English Coordiantion: Underspecification and Ellipsis*

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Chung, Chan. 2006. English Coordiantion: Underspecification and Ellipsis. *The Linguistic Association of Korea Journal, 14*(1), 1-35. From a phrase structure grammar perspective, the mechanisms of *underspecification* and *ellipsis* are crucial in that they provide efficient ways of analyzing unlike-category and non-constituent coordination constructions (Sag et al. 1985, Sag 2002, Beavers and Sag 2004, among others). However, those approaches, as they are, are too powerful and have serious overgeneration and spurious ambiguity problems. Exploring a solution to the problems, this paper proposes to impose more constraints on the ellipsis through the type inheritance hierarchy. Some of the constraints interact with each other and eliminate the spurious ambiguity between constituent and non-constituent coordination structures.

Key Words: unlike-category coordination, argument cluster coordination, right-node raising, ellipsis, underspecification, head-driven phrase structure grammar

1. Introduction

From a syntactic perspective, a crucial matter in the analysis of the English coordination constructions is how to adapt the locality violation illustrated by Wasow's generalization in (1) to take account of the unlike-category coordination constructions (e.g., *Pat is healthy and of sound mind*) and the non-constituent coordination constructions—usually called gapping

* Earlier versions of this paper were presented at the 2005 Coordination Workshop of the Korean Society for Language and Information, and at the 2005 Fall Conference of the Linguistic Society of Korea. My special thanks go to Jong-Bok Kim, Hyon Sook Choe, In-Cheol Choi, Myong-Hi Chai, Yongkyoon No, and other audiences for their comments and suggestions. Of course all remaining errors are mine.

constructions (e.g., *Kim gave a dollar to Bobbie and a dime to Jean*).

(1) Wasow's generalization
An element in construction with a coordinate constituent must be syntactically construable with each conjunct. Thus, a structure of the form D [A, B, and C] is grammatical only if structures of the form DA, DB, and DC are each grammatical (Yatabe 2004).

From an HPSG perspective, on whose theory this paper is based, proposals for capturing Wasow's generalization may be summarized in two approaches: those using the notions of underspecification (Sag 2002) and of ellipsis (Beavers and Sag 2004). However, these approaches, as they are, seem to cause serious problems. A brief sketch of the problems with the ellipsis is illustrated in (2) and (3) (See section 3 for more discussions on their problems):

(2) a. Kim loves a cat and Fred loves a cat.
b. *Kim ~~loves a cat~~ and Fred loves a cat.
(3) a. John sang a carol and sang beautifully.
b. *John sang a carol and ~~sang~~ beautifully.

That is, the ellipsis approach has an overgeneration problem in the sense that ill-formed sentences like (2b) and (3b) can be licensed by well-formed sentences like (2a) and (3a).

The main goals of this paper are (i) to examine all the relevant constraints imposed on various constructions of coordination that are related to Wasow's generalization, (ii) to explore how to impose more constraints on the ellipsis mechanism to solve problems of overgeneration and spurious ambiguity, and (iii) to show how to implement the constraints into the HPSG theory through the type inheritance hierarchy (Sag 1997, Ginzburg and Sag 2001).

Besides the unlike-category coordination and the non-constituent coordination, this paper also briefly discusses the so-called summative coordination (e.g., *The pilot claimed that the first nurse, and the sailor proved that the second nurse, were spies* (Yatabe 2002)) and the coordination with proximity agreement (e.g., *There was (either) a bee or two flies in the*

room/There were (either) two flies or a bee in the room).

The organization of this paper is as follows. In section 2, six types of coordination constructions are discussed. In section 3, previous phrase structure analyses are reviewed and their problems are discussed. In section 4, a new proposal is presented, focusing on how the constraints should be imposed to distinguish the non-constituent coordination from the constituent coordination and block the overgeneration problem caused by ellipsis. Section 5 is the conclusion.

2. Types of Coordination

For expository convenience, the coordination constructions are classified into six different subtypes according to their syntactic patterns : coordination of inconsistent features, coordination of unlike categories, argument cluster coordination, coordination with right node raising, summative coordination, and coordination with proximity agreement.

2.1. Coordination of Inconsistent Feature Values

NPs with inconsistent agreement feature values can be coordinated, which raises a question of what feature values the conjoined NP carries. In English, the relevant typical features are number and person. First let's consider examples of different number values. According to Sag et al. (1985), (i) the coordination of plural NPs are always plural, (ii) the coordination of a plural NP and a singular NP is always plural, (iii) the coordination of two singular NPs with *or* is either singular or plural, and (iv) the coordination of two singular NPs with *and* is always plural. The relevant examples are in (4):

(4) a. The boys and the girls seem/*seems happy.
b. Either the boys or the girls are/*is going to be there.
c. The students and professor Swansong are/*is meeting in the park.
d. Either Dana or Lee is/are going to lead the parade.
e. Kim and Terry are/*is happy. (Sag et al. 1985)

Here note that as shown in (4d), even when two singular NPs are conjoined with *or*, the conjoined NP can be plural at least for some speakers.

Another feature involved here is the person feature:

(5) a. Either we Americans or I myself will get ourselves in trouble.
b. Either you or I will perjure ourselves.
c. You and I may perjure ourselves.
d. We Americans and the British pamper ourselves.
e. You British and you Americans pamper yourselves.
f. You and Kerry have outdone yourselves.
g. You or Kerry have perjured yourselves. (Sag et al. 1985)

The examples show that the conjoined NP carries the lowest person among the person values of the conjunct daughters. That is, when a first person and a second person are conjoined, the conjoined NP carries a first person value (e.g., (5b)). When a second person and a third person are conjoined, the conjoined NP carries a second person (e.g., (5f)).

Besides the agreement features, the feature of finiteness affects the grammaticality in the coordination constructions as shown in (6) and (7) (Sag 2002):

(6) a. Kim [alienates cats] and [beat his dog].
b. Kim [alienated cats] and [beats his dog].
(7) a. *Kim [alienated cats] and [beating his dog].
b. *Kim [alienated cats] and [to beat his dog].
c. *Kim [alienates cats] and [beaten his dog].

The examples in (6) show that finite VPs can conjoin with each other, while examples in (7) show that finite and non-finite VPs cannot.

However, coordination is not sensitive to the auxiliary (AUX) feature (Sag 2002):

(8) Kim [likes bananas] and [is happy]. ([AUX -] & [AUX +]

Here, the first conjunct is headed by the lexical verb *likes* while the second conjunct is headed by the auxiliary verb *is*.

2.2. Coordination of Unlike Categories

In introductory linguistics textbooks, it is often stated that only the elements of the same category can be conjoined, and this simple and nice generalization is still valid in the practice of syntax in general. However, when we more seriously consider what 'the same category' represents, we find that this nice generalization gets much more complicated. Let's consider well-known examples in (9) and (10) from Sag et al. (1985), where the categories of the conjoined elements are not of the same categories at least in terms of the traditional category classification.

(9) a. Pat is either [$_{AP}$ stupid] or [$_{NP}$ a liar].
b. Pat is [$_{AP}$ healthy] and [$_{PP}$ of sound mind].
c. Sandy is either [$_{NP}$ a lunatic] or [$_{PP}$ under the influence of drugs].
d. I am [$_{VP}$ hoping to get an invitation] and [$_{AP}$ optimistic about any chances].

(10) Pat has become [$_{NP}$ a banker] and [$_{AP}$ very conservative].

According to Sag et al. (1985), whose theory is based on Generalized Phrase Structure Grammar where a category is defined as a set of partial descriptions of feature-value pairs, the common feature of each conjoined element in (9) is [PRED +], i.e., the category of the conjoined element is a predicate. In (10), by the same reasoning, the category involved is [PRD +, N +], a nominal predicate.

A different type of unlike coordination construction is illustrated by Peterson (2004). He proposes that the coordination of the unlike categories is in fact more sensitive to their functions rather than their categories. His examples are shown in (11):

(11) a. We walked [$_{ADVP}$ slowly] and [$_{PP}$ with great care].
b. They wanted to leave [$_{NP}$ tomorrow] or [$_{PP}$ on Tuesday].

c. We are open [$_{NP}$ Saturdays], [$_{NP}$ any national holiday], and [$_{PP}$ on alternate Sundays].

Here the categories of each conjunct are not the same, but they are all of the same function, the adjunct. His claim seems to be further supported by ill-formed examples like (12) where a complement and an adjunct are conjoined:

(12) a. *The scene [of the movie] and [that I wrote] was in Chicago.
b. *John sang [a carol] and [beautifully].

Another example of the unlike-category coordination is the one conjoining an NP and S (Sag et al. 1985):

(13) a. Pat remembered [$_{NP}$ the appointment] and [$_{S}$ that it was important to be on time].
b. We talked about [$_{NP}$ Mr. Colson] and [$_{S}$ that he had worked at the White House].
c. You can depend on [$_{NP}$ my assistant] and [$_{S}$ that he will be on time].
d. Pat was annoyed by [$_{NP}$ the children's noise] and [$_{S}$ that their parents did nothing to stop it].

What is special about the coordination of an NP and S is that a processing effect seems to be involved when a preposition takes an S as its complement, as shown by the contrast in (14):

(14) a. We talked about [$_{NP}$ the issues we had worked on as students] and [$_{S}$ that our perspectives had changed over the years].
b. *We talked about [$_{S}$ that our perspectives had changed over the years] and [$_{NP}$ the issues we had worked on as students].

Here, it is hard to imagine any theory that can syntactically account for the contrast. (14a) and (14b) are exactly the same except for the order of the conjuncts. We may assume that the sentences in (14) as well as (13b-d)

are all ungrammatical since a preposition cannot take a *that*-clause as its complement. However, this ungrammaticality may be ameliorated by a processing effect, i.e., an NP complement right after a preposition makes a remote *that*-clause complement much less offensive.

The coordination constructions are also sensitive to the dependent structures such as the subcategorization frame and unbounded dependency. The examples in (15) show that transitive and intransitive verbs, which have different subcategorization frames, cannot be conjoined:[1)]

(15) *John [kicked and died] the ball.

Examples in (16) show that the coordination constructions are also sensitive to the unbounded dependency structure, often called the Across The Board (ATB) constraint (Ross 1967):[2)]

(16) a. Which books did Robin [read ___] and [hate ___].
b. *Which books did Robin [talk to Chris]and [read ___]?
c. *Which books did Robin [read ____] and [talk to Chris]?
(Sag et al. 1985)

The ATB constraint says that each conjunct should carry an identical gap value. (16b,c) are ungrammatical since here one conjunct has a gap in it while the other does not.[3)]

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1) The following example may be an exception to the constraint of subcategorization frame, i.e., the valence identity in terms of HPSG:

(i) Ken wants [to go to Berlin] and [for Jane to visit the city as well]. (Yatabe 2004 quoting Carl Pollard (personal communication))

The first conjunct here has the non-empty subject list while the second conjunct has the empty subject list. The account of this example will be discussed in section 4.

2) Different from the examples in (16), the example in (i) below, where the whole conjuncts are extracted, requires another type of constraint such as the A-over-A Principle in Ross (1967) and the Trace Principle in Pollard and Sag (1994) (Kehler 1996):

(i) *Who did Robin visit ___ and ___?

3) The V-and-VP construction illustrated in (i) below is an exception to the

2.3. Argument Cluster Coordination

A special property of the argument cluster coordination (ACC), or so-called gapping, is that the matrix head of a non-first conjunct is elided:

(17) a. Kim likes Sandy, and Lee Leslie.
b. Kim gave a dollar to Bobbie and a dime to Jean. (Sag et al. 1985)

However, the elided element is not limited only to a head. A complement can also be elided:

(18) a. Kim went to the store, and (then) Lou.
b. Pat wanted to try to go to Berne, and Chris to try to go to Rome.
c. Pat wanted to try to go to Berne, and Chris to go to Rome.
d. Pat wanted to try to go to Berne, and Chris to Rome. (Sag et al. 1985)

In the ACC, a conjunct can carry more than two non-constituent elements including an adjunct:

(19) a. John gave the books to Mary at Christmas, and the records to Sue for her birthday.
b. Peter talked to his boss on Tuesday, and Betsy to her supervisor on Wednesday.
c. A businessman will drink a martini to relax, and a health nut, a glass of wine, just to remain healthy. (Sag et al. 1985)

In the ACC, the linear order of the non-constituent elements can be switched:

ATB constraint (Ross 1967):

(i) a. Here's the whisky which I [went to the store] and [bought ___].
b. Which dress has she [gone] and [ruined ___] now?

According Sag et al. (1985), this construction differs from the ordinary coordination construction. Here a verb like *go* inherently takes as its complement the VPs with a gap in it, such as [*bought* ___] and [*ruined* ___].

(20) a. A policeman walked in at 11, and at 12, a fireman (Sag et al. 1985).
b. John gave Mary a book and to Peter a record. (Crysmann 2003 citing Bob Levine)

According to Beavers and Sag (2004), the ACC of unlike categories is also possible as shown in (21).

(21) a. Jan travels to Rome tomorrow, to Paris on Friday, and will fly to Tokyo on Sunday.
b. Jan wanted to study medicine when he was 11, law when he was 13, and to study nothing at all when he was 18.
c. Yo either visits Jan on Monday, Pat on Tuesday, or else will visit them both at the end of the week.

For example, (21a) might be analyzed as a VP coordination, i.e., [$_{VP}$ *travels to Rome tomorrow, to Paris on Friday*], *and* [$_{VP}$ *will fly to Tokyo on*]. Then, the first VP conjunct should be analyzed as having an internal structure like [*travels* [[*to Rome tomorrow*], [*to Paris on Friday*]]], where [*to Rome tomorrow*] and [*to Paris on Friday*] form a non-constituent structure. However, as pointed out by Beavers and Sag (2004), a crucial problem with this analysis adopted by Combinatory Categorial Grammar (CCG) is that it must absurdly assume a comma between [*to Rome tomorrow*] and [*to Paris on Friday*] as a conjunction.

A better treatment of this construction may be to assume that all three conjuncts here are VPs, where the verb of the second VP is elided:

(22) Jan travels to Rome tomorrow, ~~travels~~ to Paris on Friday, and will fly to Tokyo on Sunday.

2.4. Coordination with Right Node Raising

Another coordination type often discussed in the literature is the coordination with right node raising (RNR):

(23) [Jan visited ___ and Yo refused to visit___] [my stepmother's father].

One of the special properties of this construction is that a phonological identity can resolve a syntactic feature conflict (Pullum and Zwicky 1986):

(24) a. *[I certainly will ___, and you already have ___] [clarify/clarified the situation with respect to the budget].
b. [I certainly will ___, and you already have ___] [set the record straight with respect to the budget].

In (24a), the verb form of the VP extracted rightward from the first conjunct should be the base, while the one from the second conjunct should be the past participle. This syntactic feature conflict induces the ill-formedness of (24a). Exactly the same situation occurs in (24b). Here the only difference is that the verb form of the right node raised VP has no phonological distinction between the base and the past participle. The existence of the neutralized form, *set*, is assumed to resolve the feature conflict, and thus (24b) is acceptable.

However, the following examples show that only the prosodic identity is not sufficient for the resolution:

(25) a. *At present the project managers, but in the past the executive directors, set the research priorities.
b. *Last year the major airlines, and every day numerous computer companies, cut their prices quite dramatically. (Pullum and Zwicky 1986)

Here the right-node raised VP's verb form might be a neutralized form of the present and past. However, the ungrammaticality of the given sentences suggests that such a neutralized form does not exist in English.

The examples in (25) show that the right-node raised neutralization requires more than just a phonological identity. We may consider which morphological forms are possible for neutralization. Also we may consider whether the expressions with the identical phonological form are really the same expression with the same reference or meaning.[4)]

The RNR coordination can cooccur with the ACC, resulting in a more complicated construction:

(26) [Kim told Pat that Jan visited ____] and [Sandy that Yo refused to visit ___] [my stepmother's father]. (Beavers and Sag 2004)

2.5. Summative Coordination

The sentence in (27) is an instance of the so-called summative coordination construction:

(27) The pilot claimed that the first nurse, and the sailor proved that the second nurse, **were** spies. (Yatabe 2002)

Sentence (27) has exactly the same meaning as the unelided version of (28) and thus may be considered to be licensed from (28) by the ellipsis of *was a spy*:

(28) The pilot claimed that the first nurse ~~was a spy~~, and the sailor proved that the second nurse was a spy.

Here what makes this construction intriguing is the plural form of the verb, *were*, in (27), which agrees with the summation of the first nurse and second nurse.

However, Beavers and Sag (2004) point out that a sentence like (29) below is more natural than (27) and claim that the summative agreement shown in (27) should be an extra-grammatical phenomenon.

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4) According to Beavers and Sag (2004), the semantic identity is not necessarily required for ellipsis:

(i) Stanford sent a letter to Bill informing him he was accepted and ~~a letter~~ to Jake informing him he was rejected.

Here the letters are semantically different ones, but one of them can be elided.

(29) The pilot claimed that the first nurse, and the sailor proved that the second nurse, **was** a spy.

According to them, (27) is an instance of various performance phenomena of summative agreement shown in (30):

(30) a. One of the children are not feeling well.
b. The pump as well as the motor are defective.
c. The helicopter for the flights over the canyon were . . .
d. Filling in for Mike and John on the weekends are among Stan's favorite duties.

This paper follows Beavers and Sag's (2004) position and considers the summative coordination as an extra-syntactic phenomenon.

2.6. Proximity and Coordination

Morgan (1972) observes the proximity condition in the *there* construction and the *or*-conjoined subject construction. At least for some speakers, the verb agrees with the closest conjunct NP when the subject is an *or*-conjoined NP, as shown in (31). The same observation is also made in the *there* construction even when the subject is *and*-conjoined as shown in (32) and (33):

(31) a. (Either) Harry or his parents *is/are coming.
b. (Either) Harry's parents or his wife ?is/*are coming.
(32) a. There was (either) a bee or two flies in the room.
b. There were (either) two flies or a bee in the room.
(33) a. There was a man and a woman in the room.
b. There was a man and two women in the room.
c. There were two women and a man in the room.

However, the grammaticality judgment varies among the speakers, and for some speakers, neither possibility is acceptable:

(34) a. ??Are/??Is (either) John or his parents here?
b. ??Are/*Is (either) John's parents or his wife here? (cf. (4b,c))

Moreover, when the verb carries no overt morphological manifestation of the agreement, this problem does not arise:

(35) Did (either) John or his parents leave?

There might be two approaches to this proximity condition on the agreement in the coordination constructions. One is Yatabe's (2004) view where separate parametric syntactic mechanisms are assumed for the *or*-conjoined coordination constructions that accommodate the speaker's variations. However, a big disadvantage of this approach is that it needs a very complicated agreement system.

Alternatively, we may assume that the proximity condition in English is simply extra-grammatical strategies. According to Peterson (2004), speakers may choose one of the several strategies to determine the verbal number. Differently from the core syntactic rules, the strategies are marked by hesitation and idiolectal variation, which are exactly shown in the agreement observed above.

Following Peterson (2004), this paper assumes that the number of verbal agreement is determined by the strategies at least when the subject is a coordinated NP. Some speakers may choose the 'closest conjunct' strategy (e.g., (31)-(33)), while others may choose the 'plural wins' strategy (e.g., *Either Dana or Lee are going to lead the parade* (=(4d)). Some other speakers cannot determine their strategy, and thus neither is possible for them (e.g., (34)).

3. Previous Phrase Structure Grammar Analyses and their Problems

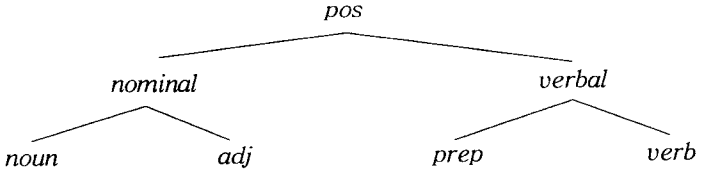
3.1. Underspecification-Based Analyses

Sag et al. (1985) provide a convincing and thorough analysis on English

coordination based on the set theoretic feature structures under the framework of Generalized Phrase Structure Grammar (GPSG, Gazdar et al. 1985). This GPSG approach uses the notion of underspecification to account for the unlike-category coordination. Even though this set-theoretic approach does not fit well in the current HPSG framework that has 'totally well-typed' and 'sort-resolved' feature structures (Ingria 1990), the notion of underspecification is adapted by Sag's (2002) version of HPSG analysis that is supplemented with the type hierarchy and has weak restriction on the sort-resolution. In this approach, a supertype in the type hierarchy plays the role of an underspecified category of its subtypes.

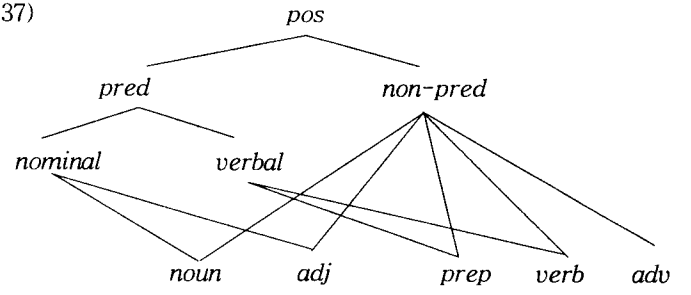
For example, the sentence like *Pat has become a banker and very conservative* (=(10)) is accounted for by the following type hierarchy on the parts of speech under the assumption that a verb like *become* takes a nominal as its complement, and that the nominal has subtypes *noun* and *adjective* (Sag 2002):

(36)



However, it is hard to extend this type-hierarchy based underspecificaton approach to account for the unlike-category coordination in (9) and (11). In order to account for (9), for example, we may need a new supertype *predicate* (or a new category, Predicate, as proposed in Fakas and Ojeda 1983) that includes as its subtype all the major four categories. This idea may be represented in the type hierarchy in (37):

(37)



This approach also accounts for examples like (11). Here a non-predicative adverb and preposition (or a non-predicative noun and preposition) are conjoined, where the conjoined elements' underspecified category is the *non-pred* in the hierarchy in (37). However, if we assume that any non-predicative category can be conjoined to allow (11), one of the general restrictions on coordination—only identical categories are conjoined—is totally lost, and the grammar allows many ill-formed sentences such as **John* [[*swam*] *and* [*happy*]] and **John sang* [[*a carol*] *and* [*beautifully*]].

A more serious problem with an underspecification-based approach is that the underspecification alone lacks explanation on argument cluster coordination and right-node raising coordination constructions discussed in sections 2.3 and 2.4.

Similar approaches to underspecification are made based on the theory of lattice (Levy and Pollard 2002, Daniels 2002). However, they also have the same problems. That is, it is not clear how they can be extended to account for the various unlike-category coordination and non-constituent coordination constructions.

3.2. Ellipsis-Based Approach

3.2.1. Ellipsis in HPSG

Beavers and Sag (2004) (B&S herefater) propose an ellipsis account of the non-constituent coordination based on the HPSG word order-domain theory (Reape 1994). Various proposals have been made for proper representations

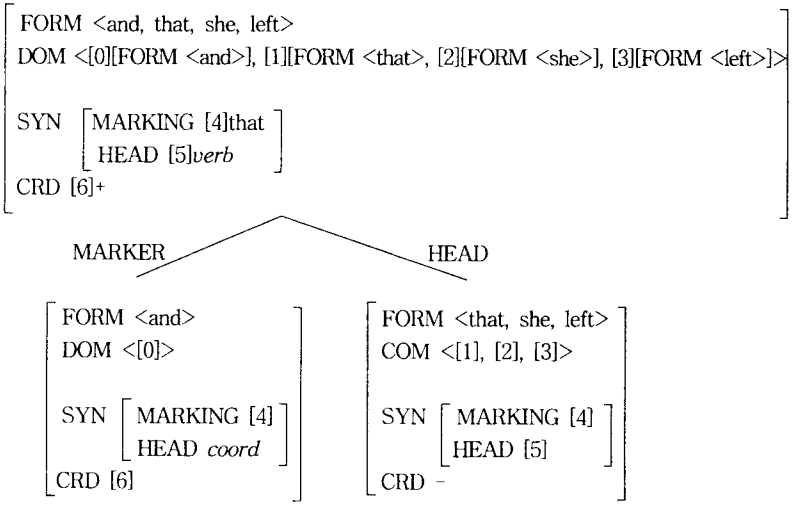
of constituency. One of the proposals is to separate the prosodic constituency or superficial linear order from the traditional syntactic constituency (Gazdar et al. 1985, Dowty 1992, Reape 1994, Kathol 1995, among others). For instance, Dowty (1992) presents such a distinction with the notions of the tectogrammatical structure vs. phenogrammatical structure (the syntax tree vs. domain tree in terms of Reape 1994):

(38) a. Tectogrammatical structure is a classical syntactic structure that guides the assemblage of meaning, describing the steps by which the interpretations of words and phrases combine to form the interpretation of a sentence.

b. Phenogrammatical structure describes how the combinations in tectogrammatical structure are realized in a string. It is a kind of structure in which the role of word order in realizing or expressing syntactic organization is articulated.

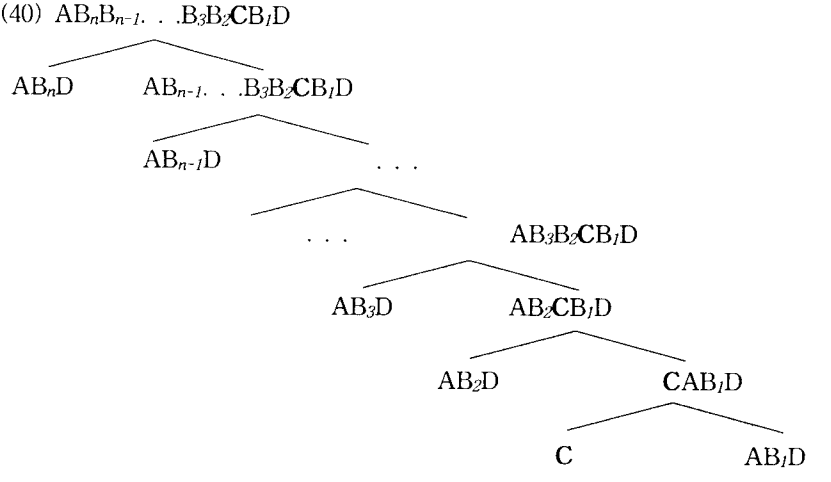
According to B&S, the phenogrammatical structure is represented by the DOM(ain) feature that takes a list of signs as its value. The structure in (39) below in B&S is an instance showing the relation between the DOM feature and other features for a clausal conjunct, *and that she left.* Here the conjunction *and* is considered as a marker. The DOM values represent the phenogrammatical structure, and it is the structure where elided elements can be identified.

(39)



The mechanism of ellipsis in B&S can be briefly sketched in the simplified DOM tree structure in (40) (=(19) in B&S):

(40) $AB_nB_{n-1}. \ . \ .B_3B_2\mathbf{C}B_1D$



Here, a coordination construction is made up of a conjunction C and other elements of the pattern AB_iD, producing a pattern of $AB_n. \ . \ .B_2\mathbf{C}B_1D$, where

the A or D is realized only once in the mother while all of the unique B_i is realized for each conjunct. The various types of coordination fall out of this schema depending on which parts of the strings are elided under identity, as shown in (41) (=(20) in B&S):

(41) a. Constituent Coordination: A=ε, D=ε (*John, Bill and Mary*)
b. Argument Cluster Coordination: A≠ε (*gave a dog a bone and a policeman a flower*)
c. Right Node Raising: D≠ε (*Sandy cooked, and Mary ate, a pizza*)
d. Both Non-Constituent Coordination and Right Node Raising: A≠ε and D≠ε (*John told mary that Bill , and Kim that Pat, was a die-hard fan of Gillian Welch*)

Here we will not go through the details of HPSG specific theory of ellipsis. Rather, the above-mentioned mechanism will suffice to show that HPSG can handle ellipsis with the word-order domain theory. Hereafter, this paper follows the traditional convention and uses crossing-out lines (e.g., ~~*ellipsis*~~) to represent elided elements, rather than using complicated DOM structures.

3.2.2. Pros and Cons of the Ellipsis-Based Approach

The ellipsis-based analysis is equipped with a very powerful mechanism and can account for various coordination constructions involving RNR (e.g., (42a)), unlike categories (e.g., (42b)), switched constituent order (e.g., (42c)), and clefting (42d,e)):

(42) a. Mary cooked ~~a pizza~~ and Bill ate a pizza.
b. Jan [[wanted another doughnut] and [~~wanted~~ to leave Boston by five sharp]].[5] (B&S)
c. John gave Mary a book and ~~gave~~ to Peter a record.
d. Stupid ~~is what Pat is~~ ___or a liar is what Pat is ___. (Yatabe 2004)

5) Pullum and Zwicky (1986) consider this pattern to be ill-formed:
(i) *I want another beer and ~~want~~ to have a good time.
Presently, we have no account of this judgment difference.

e. What he was ___ was a demagogue and ~~what he was ___ was~~ proud of it. (Yatabe 2004)

It can also account for the coordination of argument cluster with unlike categories, which is problematic with the Combinatory Categorial Grammar (B&S):

(43) a. Jan [[travels to Rome tomorrow], [[~~travels~~ to Paris on Friday], and [will fly to Tokyo on Sunday]]].
b. Jan wanted [[to study medicine when he was 11], [[~~to study~~ law when he was 13], and [to study nothing at all when he was 18]]].

Let's consider (43a) as an example to show how the ellipsis works. In the binary branching structure shown in (40), the second and third conjuncts form a constituent, [[*travels to Paris on Friday*] *and* [*will fly to Tokyo on Sunday*]]. At this stage, ellipsis cannot occur simply due to the lack of identical elements. Then, the verb *travels* in this constituent can be elided when the constituent combines with the first conjunct, [*travels to Rome tomorrow*], since both conjuncts carry the identical form of the verb, *travels*.

Despite the advantages, the ellipsis approach has an overgeneration problem, mainly due to the Conjunction Reduction, i.e. an NP coordination derived out of an S coordination by ellipsis of a verb phrase. Let's consider examples like (44). Here an ill-formed sentence like (44b) is allowed to be licensed by a well-formed sentence like (44a):

(44) a. John is my favorite friend and Mary is my favorite friend (too).
b. *John ~~is my favorite friend~~ and Mary is my favorite friend (too).

If the ellipsis is considered the only mechanism responsible for the coordination structure, another problem occurs in the reverse direction, i.e., a well-formed sentence like (45b) should be licensed from an ill-formed sentence like (45a):

(45) a. *John are my favorite friends and Mary are my favorite friends (too).
b. John ~~are my favorite friends~~ and Mary are my favorite friends (too).

A similar problem with the ellipsis-only approach is that it does not have any way of licensing sentences like (46) where different person features are involved in the conjoined subject:

(46) a. [You and I] may perjure ourselves.
b. [You or Kerry] have perjured yourselves. (Sag et al. 1985)

In order to license (46), we need to absurdly assume that ill-formed sentences in (47) license (46):

(47) a. *You may perjure ourselves and I may perjure ourselves.
b. *You have perjured yourselves or Kerry have perjured yourselves.

It also has a problem with some of the unlike category coordination, i.e., the source in (48a) is well-formed while the target in (48b) is ill-formed:

(48) a. John sang a carol and sang beautifully.
b. *John sang a carol and ~~sang~~ beautifully.

If the ellipsis mechanism is used together with the underspecification mechanism in order to license sentences like (45) and (46), it results in structural spurious ambiguity in many instances, i.e., one with underspecification (e.g., (49a)) and the other with ellipsis (e.g., (49b)):

(49) a. Pat has become [$_{nominal}$[a banker] and [very conservative]].
b. Pat has become a banker and ~~Pat has become~~ very conservative.

Another problem of the ellipsis approach already pointed out by B&S is that it cannot account for why quantifier merger reading only is allowed in

an elided sentence in (50a):

(50) a. Few people read the *WSJ* and vote Communist.
b. Few people read the *WSJ* and few people vote Communist.

B&S assume no specific syntactic constraint to block (50a) from being licensed by ellipsis from (50b). So, it is not clear how sentence (a) has only a quantifier merger reading while sentence (b) has a duplicate quantifier reading. A tentative solution suggested by B&S is to assume that sentence (a) is an instance of the VP constituent coordination with only one quantified subject and with no ellipsis involved. However, to make this assumption work, a more specific constraint needs to be added to the current B&S framework.

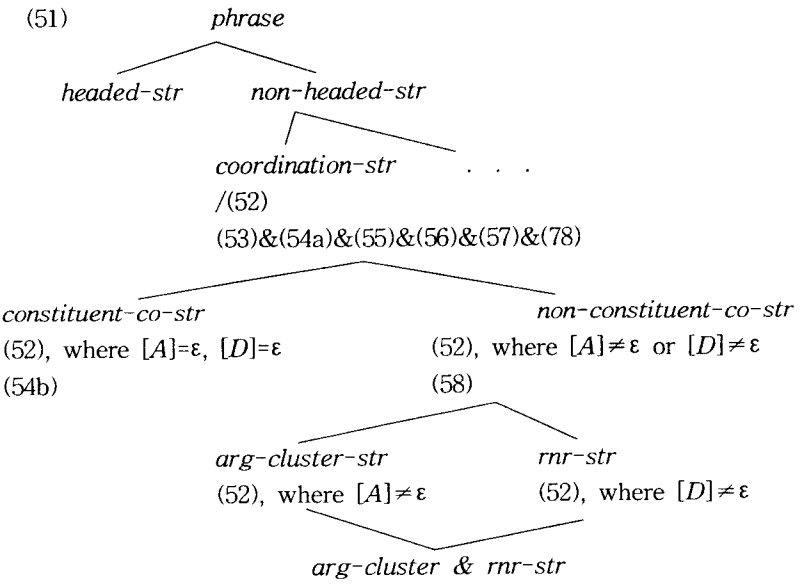
To summarize, there have been two types of approaches to coordination in the phrase structure grammar. The approach based only on underspecification is too weak mainly because it cannot account for the argument cluster and RNR coordination structures. The other approach based on ellipsis is too strong in the sense that it has illegal licensing problems (i.e., it allows the license of ill-formed sentences from well-formed sentences and vice versa). When both mechanisms are allowed to work together simultaneously, we still have an overgeneration problem as well as a spurious ambiguity problem in many instances.

4. A New Proposal

As already discussed in the previous section, underspecification alone cannot account for many of the coordination constructions, especially the argument cluster and RNR coordination structures. Thus it seems to be necessary to introduce the ellipsis mechanism even though ellipsis itself is too strong and causes its own problems. A main goal of this section is to explore how to impose constraints on the ellipsis mechanism so that the ellipsis appropriately applies only to apparent non-constituent coordination constructions such as the argument cluster, RNR, and unlike-category coordination structures.

The Head-Driven Phrase Structure Grammar (HPSG) is a theory of rich and precise lexical information. Besides the rich lexicon, another useful HPSG

mechanism is the type inheritance hierarchy. Here certain construction types are classified into subtypes, and each type carries its own constraints. The constraints in a supertype are generally inherited by its subtype. However, a more general default constraint on a supertype can be overridden by a more specific constraint on the subtype when they conflict with each other (Sag 1997, Ginzburg and Sag 2000, among others). This paper proposes the following type inheritance hierarchy for the English coordination constructions:



In (51), the coordination structure is assumed to be a non-headed structure, following Sag and Wasow (1999: 372). The non-headedness of the coordination structure arises from the observation that head features such as NUMBER and AUX in each conjunct daughter do not directly percolate up the mother node (e.g., (4)-(5) and (8)).

Also partly following B&S, the structure of the *coordination-str* in (51) is assumed to be (52):

(52)
$$\left[\begin{array}{l}\text{MTR}\ \left[\begin{array}{l}\text{DOM}\ [A]\oplus[B_1]\oplus[C]\oplus[B_2]\oplus[D]\\ \text{SYN}\ [P]\end{array}\right]\\ \\ \text{DTRS}\left\langle\left[\begin{array}{l}\text{DOM}\ [A]\left\langle\left[\begin{array}{ll}\text{FRM}&[F_1]\\ \text{HD}&[H_1]\end{array}\right],\ldots,\left[\begin{array}{ll}\text{FRM}&[F_n]\\ \text{HD}&[H_n]\end{array}\right]\right\rangle\oplus\\ \qquad [B_1]ne\text{-}list\oplus\left\langle\left[\begin{array}{ll}\text{FRM}&[G_1]\\ \text{HD}&[I_1]\end{array}\right],\ldots,\left[\begin{array}{ll}\text{FRM}&[G_m]\\ \text{HD}&[I_m]\end{array}\right]\right\rangle\\ \text{SYN}\ [Q]\\ \text{CRD}\ -\end{array}\right],\right.\\ \\ \left.\left[\begin{array}{l}\text{DOM}\ [C]\left\langle([\text{SYN}\ cnj])\right\rangle\oplus\left\langle\left[\begin{array}{ll}\text{FRM}&[F_1]\\ \text{HD}&[H_1]\end{array}\right],\ldots,\left[\begin{array}{ll}\text{FRM}&[F_n]\\ \text{HD}&[H_n]\end{array}\right]\right\rangle\oplus\\ \qquad [B_2]ne\text{-}list\oplus[D]\left\langle\left[\begin{array}{ll}\text{FRM}&[G_1]\\ \text{HD}&[I_1]\end{array}\right],\ldots,\left[\begin{array}{ll}\text{FRM}&[G_m]\\ \text{HD}&[I_m]\end{array}\right]\right\rangle\\ \text{SYN}\ [R]\\ \text{CRD}\ +\end{array}\right]\right\rangle\end{array}\right]$$

for n, m ≥ 0

This coordination structure licenses various types of coordination, depending on which element is not realized in the DOM values as shown in (40) and (41).

The constraint in (52) differs from B&S's original constraint in that it does not specify that the mother's SYN value be the same as that of each conjunct. The reason is that, as already discussed, in some coordination constructions, the values of the syntactic features such as PERSON, NUMBER, AUX, CAT, etc. can differ in each conjunct daughter and in the mother. Note that B&S do not have detailed discussions on underspecification matters.

In (51), the coordination structure has as its subtypes the *constituent-co-str*, and the *non-constituent-co-str*. The *constituent-co-str*, in turn, has as its subtypes the *argument-cluster-co-str* and the *right-node-raising-co-str*. Differences among those structures arise from the existence or non-existence of a certain material ([*A*] and [*D*]) at the relatively superficial level (i.e., at

the DOM list). Other constraints apply to a deeper syntactic level (i.e., at the SYN structure in (52)). The constraints in (53) through (57) apply at the SYN structure while (58) applies at the DOM structure, interacting with the SYN structure:[6)]

(53) Constraints on morphosyntactic features
The value types of the PERSON, VFORM, and AUX features of the mother are the same as those of each conjunct daughter or their supertype.

(54) Constraints on the number feature
a. The NUMBER value of the mother is *plural* when NPs are conjoined. (General)
b. The NUMBER value of the mother is *singular* when singular NPs are conjoined with *or*. (Specific)

(55) Constraints on the valence
The value of the VAL(ENCE) lists (i.e., SUBJ and COMPS lists) of the mother is the same as those of each conjunct daughter.

(56) Constraint on the SLASH feature
The SLASH value of the mother is the same as that of each conjunct daughter.

(57) Constraint on the category
The category value of the mother is the same as that of each conjunct daughter.

(58) Constraint on ellipsis in non-constituent coordination
Only one of the words with the identical PHON and FORM values, with the identical CAT value, and with the identical length of the VAL list value can be elided.

The constraint in (53) intends to obtain the same effect as the underspecification in Sag (2002). It accounts for examples like (5)-(8) with the assumption of the type hierarchies in (59), (61) and (63). Some of the

6) All the constraints in (53)-(58) can be represented in feature structures of the SYN and DOM values in (52). Such feature representations are not shown in this paper due to space limit.

relevant examples are repeated below each type hierarchy:

(59) PERSON
first
second
third (Sag 2002)

(60) a. [You and I] may perjure ourselves.
b. [You or Kerry] have perjured yourselves.

Here the conjoined NP's (mother node's) person value should be the lowest person among the conjunct daughters' person values. (53) accounts for this generalization since in (60a), the conjoined NP *you and I* carries a first person, which is a supertype of a second person in the first conjunct, and the same type as the second conjunct. Exactly the same account applies to (60b).

The constraint in (53) together with (61) also accounts for the examples in (62). In (62a), there exists a supertype of each conjunct, *finite*. In contrast, in (62b), the supertype of the first conjunct is *finite* while that of the second conjunct is *non-finite*. In this case, there is no supertype that can subsume each conjunct, and thus the finiteness feature value cannot be determined.

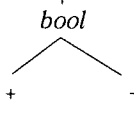
(61) VFORM
finite *non-finite*
present *past*

(62) a. Kim [alienates cats] and [beat his dog].
b. *Kim [alienated cats] and [beating his dog].

The type hierarchy in (63) assumes *bool* as the supertype of + and −,

which allows both [AUX +] and [AUX −] to be conjoined as in (64).

(63) AUX



(Sag 2002)

(64) Kim [likes bananas] and [is happy].

Constraint (54) accounts for the examples in (4) where the number value of the conjoined NP is plural. Some of the examples are repeated in (65):

(65) a. The students and professor Swansong are/*is meeting in the park.
b. Either Dana or Lee is/are going to lead the parade.
c. Kim and Terry are/*is happy.

Note that for most speakers, the conjoined NP is singular when singular NPs are conjoined with *or*. In type hierarchy (51), the general constraint in (54a) is imposed on the *coordination-str*, while the specific constraint in (54b) is imposed on its subtype *constituent-co-str*, which makes (54b) override (54a). For some speakers who judge the *or*-conjoined NP to be plural, the constraint in (54b) does not exist.

The constraint in (55) accounts for the example like (66), which is repeated from (15):

(66) *John [kicked and died] the ball.

Here *kicked* has an NP in the COMPS list while *died* has empty COMPS list. Thus the conjoined verb's VAL value is not identical to that of each conjunct daughter, and (57) is violated.

The constraint in (56) accounts for the ATB phenonenon in (16), two of which are repeated in (67):

(67) a. Which books did Robin [read ___] and [hate ___].
b. *Which books did Robin [talk to Chris] and [read ___]?

The examples in (67) can be analyzed as instances of the constituent coordination where VPs are conjoined. In (67b), the SLASH value of the mother is {NP}, while that of the second conjunct is empty. So (56) is violated.

The constraint in (57) intends to impose a general constraint,i.e., only the identical categories can be conjoined. It blocks sentences like (68) where unlike categories are conjoined

(68) a. *John sang [a carol] and [beautifully]. (=(48b))
b. *John ate [an apple] and [under the bridge].

In this approach, examples of unlike-category coordination in (9) and (10), three of which are repeated in (69) and (70), can be analyzed as instances of argument cluster coordination licensed by ellipsis:

(69) a. Pat [is healthy] and [is of sound mind].
b. Sandy [is either a lunatic] or [is under the influence of drugs].
(70) Pat has [become a banker] and [become very conservative].

The above sentences all observe the constraint in (57) at the SYN structure level since all the conjuncts here are the same VPs. The verbs in the second conjuncts here, however, can be elided under identity, and thus the second conjuncts can be analyzed as a type of non-constituent coordination—argument clusters consisting of only one argument—at the DOM structure.

A constraint on ellipsis in the non-constituent coordination structure is in (58) (i.e., only one of the words with the same phonological and morphological forms, with the same category, and with the same length of the valence list can be elided).[7] In (69a) for example, the verb *is* in the first conjunct and

7) As the name of the constraint suggests, the constraint in (58) intends to be imposed only on non-constituent coordination constructions such as argument cluster coordination (gapping) and some instances of the right node raising. It does not intend to cover other ellipsis cases like the VP ellipsis involving auxiliary verbs (Sag 1976, López 1994, Kim 2001, Kennedy 2003, Choe 2005,

the elided *is* in the second conjunct have the identical form and category. They also have the same length of the VAL value (i.e., the first *is* has [COMPS <AP>] while the second elided *is* has [COMPS <PP>]). They do not have exactly the same COMPS value but have the same length one list value. Thus, constraint (58) is observed, and the second *is* can be elided. The same constraints apply to the examples in (69b) and (70).[8)]

An example like (71), repeated from (68a), cannot be licensed by ellipsis due to violation of the constraint in (58):

(71) *John sang a carol and ~~sang~~ beautifully.

Here, the first *sang* has [COMPS <NP>] while the second elided *sang* has [COMPS < >]. So the second *sang* cannot be elided here, and (71) should be analyzed as an instance of the constituent coordination with no ellipsis involved: **John sang* [[*a carol*] *and* [*beautifully*]]. However, such a non-ellipsis analysis violates (57), and there is no way to license it.

The grammaticality judgments of unlike-category coordination examples in (11), (12) and (13) are also born out. Examples from each set are repeated in (72):

(72) a. We walked [$_{ADVP}$ slowly] and ~~walked~~ [$_{PP}$ with great care].
b. *The scene [of the movie] and ~~the scene~~ [that I wrote] was in Chicago.
c. Pat remembered [$_{NP}$ the appointment] and ~~remembered~~ [$_{S}$ that it was important to be on time].

---

among others).

8) Radford (1981: 59) considers the unlike-category coordination in (icd) awkward:

(i) a. John wrote to Mary and to Fred.
b. John wrote a letter and a postcard.
c. ?John wrote a letter and to Fred.
d. ?John wrote to Fred and a letter.

In our analysis, the sentences in (icd) can be legally licensed by the ellipsis at the level of syntax since they do not violate (58). The awkwardness may arise from a non-syntactic factor. Currently, we do not have an account of them.

In (72a), the verb *walked* in both conjuncts has the same length of the VAL lists (i.e., their COMPS lists are all empty). Thus, *walked* in the second conjunct can be elided. In (72b), *the scene* in the first conjunct has [COMPS <PP>], while the second one has [COMPS < >]. Thus, the length of the COMPS lists is not the same, and *the scene* in the second conjunct cannot be elided. In (72c), *remembered* in both conjuncts has the same length of COMPS value, <NP> and <S>, and thus the second *remembered* can be elided.[9) 10)]

Note that examples like (71) and (72b) are problematic with the ellipsis analysis in B&S since they have no specific constraints imposed on ellipsis, as shown in section 3.2.2.

The constraint on ellipsis in (58) accounts for the contrast in (73), repeated from (24), under the assumption that the verb *set* has a neutralized form of the base and past participle forms, as shown in the type hierarchy in (74), which is adopted from Sag (2002).

(73) a. *I certainly will ~~clarify the situation with respect to the budget~~, and you already have [clarified the situation with respect to the budget].
b. I certainly will ~~set the record straight with respect to the budget~~, and you already have [set the record straight with respect to the budget].

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9) The examples like (i), where the same verbs are repeated, may be problematic with our approach because *swam* in both conjuncts has the same VAL value, [COMPS < >], and thus can be elided:

(i) a. John [swam and swam].
b. *John swam and ~~swam~~.

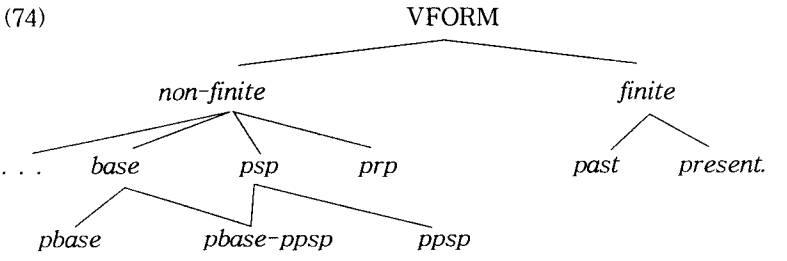
In order to block this kind of ill-formedness, we may need another constraint at the domain level.

10) In our approach, the example in footnote 2, which seems problematic with Yatabe (2004), is not problematic anymore:

(i) Ken wants [$_{VP}$ to go to Berlin] and ~~wants~~ [$_{S}$ for Jane to visit the city as well].

Here the verb *wants* in both conjuncts has the COMPS lists of the same length (i.e., <VP[*inf*]> and <S[*inf*]>), which allows the second *wants* to be elided.

(74)



In (73a), the form of the verb *clarify* in the first conjunct differs from the verb *clarified* in the second conjunct, and thus ellipsis of *clarify* violates constraint (58). In contrast, in (73b), the verb *set* in the first conjunct has exactly the same morphological form as well as the phonological form since both verbs can be assumed to have the same *pbase-ppsp* form, as shown in hierarchy (74).

However, such a neutralized form does not exist for every phonologically identical word. Let's consider the examples in (75), repeated from (25):

(75) a. *At present the project managers ~~set the research priorities~~, but in the past the executive directors [set the research priorities].
b. *Last year the major airlines ~~cut their prices quite dramatically~~, and every day numerous computer companies [cut their prices quite dramatically].

As shown in (74), a morphologically neutralized form does not exist for finite forms (i.e., for the present and past forms). In (75), the present verbs *set* and *cut* in the first conjuncts morphologically differ from the past verbs *set* and *cut* in the second conjuncts, which entails that *set* and *cut* in the second conjuncts cannot not be elided.

One of the problems with the B&S-style ellipsis analysis is that it does not provide a clear way of distinguishing constituent coordination from non-constituent coordination. The typical problem raised from this lack of distinctiveness is illustrated through the conjunction reduction examples in (76) and (77), repeated from (45) and (50), respectively:

(76) a. John is my favorite friend and Mary is my favorite friend.
b. *[John ~~is my favorite friend~~] and [Mary is my favorite friend].
c. John and Mary are my favorite friends.
(77) a. Few people read the *WSJ* and vote Communist.
b. [Few people read the *WSJ*] and [~~few people~~ vote Communist].
c. Few people [[read the *WSJ*] and [vote Communist]].

As already mentioned, a problem with the ellipsis analysis is that the ill-formed sentence in (76b) can be licensed from (76a) by ellipsis. In order to avoid this overgeneration problem, the sentence should be treated as an instance of constituent coordination where two NPs are conjoined, which entails that the subject be plural as in (76c). As for (77), we cannot simply say that (77a), which has a quantifier merger reading only, is licensed from (77b) by ellipsis of *few people*, because the unelided version of (77b) has a duplicate quantifier reading. Rather, (77a) should be analyzed to have the structure in (77c), which is an instance of the constituent coordination of two VPs. This structure naturally accounts for why (77a) has a quantifier merger reading only.

Then the question is how we can block the ellipsis in the examples in (76b) and (77b), i.e., how we can block the undesirable ellipsis so that a constituent coordination should not be misanalyzed as an instance of non-constituent coordination. To this end, a new constraint is proposed in (78):

(78) Constraint on disambiguation
In structure (52), $[A]=\varepsilon$ and $[D]=\varepsilon$ if
(i) the elements of $[B_1]$ and $[B_2]$ in the mother's DOM form a constituent at their own SYN structures, and
(ii) the constituents have the identical CAT value.

This constraint simply states that if the distinctive DOM elements of each conjunct form a constituent at each conjunct daughter's SYN structure, and if the constituent at each conjunct is the same category, then the involved structure should be a constituent coordination structure with no ellipsis involved.

By this constraint, ellipsis is not allowed for sentences like (76c) and (77c). For example, (77c) is an instance of a VP-coordinated constituent structure since the coordinated VPs, [*read the WSJ*] and [*vote Communist*], form their own constituents at their own SYN structures, respectively, and they are the same categories. So, the structure involved here is a constituent coordination structure, and the ellipsis is not allowed due to the violation of constraint (78).

Note that a duplicate quantifier reading of the subject is possible in the non-constituent coordination structure as shown in (79):

(79) a. ?A letter was posted from Gozo last Saturday and from Tunis this week.
b. Three men died in Baghdad on Tuesday and in Tikrit on Friday night. (B&S 2004)

Here neither [*from Gozo*] [*last Saturday*], nor [*from Tunis*] [*this week*], form a constituent at their SYN structure. Thus the constraint in (78) does not apply in (79), and ellipsis is allowed here, as shown in (80). Here a duplicate quantifier reading is obtained since each conjunct has its own quantified subject:

(80) a. ?A letter was posted from Gozo last Saturday and ~~a letter was posted~~ from Tunis this week.
b. Three men died in Baghdad on Tuesday and ~~three men died~~ in Tikrit on Friday night.

5. Conclusion

This paper explores a constraint-based approach to English coordination constructions. The main proposals of this paper are summarized as follows. First, it is shown that even though the mechanisms of underspecification and ellipsis provide convenient ways of analyzing unlike-category and non-constituent coordination constructions (Sag et al. 1985, Sag 2002, Beavers and Sag 2004, among others), they cause problems of overgeneration and spurious ambiguity.

Second, in order to avoid the problems, it is proposed that more constraints need to be imposed especially on the ellipsis: e.g., the constraint on ellipsis in the non-constituent coordination in (58) and the constraint that blocks the ellipsis analysis when a constituent coordination analysis is possible as in (79). These constraints interact with other constraints (e.g., the constraint on category identity in (57)) to eliminate the spurious ambiguity and overgeneration problem.

Third, classification of the various coordination into sub-constructions through the type inheritance hierarchy and incorporation of the various constraints into the hierarchy provide a more effective way of analyzing overall English coordination constructions.

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Received: 30 Dec, 2005
Accepted: 15 Mar, 2006