain than the non-distributive reading in many cases). We discuss these factors in what follows in an attempt to further clarify the interactions of grammatical and nongrammatical factors involved in inducing the patterns that are apparently found in the data. Readers who are comfortable in accepting the main generalization in (95) can skip this section by quickly glancing over the examples below (especially the ones illustrating the more difficult, distributive reading—(99), (101), and (103)) and checking whether the relevant readings are indeed available.

We start with non-DE quantifiers. The examples in (96) involve conjunction (with the (96a) examples instantiating constituent coordination and the (96b) examples NCC).

(96) a. { Some minstrel / Every minstrel / Six minstrels / Most minstrels } sang and danced. (non-DE, CC, $\wedge$)

b. I gave { a minstrel / every minstrel / six minstrels / most minstrels } presents on Thursday and food and wine on Saturday. (non-DE, DCC, $\wedge$)

c. Mary has already subscribed, and John plans to subscribe, to { a journal / two journals } of classical archaeology. (non-DE, RNR, $\wedge$)

Parallel examples with disjunction can be readily constructed (by just replacing *and* with *or* in (96)), but with such examples, it is hard, or sometimes even impossible, to discern the relevant ambiguity, due to the logical equivalence or entailment relations that hold between the two readings ($\exists x P(x) \vee \exists y Q(y) \equiv \exists x[P(x) \vee Q(x)], \forall x P(x) \vee \forall y Q(y) \models \forall x[P(x) \vee Q(x)]$, and so on). Thus, we focus on conjunction here and assume that the same result carries over to disjunction. With conjunction, the two readings are

clearly distinct. For example, the distributive reading for (96a) with *some* should be compatible with a situation in which different minstrels sang and danced, and with *six minstrels*, it should entail a total of maximally twelve (rather than six) minstrels to be involved. In examples like those above, the distributive reading might seem to be harder to obtain, but this is most likely a pragmatic blocking effect (that is, saying explicitly *Some minstrels sang and some minstrels danced* disambiguates the relevant reading). In fact, this pragmatic effect can be overridden quite readily with a judicious choice of lexical content:

(97) a. $\left\{\begin{array}{c}\text{A mob boss was}\\ \text{Three mob bosses were}\end{array}\right\}$ assassinated in Boston earlier last month and executed for murder in New York this weekend.

b. I gave $\left\{\begin{array}{c}\text{an exam}\\ \text{three assignments}\end{array}\right\}$ to my advanced calculus seminar on Monday and my basket-weaving class on Thursday.

We thus take it that non-DE quantifiers induce scope ambiguity in coordination in general.

Turning to DE quantifiers such as *no*, *few*, and *hardly any*, we see an (apparently) quite different pattern. Ordinary constituent coordination with a DE quantifier in the subject position appears to strongly resist the distributive reading:

(98) a. $\left\{\begin{array}{c}\text{No man}\\ \text{Few men}\\ \text{Hardly any man}\end{array}\right\}$ sang and danced. (DE, CC, $\wedge$)

b. $\left\{\begin{array}{c}\text{No man}\\ \text{Few men}\\ \text{Hardly any man}\end{array}\right\}$ sang or danced. (DE, CC, $\vee$)

However, there is reason to believe that the unavailability of the distributive reading here is not syntactic, for either conjunction or disjunction. We consider the disjunction case first, since the overall pattern is somewhat simpler with disjunction than with conjunction. Consider first the following example:

(99) Your family won't have any trouble getting past the border, as long as no one (either) is caught with a gun or has left their gun license at home. (DE, CC, $\vee$)

Suppose (99) is uttered by a lawyer advising a family who are crossing the border into a country in which gun ownership is legal, but where guns are regarded as a family possession/responsibility. In this context, the native speakers whom we have consulted agree that (99) is unexceptional in the distributive reading, which essentially says that as long as either of the two conditions (no one getting caught; no one leaving their license at home) is satisfied, one is free to cross the border; in other words, if no one is

caught with a gun, it doesn't matter if anyone has forgotten their gun license, and if no one has forgotten their license, it doesn't matter if anyone gets caught with a gun.[2]

Parallel patterns hold for DCC. Cases such as (100) are parallel to (98b) in seemingly resisting the distributive reading robustly:

(100) Terry gave { no man / few men / hardly any men } a book on Friday or a record on Saturday.

(DE, DCC, ∨)

But again, just a bit of pragmatic manipulation changes the situation dramatically. Suppose the speaker is planning to travel to Berlin, and the success of the trip is contingent on train transport being available *both* at Düsseldorf and Cologne. Then the following sentence easily allows for the distributive reading:[3]

(101) Deutche Bahn is routing no trains to (either) Düsseldorf on Thursday or to Cologne on Friday, but in either case, we won't be able to get to Berlin this week.

(DE, DCC, ∨)

The relevant reading (accepted by our informants) is one in which there are two possible states of affairs which have the consequence that our speaker's travel to Berlin will not be possible, and (at least) one of them holds, but the speaker doesn't know, or remember, which of the two it is. Thus, with careful preparation of the pragmatic context, the distributive reading of DE quantifiers is in fact available. The overwhelming preference for the non-distributive reading in "out of the blue" contexts, then, is presumably a consequence of some (in principle) overridable default interpretation strategy along the lines of the "strongest meaning principle" (Dalrymple et al. 1998).[4]

2. The distributive reading in addition involves a distinctive prosody, with a marked stress on *caught* and high intonation from that word to the end of the intonation phrase, followed by a slight but distinct pause, ending with moderately emphatic stress on *home*. This sort of specialized intonation is in itself hardly surprising; a distinct prosody is also typically required to enforce distributive readings arising from negated modals in Gapping sentences (see, e.g., Oehrle 1987; Kubota and Levine 2013a). The crucial factor that facilitates the distributive reading in this example seems to be the possibility of construing the conjuncts as instantiating what Kehler (2002) refers to as a *Resemblance* relation. When this relation holds between two clauses, the respective propositions they express are manifestations of some common and more general relation that is relevant in the larger discourse. In (99), what is common to the two conjuncts (under the distributive reading) is that they both alone count as sufficient conditions for passing the border without trouble, which is precisely the issue under discussion in the larger context.

3. Here, the two clauses have a parallel status to the larger discourse (instantiating a Resemblance relation) in that both count equally as a factor that results (*in either case*) in the eventual failure of the trip.

4. It may be that for some speakers, this default interpretive strategy is grammaticized to such an extent that the distributive reading is completely blocked.

RNR exhibits an opposite pattern. Examples such as the following seem to allow for only the distributive reading:[5]

(102) John said to Mary or Bill said to Ann nothing about the final report.
(DE, RNR, $\vee$)

Conjunction with DE quantifiers presents an apparently somewhat more complex pattern, since constituent coordination and NCC don't initially seem to behave in a completely parallel fashion. Let us examine constituent coordination first. Examples such as (98a) seem to rule out a distributive reading for negation. However, as noted by Szabolcsi and Haddican (2004), conjunction under negation in fact allows for the distributive reading much more readily than one might initially be led to believe (note, for example, their examples involving "stereotypical conjunction," such as *Mary didn't take math and physics* (cf. #*Mary didn't take math and hockey*)). The following example illustrates this point:[6]

(103) Nobody wants to help spammers and be taken advantage of by hackers, but the reality is, if you don't install the appropriate security software, you are vulnerable to both types of danger. (DE, CC, $\wedge$)

Thus, the constituent coordination case for conjunction is very much like disjunction under negation in that contextual manipulation makes available an apparently unavailable distributive reading.

With RNR, the more readily available reading is similarly the quantifier wide-scope reading:

(104) John will bet five C-notes and Mary will bet double the kitty, on NONE of the poker hands this evening, I predict. (DE, RNR, $\wedge$)

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5. We are currently not sure why the quantifier wide-scope reading is unavailable in (102). It may have something to do with the fact that the right-peripheral position does not license most negative polarity items:

(i) a. I said nothing about the final report to anyone.
b. I said to Terry NOTHING about the final report.
c. *I said to anyone NOTHING about the final report.

6. Here again, what crucially supports the distributive reading seems to be the discourse relation. As Szabolcsi and Haddican (2004) note, one factor that facilitates the distributive reading for conjunction under negation is a "violation of expectation"–type discourse relation, supported by a parallel expectation for contrasted entities, which then ends up being denied by the negation of the two conjuncts (cf. their minimal pair in (43) and (44) [Szabolcsi and Haddican 2004, 235]). In (103), this common contextual expectation is to keep one's computer secure from external attack, and the sentence makes an assertion about two types of threat that have an equal status in counting as potential violations of this expectation. This parallel violation of expectation again establishes a Resemblance relation between the two conjuncts, supporting the distributive reading.

But the distributive reading seems available too, especially with comma intonation following *C-notes* and heavy emphatic stress on *none*.

We see a seemingly different (and initially somewhat surprising) pattern in the DCC case. In DCC examples like (105), it seems that the more easily available interpretation is actually the distributive reading:

(105) I intend to say nothing to Robin on Thursday and to Leslie on Friday.
(DE, DCC, $\wedge$)

But in fact, the non-distributive reading is available too, if two nonstructural conditions are satisfied, as in the following example (106): on the prosodic side, a marked stress on both *no* and *and*, and on the semantic/pragmatic side, a referentially more specific nominal head, in contrast to the minimally informative *nothing* of (105).[7]

(106) I told NO joke to Robin on Thursday AND to Leslie on Friday. (DE, DCC, $\wedge$)

The intended reading here is that there is no one joke such that the speaker told it to Robin on Thursday and also to Leslie on Friday. As Szabolcsi and Haddican (2004, 226) note, a stress on *and* is actually required for the non-distributive reading in NP coordination cases as well:

(107) Mary didn't take hockey AND algebra.

Thus, the initial difficulty of obtaining the non-distributive reading for NCC like (105) is most likely due to the semantic/prosodic factors noted above (note that stressing *and* is not among the most natural prosodies for NCC sentences, unlike in NP coordination like (107)).

To summarize the findings in this section, both the distributive and non-distributive readings are in principle available for both DE and non-DE quantifiers, regardless of the type of the conjunction word (disjunction vs. conjunction) and regardless of the type of coordination (constituent coordination vs. DCC vs. RNR).

4.3 Current Approaches to Coordination and Scope in Major Syntactic Frameworks

In this section, we review representative analyses of NCC in three major contemporary syntactic theories—the Minimalist framework, HPSG, and LFG. We note at the outset that the purpose of the present subsection is *not* to give a comprehensive review of the literature on NCC in various grammatical theories. In particular, we will not attempt to

7. Pragmatic factors are likely to play a role here too. Not telling a single joke to two different people has a kind of real-world plausibility (for example, the two people in question might have completely incompatible senses of humor, so that at least one of them will probably hate the joke, regardless of what it is). But a general determination that, regardless of what one might say, one is not going to say it to *both* Robin and Leslie on different respective days seems quite odd and far more difficult to find a natural context for.

do justice to the literature on RNR, which is quite extensive (see Sabbagh [2014] and Chaves [2014] for some recent reviews). The common view across different theoretical frameworks seems to be that RNR is a label for a set of distinct grammatical phenomena (e.g., a surface-oriented ellipsis phenomenon and an extraposition-like phenomenon) which sometimes happen to yield the same surface string. The purpose of the present section is rather to highlight the similarities and differences between different analytic ideas entertained in phrase structure–based theories of syntax (in the broader sense) and thereby clarify the fundamental nature of the problem that the empirical patterns of coordination pose for such theories.

4.3.1 Transformational Approaches

While there are several approaches to RNR (e.g., the movement-based approach by Sabbagh [2007], the multidominance approach by Bachrach and Katzir [2008], and hybrid approaches like the ones proposed by Barros and Vicente [2011] and Belk and Neeleman [2018]; see Sabbagh [2014] for a recent overview), there is considerably less work on DCC in the transformational literature. Since the purpose of the present chapter is not to offer a comprehensive review of all kinds of previous approaches to NCC in major grammatical frameworks (which would be a worthwhile project on its own), we focus on the treatment of DCC in movement-based approaches in this section, which we believe highlights most clearly the kinds of challenges that the currently dominant transformational architecture of grammar faces in view of the empirical facts found in the domain of coordination.

The only concrete proposal for an analysis of DCC in the transformational literature we are aware of is that by Sailor and Thoms (2014). Their proposal is a version of the familiar movement + deletion type analysis for constructions involving apparent nonconstituents in the transformational literature. That is, an apparent nonconstituent is analyzed as a syntactic constituent by a series of movement operations of subconstituents out of some larger structure followed by the deletion of the entire extraction site, resulting in a surface structure consisting solely of the movement remnants.

This type of analysis is typically justified by the claim that the assumed movement operations obey the same syntactic constraints independently known to govern standard movement operations—most notably, island constraints (see chapters 6 and 8 for an extended critique of this type of approach in the domain of ellipsis phenomena). Indeed, Sailor and Thoms attempt to justify their proposal exactly along these lines, but the empirical argument they offer seems quite frail, as we discuss immediately.

The actual argument takes the following form. Sailor and Thoms start by noting the condition blocking fronting of clauses when a complementizer is left behind, as illustrated in (108):

(108) *He knows Icelandic, I'm $\left\{ \begin{array}{c} \text{sure that} \\ \text{not sure whether} \end{array} \right\}$.

They then offer (109) as evidence that movement must be involved in ellipsis, in particular DCC:

(109) The witness will testify to [whether John knew Icelandic] tomorrow and [*(whether) he knew Faroese] next week.

Since (108) shows that fronting of postcomplentizer clauses is prohibited, a movement-based account predicts that movement of such clauses out of the VP prior to deletion of the latter should be forbidden, as is indeed the case. Sailor and Thoms conclude from this observation that such data confirm the dependence of NCC on movement.

This line of argument, while widespread in the transformational literature, is in fact quite weak, or even worse: to the extent that a constraint against movement of a certain kind of syntactic material obliges a movement-based theory of NCC to predict that such material is barred from NCC constructions, the argument actually provides a powerful piece of evidence *against* a movement account of DCC.

To see this point, note that there are abundant cases of discrepancies of extractability and DCC licensing such as the following (note that emphatic contrast prosody does not materially improve (111b)):

(110) a. *What did you discuss John's __?
b. I discussed John's BIRTHDAY with SUE and ANNIVERSARY with MARY.

(111) a. Which country is John the King of __?
b. ??*I taught the King of NORWAY how to DANCE and SWEDEN how to SING.

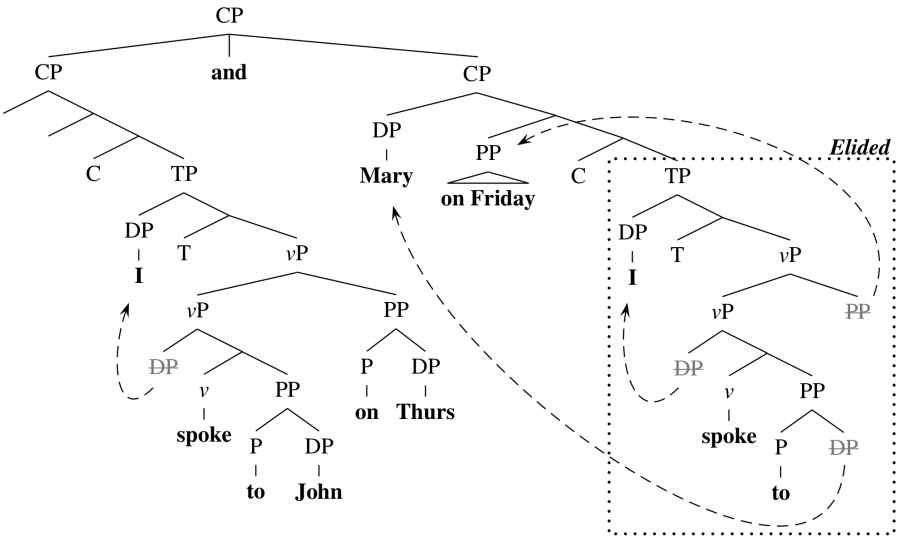
(110) shows that stranding the possessive phrase inside an NP is prohibited for extraction while DCC formation is free from this constraint. (111) is an instance of the opposite pattern, where a movement operation acceptable for leftward extraction (out of the complement of the genitive *of*) produces an unacceptable string in the case of DCC. Since there is no obvious independent explanation for the ill-formedness of either (110a) or (111b), the above data contraindicate Sailor and Thoms's approach, which predicts that, other things being equal, the judgment patterns in extraction and DCC should strictly correlate with each other.[8]

8. A second line of argument for covert structure in NCC offered by Sailor and Thoms is based on the somewhat controversial claim that languages which block preposition (P-) stranding also block NCC. They offer Russian data to back up this claim and refer the reader to Frazier et al. (2012), in which the generalization is supposedly supported by a larger set of languages. The Frazier et al. paper actually does not offer any extensive cross-linguistic data, but merely lists the names of ten or so languages that are claimed to follow the generalization, including Japanese. Given the lack of actual empirical data, it is hard to accurately assess the validity of the generalization here. In particular, the fact that Japanese is included in the set of languages that exhibits P-stranding in NCC is puzzling, since it is well-known in the literature (see,

The noncorrelation between leftward extraction and DCC considerably weakens the movement-based analysis by Sailor and Thoms (2014), but the actual content of their analysis has other serious problems which the authors themselves do not address in any depth. Sailor and Thoms's approach is predicated on the assumption that "NCC always involves clausal ellipsis" (2014, 365) and is summarized in their depiction of the essential operations involved in deriving the sentence in (112), given in (113):

(112) I spoke to John on Thursday and Mary on Friday.

(113)



As shown in (113), Sailor and Thoms's approach involves a series of leftward movements and a deletion operation for which no independent motivation is given at any point. Movement of the *v*P specifier to the [Spec,TP] position has long been assumed as part of the derivation of basic English clause structure, but the topicalization operations that this scenario requires are certainly suspect—particularly in view of the fact that in the absence of ellipsis, the resulting structures are markedly ill-formed:

(114) *I spoke to John on Thursday and Mary$_1$ [on Friday]$_2$ [$_{TP}$ I spoke to t_1 t_2].

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for example, Yatabe 2012) that the empirical pattern is the opposite of what Frazier et al. claim to be the case, if they have in mind the kinds of postposition-omission examples in Japanese such as the following (note that the first conjunct in (i) is unlikely to allow for the kind of silent copula analysis that Mukai [2003] suggests for caseless NCC examples):

(i) John-ga Tookyoo, matawa Bill-ga Kyooto-kara kuru-hazu-da.
John-NOM Tokyo or Bill-NOM Kyoto-from come-must-COP
'It must be that either John comes from Tokyo or Bill comes from Kyoto.'

More complex cases are still worse in the absence of ellipsis:

(115) *I spoke to John on Thursday about Bill at the office and Mary on Saturday about Sue in the park (*I spoke).

Whatever the source of the ill-formedness in such examples might be, it seems reasonable from a transformational point of view to regard them as arising from forbidden movement operations. In the absence of a well-motivated basis for predicting that the effects of this illicit movement will become acceptable through ellipsis—a line of argument that Thoms himself (Barros et al. 2014) has argued against—we have reason to be skeptical of any account which depends on such movement. The Sailor-Thoms analysis says nothing about this rather crucial issue.

Furthermore, there is a specific problem arising from Sailor and Thoms's account of the scopal interactions between quantifiers and DCC, exemplified by sentences such as (116). Sailor and Thoms take the wide-scope interpretation for the quantifier to reflect the position of the subject quantifier outside the *v*P conjunction via A-movement to TP:

(116) Few people went to the play on Thursday and the concert on Friday.

But what happens in a case such as (117), with the indicated compositional structure and wide-scoping indefinite, with a source (117a) giving rise to the ellipsed form (117b):

(117) a. I [[bet John a certain amount of money on the ballgame] on Saturday] and [[bet John a certain amount of money on the horse race] on Wednesday].
b. I [[bet John a certain amount of money on the ballgame] on Saturday] and [[on the horse race] on Wednesday].

Here, it is not the subject, on the left edge of the TP, which has to scope wide but a secondary argument of the verb, buried in a Larsonian shell in both the left and right conjuncts in the source, which has to scope over the conjunction, but with no plausible landing site for this object. How then is this wide scoping over conjunction achieved? Following Sailor and Thoms's analysis of the subject-quantifier example (116), we seem to be led to the assumption that, just as in the case of (116), the direct object NP *a certain amount of money* somehow moves out of the *v*P to a position sufficiently high to scope over the entire conjunction. But this gives rise to a host of questions whose answers are not at all clear (note in this connection that very similar questions arise in connection with the transformational analyses of Gapping we have examined in the preceding chapter): What is the landing site for such a movement, why is there no evidence for this movement in the linear ordering of elements in the left conjunct

(which all appear to be exactly in situ in the positions they were Merged into), and why is the direct object moving in the first place?[9]

It should be clear from the above discussion that DCC poses a rather difficult empirical challenge to the standard transformational architecture of grammar. Sailor and Thoms's work—the only concrete proposal for DCC in the current literature—has several nontrivial issues in the basic analytic perspective, which, so far as we are aware, have never been addressed in the subsequent literature. We therefore conclude that DCC constitutes an empirical domain in which no satisfactory analysis currently exists in the mainstream transformational literature.

4.3.2 Linearization-Based Ellipsis in HPSG

4.3.2.1 Linearization-based ellipsis: An overview Within phrase structure–based theories, by far the most formally well-developed approach to NCC is what we will call the *Linearization-Based Ellipsis* (LBE) approach to coordination, discussed and developed in Yatabe (2001), Crysmann (2003), Beavers and Sag (2004), Chaves (2007), and Yatabe and Tam (2019). The central claim of this approach is that apparently nonstandard coordinations such as those reviewed in section 4.1 all reduce to constituent coordination under prosodic ellipsis.[10] The analysis is technically implemented in a variant of HPSG that relaxes the mapping between the combinatoric structure and the surface string known as Linearization-Based HPSG (Reape 1996; Kathol 1995).[11]

The gist of the Linearization-Based framework involves associating a single combinatoric structure feeding into semantic interpretation with multiple possibilities of

9. Similar difficulties for Sailor and Thoms's proposal arise in connection with other scopal operators such as symmetrical predicates (see chapter 5 for an extensive discussion of the relevant data and the theoretical issues that such data raise):

(i) John introduced the same girl to Chris on Thursday and to Peter on Friday.

Assuming (as seems relatively uncontroversial in the transformational literature; cf., e.g., Sabbagh 2007) that the internal reading of *same* requires the NP containing *same* to outscope the conjunction at LF, essentially the same issue of the status of movement for the object NP *the same girl* arises in (i) as in the quantifier example (117b).

10. Maxwell and Manning (1996), Mouret (2006), and Abeillé et al. (2014) pursue a different type of approach where noncanonical coordinated strings are taken to reflect actual constituents directly licensed by the grammar. These approaches fail to provide satisfactory semantic analyses, as acknowledged in Mouret (2006). See section 4.3.3 for a critique of Maxwell and Manning (1996).

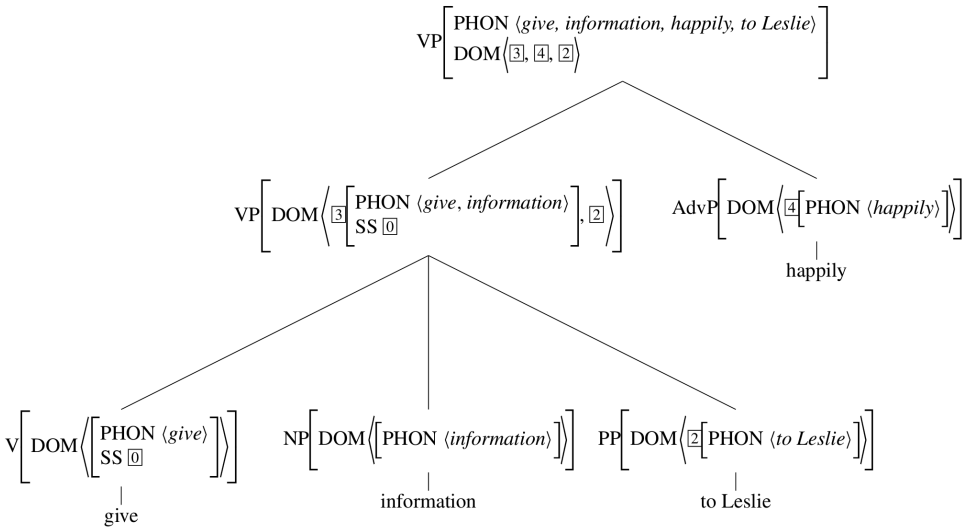
11. The general architecture of Linearization-Based HPSG has precedent in the "pheno/tectogrammar" distinction advocated in Curry (1961) and pursued in the context of CG in Dowty (1996b). The core of this proposal is a dramatic separation of prosodic representations, including word order, from syntactic combinatorics, so that, for example, words that are dependents of different subcategorizing heads may nonetheless be adjacent to each other in the surface string, while words that are dependents of the same head may be separated from each other by elements subcategorized by a different head. This broad idea has been adopted in the literatures of both HPSG and CG. See Mihalicek (2012) and Kubota (2010, 2014) for an application of this technique in the latter.

surface phonological realization. English exhibits flexibility of word order that this approach is designed to handle to a much more limited degree than languages like German and Japanese, but even in English, it considerably simplifies the analysis of phenomena such as adverb placement, where an adverb can appear in any of the four positions indicated in (118):

(118) Robin (*happily*) will (*happily*) give information (*happily*) to Leslie (*happily*).

In the linearization-based approach, variation in word order exhibited in (118) can be accounted for by allowing for a single combinatoric structure in (119) to be associated with the four different realizations of the surface string in (118).

(119)



Unlike phrase structure trees, (119) does not represent word order as a left-to-right yield of the terminal nodes. The surface pronunciation is instead explicitly encoded in the PHON(OLOGY) feature on each node, and the list-valued DOM feature regulates the way in which the phonology of a mother node is determined based on the phonologies of its daughters. In (119), the verb and the direct object form one unit 3 (called "domain object") in the DOM specification of the VP, thus forming an inseparable unit in surface pronunciation. The PP *to Leslie*, on the other hand, forms a domain object by itself, and hence, the adverb *happily* can linearly intervene between the strings *give information* and *to Leslie*, giving rise to a mismatch between combinatoric structure and the surface string realization.

This architecture potentially allows for a significant mismatch between underlying structure and surface pronunciation. The key idea of the LBE approach is to exploit the flexible mapping between surface form and combinatoric structure in the Linearization-

Based setup to implement a surface ellipsis-based analysis of noncanonical coordination along the lines of (120) (here and below, strikeout indicates the material that undergoes phonological ellipsis):

(120) a. [$_S$ I gave Robin a book on Thursday] and [$_S$ ~~(I) gave~~ Leslie a book on Friday].
b. [$_S$ I gave Robin ~~a pair of pliers~~] and [$_S$ Leslie offered Terry, a pair of pliers].
c. [$_S$ Leslie bought a CD], and [$_S$ Robin ~~bought~~ a book].

Since the mapping from the combinatoric structure to the surface string is not one-to-one, it is in principle possible to posit an expression in the underlying structure which does not correspond to an overt string. In the LBE approach, the condition of this surface deletion operation is stated in terms of identity in form to a "shared" string in the other conjunct. Essentially, this approach reconciles the mismatch between the overt forms of apparently anomalous coordination in (37) and the null hypothesis of "like category coordination" by faithfully embodying (in a contemporary guise) the key idea of the Conjunction Reduction analysis from the old transformational literature.

4.3.2.2 Problems with the LBE approach An ellipsis-based analysis of noncanonical coordination along the lines of (120) encounters an immediate empirical challenge in the availability of the non-distributive reading in such noncanonical coordination constructions, as in, for example, (121) (= (100)):

(121) Terry gave no man a book on Friday or a record on Saturday.

Assuming LBE automatically imposes, as the null hypothesis, the existence of an exclusive distributive interpretation.[12] This point emerges most clearly from Beavers

12. Yatabe (2001) and Yatabe and Tam (2019) (the latter of which contains a much more accessible exposition of essentially the same proposal as the former) propose a somewhat different analysis. Unlike Beavers and Sag, who assume that semantic composition is carried out on the basis of the meanings of *signs* on each node (which is the standard assumption about semantic composition in HPSG), Yatabe and Tam shift the locus of semantic composition to the list of domain objects, that is, the component that directly gets affected by the deletion operation that yields the surface string.

This crucially changes the default meaning predicted for examples such as (121). Specifically, in the Yatabe-Tam approach, the surface string for (121) is obtained by the "compaction" operation on word order domains that collapses two quantifiers originally contained in the two conjuncts into one. The semantics of the whole sentence is computed on the basis of this resultant word order domain representation, which contains only *one* instance of a domain object corresponding to the quantifier. The quantifier is then required to scope over the whole coordinate structure due to independently motivated principles of underspecification resolution. While this approach successfully yields the wide-scope reading for quantifiers, the distributive, narrow-scope reading for quantifiers (which is trivial for Beavers and Sag) now becomes a challenge. Yatabe and Tam simply stipulate a complex disjunctive constraint on semantic interpretation tied to the "compaction" operation that takes place in coordination so as to generate the two scopal readings—in effect, writing in a special exemption for an effect that contradicts their core proposal. Thus, though the specific details vary, the overall complexity of the proposal seems to be about the same in these two approaches in the LBE literature.

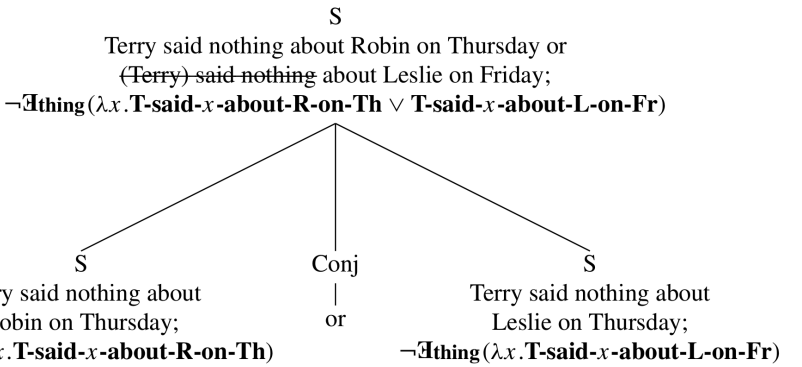
and Sag's (2004) proposal of *Optional Quantifier Merger* (OQM), a mechanism that is supposed to yield the non-distributive readings for quantifiers in NCC in the LBE approach. For ease of exposition, we keep the discussion in what follows at a somewhat informal level. For a more thorough critique, see Levine (2011).

Beavers and Sag sketch the content of OQM in the following terms:

(122) **Optional Quantifier Merger:** For any elided phrase denoting a generalized quantifier in the domain of either conjunct, the semantics of that phrase may optionally be identified with the semantics of its non-elided counterpart.

As should be evident, this is essentially an ad hoc fix for the marked discrepancy between the default predictions of the LBE analysis on the one hand and the empirical patterns observed in section 4.2 on the other. The point can be schematically summarized in (123):

(123)



The quantifier ¬∃thing, which on a strictly compositional account should be represented in the top-level clausal semantics by two separate tokens, instead is merged into one and takes scope over the whole disjunction.[13]

Though perspectives on compositionality vary among researchers, it is reasonable to assume, as Dowty (2007) emphasizes, that the null hypothesis for semantic interpretation incorporates a strictly local mapping from the denotations of subcomponents of a constituent to the denotation of that constituent (Dowty calls this "context-free semantics"). OQM clearly goes against this null hypothesis: it takes two conjuncts whose meanings have already been composed in a normal fashion, and on the basis of a purely prosodic (non-)realization in the second conjunct, removes an operator from

13. One might think that such an operation cannot be formulated, since it involves arbitrarily decomposing and rewriting the formulas that notate the translations of the two clauses. But note that (123) is a simplified notation for an expository purpose only. Beavers and Sag (2004) actually implement their analysis in the underspecified semantics framework of Minimal Recursion Semantics (Copestake et al. 2005), in which the effect represented in (123) can be encoded. See Levine (2011) for a detailed critique.

both conjuncts, replacing it with a new token of the same operator which scopes over the whole coordinate structure.[14]

We should hasten to add that a violation of compositionality by itself is not a problem. In fact, Beavers and Sag (2004) (along with much recent HPSG literature) assume that constructions themselves may supply extra components of meaning. The disconnection between input and output semantics embodied in OQM can therefore be attributed to the contribution of the coordination construction itself. However, note that invoking the notion of constructional meaning does not make the actual content of OQM any less ad hoc.

Moreover, this type of non-monotonic (or *subtractive*, as one might call it) constructional meaning is unheard of. Most constructional meanings proposed in the literature of Construction Grammar (Goldberg 1995) and Construction-based HPSG (Sag 1997, 2012) are *additive*, in the sense that, given the meanings of the daughter nodes f and g, the construction simply supplies some extra piece of meaning h when f and g are composed, producing, for example, $f(h(g))$ or $h(f(g))$ as the meaning of the mother node. (Sag's [1997] analysis of relativizer-less relative clauses is an instance of this; in effect, the headless relative clause construction contributes the meaning [roughly equivalent to the lambda term $\lambda P \lambda Q \lambda x[P(x) \wedge Q(x)]$] that takes the meaning of the single daughter (P) to form a proper meaning for a noun-modifying expression.) A somewhat more elaborate type of meaning composition has been proposed in the HPSG literature, where an adjunct scopes only over a subexpression of the head daughter that it locally combines with in the syntax (Cipollone 2001; Kubota 2007). But even such mechanisms—which one might characterize as *intrusive* meaning manipulation—are non-subtractive. In Cipollone's (2001) and Kubota's (2007) proposals, the adjunct meaning f is allowed to combine with the meaning representation of the head complex verb $g(h)$ to optionally return the output $g(f(h))$ or $f(g(h))$. Subtractive meaning manipulation embodied in OQM is crucially different from (and is arguably much more powerful than) both additive and intrusive meaning manipulation in that it *removes* a piece of meaning contributed by a subexpression (schematically: $f(g), f(h) \Rightarrow f(k(g)(h))$, where one token of f present in the input goes missing in the output). It is in this sense that we find the particular form of violation of compositionality incurred by OQM worrisome.

14. One point that Dowty (2007) emphasizes is that the best analysis is the one which balances criteria pertaining to the syntactic and semantic components respectively, as well as criteria pertaining to their interface (he moreover notes, correctly we think, that past research in syntax and semantics has tended to take the first two types of requirements to be predominant, overlooking the importance of the simplicity criteria for the interface component). Beavers and Sag's (2004) proposal can be thought of as an extreme example of prioritizing the simplicity of syntactic assumptions at the expense of excessive complications in the interface component.

Moreover, there is morpho-syntactic evidence against any ellipsis-based approach as well:

(124) I said nothing to Robin on Thursday nor (to) Leslie on Sunday.

For (124), simply recovering the "elided" material in the second conjunct results in a completely ungrammatical string, whereas deriving it from the grammatical source *I said nothing to Robin on Friday nor did I say anything to Leslie on Sunday* via neg-fronting would involve a host of ad hoc item-by-item replacements in the mapping to the surface form.[15]

Importantly, though OQM is a framework-specific mechanism, it is representative of the kind of solution one is forced to invoke in an ellipsis-based approach to NCC. By its very nature, ellipsis requires multiple tokens of the elided material in the underlying representation, and when these are (or contain) scopal elements, problems arise of exactly the sort that OQM was intended to solve. Given that OQM is a fairly straightforward implementation of a solution for this problem, it seems reasonable to take its failure to be symptomatic of some fundamental analytical difficulty that ellipsis-based approaches to NCC in general face (as noted in footnote 12, Yatabe and Tam [2019] propose a different approach to this problem within the larger LBE literature, but its failure to offer a more explanatory account than Beavers and Sag [2004] seems to reinforce the conclusion that the NCC paradigm poses a fundamental difficulty for the phrase structure–based architecture of grammar).

4.3.3 LFG

In comparison with HPSG, researchers in LFG have devoted little attention to non-canonical varieties of coordination. The most recent detailed treatment, which we consider in this section, is Maxwell and Manning (1996). Maxwell and Manning propose "an extension to LFG, which allows new forms of c-structure licensing" as a way to provide an analysis of nonconstituent coordination in LFG.[16] The extension they introduce is essentially a meta-notation added to phrase structure expansions of the form in (125).

(125) ZP $\rightarrow$ ZP-x [x-ZP-y Conj x-ZP-y] y-ZP

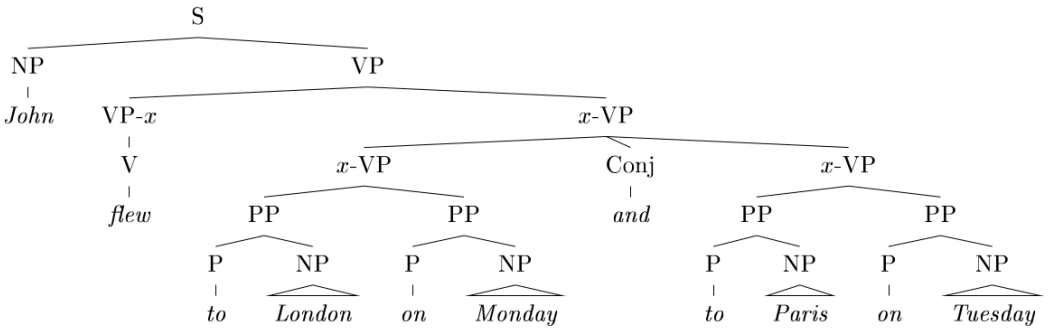
15. For some speakers, it appears that (*)*I said nothing to Robin on Thursday nor said nothing to Leslie on Sunday* is acceptable and could therefore be the underlying source for (124). However, in many speakers' variants of English (including the second author's), the neg-concord pattern in this example is robustly ill-formed, yet (124) is completely unexceptionable.

16. The topic receives a very brief discussion in Dalrymple (2001), which is largely a summary of Maxwell and Manning (1996), while the large-scale LFG textbook by Bresnan et al. (2016) explicitly excludes coordination of any kind from the scope of its coverage.

The intended effect of this rule is that, given a phrase structure rule (126), the tree in (127) is licensed, where x-VP is a "partial constituent" such that it would become a complete VP by being a right sister of VP-x. VP-x and x-VP are obtained by parsing the right-hand-side category "V PP PP" of the VP expansion rule (126).

(126) VP → V (NP) (NP) PP*

(127)



That is, (125) temporarily assigns a constituent status "on the fly," as it were, to a string of category symbols that is not licensed by the narrower grammar as the phrase structure rule (126) is expanded, and such phantom constituents are allowed to be conjoined as long as they correspond to the same sequence of category symbols.

The effect of this system is to allow the coordination of sequences of categories, each of which combines with some preceding (or following) part of a category C to yield a canonical realization of C. This is, of course, exactly what falls out of a variety of subvarieties of categorial grammar, as Maxwell and Manning themselves observe.[17]

There are both conceptual and empirical issues with this approach to NCC. The conceptual issue is the status of the coordination rule (125). The expansion of the x-VP category into a sequence of PP PP in (127) is based on the fact that this sequence can function as a "completion" of a VP node starting with the V category, which itself

17. Maxwell and Manning argue that the type-logical approach their rule system appears to simulate—specifically, the Lambek calculus—overgenerates to an extent that makes it undesirable as a framework for the analysis of coordination, based on data such as the following (on the reading where one person located was a friend of Mary and the other was the manufacturer of her handbag):

(i) *I found a friend of and the manufacturer of Mary's handbag.

They (correctly) note that the Lambek calculus overgenerates this example. This is in fact a version of Dekker's puzzle noted in chapter 2 (see footnote 8 on p. 35). As we noted in that discussion, however, remarks on inadequacies of associative systems as the underlying combinatoric system for English grammar of this sort critically overlook the considerable real-time processing difficulties that examples such as (i) present. Moreover, such criticisms only hold in versions of the Lambek system with completely unrestricted associativity. As we discuss in greater detail in chapter 11, the varieties of extensions of the Lambek calculus currently in play as frameworks for natural language grammars all have ways of controlling associativity, making the type of objection that Maxwell and Manning raise largely obsolete.

projects the VP-*x* category to indicate its status as a partial VP category corresponding to the left substring of the expansion. This effectively means that if one views (125) as a rule inside the narrow grammar, it is a device to introduce context sensitivity to the otherwise context-free c-structure component of LFG. It is unclear what consequences ensue by admitting such a mechanism in the overall architecture of LFG.

An alternative possibility (and this seems to be what is intended by Maxwell and Manning themselves) would be to view (125) as part of the human sentence parsing mechanism. That is, even though the competence grammar is not equipped with a mechanism to explicitly recognize NCC sentences as belonging to the set of well-formed sentences of English, native speakers can nevertheless parse such strings and make sense of them by somehow being guided by the processing strategy of parsing repeated occurrences of the same strings of categories as having an "equal" status (of being part of an expansion of some PS rule). While such a view may seem viable in view of the simplest instances of NCC, it is unclear whether it scales up properly to more complex examples involving interactions of DCC, RNR, and Gapping, of the sort exemplified by (94). At the very least, it is difficult to evaluate Maxwell and Manning's proposal in view of such data since they do not work out the relevant details of the parsing algorithm explicitly enough.

A related, empirical issue arises in connection to semantic interpretation. Whether one views the coordination rule (125) as part of the competence grammar or the processing mechanism, the fact that native speakers of English unambiguously understand the intended meanings of such strings needs to be accounted for. In particular, the coordination scope generalization from section 4.2 tells us that the coordinated nonconstituent strings behave just like coordinated ordinary constituents with respect to scopal interactions with generalized quantifiers (we will see in chapter 5 that this generalization extends to more complex types of scope-taking expressions such as symmetrical predicates and the so-called respective readings of plural and conjoined terms). It is rather unclear how (if at all) this type of complex interaction between coordination and scopal operators is to be accounted for in Maxwell and Manning's approach. The special status of the coordination rule entails that it somehow overrides the ordinary compositional semantics associated with the ordinary phrase structure rules, but the exact process by which complete interpretations of the sentences are built is nowhere stated explicitly in Maxwell and Manning's sketch of their proposal. Given these limitations and uncertainties, it seems reasonable to conclude that, at least as it stands, the Maxwell and Manning proposal does not count as an explicit analysis of NCC whose consequences can be meaningfully compared with other approaches (such as the LBE

approaches in the HPSG literature) for which the relevant details are worked out in more detail.[18]

4.4 Coordination and Scope in Hybrid TLCG

Having reviewed the difficulties that NCC data pose for phrase structure–based approaches to syntax (both transformational and nontransformational), we are now ready to see how these same data are handled in Hybrid TLCG.

As illustrated in chapter 2, hypothetical reasoning with the directional slashes enables a simple and elegant analysis of coordination (including NCC). The real advantage of this approach, however, comes from a range of more complex examples involving interactions between coordination and scopal expressions. We briefly illustrate here the breadth of coverage inherent in our approach with examples involving generalized quantifiers. The issue will be discussed in greater detail with more complex types of scope-taking expressions (such as the "respective" readings of conjoined and plural expressions and the internal readings of symmetrical predicates such as *same* and *different*) in chapter 5.

The coordination scope generalization from section 4.2 says that when a scope-taking expression appears outside the coordinate structure in the surface string, both the *wide-scope reading* (in which the scopal operator scopes over the conjunction) and the *distributive reading* (in which the scope-taking expression scopes within each conjunct separately) are available. Which of the two readings is more prominent (or more readily available) in a particular sentence often depends heavily on pragmatic factors (in particular, the distributive reading tends to be more difficult in many examples), but there is reason to believe that the combinatoric component of grammar makes both $\Phi(\alpha \wedge \beta)$ and $\Phi(\alpha) \wedge \Phi(\beta)$ possible readings for all sentences of the form "Φ $[_A[_A \alpha]$ *and* $[_A \beta]]$," and likewise for disjunction.

For (128), the more prominent reading is the wide-scope reading for the quantifier, in which the negative quantifier scopes over the disjunction, yielding an entailment of negation of two propositions (i.e., $\neg(\varphi \vee \psi) \equiv \neg\varphi \wedge \neg\psi$).

(128) Terry said nothing to Robin on Thursday or to Leslie on Friday.

In Hybrid TLCG, the availability of both the wide-scope reading and the distributive reading is automatically predicted from the independently motivated analyses of coordination and quantification already introduced in chapter 2.

18. Dalrymple (2001) contains a summary of Maxwell and Manning (1996) but remains silent on how this approach may be combined with a modern approach to the syntax-semantics interface in LFG employing "glue semantics," a version of semantics that has an explicit account of quantifier scope.

We illustrate the analysis of the quantifier wide-scope reading first, since the derivation is somewhat simpler for this reading. The derivation is given in (129).

(129)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{[\varphi_1; P; \mathrm{VP/PP/NP}]^1 \quad [\varphi_2; x; \mathrm{NP}]^2}{\varphi_1 \circ \varphi_2;\ P(x);\ \mathrm{VP/PP}}/\mathrm{E} \quad \begin{array}{l}\mathsf{to} \circ \mathsf{robin};\\ \mathbf{r};\ \mathrm{PP}\end{array}}{\varphi_1 \circ \varphi_2 \circ \mathsf{to} \circ \mathsf{robin};\ P(x)(\mathbf{r});\ \mathrm{VP}}/\mathrm{E} \quad \begin{array}{l}\mathsf{on} \circ \mathsf{thursday};\\ \mathbf{onTh};\ \mathrm{VP}\backslash\mathrm{VP}\end{array}}{\varphi_1 \circ \varphi_2 \circ \mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday};\ \mathbf{onTh}(P(x)(\mathbf{r}));\ \mathrm{VP}}\backslash\mathrm{E}}{\varphi_2 \circ \mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday};\ \lambda P.\mathbf{onTh}(P(x)(\mathbf{r}));\ (\mathrm{VP/PP/NP})\backslash\mathrm{VP}}\backslash\mathrm{I}^1}{\mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday};\ \lambda x\lambda P.\mathbf{onTh}(P(x)(\mathbf{r}));\ \mathrm{NP}\backslash(\mathrm{VP/PP/NP})\backslash\mathrm{VP}}\backslash\mathrm{I}^2$$

$$\dfrac{\begin{array}{l}\mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday};\\ \lambda x\lambda P.\mathbf{onTh}(P(x)(\mathbf{r}));\\ \mathrm{NP}\backslash(\mathrm{VP/PP/NP})\backslash\mathrm{VP}\end{array} \quad \dfrac{\begin{array}{l}\mathsf{or};\\ \lambda\mathcal{V}\lambda\mathcal{W}.\mathcal{W} \sqcup \mathcal{V};\\ (X\backslash X)/X\end{array} \quad \begin{array}{l}\mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \lambda x\lambda P.\mathbf{onFr}(P(x)(\mathbf{l}));\\ \mathrm{NP}\backslash(\mathrm{VP/PP/NP})\backslash\mathrm{VP}\end{array}}{\begin{array}{l}\mathsf{or} \circ \mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \lambda\mathcal{W}.\mathcal{W} \sqcup [\lambda x\lambda P.\mathbf{onFr}(P(x)(\mathbf{l}))];\\ (\mathrm{NP}\backslash(\mathrm{VP/PP/NP})\backslash\mathrm{VP})\backslash(\mathrm{NP}\backslash(\mathrm{VP/PP/NP})\backslash\mathrm{VP})\end{array}}/\mathrm{E}}{\begin{array}{l}\mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday} \circ \mathsf{or} \circ \mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \lambda x\lambda P\lambda z.\mathbf{onTh}(P(x)(\mathbf{r}))(z) \vee \mathbf{onFr}(P(x)(\mathbf{l}))(z);\mathrm{NP}\backslash(\mathrm{VP/PP/NP})\backslash\mathrm{VP}\end{array}}\backslash\mathrm{E}$$

$$\dfrac{\begin{array}{l}\mathsf{terry};\\ \mathbf{t};\mathrm{NP}\end{array} \quad \dfrac{\begin{array}{l}\mathsf{said};\\ \mathbf{said};\\ \mathrm{VP/NP/PP}\end{array} \quad \dfrac{\begin{bmatrix}\varphi_3;\\ x;\\ \mathrm{NP}\end{bmatrix}^3 \quad \begin{array}{l}\mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday} \circ \mathsf{or} \circ\\ \quad \mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \lambda x\lambda P\lambda z.\mathbf{onTh}(P(x)(\mathbf{r}))(z) \vee\\ \quad \mathbf{onFr}(P(x)(\mathbf{l}))(z);\\ \mathrm{NP}\backslash(\mathrm{VP/PP/NP})\backslash\mathrm{VP}\end{array}}{\begin{array}{l}\varphi_3 \circ \mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday} \circ\\ \quad \mathsf{or} \circ \mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \lambda P\lambda z.\mathbf{onTh}(P(x)(\mathbf{r}))(z) \vee\\ \quad \mathbf{onFr}(P(x)(\mathbf{l}))(z);(\mathrm{VP/PP/NP})\backslash\mathrm{VP}\end{array}}\backslash\mathrm{E}}{\begin{array}{l}\mathsf{said} \circ \varphi_3 \circ \mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday} \circ\\ \quad \mathsf{or} \circ \mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \lambda z.\mathbf{onTh}(\mathbf{said}(x)(\mathbf{r}))(z) \vee \mathbf{onFr}(\mathbf{said}(x)(\mathbf{l}))(z);\mathrm{VP}\end{array}}\backslash\mathrm{E}}{\begin{array}{l}\mathsf{terry} \circ \mathsf{said} \circ \varphi_3 \circ \mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday} \circ\\ \quad \mathsf{or} \circ \mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \mathbf{onTh}(\mathbf{said}(x)(\mathbf{r}))(\mathbf{t}) \vee \mathbf{onFr}(\mathbf{said}(x)(\mathbf{l}))(\mathbf{t});\mathrm{S}\end{array}}\uparrow\mathrm{I}^3 \quad \begin{array}{l}\lambda\sigma.\sigma(\mathsf{nothing});\\ \neg\exists_{\mathbf{thing}};\\ \mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP})\end{array}}{\begin{array}{l}\mathsf{terry} \circ \mathsf{said} \circ \mathsf{nothing} \circ \mathsf{to} \circ \mathsf{robin} \circ \mathsf{on} \circ \mathsf{thursday} \circ \mathsf{or} \circ \mathsf{to} \circ \mathsf{leslie} \circ \mathsf{on} \circ \mathsf{friday};\\ \neg\exists_{\mathbf{thing}}(\lambda x.\mathbf{onTh}(\mathbf{said}(x)(\mathbf{r}))(\mathbf{t}) \vee \mathbf{onFr}(\mathbf{said}(x)(\mathbf{l}))(\mathbf{t}));\mathrm{S}\end{array}}\uparrow\mathrm{E}$$

The key point in this derivation is that, via hypothetical reasoning, the string *to Robin on Thursday or to Leslie on Friday* forms a syntactic constituent with a full-fledged meaning assigned to it in the usual way. The quantifier takes scope above this whole coordinate structure, yielding the non-distributive, quantifier wide-scope reading.

The derivation for the distributive reading is a bit more complex. We first illustrate the relevant steps with the constituent coordination example (130) and then show that the NCC case is treated in essentially the same way.

(130) During the past month, a mob boss was assassinated in Boston and executed in New York.

To see how the distributive reading is derived, note first that a quantifier entry of type $S\uparrow(S\uparrow NP)$ (with prosodic type $(\mathbf{st}\rightarrow\mathbf{st})\rightarrow\mathbf{st}$) can be converted to a sign with type $S/(NP\backslash S)$ (with a simple string prosody) as follows (see section 4.5 for a step-by-step "verbalization" of this proof):

(131)
$$\dfrac{\dfrac{\lambda\sigma.\sigma(\mathsf{a}\circ\mathsf{mob}\circ\mathsf{boss});\ \exists_{\mathbf{mb}};\ S\uparrow(S\uparrow NP) \qquad \dfrac{\dfrac{[\varphi_1;x;NP]^1 \quad [\varphi_2;P;NP\backslash S]^2}{\varphi_1\circ\varphi_2;\ P(x);\ S}\backslash E}{\lambda\varphi_1.\varphi_1\circ\varphi_2;\ \lambda x.P(x);\ S\uparrow NP}\uparrow I^1}{\mathsf{a}\circ\mathsf{mob}\circ\mathsf{boss}\circ\varphi_2;\ \exists_{\mathbf{mb}}(\lambda x.P(x));\ S}\uparrow E}{\mathsf{a}\circ\mathsf{mob}\circ\mathsf{boss};\ \lambda P.\exists_{\mathbf{mb}}(\lambda x.P(x));\ S/(NP\backslash S)}/I^2$$

This "lowered" quantifier sign, a theorem of our type logic applied to the higher-order lexical entry for the quantifier, is identical to the familiar type specification for quantifiers in variants of CG (such as CCG) with directional slashes only.

Once we have this derived entry, the distributive reading is straightforwardly obtained. The derivation involves first lifting the type of the VP to take GQ-type arguments in the subject position and then coordinating such higher-order VPs, to which the quantifier is then given as an argument:

(132)
$$\dfrac{\dfrac{\mathsf{a}\circ\mathsf{mob}\circ\mathsf{boss};\ \exists_{\mathbf{mb}};\ S/VP \qquad \dfrac{\dfrac{\begin{bmatrix}\varphi;\\ \mathscr{P};\\ S/VP\end{bmatrix}^1 \quad \mathsf{was}\circ\mathsf{assassinated}\circ\mathsf{in}\circ\mathsf{boston};\ \mathbf{ass'd\text{-}in\text{-}b};\ VP}{\varphi\circ\mathsf{was}\circ\mathsf{assassinated}\circ\mathsf{in}\circ\mathsf{boston};\ \mathscr{P}(\mathbf{ass'd\text{-}in\text{-}b});\ S}\backslash E}{\mathsf{was}\circ\mathsf{assassinated}\circ\mathsf{in}\circ\mathsf{boston};\ \lambda\mathscr{P}.\mathscr{P}(\mathbf{ass'd\text{-}in\text{-}b});\ (S/VP)\backslash S}/I^1 \qquad \dfrac{\mathsf{and};\ \lambda\mathcal{W}\lambda\mathcal{V}.\ \mathcal{V}\sqcap\mathcal{W};\ (X\backslash X)/X \qquad \dfrac{\vdots}{\mathsf{was}\circ\mathsf{executed}\circ\mathsf{in}\circ\mathsf{ny};\ \lambda\mathscr{P}.\mathscr{P}(\mathbf{ex'd\text{-}in\text{-}ny});\ (S/VP)\backslash S}}{\mathsf{and}\circ\mathsf{was}\circ\mathsf{executed}\circ\mathsf{in}\circ\mathsf{ny};\ \lambda\mathcal{V}.\mathcal{V}\sqcap\lambda\mathscr{P}.\mathscr{P}(\mathbf{ex'd\text{-}in\text{-}ny});\ ((S/VP)\backslash S)\backslash((S/VP)\backslash S)}/E}{\mathsf{was}\circ\mathsf{assassinated}\circ\mathsf{in}\circ\mathsf{boston}\circ\mathsf{and}\circ\mathsf{was}\circ\mathsf{executed}\circ\mathsf{in}\circ\mathsf{ny};\ \lambda\mathscr{P}.\mathscr{P}(\mathbf{ass'd\text{-}in\text{-}b})\sqcap\lambda\mathscr{P}.\mathscr{P}(\mathbf{ex'd\text{-}in\text{-}ny});\ (S/VP)\backslash S}\backslash E}{\mathsf{a}\circ\mathsf{mob}\circ\mathsf{boss}\circ\mathsf{was}\circ\mathsf{assassinated}\circ\mathsf{in}\circ\mathsf{boston}\circ\mathsf{and}\circ\mathsf{was}\circ\mathsf{executed}\circ\mathsf{in}\circ\mathsf{ny};\ \exists_{\mathbf{mb}}(\mathbf{ass'd\text{-}in\text{-}b})\wedge\exists_{\mathbf{mb}}(\mathbf{ex'd\text{-}in\text{-}ny});\ S}\backslash E$$

We call the type of derivation shown in (131) *slanting*, in the sense that from an expression involving the vertical slash, a sign involving "slanted" (i.e., forward and backward) slashes is derivable by proof. As in (131), slanting exploits the "hybrid" architecture of the present framework, in which syntactic inferences involving the vertical slash freely interact with those involving the forward and backward slashes. See section 4.5 for more on slanting.

Note that the ambiguity for quantifiers in sentences involving coordination is due to the polymorphic specification for the conjunction word *and*. Without this lexical ambiguity for the conjunction word, slanting would just result in a detour in the proof that doesn't have any semantic consequence and which will be systematically eliminated in proof normalization.

Since slanting and type-lifting are generally available as theorems for any argument position of a verb, they can be applied to induce the distributive reading for quantifiers that occupy any argument position of a verb (extension to adjunct positions is also straightforward). In (133), the quantifier occupies the direct object position of a prepositional ditransitive verb.

(133) Terry gave a present to Robin on Thursday and to Leslie on Friday.

Thus, the distributive reading for this quantifier can be obtained by lifting the type of this argument position for the verb and slanting the quantifier accordingly. Note that the type of the argument clusters is a bit more complex than in the simpler cases above since they are specified to take the slanted quantifier as one of their arguments (so that the quantifier meaning is distributed to each conjunct). The derivation is given in (134). (Here, PTV abbreviates VP/PP; note that we are assuming an "already slanted" version of the quantifier in (134)—for the derivation of this (PTV/NP)\PTV entry for the quantifier, see (137) in the next section.)

(134)

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\left[\begin{array}{l}\varphi_2;\\ P;\mathrm{PTV/NP}\end{array}\right]^2 \quad \left[\begin{array}{l}\varphi_1;\\ \mathscr{P};(\mathrm{PTV/NP})\backslash\mathrm{PTV}\end{array}\right]^1}{\varphi_2\circ\varphi_1;\ \mathscr{P}(P);\ \mathrm{PTV}}/\mathrm{E} \quad \begin{array}{l}\mathsf{to}\circ\mathsf{robin};\\ \mathbf{r};\mathrm{PP}\end{array}}{\varphi_2\circ\varphi_1\circ\mathsf{to}\circ\mathsf{robin};\ \mathscr{P}(P)(\mathbf{r});\ \mathrm{VP}}/\mathrm{E} \quad \begin{array}{l}\mathsf{on}\circ\mathsf{thursday};\\ \mathbf{onTh};\mathrm{VP}\backslash\mathrm{VP}\end{array}}{\varphi_2\circ\varphi_1\circ\mathsf{to}\circ\mathsf{robin}\circ\mathsf{on}\circ\mathsf{thursday};\ \mathbf{onTh}(\mathscr{P}(P)(\mathbf{r}));\ \mathrm{VP}}\backslash\mathrm{E}}{\varphi_1\circ\mathsf{to}\circ\mathsf{robin}\circ\mathsf{on}\circ\mathsf{thursday};\ \lambda P.\mathbf{onTh}(\mathscr{P}(P)(\mathbf{r}));\ (\mathrm{PTV/NP})\backslash\mathrm{VP}}\backslash\mathrm{I}^2}{\begin{array}{l}\mathsf{to}\circ\mathsf{robin}\circ\mathsf{on}\circ\mathsf{thursday};\\ \lambda\mathscr{P}\lambda P.\mathbf{onTh}(\mathscr{P}(P)(\mathbf{r}));((\mathrm{PTV/NP})\backslash\mathrm{PTV})\backslash((\mathrm{PTV/NP})\backslash\mathrm{VP})\end{array}}\backslash\mathrm{I}^1$$

$$\dfrac{\dfrac{\dfrac{\dfrac{\vdots}{\text{a} \circ \text{present};\ \lambda P\lambda y\lambda z.\exists_{\mathbf{pr}}(\lambda x.P(x)(y)(z));\ (\text{PTV}/\text{NP})\backslash\text{PTV}} \quad \dfrac{\vdots}{\begin{array}{l}\text{to} \circ \text{robin} \circ \text{on} \circ \text{thursday} \circ \\ \quad \text{and} \circ \text{to} \circ \text{leslie} \circ \text{on} \circ \text{friday}; \\ \lambda\mathscr{P}\lambda P.\mathbf{onTh}(\mathscr{P}(P)(\mathbf{r})) \sqcap \\ \quad \lambda\mathscr{P}\lambda P.\mathbf{onFr}(\mathscr{P}(P)(\mathbf{l})); \\ ((\text{PTV}/\text{NP})\backslash\text{PTV})\backslash((\text{PTV}/\text{NP})\backslash\text{VP})\end{array}}\backslash\text{E}}{\begin{array}{l}\text{a} \circ \text{present} \circ \text{to} \circ \text{robin} \circ \text{on} \circ \text{thursday} \circ \\ \quad \text{and} \circ \text{to} \circ \text{leslie} \circ \text{on} \circ \text{friday}; \\ \lambda P.\mathbf{onTh}(\lambda z.\exists_{\mathbf{pr}}(\lambda x.P(x)(\mathbf{r})(z))) \sqcap \lambda P.\mathbf{onFr}(\lambda z.\exists_{\mathbf{pr}}(\lambda x.P(x)(\mathbf{l})(z))); \\ (\text{PTV}/\text{NP})\backslash\text{VP}\end{array}}\backslash\text{E}}{\begin{array}{l}\text{gave}; \\ \mathbf{gave}; \\ \text{PTV}/\text{NP}\end{array}}$$

$$\text{gave} \circ \text{a} \circ \text{present} \circ \text{to} \circ \text{robin} \circ \text{on} \circ \text{thursday} \circ \text{and} \circ \text{to} \circ \text{leslie} \circ \text{on} \circ \text{friday};\ \mathbf{onTh}(\lambda z.\exists_{\mathbf{pr}}(\lambda x.\mathbf{gave}(x)(\mathbf{r})(z))) \sqcap \mathbf{onFr}(\lambda z.\exists_{\mathbf{pr}}(\lambda x.\mathbf{gave}(x)(\mathbf{l})(z)));\ \text{VP}$$

Thus, the present approach licenses both the distributive and non-distributive readings for quantifiers when they interact with coordination, both in the constituent coordination and NCC cases. We take this to be an empirically correct result. As we discussed in section 4.2, the apparent difficulty for the distributive reading for downward entailing quantifiers disappears once appropriate contexts are established.[19]

4.5 A Note on Slanting

As discussed above, an operation (or a family of theorems) called *slanting* plays a crucial role in deriving entries of quantifiers that are used in licensing distributive readings

19. There does nonetheless seem to be an overwhelming preference for the non-distributive readings for downward entailing quantifiers in many cases, especially in "out of the blue" contexts. We believe that this is a reflection of a much larger generalization about the (preferred) scopal relation between negation (which is part of the meaning of downward entailing quantifiers) and other operators. Specifically, negation tends to resist inverse scope readings in relation to operators that it "c-commands":

(i) a. John didn't talk to every teacher. ($??\forall > \neg$)
b. No student/few students/hardly any student talked to every teacher. ($??\forall >$ *no, few, hardly any*)

Note in particular that ordinary negation exhibits basically the same pattern as downward entailing quantifiers when it interacts with coordination:

(ii) a. Terry didn't say anything to Robin or Leslie. ($\neg > \vee$, $*\vee > \neg$)
b. Terry didn't say anything to Robin on Thursday or to Leslie on Friday. ($\neg > \vee$, $*\vee > \neg$)

At least in the disjunction cases like (ii), the dispreference for the distributive reading is clear in both constituent coordination and NCC. The relative inaccessibility of the distributive reading in such examples most likely results from a complex interaction of multiple factors, one of which is the absence (in ordinary contexts) of the relevant discourse relations supporting the distributive reading. As noted in section 4.2, the distributive "$\neg p \vee \neg q$" reading is inherently anomalous except in contexts where the speaker is known to be ignorant of which of two possibilities is true. In an "out of the blue" utterance especially, the discourse context fails completely to support this assumption of ignorance.

of quantifiers in coordination examples. We reproduce here the slanting derivation for the subject position quantifier (135) (= (131)), together with two more cases, one for the object position for transitive verbs (136) and the other for the direct object position of prepositional ditransitive verbs (137) (the latter is used in the derivation of the distributive reading for an NCC example in (134)).

Since slanting is a lemma (or, more precisely, a set of lemmas) applicable to a set of lexical entries rather than just to some specific words, we present it in a schematic form with quantifier entries with some string prosody p, where p is a metavariable ranging over the set of actual quantifier strings. We start with slanting for the subject position quantifier:

(135)
$$\dfrac{\lambda\sigma.\sigma(p);\ \exists_{\mathbf{mb}};\ \mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP}) \quad \dfrac{\dfrac{[\varphi_1;x;\mathrm{NP}]^1 \quad [\varphi_2;P;\mathrm{NP}\backslash\mathrm{S}]^2}{\varphi_1\circ\varphi_2;\ P(x);\ \mathrm{S}}\backslash\mathrm{E}}{\lambda\varphi_1.\varphi_1\circ\varphi_2;\ \lambda x.P(x);\ \mathrm{S}\uparrow\mathrm{NP}}\uparrow\mathrm{I}^1}{\dfrac{p\circ\varphi_2;\ \exists_{\mathbf{mb}}(\lambda x.P(x));\ \mathrm{S}}{p;\ \lambda P.\exists_{\mathbf{mb}}(\lambda x.P(x));\ \mathrm{S}/(\mathrm{NP}\backslash\mathrm{S})}/\mathrm{I}^2}\uparrow\mathrm{E}$$

The derivation in (135) can be understood as follows. We start by hypothesizing a VP (i.e., NP\S, indexed as 2) and an NP (indexed as 1). After a complete sentence is formed, the NP hypothesis is withdrawn so that the quantifier can take scope. The resulting expression is indeed of the right type (S↑NP) to be given as an argument to the quantifier, and the quantifier string is lowered to the subject position. This yields a string in which the prosody of the hypothesized VP φ_2 appears at the right periphery, satisfying the applicability condition of /I. By applying /I, the quantifier string p is paired with the original denotation of the quantifier (note that the final translation is equivalent to $\exists_{\mathbf{mb}}$ via eta-equivalence) and the syntactic category $\mathrm{S}/(\mathrm{NP}\backslash\mathrm{S})$.

Similar steps of derivation yield alternative quantifier entries in other argument positions of the sentence, as follows:

(136)
$$\dfrac{\lambda\sigma.\sigma(p);\ \exists_{\mathbf{mb}};\ \mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP}) \quad \dfrac{\dfrac{[\varphi_2;P;\mathrm{S}/\mathrm{NP}]^2 \quad [\varphi_1;x;\mathrm{NP}]^1}{\varphi_2\circ\varphi_1;\ P(x);\ \mathrm{S}}\backslash\mathrm{E}}{\lambda\varphi_1.\varphi_2\circ\varphi_1;\ \lambda x.P(x);\ \mathrm{S}\uparrow\mathrm{NP}}\uparrow\mathrm{I}^1}{\dfrac{\varphi_2\circ p;\ \exists_{\mathbf{mb}}(\lambda x.P(x));\ \mathrm{S}}{p;\ \lambda P.\exists_{\mathbf{mb}}(\lambda x.P(x));\ (\mathrm{S}/\mathrm{NP})\backslash\mathrm{S}}/\mathrm{I}^2}\uparrow\mathrm{E}$$

(137)

$$\dfrac{\dfrac{\lambda\sigma.\sigma(p);\ \exists\mathbf{pr};\ \mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP}) \quad \dfrac{\dfrac{\dfrac{[\varphi_0; P; \mathrm{VP/PP/NP}]^0 \quad [\varphi_1; x; \mathrm{NP}]^1}{\varphi_0\circ\varphi_1;\ P(x);\ \mathrm{VP/PP}}/\mathrm{E} \quad \left[\begin{smallmatrix}\varphi_2;\\ y;\mathrm{PP}\end{smallmatrix}\right]^2}{\varphi_0\circ\varphi_1\circ\varphi_2;\ P(x)(y);\ \mathrm{VP}}/\mathrm{E} \quad \left[\begin{smallmatrix}\varphi_3;\\ z;\mathrm{NP}\end{smallmatrix}\right]^3}{\varphi_3\circ\varphi_0\circ\varphi_1\circ\varphi_2;\ P(x)(y)(z);\ \mathrm{S}}\backslash\mathrm{E}}{\lambda\varphi_1.\varphi_3\circ\varphi_0\circ\varphi_1\circ\varphi_2;\ \lambda x.P(x)(y)(z);\ \mathrm{S}\uparrow\mathrm{NP}}\uparrow\mathrm{I}^1}{\varphi_3\circ\varphi_0\circ p\circ\varphi_2;\ \exists\mathbf{pr}(\lambda x.P(x)(y)(z));\ \mathrm{S}}\uparrow\mathrm{E}$$
$$\dfrac{\varphi_3\circ\varphi_0\circ p\circ\varphi_2;\ \exists\mathbf{pr}(\lambda x.P(x)(y)(z));\ \mathrm{S}}{\varphi_0\circ p\circ\varphi_2;\ \lambda z.\exists\mathbf{pr}(\lambda x.P(x)(y)(z));\ \mathrm{VP}}\backslash\mathrm{I}^3$$
$$\dfrac{\varphi_0\circ p\circ\varphi_2;\ \lambda z.\exists\mathbf{pr}(\lambda x.P(x)(y)(z));\ \mathrm{VP}}{\varphi_0\circ p;\ \lambda y\lambda z.\exists\mathbf{pr}(\lambda x.P(x)(y)(z));\ \mathrm{PTV}}/\mathrm{I}^2$$
$$\dfrac{\varphi_0\circ p;\ \lambda y\lambda z.\exists\mathbf{pr}(\lambda x.P(x)(y)(z));\ \mathrm{PTV}}{p;\ \lambda P\lambda y\lambda z.\exists\mathbf{pr}(\lambda x.P(x)(y)(z));\ (\mathrm{PTV/NP})\backslash\mathrm{PTV}}\backslash\mathrm{I}^0$$

More generally, slanting is possible for any sentence-medial position. With S$ abbreviating any arbitrary directional syntactic type ending in S (a notation we borrow from Steedman [2000], where two occurrences of S$ with the same subscript instantiates the same category), slanting for quantifiers can be further schematized as follows:

(138) $\lambda\sigma.\sigma(p);\ \mathscr{P};\ \mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP}) \ \vdash$
$p;\ \lambda P\lambda x_1\ldots\lambda x_n.\mathscr{P}(\lambda x.P(x)(x_1)\ldots(x_n));\ \mathrm{S\$}_1/(\mathrm{NP}\backslash\mathrm{S\$}_1)$

(139) $\lambda\sigma.\sigma(p);\ \mathscr{P};\ \mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP}) \ \vdash$
$p;\ \lambda P\lambda x_1\ldots\lambda x_n.\mathscr{P}(\lambda x.P(x)(x_1)\ldots(x_n));\ (\mathrm{S\$}_2/\mathrm{NP})\backslash\mathrm{S\$}_2$

It is important to note that, although Slanting is a very flexible operation, it never yields entries of quantifiers that disrupt word order. For example, it is impossible to derive an entry for the quantifier of type $(\mathrm{NP}\backslash\mathrm{S})\backslash\mathrm{S}$ from the lexically specified type $\mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP})$. (If such a derivation were possible, it would overgenerate the string **Loves a sailor every boy* with the reading 'Every boy loves a sailor,' clearly a wrong result.)

The following failed derivation for $\mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP}) \vdash (\mathrm{NP}\backslash\mathrm{S})\backslash\mathrm{S}$ illustrates the point succinctly:

(140)

$$\dfrac{\lambda\sigma.\sigma(p);\ \exists\mathbf{mb};\ \mathrm{S}\uparrow(\mathrm{S}\uparrow\mathrm{NP}) \quad \dfrac{\dfrac{[\varphi_1; x; \mathrm{NP}]^1 \quad [\varphi_2; P; \mathrm{NP}\backslash\mathrm{S}]^2}{\varphi_1\circ\varphi_2;\ P(x);\ \mathrm{S}}\backslash\mathrm{E}}{\lambda\varphi_1.\varphi_1\circ\varphi_2;\ \lambda x.P(x);\ \mathrm{S}\uparrow\mathrm{NP}}\uparrow\mathrm{I}^1}{p\circ\varphi_2;\ \exists\mathbf{mb}(\lambda x.P(x));\ \mathrm{S}}\uparrow\mathrm{E}$$
$$\dfrac{p\circ\varphi_2;\ \exists\mathbf{mb}(\lambda x.P(x));\ \mathrm{S}}{\mathrm{FAIL}}**\backslash\mathrm{I}^2**$$

The proof starts by hypothesizing NP\S, since this is the category that needs to be withdrawn at the last step via \I to obtain the category $(\mathrm{NP}\backslash\mathrm{S})\backslash\mathrm{S}$. Then the proof proceeds in the same way as (135) until the very final step, at which point it fails. At this final step, in order to obtain the $(\mathrm{NP}\backslash\mathrm{S})\backslash\mathrm{S}$ category instead of the $\mathrm{S}/(\mathrm{NP}\backslash\mathrm{S})$ category as in (135), we need to apply \I. However, this is impossible since the applicability

condition of the $\backslash$I rule requires the prosody of the hypothesis to be withdrawn to appear on the left periphery of the input string—a condition that is not satisfied in (140). Thus, this derivation is correctly blocked.

Interestingly—and in contrast to quantifiers—verb lexical entries can be slanted and *un*slanted back and forth. The following derivations for a transitive verb illustrate this point:

(141)
$$\dfrac{\dfrac{\dfrac{[\varphi_2;y;\mathrm{NP}]^2 \quad \dfrac{p;\, R;\, (\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP} \quad [\varphi_1;x;\mathrm{NP}]^1}{p\circ\varphi_1;\, R(x);\, \mathrm{NP}\backslash\mathrm{S}}/\mathrm{E}}{\varphi_2\circ p\circ\varphi_1;\, R(x)(y);\, \mathrm{S}}\backslash\mathrm{E}}{\lambda\varphi_2.\varphi_2\circ p\circ\varphi_1;\, \lambda y.R(x)(y);\, \mathrm{S}\uparrow\mathrm{NP}}\uparrow\mathrm{I}^2}{\lambda\varphi_1\lambda\varphi_2.\varphi_2\circ p\circ\varphi_1;\, \lambda x\lambda y.R(x)(y);\, (\mathrm{S}\uparrow\mathrm{NP})\uparrow\mathrm{NP}}\uparrow\mathrm{I}^1$$

(142)
$$\dfrac{\dfrac{[\varphi_2;y;\mathrm{NP}]^2 \quad \dfrac{\lambda\varphi_3\lambda\varphi_4.\varphi_4\circ p\circ\varphi_3;\, R;\, (\mathrm{S}\uparrow\mathrm{NP})\uparrow\mathrm{NP} \quad [\varphi_1;x;\mathrm{NP}]^1}{\lambda\varphi_4.\varphi_4\circ p\circ\varphi_1;\, R(x);\, \mathrm{S}\uparrow\mathrm{NP}}\uparrow\mathrm{E}}{\varphi_2\circ p\circ\varphi_1;\, R(x)(y);\, \mathrm{S}}\uparrow\mathrm{E}}{p\circ\varphi_1;\, \lambda y.R(x)(y);\, \mathrm{NP}\backslash\mathrm{S}}\backslash\mathrm{I}^2}{p;\, \lambda x\lambda y.R(x)(y);\, (\mathrm{NP}\backslash\mathrm{S})/\mathrm{NP}}/\mathrm{I}^1$$

Slanting and unslanting that disrupt word order are underivable in Hybrid TLCG since the prosodic labeling keeps track of the string positions of both hypothesized and real expressions. That is, inferences that go against the linear order properties encoded via / and $\backslash$ in the syntactic categories of the relevant expressions will be automatically ruled out in the calculus. This was illustrated for the failed quantifier slanting in (140). Similarly, the unslanted category S$\uparrow$NP$\uparrow$NP for the transitive verb obtained in the derivation in (141) does not give rise to any additional word order possibilities, since the word order information originally encoded in the / vs. $\backslash$ distinction in the syntactic category is "transferred" to the explicit encoding of word order in the (functional) prosodic specification of the derived expression. In this sense, proofs in the present calculus are strictly order-preserving.

4.6 A Note on Summative Agreement

As we have shown above, the "constituent coordination" analysis of NCC in CG straightforwardly captures the scopal interactions between NCC and quantifiers. We argue in the next chapter that further support for this approach comes from similar scope interactions involving more complex types of scope-taking expressions. While we believe that the CG analysis represents the most successful analysis of coordination that is currently available, there are opposing views in the literature. In this subsection, we address one specific issue involving an empirical phenomenon called "summative

agreement," which in our view is possibly the strongest piece of evidence that has so far been identified in the literature as a potential problem for the direct coordination analysis of NCC in CG.

4.6.1 Summative Agreement

Summative agreement is exemplified in the following example from Postal (1998):

(143) The pilot claimed that the first nurse, and the sailor proved that the second nurse, were spies.

This agreement pattern appears problematic under the assumption that the "raised" VP in such data is a single token of VP linked to two separate gap sites, with its form regulated by the morpho-syntactic condition in each of the corresponding gaps' sites:

(144) The pilot claimed that the first nurse $\left\{ \begin{array}{c} \text{was a spy} \\ \text{*were spies} \end{array} \right\}$ and the sailor proved that the second nurse $\left\{ \begin{array}{c} \text{was a spy} \\ \text{*were spies} \end{array} \right\}$.

Postal (1998, 172) argues that (143) could conceivably be explained by "the possibility of seeing *were spies* . . . as some sort of realization of an *n*-ad of ATB extracted singulars," a suggestion that is difficult to assess since nothing beyond this speculation is offered that would make formal sense of the notion of a filler as an "*n*-ad" of singulars. Below, however, we offer a reinterpretation of Postal's idea in terms of semantic conditions involving the speaker's perspective.

Yatabe and Tam (2019) claim that the pattern exhibited in (143) poses a "potential empirical problem" for the analysis of RNR—and with the treatment of coordination more generally—in Hybrid TLCG. The crux of their argument is the contrast between the respective patterns in (143) and in (145):

(145) a. ??The pilot claimed that the first nurse, or the sailor proved that the second nurse, were spies.
b. ?*The pilot claimed that the nurse from the United States, and the sailor also claimed that the nurse from the United States, were spies.
c. ?*The pilot claimed that the nurse from the United States, and the sailor claimed that no one, were spies.

The conjoined expressions are uniformly of type S/VP_{sing} in both (143) and (145), and this syntactic category does not directly encode the information about the semantics of the subject NPs in each conjunct. Yatabe and Tam (2019) conclude from this that there is no way of capturing the acceptability contrast between (143) and (145) in the CG analysis of RNR. At first sight, this argument appears quite compelling.

Summative agreement is a peculiar phenomenon. Intuitively (and informally speaking), this agreement pattern is induced by the fact that the speaker has reason to believe that the RNR'ed VP is predicated of a plural individual. This is the key intuition common to all previous accounts of summative agreement (including Beavers and Sag [2004] and Chaves [2014]), and our own account, which we articulate below, also builds on this idea.

But before examining the relevant details of the syntax and semantics of RNR that induce summative agreement, it is worth noting, in support of the general approach just alluded to, that we have prima facie evidence for this "speaker's perspective" interpretation available to—and perhaps preferred for—RNR. Note the following examples exhibiting the effect of this interpretation on the form of the pronominal determiners in the RNR'ed expression:

(146) a. Mr. J_1 sent a Christmas card, and Mrs. J_2 sent a party invitation, to their$_{1+2}$ next-door neighbors.

b. *Mr. J_1 sent a Christmas card to their next-door neighbors$_{1+2}$, and Mrs. J_2 sent a party invitation to their$_{1+2}$ next-door neighbors.

(147) a. John$_1$ sent a Christmas card, and Mary$_2$ sent a party invitation, to each other's$_{1+2}$ bosses.

b. *John$_1$ sent a Christmas card to each other's$_{1+2}$ bosses, and Mary$_2$ sent a party invitation to each other's$_{1+2}$ bosses.

It is evident that in such cases, the RNR'ed expression contains a determiner which does not reflect anaphoric reference to the relevant NP in either of the conjoined clauses, but rather receives an interpretation reflecting the speaker's retrieval of these NPs and their referents, to form a set which the anaphoric expression refers to. This retrieval is possible in contexts embedded under propositional attitude predicates:

(148) John suspected that Mary, and Bill thought that Ann, were $\left\{\begin{array}{c}\text{each}\\ \text{both}\end{array}\right\}$ involved in the robbery.

Getting back to the examples in (145), (145c) is particularly interesting. Note that the same singular agreement pattern appears in (149):

(149) The pilot claimed that the nurse from the United States, and the sailor claimed that every nurse from Scotland, $\left\{\begin{array}{c}\text{?*were spies}\\ \text{was a spy}\end{array}\right\}$.

The pattern in (145c) and (149) is in fact characteristic of a much broader class of coordination phenomena involving singular determiners corresponding to universal quantification. Even with a background assumption that the set of nurses from Scotland is non-empty, a singular VP agreement pattern is mandated for (149). To provide a com-

plete answer to the apparent problem posed by (145c) and (149), therefore, we need to determine just what underlies the singular agreement pattern associated with singular universals and how it impacts the agreement patterns associated with coordination.

The most basic morpho-syntactic fact about universal singular determiners is that they require a singular-marked VP:

(150) { Every / Each } submission was/*were sent to the referees.

The morphological marking on the determiner's nominal argument suggests that *every/each* do not permit interpretation of the subject as a plural/aggregate/collective object that can enter into collective predication relations, in contrast to the plural determiner *all*, a suggestion strongly supported by other data. Consider the difference between the cases displayed in (151):[20]

(151) a. All (the) participants met in the park.

b. { John and Mary / An author and an editor / The author and the editor } met in the park.

c. #Every/each man and every/each woman met in the park.

These examples show that a coordination of atomic individuals can be construed, in effect, as a collective object. For notational convenience, we introduce two subtypes for the type e: e_ι for atomic individuals and e_σ for sums. What (151c) shows is that coordination of "quantified NPs" cannot undergo this collective interpretation when the determiner is a singular universal GQ. The predicate **meet** (i.e., the denotation of *meet*) can only hold of entities with aggregate structure, and evidently the coordination of *each/every* subjects does not yield a functor which can apply to **meet**. This conclusion is made more or less explicit by the parallel contrast in the agreement facts:

(152) a. All (the) participants are getting an award.

b. { John and Mary / An author and an editor / The author and the editor } are getting an award.

c. Every/each mathematician and every/each physicist { *are / is } getting an award.

Thus, the morphological number marking displayed in the VP corresponds to the properties of the subject along the following lines:[21]

20. The issues on collective interpretation raised in the following discussion have a long history in the formal semantics literature; see, e.g., Bennett (1974); Scha (1981); Dowty (1987).

21. See the discussion of the distributivity of *each/every* in Beghelli and Stowell (1997) and Winter (2001) in this connection. We propose an analysis of distributive quantifiers *every* and *each* as denoting sums (or,

- The subjects of plural-marked VPs are also possible subjects of VPs which can combine to give a semantically well-formed result only with collectivities, e.g., *meet*, *gather*, *assemble*, and *interact*.
- The subjects of singular-marked VPs (including quantifiers with *each/every*, which invariably contain a singular nominal, even when two or more such quantified phrases are conjoined) cannot, as a rule, combine with VPs which denote properties of collectivities.

4.6.2 Semantic Agreement and Summative Agreement

With the semantics for morphological number marking introduced above, the summative agreement facts in question fall readily into place.

Suppose that RNR is licensed by the grammar by a special entry for *and* with the syntactic type $((S/VP_{sg})\backslash(S/VP_{pl}))/(S/VP_{sg})$, which comes with the additional pragmatic condition for its felicitous use: the summative agreement *and* is possible only when the speaker can entertain a perspective (which she or he does not necessarily endorse) which guarantees the existence of some plural entity (of type e_σ) of which the RNR'ed VP predicate can be appropriately predicated. We have seen clear independent evidence for the sensitivity of the RNR'ed expression to the speaker's perspective in, for example, (148): in this type of example, the RNR'ed expression contains an anaphoric element reflecting the speaker's assessment of the relevant state of affairs, which the attitude holders in the respective two clauses do not necessarily have direct access to.

Summative agreement can then be taken to be a grammaticalized extension, as it were, of this anaphoric possibility sensitive to the speaker's perspective.[22] When the

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more precisely, tuples) in chapter 5, in order to capture their behavior in relation to symmetrical predicates such as *same* and *different*. Our assumption in the current chapter is consistent with such an analysis of *every* and *each*. The sum/tuple-based analysis of universals requires a covert distributive/respective operator to be present to ensure distributive readings for *every* and *each*. Thus, in this alternative analysis, even though *every/each N* and *all Ns* both denote sum/tuple-type objects, the crucial difference between them—that only the latter can combine with collective predicates—is ensured by the obligatory presence of the distributive/respective operator when *every/each* enters into a predication relation with some $e \rightarrow t$ property.

22. See Chaves (2014) for a similar view on summative agreement as a constructional property of RNR. Note that the speaker's "role" here is merely that of summarizing the reported speeches, from which it does not necessarily follow that the speaker endorses the truth of the reported statements, as can be clearly seen from the fact that examples like the following are possible:

(i) The pilot claimed that the first nurse, and the sailor insisted that the second nurse, were spies, and then everybody got terrified, but it later turned out that both reports were unfounded rumors.

Though our approach is inspired by an earlier proposal by Beavers and Sag (2004), it (as well as Chaves's [2014] account) crucially differs from the latter in that it takes summative agreement to be a phenomenon licensed by the grammar (under certain pragmatic conditions), rather than characterizing it as a case of tolerated performance error.

subjects of the two clauses corresponding to the reported propositions are denoted by, for example, definite descriptions, the speaker can *construe* the "referents" of the embedded subjects in the two clauses (i.e., *the first nurse* and *the second nurse*) as forming the sum **nurse1** $\oplus$ **nurse2**, which is appropriate as an argument of plural predicates, for example, *were spies*, since this semantic object is of the right type to serve as an argument to a sum-seeking plural VP. The same holds for other singular existentials, for example, names and *a/the* terms, and for certain plural universals as well. But when these subjects are represented by singular universals, no appropriate plural individual (i.e., sum) can be constructed within the speaker's perspective to support agreement with a plural VP, paralleling the judgment patterns of the simpler non-RNR examples of conjoined singular quantifiers in (150).

Thus, all we need assume in order to account for summative agreement in RNR is the existence of the syntactic type $((S/VP_{sg})\backslash(S/VP_{pl}))/(S/VP_{sg})$ for *and* and the following three independently motivated assumptions:[23]

- Names, definites, indefinites, and plurals of the form *all (the) Ns* denote individuals, all of which can be conjoined to form an individual of type e_σ.
- Singular quantifiers of the form *each N*, *every N*, and *no N* all denote generalized quantifiers of type $(e_\iota \rightarrow t) \rightarrow t$.
- The RNR'ed expression can reflect a speaker's perspective in which the separate arguments of the single VP predicate are in effect retrieved by the speaker from their separate S/VP_{sg} clauses and thrown together by the speaker's construal of them as forming a single plural entity to which the RNR'ed VP applies, just in case it can take such arguments.

The three principles itemized—each of which, as noted earlier, is separately supported—interact to yield (143) as a straightforward consequence. Definite descriptions such as *the first nurse* and *the second nurse* can form plural objects under implicit summative conjunction and hence are legitimate antecedents for plural anaphoric expressions such as personal pronouns, reflexives, and reciprocals—and, in the case of verbal morphology, the plural number marking that reflects summative agreement. This combination of pragmatic assumptions (needed in order to understand data such as (146)) and the behavior of coordinate subjects of explicitly plurality-seeking VPs suffice to account for the summative agreement facts. The syntactic type $((S/VP_{sg})\backslash(S/VP_{pl}))/(S/VP_{sg})$ may well have the status of an emergent category, ac-

23. In the revised version of the analysis of *every* and *each* introduced in chapter 5, the distributive/respective operator that forces the obligatorily distributive interpretations of these quantifiers converts the sum/tuple-type denotations to "singular" quantifiers of type $(e_\iota \rightarrow t) \rightarrow t$ that are only compatible with "singular" predicates.

cessible for certain speakers under certain pragmatic conditions, but does not represent an "established," canonical type available to all English speakers.[24]

To conclude, despite what may initially appear, summative agreement facts are amenable to a relatively simple treatment in the CG analysis of RNR.

24. In this connection, it is worth recalling the point made in Beavers and Sag (2004) that "Yatabe's work with native speaker informants reveals that such sentences [as (143)] are of intermediate acceptability (only 7 of the 23 subjects he studied found this sentence to be perfectly acceptable)." This fact suggests that the type $((S/VP_{sg})\backslash(S/VP_{pl}))/(S/VP_{sg})$ is still missing from the lexicon of the majority of English speakers. It is of course possible, though, that such a type has been fully grammaticized in the syntax-semantics interface of other languages, corresponding to Yatabe and Tam's (2019) claim that summative agreement is standard in RNR in a number of languages.

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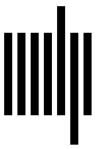

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