

# Bare Numeral Constructions and the Discourse Representation of Partitivity

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**Minpyo Hong. 2001. Bare Numeral Constructions and the Discourse Representation of Partitivity.** *Language and Information* 5.1, 17–34. Kamp & Reyle's (1993) proposal to represent split antecedents to a plural pronoun in terms of summation and abstraction is critically reviewed in this paper. I point out some weaknesses of their analysis as well as wrong predictions they make. I propose to treat the partitive reading found in bare numeral constructions by separating the conventional DRS construction rules from the cognitively motivated DRS-operations at a different level. A preference rule is also proposed that would constrain the sortal structure of discourse referents when such operations as summation and abstraction are enforced at the DRS's of relevant levels. Evidence for the separate treatment of linguistically motivated processes apart from cognitively motivated ones comes from both English and Korean constructions involving definite plural pronouns and numeral classifiers. (Myongji University)

## 1. Introduction

Since Kamp (1981) and Heim (1982) proposed a non-quantificational interpretation of indefinites, puzzles involving donkey anaphora seem to have been resolved as a by-product. For example, Kamp's Discourse Representation Structure (DRS) construction rules introduce a discourse referent, along with their conditions, whenever there is a nominal expression within a sentence that is being computed. The subsequent occurrence of anaphoric expressions like English pronouns can pick up one of the discourse referents that are already introduced by earlier computation of the sentence. And, of course, there are some restrictions on the accessibility of those variables. Neither Kamp nor Heim, however, included any treatment of plural NP's in their analyses.

In a non-dynamic framework, Link (1983) proposes to treat plural NP's as denoting individuals which are internally structured, not as denoting a set of simple individuals. The main claim of Link's logic of plurals is that the traditional concept of ontology or the domain of discourse should be modified so that the denotation of an individual is conceived not simply as an object that meets the description of the relevant nominal predicate, but an object that has its own structure, namely, the complete semi-lattice structure. Link argues that the plural expressions refer to the individual which consists of atomic parts. With such new concepts of an individual denotation, problems with plural constructions could be handled rather easily.

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One interesting question arises now about the representation of plural NP's in the discourse representation theory, since there are some cases where a plural NP serves as an antecedent to an anaphoric expression as illustrated below where the plural pronoun *they* is anaphoric to the plural NP *students*.<sup>1</sup>

- (1) Students came to the party. *They* seemed to enjoy it.

In order to account for the anaphoric relation between the plural antecedent and the plural pronoun, it seems that one needs to introduce Link's notion of sum-individual into the domain of discourse referents. And this is what Kamp & Reyle (1993) propose.

Kamp & Reyle adopt Link's plural logic and slightly modify the notion of domain of discourse according to Link's proposal. Then the example above seems to pose no problem because the occurrence of the plural NP *students* introduces a discourse referent, say X, just like other ordinary NP's. The pronoun *they* in the second utterance picks up that variable as its antecedent, though the notion of referent for the new variable X is now different from simple referents in that it has its own internal lattice structure. In addition, by introducing the part-relation into the condition component of the DRS, they can correctly predict collective or distributive readings of plural NP's.

Now let's consider a slightly different discourse in the following:<sup>2</sup>

- (2) Students came to the party. Five had a good time.

One of the possible readings of the numeral subject in the second utterance is the partitive reading, meaning roughly that among those students who came to the party, five of them had a good time. Such partitive constructions are interesting in that the number word *five* does not pick up the whole set of entities that meet the descriptive content *student* (i.e., the closure of student), but just part of the denotation of the antecedent. Thus, one should be able to account for where the partitive reading comes from even though there are no overt morpho-syntactic cues, e.g., 'of them' as in *five of them*, which would undoubtedly lead us to interpret the construction as a partitive.<sup>3</sup>

English has a rather limited range of "bare numerals." In Korean and Japanese, however, where the numeral is normally flanked by a classifier due to language-particular morpho-syntactic constraints, such constructions are very productive and always give a partitive interpretation. Furthermore, since the classifier of an appropriate type shows up very frequently in the numeral phrase of these languages, the anaphoric relation between the "antecedent" noun and the numeral phrase becomes more perspicuous. For example, when the antecedent common noun denotes the set of objects that are human, then the classifier that comes with a number word should be of an appropriate form, namely, *myeng* for ordinary human individuals, *pwun* for respected persons like professors or teachers. If, on the other hand, the head noun refers to a slim, long objects like pencils, then classifiers other than *calwu* will make the sentence unacceptable. Let's consider the following examples:

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1. In this paper, I restrict my discussion to the intersentential anaphoric relation in an utterance by a single speaker. For a recent discussion on coreference in multi-speaker discourse and some other important issues, see Groenendijk, Stokhof & Veltman (1997).
  2. Apparently, the bare numeral phrases are similar to one-anaphora in the sense that both of them need a descriptive content of the antecedent noun.
    - (i) John bought a blue shirt. Mary bought a red one.
 I will limit the discussion to bare numerals in this paper and will not go into one-anaphora. For details on one-anaphora, see Webber (1978).
  3. Following Barwise & Cooper (1981), Comorovski (1992) interprets the partitive preposition of as a function that maps an NP denotation into a common noun denotation, a kind of generator set of the noun phrase in the of-phrase.

- (3) Haksayngtul-i tuleowassta. Camsihwuey sey *myeng*-i nagassta.  
students-Nom came in. after a while three CL-Nom went out  
“Students came in. After a while, three (of them) went out.”
- (4) Chelswu-ka yenphil-ul sassta. Twu *calwu*-ka pwulecye issessta.  
Chelswu-Nom pencil-Acc bought. two CL-Nom broken was  
“Chelswu bought pencils. Two (of them) had (already) been broken.”

Compare these with the following where the classifiers do not agree with the antecedent common noun:

- (5) \*Haksayngtul-i tuleowassta. Camsihwuey sey *calwu*-ka nagassta.  
students-Nom came in after a while three CL-Nom went out  
(Int.) “Students came in. After a while, three (of them) went out.”
- (6) \*Chelswu-ka yenphil-ul sassta. Twu *pwun*-i pwulecye issessta.  
Chelswu-Nom pencil-Acc bought. two CL-Nom broken was  
(Int.) “Chelswu bought pencils. Two (of them) had (already) been broken.”

The only reason these sentences are ruled out is that they do not have an appropriate classifier form. So, the anaphoric tie between the antecedent noun and the numeral classifier phrase is much closer than in English.

Just like the English case, the numeral phrases in the above examples give a partitive reading. What is more interesting in these examples, as well as their English counterparts, is that the subsequent occurrence of the number word modifies the meaning of the antecedent. That is, metaphorically speaking, when the hearer comes across the numeral *five* in (2), he/she goes back to the discourse referent for students and adds another condition that the number of atomic parts of the referent of students is more than five. I will refer to this kind of modification as “cardinality accommodation.”<sup>4</sup>

Among the observations that are related to these examples is that there must be some sortal structure to the discourse referents so that the component parts of the structure is available for later reference by anaphoric elements. Let’s consider the following example:

- (7) Students came to the party. The boys seemed to enjoy it.

It is not the whole set of boys in the domain, but those boys among the students who came to the party, who seemed to enjoy the party in this discourse.<sup>5</sup> So, the discourse referent introduced by students seems to have an internal structure which is subdivided into different sorts or kinds, which are available for later reference.

In sum, the following are the issues that need a consistent account of concerning these bare numeral anaphora:<sup>6</sup> (a) Where does the partitive reading come from even in the absence of the partitive marker of them? (b) How could the anaphoric relation

4. Cardinality accommodation is related to the pragmatic implicature of numeral expressions. According to Horn (1972) and Kempson (1982) (a la Kadmon (1985)), the [numeral common noun] is assigned “at least” reading, which implicates that the referent of the numeral expression consists of more than the designated number. If the number of students who came to the party in our example (2) were five, the pragmatic principles would enforce the definite pronoun (*they*) or definite numeral (*the five*). For details, see section 3.2 below.

5. Of course, the example (7) can have other readings, too. So, the reading where the boys are not included among the students and the one where the boys overlap with the students are possible. What I am interested in here, however, is the reading where *the boys* refers to part of its antecedent.

6. In addition to the issues that I bring up below, there is another aspect that needs attention. When the plural antecedent occurs in a generic sentence, or a characterizing sentence in the sense of

be established between the antecedent and the numeral? (c) How could the cardinality accommodation be represented? (d) What is the nature of sortal structure in those plural nouns?

Questions (b) and (c) are related to each other and in fact (c) will be automatically answered if an account of (b) is sought, because once the antecedent of the anaphoric numeral expression is identified, the cardinality accommodation would naturally follow, due to the cumulative nature of information flow. Question (a) can also be regarded as part of question (b), since partitive constructions seem to obey constraints that apply to anaphoric expressions.

In the subsequent sections, I will first argue that bare numerals in English and numeral classifier phrases in Korean should be treated as a special kind of anaphor that needs a common noun antecedent to be properly interpreted. Afterwards, I will introduce Kamp & Reyle's treatment of plural pronouns and their operations for a particular set of discourse referents, namely summation and abstraction, and discuss their problems. I propose a two-levelled discourse representation structure, Level 1 for overt linguistic processes and Level 2 for cognitively motivated processes, to account for the questions raised above, along with relevant evidence for it.

## 2. Anaphoricity of Numeral Expressions

Contrast the following discourse to the preceding example (2) which is repeated below as (9):

(8) Two came to the party. Students had a good time.

(9) Students came to the party. Two had a good time.

The contrast between (8) and (9) shows that the numeral *two* cannot refer to the common noun *students* introduced later in the discourse. This resembles the ban on pronominal cataphora observed in the following:

(10) They came to the party. Students had a good time.

Likewise, the numeral-classifier phrases in Korean, show similar behaviors with respect to their relation to the common noun in that they keep certain structural relationships to each other. First of all, they seem to follow the restrictions on linear ordering just like ordinary pronouns.

(11)

- a. \*Kutul-i tuleoassta. Haksayngtul-un cwuyui-lul salpyessta.  
 they-Nom came in students-Top surrounding-Acc look around  
 “\*They came in. Students looked around the surroundings.”

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Krifka et. al. (1990), it is usually not possible for the bare numeral to pick the plural as an antecedent as in the following:

(i) Americans like pizza. Two eat a big pizza.

Eventually, an optimal theory will have to explain why the type of predicates matters here. As will be discussed below, the reason seems to be that the plural noun *Americans* in the first sentence is quantified by a generic operator, resulting in a duplex condition, from which the discourse referent within the sub-box is not accessible to the numeral. See below for further discussion.

- b. \*Han myeng-i tuleoassta. Haksayngtul-un cwuyui-lul salpyessta.  
one CL-Nom came in students-Top surrounding-Acc look around  
“\*One came in. Students looked around the surroundings.”
- c. Haksayngtul-i tuleoassta. Kutul-un cwuyui-lul salpyessta.  
students-Nom came in they-Top surrounding-Acc look around  
“Students came in. They looked around the surroundings.”
- d. Haksayngtul-i tuleoassta. Han myeng-un cwuyui-lul salpyessta.  
Students-Nom came in one CL-Top surrounding-Acc look around  
“Students came in. One looked around the surroundings.”

The numeral phrases cannot take a common noun as its antecedent when it is introduced later in the discourse.

Second, just as pronouns cannot pick up an antecedent that is c-commanded by them, the numeral classifier phrases cannot be linked to a common noun that is c-commanded by them, as illustrated below:

(12)

- a. Aytul-i ecey na-eykey sey myeng-i kachi nolassta-ko malhayssta.  
children-Nom yesterday me-to three CL-Nom together played-Comp told.  
“The children told me yesterday that three played together.”
- b. \*Sey myeng-i ecey na-eykey aytul-i kachi nolassta-ko malhayssta.  
three CL-Nom yesterday me-to children-Nom together played-Comp told.  
“\*Three told me yesterday that the children played together.”

Now that we have seen the similarity between the definite plural pronouns in English and the numeral phrases in Korean, let’s turn to their differences. One of the differences is that in the former case, the set itself whose elements are students qualifies as the antecedent of *they*, whereas in the latter case, the number phrase just picks up the sum individual that consists of the corresponding number of atomic parts of the meaning of *students*.

One should also distinguish the numeral phrases that give partitive readings from those that have the definite pronoun reading. The plural pronoun *they* seems to readily allow so-called split antecedents whereas a bare numeral phrase is more or less reluctant to split antecedents. Let’s consider the following example: (This is a slightly modified version of Rooth’s (1992) example.)

(13) Two American farmers and three Canadian farmers met.

- a. They got into an argument about canola.
- b. The two got into an argument about canola.
- c. Two (of them) got into an argument about canola.

The definite pronoun *they* and the definite numeral phrase *the two* seem to readily pick up the two groups of antecedents whereas the bare numeral *two* requires some kind of cognitive processing to have one American farmer and one Canadian farmer as its antecedent. This issue will be taken up again later in section 3.

As for the split antecedent phenomenon, bare numerals are different from definite plural pronouns or definite numerals. Bare numerals always require the cardinality of its antecedent to be greater than the cardinality of the bare numeral. Thus, the following discourse sounds awkward:

(14) John took Mary to Acapulco. {They / The two / ??Two} had a good time.

Here, *two* cannot refer to the sum individual  $j \oplus m$  though *they* can. This is because of the cardinality accommodation discussed earlier.

### 3. Discourse Representation of Bare Numeral Phrases

#### 3.1. Kamp & Reyle (1993)

As noted in the introduction, Kamp & Reyle (1993: K&R, henceforth) propose DRS construction rules for plural nouns and plural pronouns adopting Link's (1983) analysis of plurality. In this section, I will briefly discuss K&R's proposal and what it implies to our purposes.

K&R argue that the anaphoricity usually observed between two linguistic expressions is not a direct relationship but an indirect one, which is established via discourse referents that are introduced by nominal expressions in the process of DRS construction. Thus, in order to account for the anaphoric relationship of a plural pronoun to its antecedent, they introduce a new kind of discourse referent for plural expressions, namely 'non-atomic discourse referents,' represented by variables of a capital letter, e.g., X, Y, etc. Then, a plural pronoun like *they* also introduces a plural discourse referent, say Y, and a condition that Y is equal to the discourse referent of its antecedent is added to the condition part of the current DRS. The following example will make it clear:<sup>7</sup>

(15) Students came to the party. They enjoyed it.

X	u	Y	v
student*	(X)		
the-party	(u)		
X	came-to	u	
	Y=X		
	v=u		
Y	enjoyed	v	

The plural noun *students* introduces a new discourse-marker X, and the pronoun *they* also introduces Y and is identified with X. (*student\** is the predicate that can apply to sum-individuals as well as to atomic individuals.)

K&R, however, do not specify DRS construction rules for bare numerals (or partitive constructions) that are being discussed in this paper. They mention one example where a partitive phrase is used (their example (4.117)), and propose to treat a partitive phrase like *two of them* as introducing two plural discourse referents, one for the plural pronoun *them* and the other for the numeral phrase *two*, and a condition that the discourse referent for the numeral is the subset of the discourse referent of *them*. The following is a rather simplified version of their treatment of partitive phrases.

(16) Students came to the party. Two of them enjoyed it.

7. Note that I am ignoring the collective/distributive distinction in this DRS representation. For detailed discussion of collective and distributive readings that the plural expressions give rise to, see K&R's analysis, in particular chapter 4. In addition, the representation of definite NP's like *the party* is different from Kamp's (1981) original treatment. For details, see K&R (1993), ch. 4.

X u Y Z v
student*(X)
the-party(u)
X came-to u
Y=X
—Z—=2
v=u
Z enjoyed u

Their idea is that, after processing the first sentence, the subject of the second sentence *two of them* introduces two plural markers (Y and Z). In the condition component, the antecedent of Y (=them) is identified with X (=students) and the discourse referent for *two* (=Z) brings in the condition that it is a subset of Y, meaning that those two who enjoyed the party are among the students who came to the party, but not other students, as well as the condition that its cardinality is two. In this DRS, one can see that the anaphoric relationship between the numeral *two* and the antecedent common noun *students* is linked via an intermediate discourse referent Y for *them*.

What about the bare numeral phrases which lack the delimiting *of*-phrase after the number words? Fully crediting K&R's contention that the anaphoricity is not a matter of direct relationship between two linguistic objects but an indirect one that can be best captured in terms of discourse referents introduced by the nominal expressions, the best way to express the anaphoricity between the head noun and the bare numeral phrase would be such that the bare numeral also introduces a discourse marker, just as in the case of overt partitive marker of *them* in (16), as well as the condition that specifies the cardinality of the numeral. Thus, for a discourse such as below, the following will be the best DRS that one can build from (17):

- (17) Students came to the party. Two seemed to enjoy it.

X u Y v
student*(X)
the-party(u)
X came-to u
Y=X
—Y—=2
v=u
Y seemed-to-enjoy v

The anaphoric relation between *two* and *students* is captured by the condition  $Y=X$ . Now, the problem with this condition is that since the discourse referent for *students* (X in this DRS), is identified with Y, it means that only two students came to the party, which is not the reading people get in this example. Thus, a new mechanism is needed to remedy this.

What we need is not a new discourse referent but rather a predicate variable that would apply to the discourse marker of the numeral. Suppose that we had an antecedent discourse marker (namely, X in the above example). Then, we will need a kind of predicate that is derived from X so that the referent introduced by the numeral (i.e., Y in the above DRS) can apply to that predicate.<sup>8</sup> How can we derive a new discourse referent for the predicate variable? Some hints can be found in K&R.

8. Note that this is because of K&R's ban on direct association of an anaphoric expression with its

They propose two operations on the given discourse referents and conditions, which, they argue, reflect some kind of cognitively motivated inference processes in the language users' mind. One is summation and the other is abstraction. Summation takes discourse referents that are already introduced in the previous discourse and combines them into a sum-individual. Their construction rule is as follows (K&R 1993: 341):

## (18) Summation

- a. Triggering configurations:  $K'$  is a sub-DRS of the DRS  $K$  (possibly  $K$  itself) and  $v_1, \dots, v_k$  ( $k \geq 2$ ) are discourse referents occurring in  $K$  and accessible from  $K'$ .
- b. Operation: Introduce a new non-individual discourse referent  $Z$  into  $U_{k'}$  while introducing into  $\text{Con}_{k'}$  the condition  $Z = v_1 \oplus \dots \oplus v_k$ .

It explains the split antecedent phenomenon. Thus, for example, (19) will have the DRS in the following:

## (19) John took Mary to Acapulco. They had a lousy time.

u	v	y	Z	U
John(u)				
Mary(v)				
Acapulco(y)				
u took v to y				
Z = u ⊕ v				
U = Z				
U had a lousy time				

Here, the condition  $Z = u \oplus v$  is added to the DRS due to the summation operation of  $u$  and  $v$  to form a sum-individual, which serves as an antecedent to the plural pronoun *they*, represented by  $U$  above.

The summation operation also gives us a correct representation for the sentence discussed in the previous section which is repeated below:

## (20) An American farmer was talking to a Canadian farmer. They got into an argument about canola.

The plural pronoun *they* in the second sentence picks up the discourse referent introduced by the summation operation of an American farmer and a Canadian farmer.<sup>9</sup>

The other operation is abstraction, where one can get another sum-individual from a quantified NP. Their construction rules are as follows (K&R 1993: 344):<sup>10</sup>

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antecedent. We might abandon this hypothesis and pursue other directions. But we are not considering this possibility in this paper.

9. The summation operation should be allowed to cover the following case as well, where the sum individual is composed of more than two:

(i) John took Mary to Acapulco. On their way, they met Sue and Bill. They went together and had a lousy time.

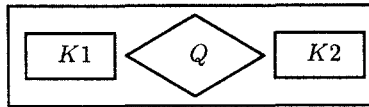
Here, the new sum individual must be  $j \oplus m \oplus s \oplus b$  which serves as the antecedent to *they* in the third sentence. One might wonder how one can exclude the discourse referent for *Acapulco* from being summated, about which K&R do not give any constraints. In section 4, I will propose some constraints on summation.

10. The triggering configuration for abstraction is the split-box, which is usually introduced by quantified expressions. Thus,  $Q$  in the diamond box expresses the quantificational operators such as generic operator, quantificational determiner, or adverbial quantifiers in the sense of Lewis (1975);  $K1$  the antecedent or restrictor box; and  $K2$  the consequent or nuclear scope. For details, see K&R (1993), ch. 4.



(21) Abstraction

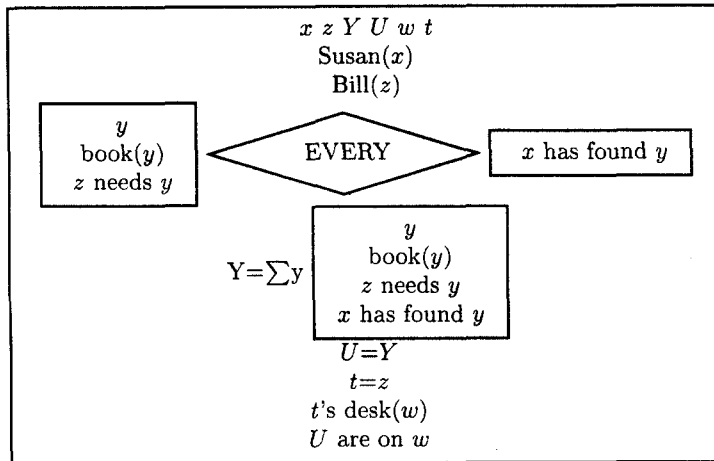
a. Triggering configurations:



b. Operation: From the union  $K_0=K_1\cup K_2$  of the two component DRSs of this condition, choose a discourse referent  $w$  from  $U_{k_0}$ . Introduce into  $U_k$  a new discourse referent  $Y$  and add to  $Con_k$  the condition  $Y=\sum w: K_0$ .

In the following discourse, for example, we see that the plural pronoun *they* refers to the books that Bill needs. But, unfortunately, there is no candidate discourse referent for *they*. What abstraction does is pick up every instance of book introduced in the split box of the quantifier to form a new sum-individual.

(22) Susan has found every book which Bill needs. They are on his desk.



The condition that begins with  $Y=\sum y...$  stands for the abstraction operation that K&R propose. It introduces a new discourse marker  $Y$  that stands for the set consisting of all individuals  $y$  which satisfy the condition of the DRS behind the sigma sign. So, abstraction applies to the duplex box introduced by *every book which Bill needs* to create a new plural referent ( $Y$ ) for later reference.

Summation and abstraction can be thought of as two major processes reflecting the cognitive processes, or inference patterns, that people undergo when they come across a certain discourse. K&R explicitly propose to see them as “kinds of inference principles” on DRS’s. So, they are more or less related to the cognitive ability of ordinary speakers. That is, language users seem to have such intuitive abilities to form a larger unit out of a small segment of linguistic expressions and it’s K&R’s novelty to incorporate such invisible mental processes into their discourse representation.

**3.2 Two-levelled Discourse Representation Structure**

Now, given K&R’s two operations, what kinds of manipulations are needed to account for the partitive reading in bare numeral constructions? First of all, the common noun predicate that restricts the plural discourse referent (namely, *student\** as in *Students*

*came to the party. Two enjoyed it*) should be made available to the discourse referent introduced by the bare numeral. That is, if the bare numeral introduces *Y* into the universe of discourse, then it should be an argument of a plural predicate *student\**. Note, however, that we cannot relate *Y* with *student\** in a direct way due to the ban on direct relationships between two anaphoric expressions. We need some kind of operation on a discourse referent that is already introduced by the ‘antecedent’ plural NP, in a way similar to K&R’s summation and abstraction.

It was noted above that both summation and abstraction (and possibly their treatment of other semantic phenomena) are not linguistically motivated but rather extra-linguistically. So, from a conceptual point of view, one might suspect whether these operations should be represented as DRS conditions as K&R do. It is true that many semanticists have had doubts on their treatment of semantic phenomena only in terms of introducing different discourse referents and conditions, which might result from more fundamental reasons.<sup>11</sup> Thus, I would like to propose that the DRS’s should be divided into two levels, whose discourse referents are essentially available to each other: level one for the representation of purely linguistically motivated discourse referents and conditions, and the other level for extra-linguistically motivated ones. Level one represents those discourse referents and conditions that come from overt linguistic expressions just like the usual notion of DRS conceived so far. On the other hand, level two is to represent covert cognitive processes, e.g., K&R’s summation and abstraction operation, which are relevant to world knowledge in general. My proposal is that K&R’s summation and abstraction must be separated from the ordinary DRS’s and represented at a new level, say, level 2 DRS. Thus, the following would be a general figure for such dual processes:

(23) Two Tiers of DRS’s

LEVEL 1	LEVEL 2
Linguistically Motivated	Extra-linguistically Motivated

The idea of multi-level DRS’s is not totally new in the field.<sup>12</sup> In fact, when Asher (1986, 1987) proposed to treat the anaphoric relations between sentences involving propositional attitude verbs in DR theoretic terms, he introduced a new level of DRS called “delineated DRS,” which contains “conceptual individuals” that the discourse participants ascribe to the agent of propositional attitudes (Asher 1987: 138). Asher’s idea and mine are similar in a very broad sense that both are motivated by cognitive reasons. As will be made clear below, however, Asher’s delineated DRS is different from the extra-level proposed in this paper. First of all, the delineated DRS is introduced by a definite NP within a propositional attitude context in Asher’s theory while there is no such conditions on the type of NP’s or the context of discourse in which the NP occurs. Second, the delineated DRS represents the cognitive state of a particular agent holding a particular propositional attitude. i.e., only the subjects of propositional attitude verbs can introduce the delineated DRS.

Now, (19) and (22) will be represented as in (19’) and (22’), respectively.

11. Manfred Krifka, personal communication.

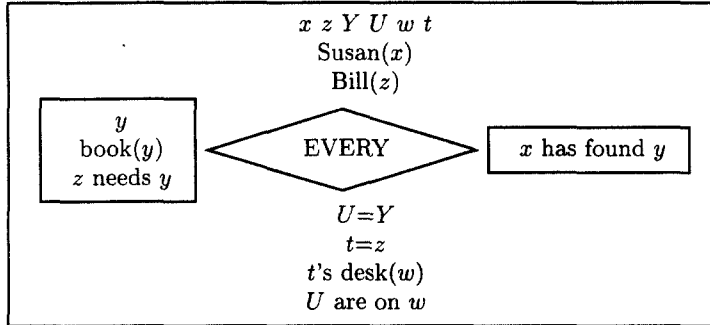
12. I thank one of the referees who reminded me of the approach taken by Asher.

(19')

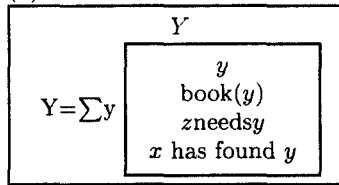
u v y U John(u) Mary(v) Acapulco(y) u took v to y U = Z U had a lousy time	Z  Z = u ⊕ v
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(22')

(i) Level 1



(ii) Level 2



The idea behind this separation of DRS levels is that we need to distinguish different comprehension processes that language users seem to undergo. In fact, this move seems to be more in line with Kamp's original conception of discourse representation theory that bears on "the nature of mental representation and the structure of thought, a large array of data relating to our intuitions about the truth-conditions of the sentences and sentence sequences we employ." (Kamp 1981: 6)

With this new concept of two-levelled discourse representation, K&R's summation operation can be extended for bare numeral constructions, in such a way that two given discourse referents are summated without introducing a new discourse referent for the summated expression. Let's consider the following discourse:

(24) Students came to the party. Two seemed to enjoy it.

X u Y v student*(X) the-party(u) X came-to u —Y—=2 v = u Y seemed-to-enjoy v	X ⊕ Y = X
------------------------------------------------------------------------------------------------	-----------

The subject of the second sentence *two* introduces a plural discourse referent  $Y$  as usual since it is a nominal category, along with the cardinality condition. Now, the summation applies to this new plural referent without creating a new discourse referent: the condition  $X \oplus Y = X$  is simply added to the DRS level 2, reflecting the speaker's inference process. This does not impose any harm to existing DR principles. Rather it solves the question about the nature of sortal structure that I raised earlier. It was noted that in (25) *the boys* does not denote any supremum of a number of boys, but denotes only those boys within the set of the students who came to the party.

(25) Students came to the party. The boys seemed to enjoy it.

In the process of interpreting this discourse, it seems that the cognitive-pragmatic inference is performed on the hearer's part and he/she adds the condition that the boys are those boys in the set of students who came to the party. The discourse (25) will then have the following DRS:

$X$ u $Y$ v student*( $X$ ) the-party(u) $X$ came-to u the-boy*( $Y$ ) $v = u$ $Y$ seemed-to-enjoy v	$X \oplus Y = X$
------------------------------------------------------------------------------------------------------------------------	------------------

Thus, sortal structures can be considered as basically a variant of lattice structure, defined by 'part' relation and motivated by world knowledge in general, but not directly by the overt linguistic expression. Note that the two-levelled DRS can express this information more explicitly, namely that the boys in the subject of the second sentence in (25) are part of the students who came to the party and that this information is not directly added from the overt linguistic expressions per se but from the world knowledge in general. One of the questions that I raised earlier is answered with the new two-levelled DRS and the optional summation operation.

The two-levelled DRS theory also provides an answer to other questions too. I have raised the issue where the partitive reading comes from in the absence of an overt partitive marker of *them* in bare numeral constructions. My account is that the partitive reading comes from the summation operation at the DRS level 2, more specifically, from the condition  $X \oplus Y = X$ , which means that the denotation of  $Y$  is part of  $X$ , that is,  $Y \subseteq X$ . Thus, our world knowledge allows the summation operation, which is independently motivated for split-antecedents, to be performed on the discourse referents that are already introduced previously. And this information is represented separately from the ordinary linguistic information at the second level of DRS.

Note also that the cardinality accommodation, the third issue that was raised earlier, follows automatically from the summation operation at level 2. This is because the new representation says that, in set-theoretic terms,  $X$  is the superset of  $Y$ , the cardinality of  $X$  must be greater than or equal to the cardinality of  $Y$ . Along with the cumulative nature of information flow, it amounts to saying that the number of students who came to the party is more than two. Note that the use of bare numeral in this context implies that the number of students who came to the party is not just two but more than two. Otherwise, a definite pronoun (e.g., *they*) or definite numeral (e.g., *the two*) would have been used instead of the bare numeral due to pragmatic principles. In other words, bare numerals or partitive anaphors in general are semantically more complex than simple definite pronouns in that the partitives pick up a subset of the antecedent set whereas

the definite pronouns pick up the antecedent set itself. Thus, the use of semantically more complex form carries the implication that the simple form is not enough for expressing the speaker's intention. In our example, the partitive anaphor is employed since the cardinality of the bare numeral is not the same as its antecedent.<sup>13</sup>

### 3.3 Restrictions on Level 2 DRS Construction: Sortal Structure

K&R do not consider any negative aspects of their summation and abstraction operation, and I have not imposed any constraints on DRS level 2 construction so far. It is obvious, however, that the construction rule should be constrained tight enough to exclude anomalous representations. In this section, I will examine some apparent counter-examples to our claim and I will propose some constraints to exclude unwanted results.

First of all, let's consider whether other operations besides summation and abstraction can be performed at level 2. We will have to ask whether, say, subtraction is allowed at level 2. A good example will be the marble sentences from Heim (1982: 21) for us to see whether the DRS level 2 can arbitrarily introduce new discourse referents for "contextually salient" objects by subtraction operation or whether level 2 construction also depends on how the utterance is worded.

(26) I dropped ten marbles and found all of them except for one.  
It is probably under the sofa.

(27) I dropped ten marbles and found only nine of them.  
?? It is probably under the sofa.

The intuition is that when there is no explicit word that can serve as an antecedent, the singular pronoun cannot pick up a contextually salient element as we see in the above contrast. Suppose that the first sentence of (27) introduces discourse referents X and Y for *ten marbles* and *nine*, respectively. Then one might argue that a correct representation of our intuition that there must be one which is not found yet has to be represented at level 2, introducing a new discourse referent for the unfound marble, which is conceptually salient. However, it is clear from the contrast above that our level 2 should be banned from performing such operations as subtraction since, otherwise, the operation would create a new discourse referent at the level 2, which might provide a possible antecedent for the pronoun *it* in the second sentence. Therefore, I propose that subtraction is not allowed in general.

Let's turn to summation now. Basically, K&R's construction rule does not provide any restrictions to it, and thus it is allowed in principle to summate discourse referents of any kind, e.g., one for an animate noun, another for inanimate noun, or another for something else. One might wonder how one can prevent the summation of the following kind, for example:

(28) John bought a pen at the store. \*They are in his room.

13. One note is in order here concerning the verification rules. Since I have not introduced any new DRS conditions here, I can use the ordinary verification rules proposed elsewhere. I will simply follow K&R's verification rules for DRS's introduced so far. One might wonder how both levels of DRS I propose here could be embedded to our model to be verified. Note, however, that the level 2 DRS is just for summation and abstraction, whose verification rules are already proposed in K&R (1993: 425-426).

K&R's summation can create a new plural discourse referent, say  $X$ , that consists of  $x$ ,  $y$ , and  $z$  for *John*, *a pen*, and *the store*, respectively (i.e.,  $X=x\oplus y\oplus z$ ), as illustrated below. This is clearly not what we want.

x y z Y u	X
John(x)	
pen(y)	
the-store(z)	
x bought y at z	$x\oplus y\oplus z=X$
Y = X	
u = x	
X are in u's room	

Note that this is not only K&R's problem but also one of the tasks that our DRS level 2 should exclude.

A possible solution can be sought in the theory of reference. I noted above that there is some kind of sortal structure within discourse referents. In particular, those non-atomic referents have lattice-structure defined by part-relation. Thus, one should restrict the summation operation only to the discourse referents that are sortally related. This amounts to saying that the nominal expressions introducing atomic referents, which might later undergo summation, should be in a semantic field, or share some semantic features in common. How could we express this restriction in DR-theoretic terms?

One way would be to specify this condition at the level of lattice-structure, i.e., as a condition on the structure of the domain of discourse in general. So, let's impose the following constraint on the lattice structure,  $\langle D, \leq \rangle$ , where  $D$  is the universe of discourse and  $\leq$  is the join relation on  $D$ .

$$(29) \forall xy[x \leq y \rightarrow \exists P[P \in S \ \& \ P(x) \ \& \ P(y)]]$$

Here,  $P$  is a variable over properties and  $S$  over a set of sorts relevant for the language, which is usually realized as classifiers in classifier-languages. This constraint makes sure that whenever there is a join-operation between two individuals, then they must have some property in common, and that the common property must be one of the relevant sorts of the language.<sup>14</sup> The relevant sorts may be determined by both language-universal and language-particular properties depending on how humans perceive the objects in the world and their mind.<sup>15</sup>

One should note at this point that this condition (29) is too strong as a rule for lattice structures in general since the following kind of coordination is not unusual at all:

(30) John and this pencil weigh 161 pounds.

x y X	
John(x)	
this-pencil(y)	
$x\oplus y=X$	
X weigh 161 pounds	

14. Of course, those properties like self-identity (i.e., the property of being identical with the individual itself) will be automatically excluded from the properties that are being discussed here since those predicates will not be in the set of sorts  $S$  at all, in any language.

15. There arises a question concerning the status and range of sorts discussed here. It is, however, an ontological issue that goes well beyond the scope of this paper, and I would rather leave it for future research.

Here the coordination of *John* and *this pencil* which is forced by a linguistically overt summation marker (ie., conjunction *and* here) and will result in the new sum-individual  $j \oplus p$  which does not share any common properties of any sort. Thus, the condition (29) cannot be a constraint on the lattice structure in general.

Instead, I would like to interpret it as a preference rule working at DRS level 2. This move seems intuitively more plausible since our perception of the world is not randomly enforced but follows some sort of pattern, whose representation I have argued should be expressed at a separate level. In the previous example (28) where totally irrelevant terms were summated, each part has no sortal property in common. This kind of join operation is not allowed due to our preference rule (29). In contrast, this condition has nothing to do with the summation of discourse referents that is performed at the DRS level 1, as we see in example (30).

The contrast between (28) and (30) can be thought of as an indirect support to our claim that the DRS should be divided into two levels. In other words, (28) and (30) are not distinguishable from one another if we had one-layered DRS's, which would make it extremely difficult to rule out one while admitting the other. With our two-levelled conception of DRS's, we can differentiate one from the other: the summation in (30) is allowed in spite of the absence of any common sortal property because it is triggered by overtly realized linguistic expressions and thus it is represented at the DRS level 1. On the other hand, in (28) summation is not allowed because cognitive processes that are to be performed at DRS level 2 should be constrained by our preference rule (29).

In sum, the condition above will correctly rule out the summation of totally irrelevant discourse referents at DRS level 2, leaving the linguistically enforced operations at level 1 intact. Note that we need this kind of constraint on the structure of nominal reference anyway.

#### 4. Sortal Structure and Classifier Languages

Our discussion so far makes interesting predictions on the distribution of numeral phrases in classifier languages where the sortal structure is somehow reflected overtly in the lexicon in the form of classifiers. In this section, I will discuss the effect of two-levelled DRS and the preference rule (29) in Korean.

First of all, let's look at relevant data in the language. The simplest case is when the summated antecedents are of the same sort, in which the classifier of a relevant sort is used as in the following:

- (31) Yenphil-lul sa-ko, polpen-lul sassta. Kulendey, twu calwu-lul ilebeliessta.  
pencil-Acc buy-and, ballpen-Acc bought. but two CL-Acc lost  
“(I) bought pencils and ball pens. (I) lost two (of them).”

Pencils and ball-point pens are of the same sort and the classifier above, *calwu*, which is for long and slim objects, can refer to the sum-entity of each of those that the speaker bought. (Of course, it can refer to either the pencils only or the ball-point pens only.)

Secondly, when the antecedents are of different sort, for example, flowers and trees which are counted by different classifiers, then the use of classifiers for one sort (e.g., *kulwu* for trees) excludes the other (flowers in this case) from its reference.

- (32) Kkoch-ul sim-ko, namwu-lul simessta. Kulendey, twu kulwu-ka situlessta.  
flower-Acc plant-and, tree-Acc planted. but two CL-Nom withered.  
“(I) planted flowers and trees. Two withered.”

Here, *twu kulwu* cannot take 'flowers' as its antecedent, but only 'trees,' since the classifier *kulwu* is reserved for 'trees.' Note, by passing, that when the classifier is omitted, it will result in a true bare numeral (e.g., *twul*) in Korean, and the numeral can take either of the nouns as its antecedent (and combination of each) since the sort is not specified.

Thirdly, when a classifier of a broader sort is available in the context where the possible antecedents are of narrower sorts within the same sortal structure, classifier of the broader sort will be used to refer to both of them.<sup>16</sup>

- (33) CD (sey cang-)ul sa-ko chayk (ney kwon-)ul sassta.  
 CD (three CL)-Acc buy-and book (four CL)-Acc bought.  
 "(I) bought (three) CD's and (four) books."  
 Kulendey, kakkak twu kay-ssik ilepelyessta.  
 but, each two CL-Distributive lost  
 "But, (I) lost two of each."

Normally, flat objects like CD's and papers require the classifier *cang* and books require *kwon* when they are counted. In this example where the numeral phrase of the second sentence should pick up both of the two distinct sorts, which is enforced by the distributive marker, only the classifier of a broader sort, namely the neutral classifier *kay* which is most frequently used regardless of the shape of objects, is allowed in this context; neither of the other classifiers will make the sentence grammatical.

An interesting fact is observed when we eliminate the overt linguistic cues for the numeral phrase to pick up both antecedents. In the following example where the enforcement is not overtly expressed, the use of a broader classifier does not help:

- (34) CD (sey cang-)ul sa-ko chayk (ney kwon-)ul sassta.  
 CD (three CL)-Acc buy-and book (four CL)-Acc bought.  
 "(I) bought (three) CD's and (four) books."  
 ??Kulendey, twu kay-lul ilepelyessta.  
 but, two CL-Acc lost  
 "But, (I) lost two."

Here the most neutral classifier *kay* is reluctant to take both *CD's* and *books* as its antecedent. It seems, instead, to be used as a kind of deictic expression, referring to two of the contextually salient objects.

What does this contrast between (33) and (34) imply to the proposal that the DRS's are divided into two levels, one for overt linguistic processes and the other for covert cognitive processes? My interpretation is that it dramatically supports our two-levelled DRS theory, in addition to the contrast in English between (28) and (30), because even the classifier languages differentiate the two levels of discourse representation. In (33), the summation of CDs and books is triggered or even forced by the overtly expressed distributive operator 'each,' and will be represented at level 1 according to our theory. In (34), on the other hand, the apparently same operation on the same objects is not warranted because there is no such linguistic force, and our preference rule (29) does not allow it at DRS level 2.<sup>17</sup>

16. I have added the distributive marker here just to see what kind of classifier is used in the numeral phrase of the second sentence when reference to both of the antecedents are enforced by an overt cue, the distributive marker in this case. For discussions about the semantics of Korean distributive marker *ssik*, see Choe (1987).

17. One may wonder why the broader classifier *kay* in (34) does not force the two previous noun phrases



In sum, in this section it was shown that the classifier languages that are already equipped with part of the sortal structure explicitly manifested in morphology in terms of different classifiers show the contrast between overt linguistic processes and covert cognitive processes.

### 5. Concluding Remarks

I have examined the anaphoric behavior of bare numerals and their discourse representation structure. I argued that they are special kind of anaphora different from other pronominal anaphors in the sense that, whereas the pronouns pick up the discourse referent of its antecedent (expressed by the condition of the sort  $x=y$ ), bare numerals do not pick up the antecedent's discourse referent directly but enter into the part-whole relationship (expressed as something like  $X \oplus Y = X$  in which X is the discourse referent of the antecedent and Y is that of the bare numeral). I have also argued for the sortal structure of nominal reference, which is essentially a variant of lattice structure constrained by the condition (29).

One innovation in this paper is the separation of discourse representations into two levels, one for linguistically motivated representations and the other for cognitively motivated representation as well as some of the constraints that level 2 DRS construction should abide by. To prove that this dual representation is more adequate than the traditional conception of DRS, we might need more data relevant to this claim. However, it was shown that at least two kinds of constructions seem to support the proposal in this paper, namely bare numeral constructions and contextually restrained definite noun phrases.

### References

- Ahn, S.-H. (1989) Numeral Classifiers, Anaphoric Epithets, and Binding Theory in Korean. S. Kuno et. al. (eds.) *Harvard Studies in Korean Linguistics III*, 191-200.
- Asher, N. (1986) Belief in Discourse Representation Theory. *Journal of Philosophical Logic* 5, 127-189.
- Asher, N. (1987) A Typology for Attitude Verbs and Their Anaphoric Properties. *Linguistics and Philosophy* 10, 125-197.
- Barwise, J. & R. Cooper (1981) Generalized Quantifiers in Natural Language. *Linguistics and Philosophy* 4, 159-219.
- Choe, J. (1987) *Anti-Quantifiers and a Theory of Distributivity*. PhD. Dissertation, Univ. of Massachusetts at Amherst.
- Comorovski, I. (1992) Partitives and the Definiteness Effect. *WCCFL* 10, 91-102.
- Groenendijk, J., M. Stokhof, & F. Veltman. (1997) Coreference and Modality in the Context of Multi-Speaker Discourse. In H. Kamp, B. Partee (eds.) *Context Dependence in the Analysis of Linguistic Meaning*. Stuttgart: I.M.S., 195-216. <http://turing.wins.uva.nl/stokhof/>
- Heim, I. (1982) *The Semantics of Definite and Indefinite Noun Phrases*. PhD. Dissertation, Univ. of Massachusetts at Amherst.
- Horn, L. (1972) *On the Semantic Properties of Logical Operators in English*. PhD. Dissertation, UCLA, reproduced by Indiana University Linguistics Club, 1976.
- Kadmon, N. (1985) The Discourse Representation of Noun Phrases with Numeral Determiners. *NELS* 15, 207-219.
- Kamp, H. (1981) A Theory of Truth and Semantic Representation. In Groenendijk J. et. al. (eds.) *Truth Representation and Information*. Dordrecht, Foris. 1-41.

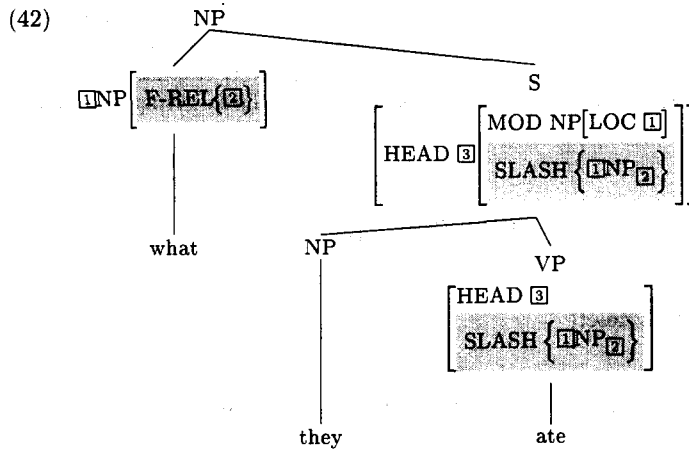
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to be summated at the linguistic level, as pointed out by one of the referees. Notice, however, that the summation operation is usually enforced by explicit, linguistic cues and that CDs and books in Korean are not sortally consistent as they are followed by different classifiers.

- Kamp, H. & U. Reyle (1993) *From Discourse to Logic*. Dordrecht, Kluwer Academic Publishers.
- Kempson, R. (1982) Negation, Ambiguity, and the Semantics-Pragmatics Distinction. Paper presented at the Winter LSA meeting.
- Krifka, M. et. al. (1990) Genericity: An Introduction. In. Krifka, M. (ed.) *The Generic Book*. Chicago: Univ. of Chicago Press.
- Lewis, D. (1975) Adverbs of Quantification. In E. Keenan (ed.) *Formal Semantics of Natural Language*. Cambridge, Cambridge Univ. Press. 3-15.
- Link, G. (1983) The Logical Analysis of Plural and Mass Terms: A Lattice-theoretic Approach. In R. Bauerle, C. Schwarze, A. von Stechow (eds.) *Meaning, Use, and Interpretation of Language*. Berlin, de Gruyter. 302-323.
- Rooth, M. (1992) A Theory of Focus Interpretation. *Natural Language Semantics* 1, 75-116.
- Webber, B. (1978) *A Formal Approach to Discourse Anaphora*. PhD. Dissertation, Harvard Univ.

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Now consider the free relatives where the *wh*-word functions as the subject:

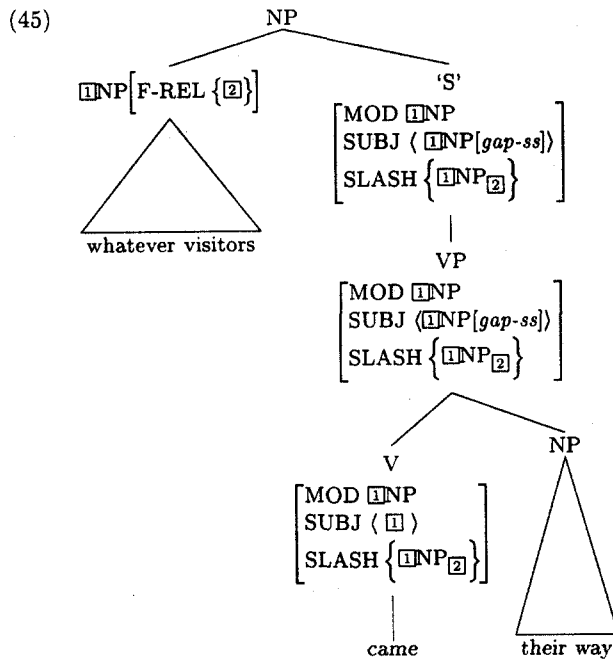
- (43) a. What happened upset him.  
 b. I took what is on the kitchen table.  
 c. They welcomed whatever visitors came their way.  
 d. Whoever did it should admit it frankly.

Following Ginzberg and Sag (2001), we treat all the subject extractions in terms of the type *head-fill-ph*. That is, sentences like (42) would be interpreted in terms of subject extraction:

- (44) a. [What [\_\_ happened]] upset him.  
 b. I took [what [\_\_ is on the kitchen table]].

This position requires no additional mechanism for subject free relatives. The general constraint in (36) is enough for generating examples like (42), as represented in the following structure for (42)c:<sup>6</sup>

6. The type *synsem* has *canon-ss* and *gap-ss* as its subtypes. The *gap-ss* element corresponds to its SLASH value. See Bouma et al. in press.



Notice that this structure also satisfies the constraint on *free-rel-cl* in that its head daughter serves as the filler of the non-head daughter that at the same time functions as its modifier.

The agreement factor immediately follows from this analysis. As noted earlier, it is the agreement features of the head daughter, not those of the clause, that match those of the matrix verb:

- (46) a. **Whatever books** have been written by the author \*is/are marked up with her notes.  
 b. **What book** has been written by the author is/\*are gone into the trash.

### 3.3 Local and Temporal Free Relative Constructions

But more complexity arises when adverbial free relative constructions function as noun phrases:

- (47) a. Here is [where I bought the food \_\_\_\_].  
 b. Now is [when I need you \_\_\_\_].  
 c. She dreams of [when she will finally have her Ph.D \_\_\_\_].  
 d. I would consider [wherever she lives \_\_\_\_] a nice place to live.

The whole clauses bracketed here here are NPs. The question arises as to the categorial mismatch between the free relative head and the missing element. It seems to be obvious that the missing elements in (47) are all adverbial elements and are not NPs. However, there is reason to argue that the missing elements here can be treated as externally or categorically NPs. Larson (1985) observes the dual properties of the so-called bare NP adverbs, such as *moment*, *day*, *week*, *yesterday*, *place*, *direction*, and so forth. These elements externally take the form of simple NPs but internally exhibit distributional parallels with other adverbial categories:

- (48) a. John arrived that moment/at 9.  
 b. You have lived some places warm and sunny/in a sunny town.  
 c. We were headed that direction/for the village.

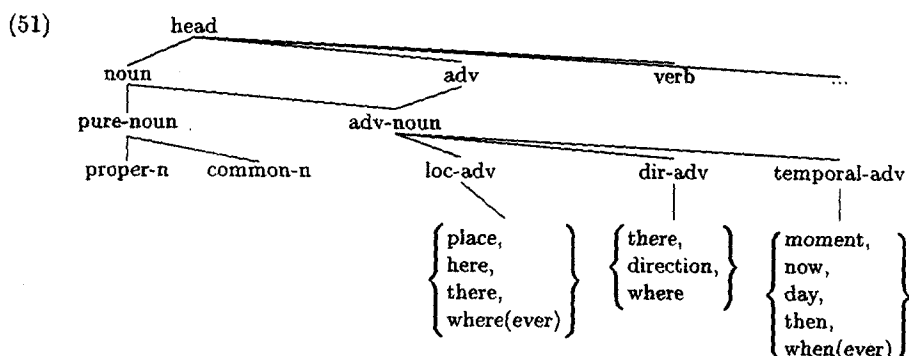
These distributional properties predict that such adverbial nominals freely alternate with other adverbial elements: they can appear wherever an adverbial element can appear. Following is another example:

- (49) a. I'll put my books { in the box.  
 { the same place I put them yesterday }

But the class of these bare-NP adverbs are lexically determined:

- (50) a. John arrived \*(during) this vacation.  
 b. You have lived \*(at) some location near Seoul.  
 c. We were headed \*(to) that course.

Though the words *vacation*, *location*, and *course*, all semantically have a certain temporal, locative, or directive meaning, they obligatorily require proper prepositions. This in turn means that the adverbial usages of noun phrases depend on the lexical properties of their heads. Given these lexical properties, I assume that the hierarchy in (51) is a more finer-grained hierarchy of English words:<sup>7</sup>



As given in (51), the *wh*-words *when* and *where* are taken to be the instances of *adv-noun*. Since the type *adv-noun* is a subtype of *noun*, a phrase projected by the members of this type will be able to occur anywhere an NP is selected.<sup>8</sup>

7. As an anonymous reviewer points out, a question arises what kind of information the type *adv-noun* will inherit from its supertypes such as *adv* and *noun*. I assume that it is categorically a noun but semantically bears adverbial features. When realized in syntax, it can appear wherever a noun or an adverbial phrase can occur.

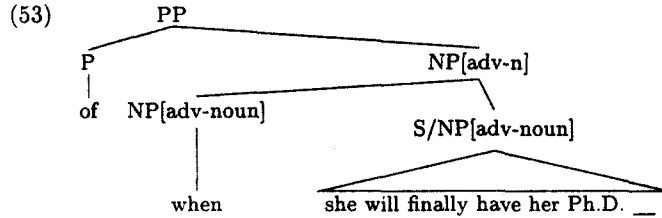
8. The need for such a fine-grained restriction on the head value is further supported by the following examples.

- (i) a. the month/day/year/\*vacation/\*occasion you traveled to France \_\_ .  
 b. the place/\*location/\*street you lived \_\_ .  
 c. the way/direction/\*course/\*path we are traveling \_\_ .

If we simply assume that the gapped element is syntactically temporal adverbials, we would encounter troubles linking the gapped element with the head.

- (52) a. The place that John has lived was ugly.  
 b. The way that I spoke to him was rude.  
 c. The day that Max arrived was remarkable.

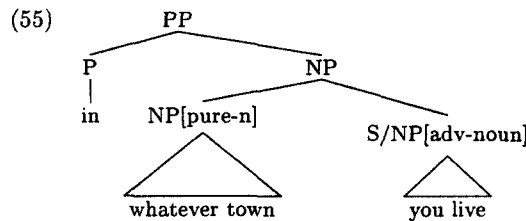
At the same time, since *adv-noun* is also a subtype of *adv*, the phrase will further have adverbial properties, such as functioning as temporal, locative, and directional modifiers. This mode of treatment assigns the representation (53) to (47c):



The sentence, missing an adverbial-noun NP, modifies the free relative word, *when*. Notice here that there is no categorial mismatch between the head phrase and missing phrase. The constraint on *free-rel-ph* states that the sentence modifies an NP element, including bare NP adverbs typed as *adv-noun* in our analysis. This predicts that the adverbials that cannot be lexically defined as NP[adv-n] have no rights to appear in free relative clause constructions. This prediction is borne out:<sup>9</sup>

- (54) a. ??I will live in [whatever town [you live \_]].  
 b. I will live in [whatever town [you live in \_]]. (Grosu 1996)

The present analysis assigns the following structure to (54)a.



The possible category of the missing element here is either a PP or an NP[adv-n]. But the head that the clause modifies is an NP projected from *pure-noun*. This conflict explains the ungrammaticality of (54)a. Notice that even a prepositional argument cannot participate in free relative constructions (data from Bresnan and Grimshaw 1978):

- (56) a. \*I'm interested in [[whatever subjects] [I think [I should be interested \_ ]]].  
 b. \*I'll speak to [[whatever group] [you're willing to speak \_ ]].  
 c. \*I'll work on [[whatever problems] [you don't work \_ ]].  
 d. \*John will be arrested by [[whoever [Kim was arrested \_ ]]].

The present analysis, where no PP gapped sentence can modify a free relative word according to the general constraint on *free-rel-ph* in (36), has no difficulty predicting the ungrammaticality of these sentences. This in turn means that we do not allow to assign the following PP head structure for the construction:

9. Though the speakers we consulted with require the preposition in free relative clauses, the literature allows the absence of the preposition. As of now, we have no clear explanation on this variation.

(57) \*I'll speak [[to whatever group] [you're willing to speak \_\_]].

This means that the only possible structures we would have are those in (56). Here, the gapped phrases in the clause are PPs but the filler head is all NPs. This clear mismatch between gap and filler makes all them unacceptable.<sup>10</sup> Such categorical mismatches can be avoidable when the head NP is NP[adv-n], as we have seen earlier.

**3.4 More on the Matching Effect**

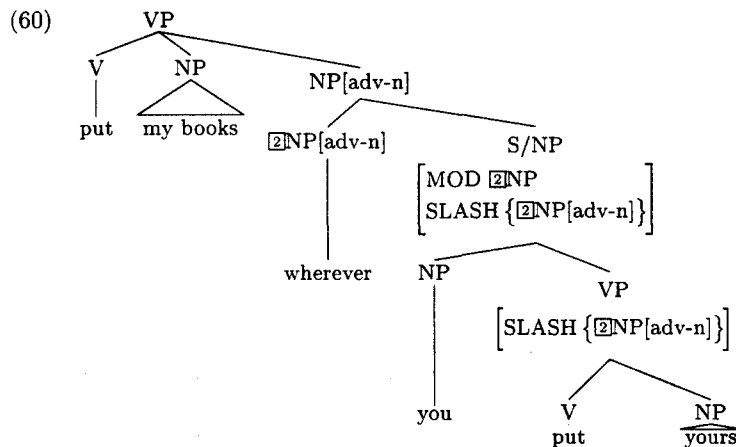
The next question arises as to how to deal with free relatives that overtly occupy a PP complement position.

(58) a. I will put my books [in the box].  
 b. I'll put my books [wherever [you put yours \_\_]].

The free relative in (58)b seems to serve as a PP complement. But as expected, our analysis assumes that the predicate *put* can select either a PP[loc] or a locative NP[adv-noun], a locative bare NP adverbial.

(59) a. John put that book here/there/someplace warm and sunny.  
 b. \*John put that book some location/some area.

Given this assumption, our analysis assigns the following NP-headed structure to (58)b:



This mode of analysis will also easily account for the impossibility of pied piping in free relatives (cf. Bresnan and Grimshaw 1978).

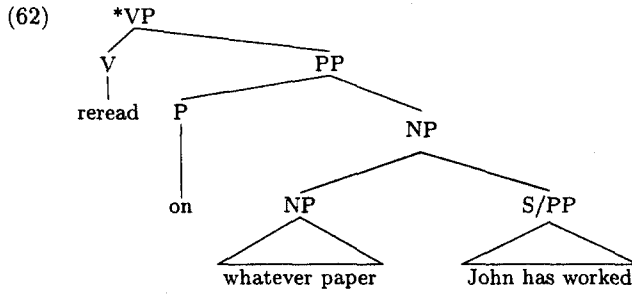
(61) a. I'll reread whatever paper John has worked on.  
 b. \*I'll reread [on [whatever paper] [John has worked]].

10. One issue arises how to account for cases like (i):

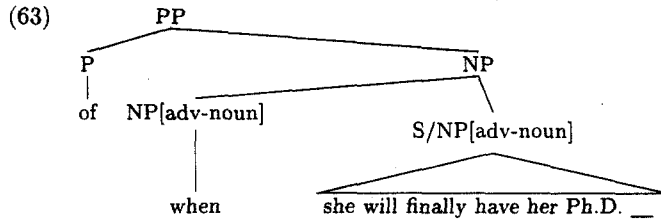
(i) a. She will make the cake [however big] you want it to be \_\_.  
 b. She will call the mayor [however often] she needs to call him.

In such cases, the head phrase in the construction is not an NP but an AP and AdvP, which our constraint rules out. One possible direction might be to posit a supertype that can include only NP, AP, and AdvP.

Our analysis would then assign the following structure to sentences like (61)b.



This structure violates two constraints. It first violates the Valence Principle: the verb selects not a PP complement, but an NP complement. Further, there is a mismatch between the gapped element and the free relative head. But sentences like (47)c has no such violations as can be seen in (63).



### 3.5 Stacking Phenomena

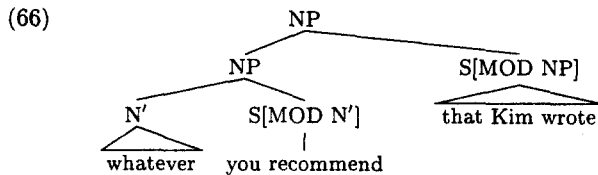
In earlier discussion, we have observed that restrictive *wh*-relatives can be stacked with the restriction that bare-relatives must be the first member of any such iteration.

- (64) a. The book [that Kim bought \_] [that Lee wrote \_] was boring.  
 b. The books [Kim bought \_][that Lee wrote \_] was boring.  
 c. \*The book [that Kim bought \_][Lee wrote \_] was boring.

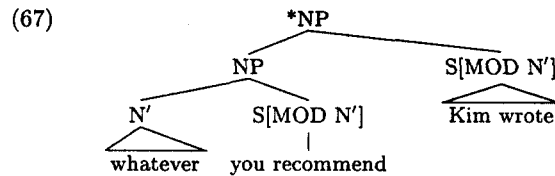
One way to account for such behavior is to assume that bare-relatives modify a lexical element or *N'*, whereas *that*-relatives (or *wh*-relatives) modify a full NP (cf. Weisler 1980, Sag 1997). We have also observed that non-specific free relatives also show certain restrictions on stacking.

- (65) a. I will read [whatever you recommend] [that Kim wrote].  
 b. \*I will read [whatever you recommend] [Kim wrote].

Together with the assumption that *wh*-relative clauses modify an NP whereas *wh*-less relative clauses modify *N'* ([MOD *N'*]), the present analysis would assign the following structure to the two sentences:







Given that bare-relatives modify a nominal head, (67) is ruled out because the *wh*-less relative does not modify a lexical head or *N'*, but modifies an NP.

#### 4. Conclusion

English free relative constructions are complicated in that they both exhibit nominal and sentential properties. The paper has shown that these seemingly complex constructions follow from a simple constructional constraint.

Our proposed analysis presents a precise analysis of English free relatives within a nonderivational, constraint-based perspective, without appealing to transformational operations or invisible categories of any kind. The key point of this analysis is to factor out generalizations about free relative clause constructions and assign proper constraints drawn from their supertypes. This factorization allows us to capture generalizations about particular constructions types in terms of constraint inheritance in a multiple inheritance type hierarchy. This results in a simpler grammar of English free relative constructions.

#### References

- Baker, C.L. 1989. *English Syntax*. Cambridge, MA: The MIT Press
- Borsley, R.D. 1992. More on the difference between English restrictive and non-restrictive relative clause. *Journal of Linguistics* 28, 139-148.
- Bouma, Gosse, Rob Malouf, and Ivan Sag. In press. Satisfying Constraints on Extraction and Adjunction. *Natural Language and Linguistic Theory*.
- Bresnan, Joan and Jane Grimshaw. 1978. The Syntax of Free Relatives in English. *Linguistic Inquiry* 9. 331-391.
- Ginzburg, Jonathan, and Ivan A. Sag. 2001. *English Interrogative Constructions*. Stanford: CSLI Publications.
- Grosu, Alexander. 1996. The Proper Analysis of "Missing-P" Free Relative Constructions. *Linguistic Inquiry* 27: 257-293.
- Grosu, Alexander. 1989. Pied piping and the matching parameter. *The Linguistic Review* 6:41-58.
- Harbert, Wayne 1983. On the nature of the matching parameter. *The Linguistic Review* 2: 237-284.
- Hirschbühler, Paul & Rivero, María L. 1983. Remarks on Free Relatives and Matching Phenomena. *Linguistic Inquiry* 14, 505-519.
- Jacobson, Pauline. 1976. *On the Syntax and Semantics of the Multiple Relatives in English*. Distributed by the Indiana Univ. Linguistic Club.
- Kim, Jong-Bok and Byung-Soo Park. 1996. English Free Relative Clause Constructions: From A Constraint-Based Perspective. In *Language, Information, and Computation (PACLIC 11)*, 31-41.
- Larson, R. 1985. Bare-NP Adverbs. *Linguistic Inquiry*. 16, 595-621.
- Larson, R. 1987. Missing Prepositions and the Analysis of English Free Relatives. *Linguistic Inquiry* 18, 239-266.
- McCawley, J. 1981. The Syntax of Semantics of English Relative Clauses. *Lingua* 53, 99-149.
- McCawley, J. 1988. *The Syntax Phenomena of English I & II*. The University of Chicago Press.
- Pollard, Carl and Ivan Sag. 1994. *Head-Driven Phrase Structure Grammar*. Chicago: University of Chicago Press and Stanford: CSLI Publications.

- Quirk, R, S. Greenbaum, G. Leech and J. Svartvik. 1985. *A Comprehensive Grammar of the English Language*. London: Longman.
- Sag, Ivan. 1997. English Relative Clause Constructions. *Journal of Linguistics* 33, 431-483.
- Sag, Ivan A. and Tom Wasow. 1999. *Syntactic Theory: A Formal Approach*. Stanford: CSLI Publications.
- Suner, Margarita. 1984. Free relatives and the matching parameter. *The Linguistic Review* 3: 363-387.
- Weisler, S. 1980. The Syntax of that-less Relatives. *Linguistic Inquiry* 11, 624-631.

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