Parsing Locative Phrases in Korean: From a Deterministic Viewpoint*

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In parsing head-final languages in a deterministic way, there seem to be some constructions where the transition to the next parse stage appears to violate determinism and yet the constructions do not create any processing difficulty. In this paper, we examine such instances from Korean locative phrases, and explore the possibility of dealing with them deterministically. Even though in general VP-internal locatives are morphologically distinguished from VP-external ones in Korean, there is a case where an identical locative marker can appear in both VP-external and VP-internal position. We claim that such an instance should be considered as two distinct locative markers sharing the same phonetic form by accident, and the human parser is able to handle them without violating determinism, given that deterministic parsing is done by computing descriptions of dominance/precedence relations, rather than by building phrase structure trees directly.

1. Introduction

Head-final languages can pose serious problems for any parsing theories assuming incrementality in the respect that the head of a phrase, which carries crucial information for computing constituent structure, appears at the end of the phrase. Given that head-final languages are not particularly different from head-initial languages in terms of the speed and efficiency of parsing, it is natural to assume that head-final languages can be parsed incrementally, and there must be some devices compensating for the disadvantages resulting from head-

* This research was supported by a 2001 research grant from the Catholic University of Korea. I would like to thank Soowon Kim and Jie-Yang Lee for their comments and suggestions. I'm also grateful to the two anonymous reviewers for their helpful suggestions. Any errors in this paper are solely mine.

finalness. Suh (1994) and Weinberg (1993, 1995), among others, claimed that in head-final languages such as Korean and Japanese, case markers play a crucial role in creating a maximal projection immediately in the absence of the head of a phrase, and hence make incremental parsing possible. Such a claim is based on the observation that case markers unambiguously signal the type of maximal projections which they ultimately belong to, and hence it is safe to create maximal projections based on the information from the case markers.

Even though case markers in Korean are generally associated with particular types of maximal projections, there are some cases where more than one structural possibility is associated with a single case marker. Locative marker *eyse* is such an instance in the respect that it can appear in both VP-external and VP-internal positions, and hence it is questionable whether deterministic parsing is possible in such a situation. Since locative marker *eyse* does not pose particular parsing problems, there should be some way to deal with such a structural ambiguity without leading to costly reanalyses, provided that the human parser has some deterministic properties.[1] We claim that it is indeed possible to handle such a structural ambiguity in a deterministic way, if deterministic paring is done by considering the statements of precedence/ dominance relations in the sense of Marcus, Hindle, and Fleck (1983), rather than by creating and attaching phrase markers directly to the current structure.

Before considering the main issue, we will look over the basic mechanism of the human parser and the properties of the deterministic parser in the next section.

2. Properties of the Parser

2.1. Incrementality

One of the basic and crucial assumptions for the human parsing mechanism is the following: In the processing of natural languages, each input item is incorporated into a constituent structure representation of

1. It may be questioned whether the human parser is essentially deterministic. We will return to this issue in section 2.

a sentence as it is encountered, and the parser tries to build the possible maximal grammatical structure with the given information at every parse stage. Such a notion, incrementality, naturally excludes delay parsing strategies, and it usually subsumes incremental structure building and incremental interpretation. Given incrementality, an obvious problem the human parser should deal with is how to proceed when the information available at a certain parse stage is not enough or decisive. In particular, when there is more than one possibility of structure building with the current input, incremental structuring may be burdensome, provided that the parser must commit itself to a certain structural possibility, and that decision, if it turns out to be incorrect, cannot be retracted without causing some processing difficulty. Below we will consider such a case, i.e., structural ambiguity.

2.2. Serial Parsing vs. Parallel Parsing

An input string is 'structurally ambiguous' when it can be assigned more than one syntactic structure. A string is 'temporarily' structurally ambiguous when the subsequent string within the sentence resolves the ambiguity. What we consider in this paper is temporal structural ambiguity rather than global structural ambiguity, since we are interested in how the human parser makes a structural commitment at each parse stage.

What the human parser can do at the onset of an ambiguity is in principle one of the following; (i) it constructs more than one structure, and abandons particular structure(s) as they become incompatible with subsequent material. (ii) it constructs only one structure, and revises it later when it is not compatible with subsequent string. (i) is a typical parallel parsing model and (ii) is a serial parsing model.

It is also logically possible that the parser delays making a structural decision until disambiguating information is available. However, such a possibility is denied by the presence of severe garden path sentences like the following.

(1) #After the girl ate the food disappeared.

(2) #The boy hit fainted.

If the parser delayed the structural decision on *the food* in (1) and *hit* in (2) until the next word is processed, a garden-path would not result. The fact that both (1) and (2) lead to conscious processing difficulty suggests that the human parser does not delay in structuring linguistic input.

(1) and (2) can also be an argument against a strict parallel parsing model in the following respect: Suppose that in (1), a parallel parser, considering the fact that *ate* can be either transitive or intransitive, computes more than one structure for *the food* at the moment, i.e., *the food* as the object of *ate*, and as the subject of the following matrix clause. Then it becomes mysterious why the parser is garden-pathed at the very next moment, given that a parallel parser should consider more than one structural possibility. Similar remarks hold for (2): Since *hit* can be either a past-tense verb or a past participle, a parallel parser would construct more than one syntactic structure at the moment. Then it can hardly be accounted for why a garden-path results immediately after the next word is encountered.

Given the severe garden path sentences such as (1) and (2), it is highly unlikely that the human parser employs a strict parallel fashion or delaying strategies. Therefore, we assume that the human sentence processing mechanism is basically serial.[2]

2.3. Determinism and D-theory

The root of recent deterministic parsing models is the description theory (D-theory), which in turn developed from the Marcus parser. Marcus (1980) hypothesized that the sentences not creating conscious

2. Some parallel parsing models have been augmented with the idea of ranking or reanalysis, and hence able to deal with garden-path sentences such as (1) and (2). However, given that the idea of ranking or reanalysis is in fact the central notion of serial parsing, it is rather difficult to distinguish such parallel models from typical serial models. See Gibson & Pearlmutter (2000) and Lewis (2000) for the related discussion.

processing difficulty can be parsed strictly deterministically. A strict deterministic parser chooses a single analysis at every ambiguous point, and does not backtrack, i.e., it neither prunes nodes from the tree nor alters the attachment site for a node. The attractiveness of a deterministic parser is that the parsing architecture itself accounts for garden path phenomena: Parsing is deterministic, and when it cannot be deterministic, i.e., when it should retract structural commitments made earlier, it breaks down.

The major problem for a strict deterministic parser is the persuasive ambiguity of natural language. Since there exist temporarily ambiguous structures which do not lead to garden-path, it was necessary for a strict deterministic parser such as the Marcus parser to employ some lookahead device in order to handle such ambiguities. However, adopting a lookahead device led to many incorrect predictions. For instance, the garden path sentences such as (1) and (2), repeated here as (3) and (4), are incorrectly predicted to create no processing difficulty if we allow a deterministic parser to look only one word ahead.

(3) #After the girl ate the food disappeared.

(4) #The boy hit fainted.

Given such weakness in terms of the psychological plausibility of the parser, it was inevitable to modify the strict determinism in Marcus (1980). Marcus, Hindle, and Fleck (1983), retaining the basic idea of determinism, tried to relax the condition that all the structure created by the parser in the parse sequence must be part of the final output. In their system, the output of the parse consists not of a tree structure but of a syntactic description, which is statements about 'dominance' relations among categories. Due to such characteristics, their theory is called description theory (D-theory). D-theory is often classified as 'underspecification' theory since structural descriptions can be underspecified due to the fact that the predicate 'dominance' encodes constituency, but not necessarily immediate constituency. Consider the following.

(5) d (B, x)
d (A, B)
d (A, C)
d (C, y)

(5') d (B, x)
d (A, B)
d (A, C)
d (C, y)
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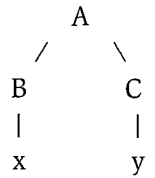
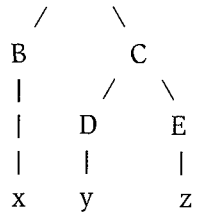
d (C, D)
d (C, E)
d (D, y)
d (E, z)

(5a)



(5b)



The descriptions on dominance relations in (5) and (5') amount to the phrase structure trees in (5a) and (5b), respectively.[3] Notice that the

3. In order to construct (5a) from (5), we also need descriptions on precedence relation. That is, two precedence statements, 'p (B, C)' and 'p (x, y)', should be added to (5) for obtaining (5a). Similar remarks hold for constructing (5b) from (5'). Since dominance relation is our major concern, descriptions on precedence relation will not be mentioned in this paper, unless it is directly relevant to the discussion.

descriptions in (5) are subsumed by those in (5'): The dominance descriptions in (5) are equivalent to the first four descriptions in (5'). Given that the dominance descriptions in (5) amount to the structure in (5a), let us consider whether (5) can be associated with (5b). If we employ the notion of 'direct dominance' in computing relevant structure, (5) cannot be equivalent to, or part of (5b), since 'y' is not directly dominated by 'C'. However, if we hypothesize that 'd (C, y)' does not necessarily mean that 'C directly dominates y', then it becomes possible that (5) is subsumed by (5b), since 'y' is still dominated by 'C' in (5b). This in turn allows (5)/(5a) to be part of the final output represented in (5b), since all of the dominance relations in (5)/(5a) are retained in (5b). Therefore, by assuming that the predicate 'dominance' does not necessarily encode immediate constituency, we can make the transition from (5)/(5a) to (5b) possible without violating determinism. This is a welcome result since there is a wide range of empirical evidence that the kind of transitions patterning with the above one creates no processing difficulty.[4]

Some remarks on the criticism of deterministic parsing are in order. There have been some psycholinguists criticizing determinism, by providing some empirical arguments.(Fodor & Inoue 1994, 2000, Meng & Bader 2000) However, their criticism is not really valid in the sense that what they have shown is that garden-path may result from something other than the violation of determinism, rather than the violation of determinism may not result in garden-path. Notice that deterministic parsing theories DO NOT claim that every garden-path results from violating determinism, i.e., being unable to maintain dominance relation throughout the entire parse sequence. Rather, they admit that some garden-paths can result from violating some other conditions, and different deterministic models indeed postulate additional conditions of their own to deal with such garden-paths.

4. Meanwhile, when a transition from one parse stage to another leads to retracting the dominance relation(s) asserted previously, then a garden-path necessarily results. For instance, the severe garden-path effect observed in (3) is attributed to the fact that the dominance relation between *ate* and *the food,* which was asserted when *the food* is encountered, cannot but be retracted at the final stage. See Gorrell (1995) and references cited there for details.

In short, the central claim of deterministic models seems to remain valid, and hence we assume that the dominance relations asserted in the parse sequence must be maintained, and that when they are retracted, a garden-path necessarily results.

2.4. Parsing head-final languages

It is an interesting question whether strict head-final languages can be parsed by employing the same principles or strategies necessary for parsing head-initial languages. That is, provided that incrementality is the basic and universal parsing principle and that the information from the head is essential in computing constituent structure, it appears to be very difficult in head-final languages to assign proper structure immediately to encountered items, since incremental processing and utilizing the information from the head are in conflict. If emphasis is put on utilizing the information from the head, the idea of (partial) delay parsing may be adopted, as in Pritchett (1991, 1992). Such an approach, however, doesn't seem desirable, given that there are strong empirical arguments for immediate constituent structure building in the absence of the head. (Inoue 1991, Inoue & Fodor 1995, Suh 1994) Therefore, we assume that in parsing head-final languages, there is some information other than from the head which plays a major role in guiding first-pass processing. In Korean, case markers seem to be able to play such a role since they signal the type of maximal projections which they ultimately belong to. In other words, it is possible to create maximal projections based on the information from the case markers. For instance, the presence of a nominative marker (on the subject) triggers creating an IP, and the presence of an accusative or a dative marker triggers creating a VP. This is one crucial operation by which constituent structure building can be done incrementally in this language, and below we will consider a specific example, i.e., a locative marker and its projection in a phrase structure tree.

3. The Syntax and Semantics of Korean Locatives

3.1. Argument vs. Adjunct Locatives

Korean locatives have a very interesting property, which is not found in English-type languages. As observed in Suh (1994) and Dorr, Lee, and Suh (1994), VP-internal locatives, i.e., argument locatives of the verbs, are morphologically distinguished from VP-external locatives. Consider the following.

(6) *Minho-nun* *lakhe-ey/ *-eyse* *kapang-ul* *nehesse*
-Top locker-Loc bag-Acc put
'Minho put his bag in the locker.'

(7) *Minho-nun* *lakhe-eyse/ *-ey* *cam-ul* *casse*
-Top locker-Loc sleep-Acc slept
'Minho slept in the locker.'

lakhe-ey in (6) functions as a verbal argument, given that *nehessta*(put) requires a locative phrase as its complement. Meanwhile, *lakhe-eyse* in (7) is not a locative phrase subcategorized by the verb. Rather, it merely sets the spatial background of the whole sentence. Hence, it is classified as an adjunct.[5] The grammatical distinction between *ey* and *eyse* marking seems rather clear; we cannot use the two locative markers the other way around, as the grammaticality of (6) and (7) suggests.[6] Notice

5. Semantically, it can be considered as a spatio-temporal argument in the sense of Kratzer (1989) or Event argument in Higginbotham (1985).

6. There seem to be a few verbs which are compatible with both ey- and eyse-marked locative phrases. Consider the following.

(i) *Inho-nun* *sewul-ey/ sewul-eyse* *sale*
-Top -Loc -Loc live
'Inho lives in Seoul.'

(i) shows us that both *ey*- and eyse-marked locatives are possible with the verb *sal-ta*(live). The existence of such a verb, however, does not undermine our proposal that the distinction between *ey* and *eyse* locatives reflects the argument/ adjunct dichotomy. We argue that there are two kinds of *sal-ta*, one taking a locative argument and the other not. In the former, a close semantic relationship between the verb and its locative is observed. Meanwhile, the latter instance of *sal-ta* is simply interpreted as 'leading a

that, as shown in the following examples, when the verb subcategorizes *ey*-marked locative phrases, they are required semantically rather than syntactically.

(8a) *Minho-nun* *seysi-ey* *hakkyo-ey/ *-eyse* *tochakhaysse*
-Top 3 o'clock-at school-Loc arrived
'Minho arrived at the school at 3 o'clock.'

(8b) *Minho-nun* *seysi-ey* *tochakhaysse*
-Top 3 o'clock-at arrived
'Minho arrived at 3 o'clock.'

(9) *Minho-nun* *(hakkyo-eyse/ *-ey)* *yakwu-lul* *haysse*
-Top school-at baseball-Acc did
'Minho played baseball (at the school)'.

Unlike *neh-ta*(put) in (6), *tochakha-ta*(arrived) in (8) does not require a locative phrase syntactically; (8b) as well as (8a) is a perfectly grammatical sentence. The fact that the locative phrase in (8a) must be *ey*-marked suggests that the dichotomy between *ey* and *eyse* should be based on whether the verb needs a locative phrase semantically. In other words, when a locative phrase functions as a verbal argument in the sense of Jackendoff (1983, 1990), it must be *ey*-marked. On the other

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certain life'. The following paradigm is relevant to that point.

(ii) *Inho-nun* *sewul-eyse* *cal* *sal-ko* *isse*
-Top -Loc well live-conj be
'Inho is leading a happy life in Seoul.'

(iii) *?*Inho-nun* *sewul-ey* *cal* *sal-ko* *isse*
-Top -Loc well live-conj be

When the verb *sal-ta* is accompanied by an adverbial *cal*, meaning 'lead a happy life', only *eyse*-marked locative is compatible with the sentence. Such a phenomenon is rather expected in the following respect: When we talk about 'somebody's leading a happy life', the focus is probably not on which place he actually lives in. In other words, the relation between the locative phrase and the verb is not tight. Therefore, if a locative phrase should be used in that case, it would provide simple background information for the event represented by the sentence, and hence it is naturally *eyse*-marked.

hand, when a locative phrase simply sets the spatial background of the event depicted by the sentence, it needs *eyse* marking, as in (9).

One remark on the distribution of Korean locative particles is in order. Thus far, we have concentrated on the distinction between *ey* and *eyse* marking. However, such a distinction between VP-internal and VP-external locatives may be extended to the other locative phrases as well. Simply put, only *eyse* (and its variant *eykeyse*) mark VP-external locatives, and the other locative particles such as *lo* or *kkaci* mark verbal arguments.

3.2. Two Kinds of *eyse*

Even though VP-internal locative particles in Korean can generally be distinguished from VP-external ones in terms of their morphology, there is a case where an identical locative particle can mark an adjunct outside VP as well as a verbal argument. Dorr, Lee, and Suh (1994) pointed out that *eyse* has such a dual function.[7] Consider the following.

(10) *Minho-ka* *chimtay-eyse* *cam-ul* *casse*
-Nom bed-Loc sleep-Acc slept
'Minho slept on the bed.'

(11) *Minho-ka* *chimtay-eyse* *tteleciesse*
-Nom bed-Loc fell
'Minho fell from the bed.'

In (10), *chimtay-eyse* is an adjunct describing spatial background of the sentence, whereas in (11) it plays a role as a Source argument of the verb. It can be clearly observed from the following sentence that *eyse*-marked phrases are able to function more than one way.

7. It has often been pointed out that semantically, *eyse* has more than one function. (See Lee 1998, Lee & Chae 1999, and references cited there.) But the majority of Korean grammarians consider that there is only one locative marker *eyse*, and different meanings of *eyse* result from associating *eyse*-marked phrases with various types of predicates (or other elements) in the clause. As for the phrase structural status of *eyse*, the possibility of positing two kinds of *eyse*, VP-internal and VP-external locative marker, has not been pursued in the literature.

(12) *kesil-eyse* *elinai-ka* *sopha-eyse* *tteleciesse*
living room-Loc child-Nom sofa-Loc fell
'In the living room, the child fell from the sofa.'

Containing two *eyse*-marked phrases, (12) receives a natural interpretation since each locative phrase plays its own role: The initial *eyse* phrase is an adjunct outside VP, while the second one is employed as a Source argument of the verb *tteleci-ta* (fell). Consequently, no contradiction or redundancy arises from the interpretation of the sentence.

In the previous section, we have shown that VP-external and VP-internal locative particles are generally differentiated in terms of their morphology. This suggests the possibility that the two instances of *eyse* observed in the above may be just one accidental phonetic realization of two different particles. Dorr, Lee, and Suh (1994) claimed that there are indeed two different *eyse*, VP-internal and VP-external locative particles, and the former is not a single morpheme but combination of two distinct morphemes. The following paradigm is relevant to that point.

(13) *ai-ka* *namwu- ey-se* *tteleci-ess-e*
child-Nom tree -Loc-se fell
'A child fell from the tree.'

(14a) *na-nun* *Inho- eykey-se* *ton-ul* *kkwu-ess-e*
I-Top -Dat-se money-Acc borrowed

(14b) *na-nun* *Inho- hanthey-se* *ton-ul* *kkwu-ess-e*
I-Top -Dat-se money-Acc borrowed
'I borrowed some money from Inho.'

The locative particle *ey-se* in (13) is used for marking an inanimate Source argument, and *eykey-se* in (14a) and *hanthey-se* in (14b) for an animate Source argument. Notice that all of the three particles have their corresponding locative or dative particle, i.e., *ey*, *eykey*, and *hanthey*, and they are derived by adding *-se* to their counterpart. This paradigm strongly suggests that *-se* has the function to derive a Source

marker from a default locative marker. This said, *eyse* in (11) or (13) should be considered to consist of two distinct morphological units, *ey* and *se*. On the other hand, *eyse* in (10) must be a single morphological unit.

In sum, the dichotomy between argument and adjunct locative markers is valid. The usage of *eyse* as a Source marker may appear to be an exception to the dichotomy, but *eyse* in that case is fundamentally different from adjunct marker *eyse*, sharing the same phonetic form by accident.

4. Parsing Korean Locatives Deterministically

4.1. Node creation and attachment

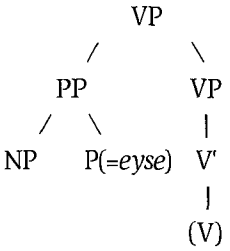
Node creation and attachment are motivated by the principles of grammar, and X-bar theory is one of them. Based on the X-bar requirement that every Xo projects to an XP, the parser projects not only Vo but also VP as soon as it receives a verb. In a head-final language such as Korean, however, projecting an XP will often be delayed if the parser uses such a strategy since Xo occurs at the end of the phrase. Hence, some information other than from the head must be utilized for incremental structure building. As observed earlier, case particles in Korean can play such a role, since they signal the type of maximal projections which they ultimately belong to. Thus, when a noun phrase with a locative particle is encountered, the parser can project a maximal projection PP and the higher projection it is attached to. Let us consider specific examples below.

Given that the morphology of locative markers generally signals whether their projections are verbal arguments or adjuncts, the parser can rely on the following strategy: (i) Locative particle *eyse* (and its variant), which marks adjunct, triggers projecting a PP and a VP, and the former is attached to the VP-adjoined position.[8] (ii) The other

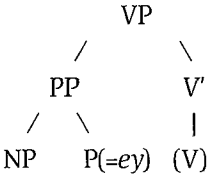
8. Theoretically, it seems also possible that adjunct PPs are attached under IP (or IP-adjoined position). Provided that adjunct PPs appear on the IP level, locative particle *eyse*, which can lead a verbal argument as well as an adjunct, can be a problem for a deterministic

locative particles, which mark verbal argument, trigger creating a PP and a VP, and the former is attached under the latter. By applying (i) and (ii), the following phrase structure trees are obtained.

(15i)



(15ii)



4.2. A Problematic case:- *eyse* as an argument marker

A potential problem for a deterministic parser is the locative marker *eyse*, which has a dual function. In dealing with an *eyse*-marked phrase, let us assume that the parser attaches it to the VP-adjoined position, as in (15i). If it turns out that it is not an adjunct but a Source argument, the parser should revise the structure and build a tree such as (15ii). Notice that the transition from (15i) to (15ii) cannot but involve deleting one VP node. Provided that, as assumed in most deterministic parsing theories, deleting previously computed nodes is violation of determinism, an *eyse*-marked phrase functioning as a Source argument is incorrectly predicted to cause conscious processing difficulty. Below, we will consider how to deal with such a problem.

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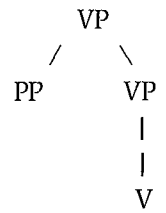
parser, since deleting previously created nodes (=IP) may be inevitable in some parse stage. That is, assuming that node deletion necessarily results in conscious processing difficulty, adjunct PPs led by *eyse* are incorrectly predicted to create processing difficulty. Admitting this problem, we simply assume that an adjunct PP is attached to a VP-adjoined position.

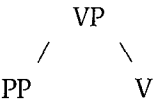
4.3. Dominance Relation in Adjunction Structure

Let us review the problem pointed out in (15i) and (15ii), repeated here as (16i) and (16ii).

(16i)



(16ii)



Assuming that determinism doesn't allow node deletion during the entire parse sequence, it appears to be impossible to move from (16i) to (16ii) without violating determinism. However, since *eyse*-marked Source arguments do not cause particular processing difficulty, there must be some way to derive (16ii) from (16i) without deleting a VP node, provided that deterministic parsing models are psychologically plausible. Let us first consider the origin of relaxed deterministic models, i.e., the D-theory in Marcus, Hindle & Fleck (1983). They proposed that the parser computes a description of a structural representation, which is then interpreted by other processors. As observed previously, the significant aspect of descriptions is that the predicate for hierarchical structure is 'dominate' rather than 'directly dominate'. Then, the descriptions (=dominance and precedence statements) which amount to the above phrase structure trees will be the following.

(17i) d (VP, PP)
d (VP, VP)
d (VP, V)
p (PP, V)

(17ii) d (VP, PP)
d (VP, V)
p (PP, V)

Notice that there is only one precedence statement, 'p (PP, V)' in (17i), and it is indeed not possible to have a statement such as 'p (PP, VP)' in this case, due to the following restriction from Partee, Meulen, and Wall(1993).

(18) Exclusivity Condition: In any well-formed tree, either p (x,y) or p (y,x) is true if and only if neither d (x,y) nor d (y,x) is true.

(18) states that two nodes are in a precedence relation if and only if they are not in a dominance relation. Given this, a precedence relation between PP and VP cannot hold in (17i), since there is a dominance relation between VP and PP.[9]

Let us reconsider the dominance statements in (17i). If we follow Partee, Meulen, and Wall (1993), among others, in assuming that every node dominates itself, then it is not necessary to specify the dominance relation between VP and VP. That is, we don't need to include 'd (VP, VP)' in (17i), and consequently (17i) and (17ii) can be considered to be identical. This means that the transition from (17i) to (17ii) becomes possible without violating determinism. Given this, computing descriptions on structural relations rather than computing structural representations directly seems to be a desirable strategy for a deterministic parser.

One remark on the nature of syntactic description is in order. Even though the descriptions in (17ii) seem to be subsumed by, or equivalent to those in (17i), there is still a clear difference between their corresponding structural representations; (16i) contains two VP nodes whereas (16ii) has only one. Such a discrepancy is in fact attributed to the basic architecture of D-theory in Marcus, Hindle, and Fleck (1983): A D-theory description is different from a structural representation in the respect that it makes

9. It is possible that 'p (PP, VP)' and 'd (VP, PP)' hold at the same time, if the two VPs in each statement are distinct. Below we will show that, adopting the mechanism of D-theory, we don't need to consider such a possibility.

use of names rather than unique node labels. This means that if two statements make reference to a VP, it is possible that the reference is to a single VP as well as to distinct VPs. If there is conflicting information in terms of maintaining the single VP interpretation, then two distinct VPs are postulated.[10] Given this mechanism and the assumption that every node dominates itself, (17i) can be associated with either (16i) or (16ii).

To recapitulate, if a deterministic parser computes a description of a structural representation, it can deal with adjunction structure effectively. It can also be considered as a psychologically plausible model in the respect that it can be free from incorrect predictions on some garden-path effects.

5. Conclusion

Given that head-final languages as well as head-initial languages are processed incrementally and hence the former need to rely on the information from the case particles for immediate structure building, the possibility that one case particle can be associated with more than one type of syntactic structure poses a serious problem for a deterministic

10. Such a way of computation seems to be another reason why D-theory is considered to be an underspecification theory. Let us consider one example from Marcus, Hindle, and Fleck (1983).

X is an NP; Z is an NP
Y is an Adjective Phrase
W is a noun
X dominates Y
Z dominates W

"If nothing else is stated about W, X, Y, or Z, then it cannot be determined whether X and Z are aliases for the same NP node or are names for two distinct nodes. If an additional statement is added to the description that "Y dominates Z", then it must be the case that X and Z name distinct entities." (Marcus, Hindle, and Fleck 1983, p.129)

Since D-theory descriptions do not use unique node labels, there is always potential ambiguity in terms of whether two names refer to different entities. Note that, as an anonymous reviewer pointed out, the same type of nodes can't be equivalent to identical nodes. In this respect, the descriptions a D-theory parser computes may not lead to perfect phrase structure representations. In fact, this is rather inevitable simply because a D-theory parser often computes underspecified structure.

parser. Korean locative marker *eyse* is such a problematic example, and it may be questionable whether deterministic parsing is possible in that case. We have claimed that if we adopt the proposal from Marcus, Hindle, and Fleck (1983), the constructions containing *eyse*-marked phrases can be parsed deterministically. This claim, of course, is based on the assumption that constituent structure can be built either by computing descriptions on dominance/ precedence relations or by computing structural representations directly from the input. Whereas Marcus, Hindle, and Fleck (1983) imply that the difference between the two mechanisms is minimal, we may need to find more instances which can tease the two apart. The Korean data observed thus far, however, suggest that direct tree building for the computation of constituent structure may not be desirable for a deterministic parser.

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