Numeral Quantifiers: NP Modifiers and Relational Quantity Nominals*

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Numeral quantifiers composed of the number and the classifier can either precede or follow nouns in Korean. This paper examines these prenominal and postnominal numeral quantifier constructions and argues that they have different structures. I propose that the numeral quantifier is an NP modifier of type <<e, t>, <e, t>> in the prenominal quantifier construction, while it is a relational quantity nominal of type <e, <e, t>> taking the associated DP as its argument and forcing a monotonic interpretation in the postnominal quantifier construction. This analysis provides an account for a number of properties of numeral quantifier constructions that appear to be problematic for an alternative approach using movement which is perhaps most familiar way of dealing with prenominal and postnominal quantifier constructions.

Keywords: classifiers, measure nouns, numeral quantifiers, monotonicity constraint, Korean

1. Introduction

Korean is a classifier language, in which nouns normally cannot combine with a numeral without a classifier, whether of mass or counted entities.

(1)	a.	twu	kwen-uy	chayk	cf.	*twu	chayk
		2	**CL**(book)-Gen	book		2	book
		'two books'					
	b.	twu	pyeng-uy	mwul	cf.	*twu	mwul
		2	CL(bottle)-Gen	water		2	water
		'two bottles of water'					

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The numeral quantifier can precede or follow the associated noun within a DP as shown in (2). When it occurs before the noun, it is often marked by the genitive case.

(2) a. cheli-ka [**twu kwen**-uy chayk]-ul ilk-ess-ta
Cheli-Nom [2 CL-Gen book]-Acc read-Pst-Dec
'Cheli read two books.'

b. cheli-ka [chayk **twu kwen**]-ul ilk-ess-ta
Cheli-Nom [book 2 CL]-Acc read-Pst-Dec
'Cheli read two books.'

(2a) and (2b) are quite similar in the sense that the numeral quantifier conveys information about the quantity of the entity denoted by the associated noun in both constructions. How and why does Korean allow the quantifier to occur on either side of the noun? Previous studies have claimed that postnominal quantifier constructions are derived from prenominal quantifier constructions or vice versa. This paper, however, argues that prenominal and postnominal quantifier constructions have different structures. I propose that the numeral quantifier is an NP modifier of <<e, t>, <e, t>> in the prenominal quantifier construction, while it is a relational quantity nominal <e, <e, t>> taking the associated DP as its argument and tracking a part-whole relationship in the postnominal quantifier construction.

The organization of this paper is as follows. Section 2 presents a number of syntactic and semantic differences between prenominal and postnominal numeral quantifier constructions, which pose problems under previous uniform approaches for these two quantifier constructions. Section 3 proposes an alternative analysis. Section 4 shows how this analysis can account for idiosyncratic properties of numeral quantifier constructions. Section 5 concludes the paper.

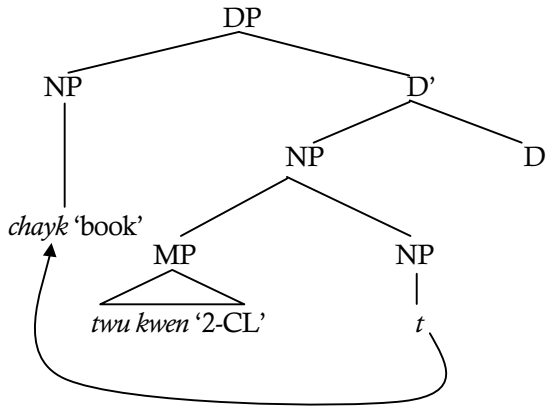
2. Idiosyncratic Properties of Numeral Quantifier Constructions: Against the Uniform Approach

Previous analyses have treated prenominal and postnominal numeral quantifiers as the same and have assumed that prenominal and postnominal quantifier constructions are transformationally related. There are two movement approaches: one is the NP movement, and the other is the numeral quantifier movement.

The NP movement assumes that the postnominal quantifier construction is derived from the prenominal quantifier construction by some syntactic movement (W Chae 1983, Y-H Kim 1983, Nakanishi 2004 among others). The numeral quantifier is base-generated as an NP adjunct, and the associated NP

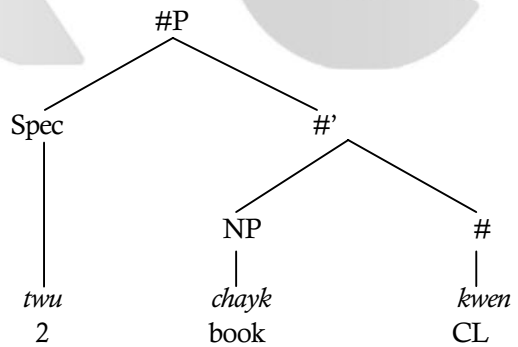
moves to Spec of DP in the postnominal quantifier construction as represented below.

(3)



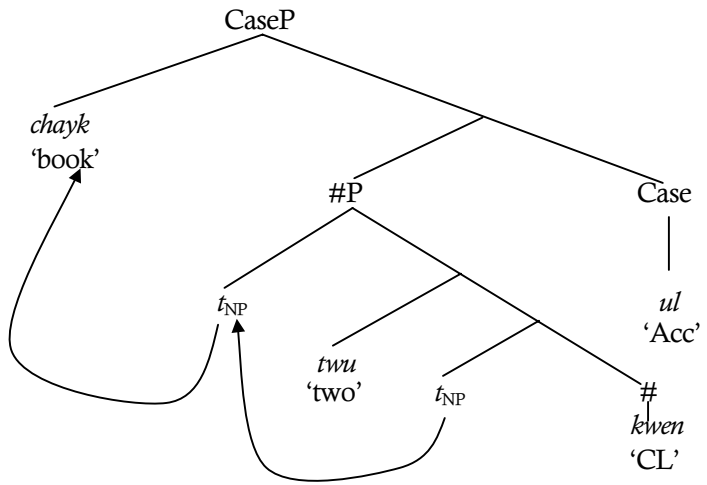
The other uniform approach is the analysis recently proposed by Watanabe (2006). He claims that the postnominal quantifier construction is the underlying structure for the prenominal quantifier construction. Following Li's (1999) analysis, he first assumes that the classifier is a head of the numeral phrase (= #P) and that the associated NP is its complement as illustrated in (4).

(4)



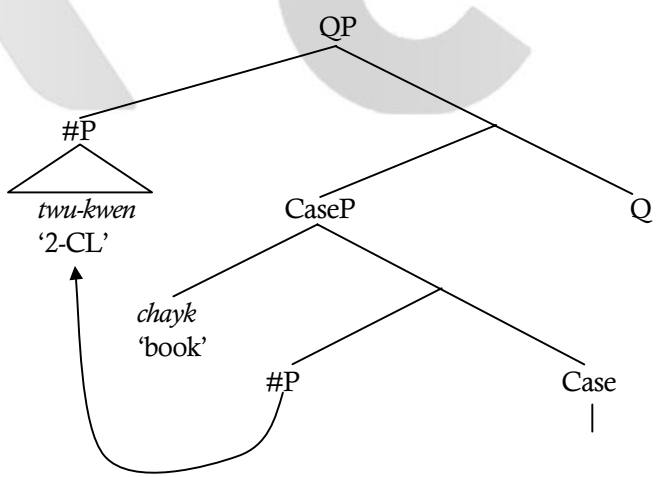
In the postnominal quantifier construction, the NP is raised to second Spec of #P for an EPP feature that the # head has, and the NP undergoes another movement to Spec of CaseP for case-checking. As a result, we can get a postnominal quantifier construction [NP + NumQ + Case].

(5)



Watanabe claims that there are at least three different functional projections above NP: #P, QP, and DP. According to his analysis, the prenominal quantifier construction is derived by raising #P to Spec of QP, where quantifiers other than numeral ones are assumed to be base-generated as represented in (6).

(6)



Given that quantifiers other than a numeral phrase cannot occur with a classifier in Japanese, Watanabe argues that an Agree relation holds between Q and #P and that this relation is responsible for the realization of a classifier (i.e., an overt head of #P); classifiers are absent for non-numeral quantifiers because Q is in the Agree relation with #P whose head is not overtly realized. Spec of QP provides another possible position to which the number phrase (#P) can move to yield the prenominal quantifier construction.

The movement approaches are appealing in that they can provide a unified analysis for the two different quantifier constructions. They can also account for how the quantifier is allowed on either side of the noun without disrupting the directionality parameter in Korean or Japanese. For example, if we assume that numeral quantifiers are NP modifiers, postnominal constructions would pose a word order problem: They would violate the word order, which dictates that the NP modifier must precede the noun. Such a word order problem can be avoided by assuming that postnominal quantifier constructions are derived from prenominal quantifier constructions as in (3).

The uniform approaches, however, face several empirical problems. The first problem with the movement approaches arises because postnominal quantifier constructions differ from prenominal quantifier constructions by their selectional restrictions. A verb may impose its selectional restrictions on the classifier in postnominal quantifier constructions, as exemplified in (7) and (8) (K Shin 2008).

(7) a. ?? cheli-ka silswulo [twu kamani-uy polissal]-ul ccic-ess-ta
Cheli-Nom accidently [2 CL(sack)-Gen barley]-Acc tear-Pst-Dec
b. cheli-ka silswulo [polissal twu kamani]-lul ccic-ess-ta
Cheli-Nom accidently [barley 2 CL(sack)]-Acc tear-Pst-Dec
'Cheli accidently tore two sacks of rice.'

(8) a. ?? cheli-ka cayppali [twu can-uy wain]-ul cip-ess-ta
Cheli-Nom quickly [2 CL(glass)-Gen wine]-Acc pick-Pst-Dec
b. cheli-ka cayppali [wain twu can]-ul cip-ess-ta
Cheli-Nom quickly [wine 2 CL (glass)]-Acc pick-Pst-De
'Cheli picked up two glasses of wine quickly.'

The verbs 'tear' and 'pick' obviously do not take the mass nouns 'barley' and 'wine' as their arguments: The sacks are the items that had been torn into pieces, and what Cheli picked up was two glasses that were filled with wine. The prenominal quantifier constructions (7a) and (8a) are not compatible with these verbs that exercise their selectional restrictions on the classifiers, whereas the postnominal quantifier constructions are as in (7b) and (8b).[1] This indi-

[1] Note that *kamani* 'sack' and *can* 'glass' (7) and (8) still function as classifiers that measure the quantity. For example, (8b) is semantically different from the following sentence when *can* 'glass' is used as an independent word.

(i) cheli-ka [(wain-)can twu kay]-lul cip-ess-ta
Cheli-Nom [(wine-)glass 2 CL]-Acc pick-Pst-Dec
'Cheli picked up two (wine) glasses.'

Unlike the above sentence, (8b) requires the two glasses to be filled with wine: (8b) is not compatible in the context where Cheli picked up empty glasses.

cates that the numeral quantifier serves as a lexical head of the quantified nominal expression on which the verb imposes its selectional restrictions in the postnominal quantifier construction. However, the prenominal quantifier simply modifies the following nominals in (7a) and (8a), and the classifier functions only as a measure noun, specifying the quantity of the associated nominal. If prenominal numeral quantifiers are the same as postnominal numeral quantifiers, then we would expect them to be subject to the same selectional restrictions.

The second argument against the uniform approaches is the difference between the associated nominals of prenominal and postnominal quantifiers. In the uniform approaches discussed above, the numeral quantifier always combines with NPs. Hence, they predict that the numeral quantifier cannot occur with proper names or pronouns that correspond to DPs in both prenominal and postnominal quantifier constructions. But this prediction is not borne out as shown in (9)-(11).

(9) a. * na-nun [twu myeng-uy [cheli-wa mini]]-lul man-ass-ta
I-Top [2 CL-Gen [Cheli-Conj. Mini]]-Acc meet-Pst-Dec
b. na-nun [[cheli-wa mini] twu myeng]-ul man-ass-ta
I-Top [[Cheli-Conj. Mini] 2 CL]-Acc meet-Pst-Dec
'I met the two of Cheli and Mini.'

(10) a. * [twu wuli]-ka ku il-ul hay-ss-ta
[2 us]-Nom that work-Acc do-Pst-Dec
b. [wuli twul]-i ku il-ul hay-ss-ta
[us 2]-Nom that work-Acc do-Pst-Dec
'The two of us did that work.'

(11) a. * [twu kay-uy kukek]-i malsseng-i-ta
[2 CL-Gen that thing]-Nom trouble-be-Dec
b. [kukek twu kay]-ka malsseng-i-ta
[that thing 2 CL]-Nom trouble-be-Dec
'The two of those cause troubles.'

Proper names or pronouns can appear in the position of the associated nominal in postnominal quantifier constructions, but not in prenominal quantifier constructions.

The third problem for the movement approaches has to do with the interpretive difference between prenominal and postnominal quantifier constructions. Y-H Kim (1983) and S-H Han (1999) point out that postnominal quantifiers tend to force a proper partitive reading, especially when the numeral quantifier appears without a classifier. Body-part terms as well as human nouns may di-

rectly combine with numerals. In this case, postnominal quantifiers force proper partitive readings. For example, (12b) is ruled out because it presupposes the existence of at least three hands and is inconsistent with the common knowledge that a human has exactly two hands.

(12) a. cheli-ka [twu son]-ul tul-ko seiss-ta
Cheli-Nom [two hand]-Acc raise-Conj stand-Dec
b. * cheli-ka [son twul]-ul tul-ko seiss-ta
Cheli-Nom [hand two]-Acc raise-Conj stand-Dec
'Cheli raised two hands.'

We can see more clearly that postnominal quantifier constructions require proper partitivity when we compare (12b) and (13).

(13) a. ? Cheli-ka [son hana]-ul tul-ko seiss-ta
Cheli-Nom [hand one]-Acc raise-Conj stand-Dec
'Cheli raised one hand.'

When *twul* 'two' in (12b) is replaced by *hana* 'one' in (13), the postnominal quantifier construction becomes more or less acceptable. The quantified nominal expression in (13) refers to a proper subpart of the arms, i.e., one of the two arms. Postnominal bare numeral quantifier constructions are allowed when the quantified nominal expression refers to a proper subpart of the entity denoted by the associated nominal in its extension. This semantic difference between prenominal and postnominal quantifier constructions would be puzzling under the movement approaches which treat numeral quantifiers uniformly in both prenominal and postnominal quantifier constructions.

Of course, movement approaches may deal with this problem by arguing that syntactic movements may bring out semantic differences such as the proper partitive meaning for postnominal quantifier constructions, but this assumption is not very plausible. According to C-S Suh (1995: 528-529), certain nouns, such as *maul* 'village,' *hakkyo* 'school' and *nala* 'country,' have no appropriate classifiers, and those nouns also directly combine with the numeral, as exemplified in (14a). They are not compatible with the postnominal quantifier construction as in (14b).

(14) a. ipen saken-ulo [tases hakkyo]-ka mwun-ul tatassta
this time accident-by [5 school]-Nom door-Acc closed
b. ?? ipen saken-ulo [hakkyo tases]-i mwun-ul tatassta
this time accident-by [school 5]-Nom door-Acc closed
'Five schools were closed by this accident.' (C-S Suh 1995: 528)

Obviously, (14b) does not violate the proper partitive requirement. Its ungrammaticality cannot be explained by semantic differences that arise from syntactic movements. The contrast between (14a) and (14b) suggests that different types of bare numeral quantifiers occur in prenominal and postnominal constructions.

The fourth problem stems from the fact that certain measure nouns can appear in prenominal quantifier constructions, but not in postnominal quantifier constructions. Classifiers include measure nouns that are metric units marked off on the scale of a measuring instrument like *liter*. There are restrictions on measure nouns in postnominal quantifier constructions For example, measure phrases such as *il lithe* 'one liter' can appear in both prenominal and postnominal quantifier constructions, as in (15). But measure phrases such as *osip tossi* '50 degree-Celsius' can occur only in prenominal quantifier constructions. They are not allowed in postnominal quantifier constructions, as in (16).

(15) a. [il lithe-uy mwul]-ul thong-ey nehe-la
[1 liter-Gen water]-Acc bucket-Loc put-Imp
b. [mwul il lithe]-lul thong-ey neh-ela
[water 1 liter]-Acc bucket-Loc put-Imp
'Pour one liter of water in the bucket.'

(16) a. [osip tossi (-uy) mwul]-ul thong-ey nehe-la
[50 degree(-Gen) water]-Acc bucket-Loc put-Imp
b. * [mwul osip tossi]-ul thong-ey nehe-la
[water 50 degree]-Acc bucket-Loc put-Imp
'Pour 50 degree water in the bucket.'

This difference between prenominal and postnominal quantifier constructions is also not expected according to the assumption that prenominal quantifier constructions are derived from postnominal quantifier constructions (or vice versa) by moving measure phrases.

Interestingly, the same semantic restriction is observed in Japanese and German (Nakanishi 2003, 2004). In Japanese, *san-do* 'three-degree' is compatible only with prenominal quantifier constructions, and it cannot occur in postnominal quantifier constructions as illustrated in (17).

(17) a. [san-do-no mizu]-ga tukue-nouede kobore-ta (koto)
[three-degree-Gen water]-Nom table-on spill-Pst
b. * [Mizu san-do]-ga tukue-nouede kobore-ta (koto)
[water three-degree]-Nom table-on spill-Pst
'Three degree water spilled on the table.' (Nakanishi 2004: 50)

This crosslinguistic semantic constraint on quantifier constructions is known as 'the monotonicity constraint,' which was originally proposed to account for restrictions on measure phrases in different types of English measure constructions.

In English, measure phrases modifying mass nouns can appear in the form of pseudo-partitives and compounds where the measure phrase and the associated noun appear to form a compound as illustrated in (18) and (19).

(18) 100 degrees-Celsius water, 18-carat gold, one-liter bottle

(19) 3 liters of water, 5 pounds of apples, 2 bottles of wine

But different types of measure phrases occur in English pseudo-partitives and compounds, and the two seem to be in complementary distribution as exemplified in (20).

(20) * 100 degree-Celsius of water, *18-carat of gold, *one liter of bottle

Krifka (1989, 1998) and Schwarzschild (2002, 2006) claim that measure phrases are subject to different semantic constraints in compounds and pseudo-partitives. That is, the syntactic difference between pseudo-partitives and compounds is related to the semantic distinction between what Schwarzschild (2002, 2006) calls monotonic and non-monotonic measure functions.[2] Adopting Lønning's (1987) idea, Schwarzschild (2002) defines monotonicity in terms of divisivity as below, assuming that measure functions (μ) are functions from objects (*x, y*) to intervals on a scale (α, β):

(21) Monotonicity
A measure function μ is monotonic on ⟦NP⟧ iff:
For every *x, y* such that ⟦NP⟧ (*x*) is a proper subpart of ⟦NP⟧ (*y*),
if α and β are intervals of a scale such that α (μ (*x*)) and β (μ (*y*)), then $\alpha < \beta$

Note that the measure function is a property (e.g., weight, volume, etc), and it is not denoted by the measure noun (cf. Krifka 1989, 1998). For example, *three liters of water* is translated as in (22), where the measure function μ maps an individual z in the extension of ⟦water⟧ to an interval on the volume scale which has the property ⟦three liter⟧.

[2] Krifka (1989, 1998) calls them extensive and non-extensive measure functions, which are defined in terms of cumulativity. According to him, extensive measure functions must be additive and commensurable and, hence, they can only be applied to English mass nouns and bare plurals which are homogeneous.

(22) λz [WATER(z) ∧ THREE-LITER(μ(z))]

In other words, a measure function is monotonic on a noun if it tracks the part-whole structure denoted by the noun (Schwarzschild 2002, 2006). Volume and weight measurements in (19) are monotonic. For example, if the quantity of water is three liters, every proper subpart of the water has a volume less than three liters. If the temperature of water is 100 degrees-Celsius, however, it is not necessary that proper parts of it will have lower or higher temperatures than 100 degrees-Celsius. Hence, *100 degrees-Celsius* in (18) measures a property that is non-monotonic relative to a given part-whole structure. Thus, we can make a semantic generalization that compounds are formed with non-monotonic measure functions, whereas pseudo-partitives are compatible with monotonic measure functions.

This notion of monotonicity also nicely captures the difference between Korean prenominal and postnominal quantifier constructions. Recall that the monotonic measure phrase *il lithe* '1 liter' can occur in the postnominal quantifier construction, but the measure phrase *osip tossi* '50 degrees-Celsius' cannot. Korean postnominal quantifier constructions require monotonicity, while prenominal quantifier constructions are not subject to the monotonicity constraint.

There are also morpho-syntactic differences between prenominal and postnominal quantifier constructions that provide further support for the claim that they have different structures. In Korean, all modifiers must precede the element they modify. Within nominal phrases, NPs follow adjectives, relative clauses, and other modifiers. Furthermore, NP modifiers are normally interchangeable with one another in terms of word order, and they may occur with the genitive case when nouns are used as modifiers. Prenominal quantifiers show these morpho-syntactic characteristics of NP modifiers. In prenominal quantifier constructions, the genitive case *-uy* is usually attached to numeral quantifiers that precede nouns, and prenominal quantifiers can switch their positions with NP modifiers such as adjectives.

(23)	a. ?	caymiissnun	twu	kwen-uy	soselchayk
		interesting	2	CL-Gen	novel
	b.	twu	kwen-uy	caymiissnun	soselchayk
		2	CL-Gen	interesting	novel
		'Two interesting novels'			

Unlike prenominal quantifiers, postnominal quantifiers do not exhibit such properties of NP modifiers. When numeral quantifiers follow the associated nominals, NP modifiers cannot occur in front of the postnominal quantifier. They can only appear before the associated nominal in postnominal quantifier

constructions.

(24)	a.	caymiissnun	soselchayk	twu	kwen
		interesting	novel	2	CL
	b. *	soselchayk	caymiissnun	twu	kwen
		novel	interesting	2	CL
		'Two interesting novels'			

In sum, it is clear now from the above discussion that variance among prenominal and postnominal quantifier constructions indicates that they have two different structures. Numeral quantifiers are NP modifiers in prenominal quantifier constructions, while they can combine with DPs such as proper names and serve as lexical heads of quantified nominal expressions on which verbs impose their selectional restrictions in postnominal quantifier constructions. In addition, the postnominal quantifier is compatible only with the measure noun whose property can be interpreted as monotonic.

3. Syntax and Semantics of Numeral Quantifier Constructions

3.1. Classifiers in a Classifier Language

Since the classifier is an important element of the numeral quantifier in Korean, I will briefly discuss the function of the classifier before proposing a syntax and semantics of prenominal and postnominal numeral quantifiers. There are two competing explanations regarding why some languages require a classifier to combine a noun with a numeral while others don't. One explanation locates the difference in the nouns. That is, nouns are different in a classifier language than in a non-classifier language. Common nouns are generally classified into two categories, count and mass. As the term 'count noun' implies, a count noun denotes a set of individuated (atomic) elements that are countable. On the other hand, mass nouns are not countable in the sense that their denotations are not divided into individuated or distinct elements. In languages such as English, the semantic difference between count and mass nouns is correlated with morpho-syntactic differences. Count nouns combine directly with numerals, while mass nouns require classifiers to combine with numerals.

(25)	COUNT NOUN	MASS NOUN
	three books	three bottles/liters of water (cf. *three water)

In Korean, which is a classifier language, nouns normally cannot combine with the numeral without being accompanied by a classifier, regardless of

whether they denote mass or count entities. Chierchia (1998a, 1998b, 2001), Nakanishi (2004) and S-N Kwon & Zribi-Hertz (2004) claim that all nouns are mass nouns in a classifier language, and this is why they require classifiers to combine with numerals. According to Chierchia's (1998a, 1998b) Nominal Mapping Parameter, Korean belongs to the NP [+arg, -pred] languages where bare NPs are used as arguments and denote kinds of type *e*. In the NP [+arg, -pred] languages, classifiers combine with DPs to form predicates (of type <e, t>), and they also have a domain shifting function from mass noun domains to count noun domains (Chierchia 1998a, 1998b).

As pointed out by B-M Kang (1994) and C Kim (2004), however, count nouns are morpho-syntactically distinguishable from mass nouns in Korean.[3] For example, the inherent plural marker *-tul* can be attached only to count nouns but not to mass nouns as in (26), and some quantifiers occur only with count nouns as in (27).

(26) a. ai-tul
kid-PL
'kids'

b. *mwul-tul
water-PL

(27) a. yele ai
several kid
'several kids'

b. *yele mwul
several water

In contrast to Chierchia, Krifka (1995) proposes that the distinction between classifier and non-classifier languages has to do with the semantics of numerals. That is, in a classifier language, numerals do not have a noun argument position lexically so that the presence of a classifier is required to incorporate noun arguments into numerals. On the other hand, the classifier is lexically built into the numeral in a non-classifier language. Following this idea, Korean and English numerals may be approximately represented in (28a) and (28b).

(28) a. ⟦sey⟧ 'three' = 3
⟦mali⟧ 'CL(animal)' = $\lambda n \lambda y \lambda x$ [OU (y)(*x*) = n]
⟦sey mali⟧ '3-CL(animal)' = $\lambda y \lambda x$ [OU (y)(*x*) =3]
b. ⟦three⟧ = $\lambda y \lambda x$ [OU (y)(*x*) =3]

Assuming that bare nouns denote kinds, the operator "Object Unit (OU)" takes a kind noun and shifts it to a specimen of that kind, which can be measured. This measure function is incorporated in the semantics of the classifier in

[3] See also Hundius and Kölver (1983) for Thai and Cheng and Sybesma (1999) for Chinese. They show that there is a distinction between mass and count nouns in other classifier languages.

Korean, while it is lexically built into the numeral in English. Hence, English *three* corresponds to the expression derived from combining the numeral *sey* 'three' and the classifier *mali* 'CL (animal)' in Korean.[4]

In fact, Krifka's (1995) claim is supported by the fact that not all count quantifiers require the classifier to quantize the noun in Korean. As exemplified in (29), when *yele* 'several' modifies the noun, the classifier is optional.

(29) a. yele (myeng-uy) haksayng
several (CL-Gen) student
'several students'

If all nouns are mass nouns or classifiers are built into nouns, then we cannot capture that a classifier can be omitted depending on what kinds of quantifiers occur. Moreover, there are count quantifiers that cannot appear with the classifier at all:

(30) a. kakkak-uy haksayng cf. * kakkak myeng-uy haksayng
each-Gen student each CL-Gen student
'each student'
b. motwun haksayng cf. * motwun myeng-uy haksayng
all student all CL-Gen student
'all students'

Thus, it is a lexical property of the quantifier itself that determines whether it combines directly with a noun. This can be captured under Krifka's (1995) hypothesis. That is, some count quantifiers do have a built-in classifier, but others, like numeral quantifiers, don't. Following Krifka's (1995) approach, I will therefore assume that the presence of the classifier is due to the lexical

[4] C Kim (2004) argues for an alternative approach: the classifier meaning is not built into the meaning of English numerals but into nouns. That is, he assumes that the classifier is required in a classifier language because count nouns lack a number argument in the lexicon. His claim is based on the fact that [+human] nouns can combine with numerals without classifiers as in (i).

(i) sey haksayng / salam
3 student / person 'three students/persons'

He argues that a human noun does not require a classifier to combine with a numeral because the classifier is built in the semantics of the human noun. But a closer examination reveals that only low numbers can combine with such nouns without classifiers. The presence of the classifier is not optional even for human nouns when they occur with relatively high numbers.

(ii) a. ?? smwu/mahun haksayng-i ttena-ss-ta
20/40 student -Nom leave-Pst-Dec
'Twenty students left.'

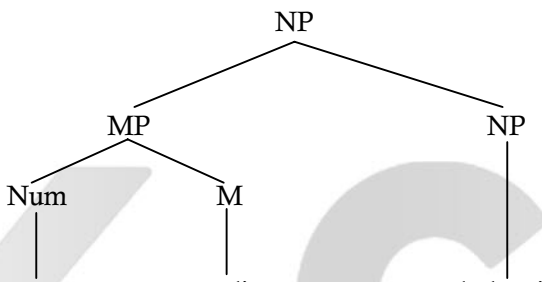
Even though it is true that only certain nouns can combine with bare numerals, the absence of the classifier in (i) is more likely to be a matter of the idiosyncrasy of low numbers.

property of the numeral in Korean: The numeral must combine with the classifier in order to combine with a noun, yielding an expression that corresponds to English *three*.

3.2. Prenominal Numeral Quantifiers

Recall that numeral quantifiers do not combine with DPs such as proper names and they behave like NP adjuncts in prenominal quantifier constructions. Hence I propose that Korean prenominal quantifier construction will have the following structure:

(31)



'two tigers'

I assume that the classifier in the prenominal quantifier construction takes a number argument and permits a common noun (NP) to combine with the number as in (32). If we adopt the algebraic approach where the domain has a complete atomic join semi-lattice structure, (Cherchia 1998a, 1998b; cf. Link 1983, Landman 1989), #(x) = n says that x consists of n atoms if x is an individual sum and # is a classifier counting atomic objects of the sum.[5,6]

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[5] A use of the numeral as a number-denoting argument of the classifier or # is adopted from Krifka (1989, 1999), Higginbotham (1994) and Chierchia (1998a, 1998b). See the derivation (28a).

[6] The lattice-theoretic approach to noun denotations was originally developed by Link (1983) and Landman (1989). Following Chierchia's (1998a, 1998b) approach where the domain has a lattice structure, generated by a set of atoms, the denotation of a count noun in Korean will be illustrated as in (i).

(i) {a, b, c},….
{a, b}, {a, c}, {b, c},…
a, b, c, … = Atoms

The above domain contains both the denotations of singulars (sets of atoms) and plurals (sets of sets of atoms). The set {a, b} (cf. $a \oplus b$ under Link's (1983) algebraic approach) denotes the individual sum consisting of atomic parts a and b. The domain is ordered by the following 'part-of' relation (≤):

(ii) {a, b} ≤ {a, b, c}
a ≤{a, b}

(32) $[\![\text{CL}]\!] = \lambda n \lambda P \lambda x [P(x) \wedge \#(x) = n]$

In a classifier language, the classifier not only allows a numeral to combine with a noun, but also has an independent meaning beyond its measuring function, which interacts semantically with the noun. Different classifiers are selected depending on the semantic properties of the noun to be quantized. As shown in (33), a noun referring to an animal combines with the classifier *mali* but not *myeng* that indicates the number of persons.[7]

(33) a. twu / 2 mali / *myeng -uy holangi-ka salaci-ess-ta
2 / *myeng -Gen tiger-Nom disappear-Pst-Dec
'Two tigers disappeared.'

Hence (32) will be modified as in (34) depending on the type of the classifier.

(34) a. $[\![\text{mali}]\!] = \lambda n \lambda P \lambda x [P(x) \wedge \text{ANIMAL}(x) = n]$
b. $[\![\text{pyeng}]\!] = \lambda n \lambda P \lambda x [P(x) \wedge \text{BOTTLE}(x) = n]$

The classifiers in (34) have two functions. One is to take the number argument, and the other is to modify the noun. ANIMAL(x) in (34a) means that the atoms of the individual sum x are counted; [ANIMAL(x) = n] says that x is an individual sum consisting of n atoms, which are animals. The classifier *pyeng* 'CL (bottle)' in (34b) combines with the mass noun. BOTTLE(x) indicates that the quantity of x is measured, and [BOTTLE(x) = n] means that x is liquid whose amount is equal to n bottles.

The classifier in (34a) combines with the numeral, forming the measure phrase of type <<e, t>, <e, t>>. For example, the prenominal numeral quantifier *twu mali* '2-CL(animal)' is translated as in (35).[8]

[7] Classifiers also play a role in the interpretation of the associated nominal by resolving the semantic ambiguity of the nominal. For example, when the classifier *kay* 'CL (inanimate object)' is attached to *holangi* 'tiger', *holangi* denotes a stuffed animal and it cannot refer to a live creature. So, the verb 'kill' is not compatible with the complement *holangi twu kay* 'tiger 2-CL (object)':

(i) chelswu-ka holangi twu kay-lul *cwuky-ess-ta / pat-ass-ta
Chelswu-Nom tiger 2 CL(object)-Acc kill-Pst-Dec / be torn-state-Dec
'Chelswu killed/receive (two tigers (= two stuffed animals).'

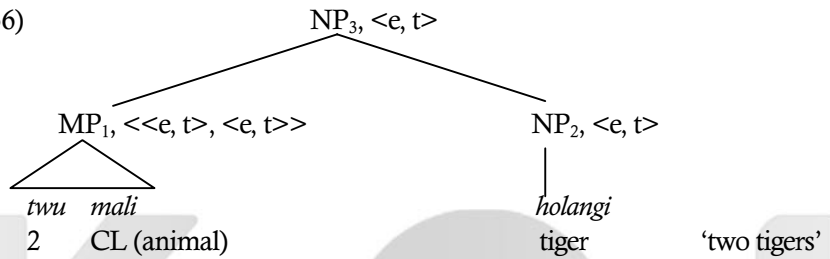
[8] Note that Korean prenominal numeral quantifier that I proposed here corresponds to the English numeral that combines with an NP: $[\![\text{three}]\!] = \lambda P \lambda x [P(x) \wedge |x| = 3]$ (Verkuyl 1981, Link 1987, Krifka 1999).

(35) ⟦twu mali⟧ = λP λ*x* [P(*x*) ∧ ANIMAL(*x*) =2]

⟦twu⟧ = 2 ⟦mali⟧ = λn λP λ*x* [P(*x*) ∧ ANIMAL(*x*) = n]

By combining the prenominal quantifier in (35) and the NP *holangi* 'tiger,' we can derive the prenominal quantified noun phrase [*twu mali-uy holangi*] 'three tigers' as in (36).

(36)



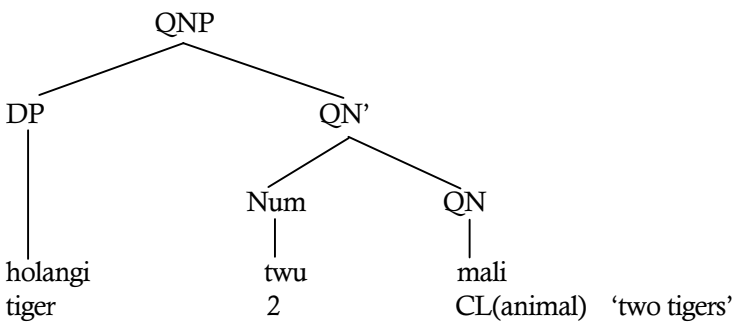
⟦holangi⟧ = λ*x* [TIGER(*x*)]
⟦twu mali⟧ = λP λ*x* [P(*x*) ∧ ANIMAL(*x*) =2]
⟦twu mali holangi⟧ = λ*x* [TIGER(*x*) ∧ ANIMAL(*x*) =2]

The prenominal quantifier *twu mali* 'two-CL (animal)' restricts the denotation of *holangi* 'tiger' to those individual sums that consist of two atomic tigers. In other words, NP ⟦twu mali holangi⟧ denotes sets of tigers consisting of two atoms which are animals.

3.3. Postnominal Quantifier Constructions

I propose that the numeral quantifier functions like a relational quantity nominal taking the associated DP as its argument in the postnominal quantifier construction as illustrated in (37).

(37)



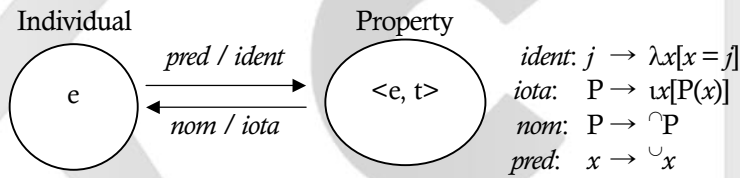
This syntactic structure makes it clear that the postnominal quantifier has a different semantics from the prenominal quantifier. In the postnominal quantifier construction, the classifier does not simply convey information about the quantity of the entity denoted by the associated nominal; it also functions as a lexical head taking the associated nominal as its argument. This suggests the following translation for the postnominal classifier, where the classifier is treated as a three-place predicate.

(38) $[\![\text{CL}]\!] = \lambda n \lambda x \lambda y\, [\#_R(x)(y) = n]$

I use a subscripted R to distinguish the classifier in the postnominal quantifier from the one in the prenominal quantifier.

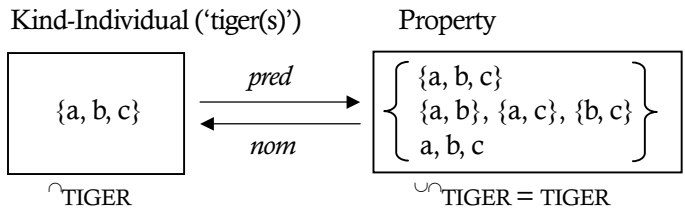
Recall that the postnominal quantifier combines with a DP like a proper name. It means that a predicate-forming operator is built into the semantics of the classifier: the classifier first takes the individual argument (of type e) and shifts it to a property-type (<e, t>) denotation by standard shifting functions parallel to *ident* or *pred* (Partee 1986; Chierchia 1984, 1998a, 1998b).

(39)



The function of the predicate-forming operator *pred* is illustrated in (40). If a, b, and c are all the tigers in a world w, then $^{\cap}$TIGER denotes {a, b, c}. Since a kind-denoting DP 'tigers' is derived from a property by Chierchia's nominalization function mapping a property to a kind individual, $^{\cup\cap}$TIGER is equivalent to the property TIGER.[9]

(40)



The classifier in the postnominal quantifier not only shifts *x* to an NP, but it also requires that the NP denotation have a structure to which a measure func-

[9] If an individual is the definite DP 'the tigers' (i.e., ιTIGER), it denotes a set of atoms which is the largest set of tigers in the world in question. The predicative reading of 'the tigers' is obtained from the individual-denotation by the function *ident*.

tion is applied monotonically. Assuming $R_{\#}$ expresses these two functions of the classifier, the definition in (38) can be seen as an abbreviation of (41) below:

(41) $[\![CL]\!] = \lambda n \lambda x \lambda y\, [y \in \phi(x) \wedge \#(y) = n] \wedge [\forall v,w\, [v,w \in \phi(x) \wedge v \leq w \rightarrow \#(v) \leq_d \#(w)]]]$

The symbol ϕ indicates a type-lowering function: it shifts the argument e to type <e, t> either by *ident* or by *pred*. The subscript d is added to $\leq$ (as in $\leq_d$) to express 'less than' in order to distinguish it from $\leq$ indicating a 'part-of' relation (see footnote 6). (41) says that y is a member of $\phi(x)$ and consists of n atoms and for every v, $w \in \phi(x)$ such that if v is a subpart of w, then $\#(v)$ is less than $\#(w)$.

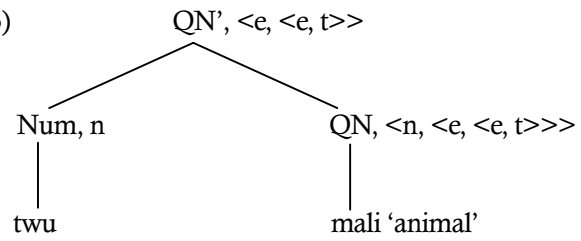
It should be noted that if y is a member of $\phi(x)$, then y should be a subpart of an individual sum x. Hence it can be considered that the definition in (41) is equivalent to the following:

(42) $[\![CL]\!] = \lambda n \lambda x \lambda y\, [\, y \leq x \wedge \#(y) = n \wedge \forall v\, [v \leq x \rightarrow \#(v) \leq_d \#(x)]]$

The classifier takes a DP argument and expresses a part-whole relationship in the postnominal quantifier construction.

Just like the prenominal quantifier, the postnominal quantifier is also derived by combining a number argument and a classifier as represented in (43). The postnominal quantifier is a two-place predicate of type <e, <e, t>>.

(43)

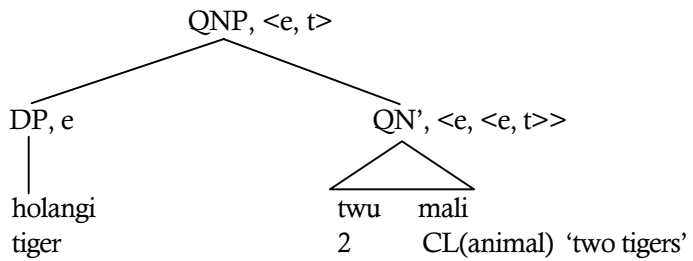


$[\![twu]\!] = 2$
$[\![mali]\!] = \lambda n \lambda x \lambda y\, [\text{ANIMAL}_R(x)(y) = n]$
$[\![twu\ mali]\!] = \lambda x \lambda y\, [\text{ANIMAL}_R(x)(y) = 2]$
$= \lambda x \lambda y\, [\, y \leq x \wedge \text{ANIMAL}(y) = 2 \wedge \forall v [v \leq x \rightarrow \text{ANIMAL}(v) \leq_d \text{ANIMAL}(x)]])$

The phrase $[\![$twu mali$]\!]$ says that y denotes a subset of x (i.e., one set of $\phi(x)$) and y consists of n atoms which are animals. If the numeral quantifier in (43) combines with a kind-denoting DP *holangi* 'tiger(s),' it will yield a one-place

nominal predicate as in (44).

(44)



$[\![\text{tiger}]\!] = {}^{\cap}\text{TIGER}$

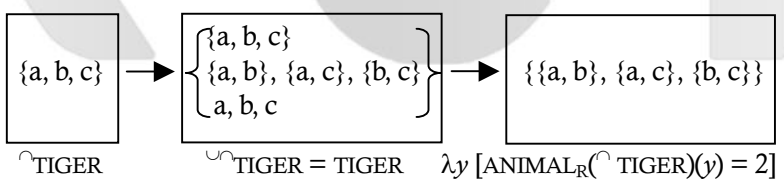
$[\![\text{holangi twu mali}]\!]$

$= \lambda y\,[\text{ANIMAL}_R({}^{\cap}\text{TIGER})(y) = 2]$

$= \lambda y\,[y \leq {}^{\cap}\text{TIGER} \wedge \text{ANIMAL}(y) = 2 \wedge \forall v\,[v \leq {}^{\cap}\text{TIGER} \rightarrow \text{ANIMAL}(v) \leq_d \text{ANIMAL}(x)]$

The quantified nominal phrase [[holangi twu mali]] has the interpretation that *y* is a subset of the set of tigers, which consists of two atomic animals. In other words, it denotes a two-membered subset of the set of tigers. The interpretation of [[holangi twu mali]] can be illustrated as follows:

(45)



In sum, I proposed that prenominal numeral quantifiers are NP modifiers of type <<e, t>, <e, t>>, while postnominal numeral quantifiers are relational quantity nominals of type <e, <e, t>>. The numeral quantifier simply modifies the following NP in the prenominal quantifier construction, but it is shifted to the relational quantity nominal which takes the associated DP as its argument and forces a part-whole interpretation in the postnominal quantifier construction.

4. NP Modifiers vs. Relational Quantity Nominals

This base-generation analysis can provide an account for a number of properties of prenominal and postnominal quantifier constructions that are problematic under the uniform approach. One important consequence is that,

unlike the uniform approach, the proposed analysis can capture the difference between (46a) and (46b), since prenominal quantifiers combine with NPs and postnominal quantifiers combine with NPs and DPs.

(46) a. * [twu wuli]-ka ku il-ul hay-ss-ta
[2 us]-ka that work-Acc do-Pst-Dec
b. [wuli twul]-i ku il-ul hay-ss-ta
[us 2]-Nom that work-Acc do-Pst-Dec
'The two of us did that work.'

(46a) is ruled out because the prenominal quantifier is an NP modifier, and it cannot occur with a DP. However, (46b) is acceptable since the postnominal quantifier is analyzed as a relational quantity nominal taking a DP as its argument.

The proposed analysis also correctly predicts that postnominal quantifier constructions are formed with monotonic measure functions. Recall that different types of measure phrases occur in prenominal and postnominal quantifier constructions: For instance, measure phrases such as *osip tossi* '50 degree (-Celsius)' cannot occur in postnominal quantifier constructions as in (47b).

(47) a. [osip tossi (-uy) mwul]-ul khep-ey neh-ela
[50 degree (-Gen) water]-Acc cup-Loc put-Imp
b. * [mwul osip tossi]-lul khep-ey neh-ela
[water 50 degree]-Acc cup-Loc put-Imp
'Pour 50°C water in the cup.'

I argue that a measure phrase in the postnominal quantifier construction should be analyzed as a two-place predicate, which tracks a part-whole relationship as below.

(48) $[\![\text{il lithe}]\!] = \lambda x \lambda y [\, y \leq x \wedge \text{LITER}(y) = 1 \wedge \forall v [v \leq x \rightarrow \text{LITER}(v) \leq \text{LITER}(x)]]$

As shown in (48), the classifier requires that the property of a measure noun (i.e., volume) be interpreted as monotonic with respect to a part-whole relation denoted by $\phi(x)$. Postnominal quantifier constructions are therefore subject to the monotonicity constraint that must track a part-whole relation of the denotation of the associated noun.

The measure phrase *osip tossi* '50-degree' is not allowed in the postnominal quantifier construction because it measures a property that is non-monotonic for the noun. [osip tossi] in (47b) would be interpreted as follows:

(49) $[\![\text{osip tossi}]\!] = \lambda x \lambda y[\, y \leq x \wedge \text{T-DEGREE}(y) = 50 \wedge \forall v[v \leq x \rightarrow \text{T-DEGREE}(v) \leq \text{T-DEGREE}(x)]]$

(47b) is unacceptable, since it is not the case that any subpart of some water x is colder than x. In the prenominal quantifier construction, however, the temperature measurement is not applied in such a monotonic way. The prenominal numeral quantifier in (47a) is treated as an adjective that modifies the associated noun by measuring it as defined in (50).

(50) $[\![\text{osip tossi}]\!] = \lambda P \lambda x[P(x) \wedge \text{T-DEGREE}(x) = 50]$

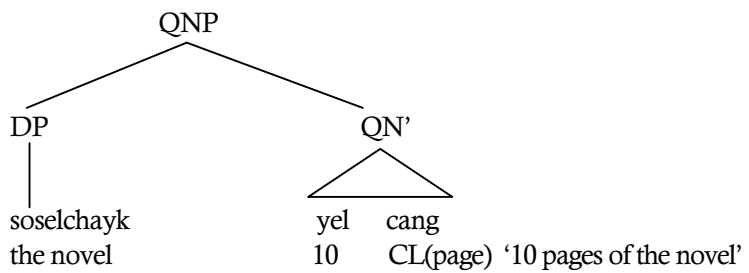
Under the base-generation approach, the difference between prenominal and postnominal quantifier constructions in terms of the monotonicity constraint can be captured by the semantic difference between measure nouns in those quantifier constructions.

There are also some restrictions on measure nouns in prenominal quantifier constructions. Prenominal and postnominal quantifier constructions are not always interchangeable, even when the numeral quantifier is associated with a count noun as in (51).

(51) a. ?? cheli-ka ecey [yel cang-uy soselchayk]-ul ilk-ess-ta
Cheli-Nom yesterday [10 CL(page)-Gen novel]-Acc read-Pst-Dec
b. cheli-ka ecey [soselchayk yel cang]-ul ilk-ess-ta
Cheli-Nom yesterday [novel 10 CL(page)]-Acc read-Pst-Dec
'Cheli read 10 pages of the novel.'

The classifier *cang* in (51) is used for flat objects such as sheets of paper. The prenominal quantifier construction (51a) cannot be used when we intend to convey the message that Cheli read 10 pages from the novel. The base-generation approach predicts the contrast between (51a) and (51b). The postnominal quantifier *yel cang* '10 CL (page)' in (51b) denotes 10 pages of something, and the quantified nominal phrase in (51b) is interpreted as 10 pages of the novel as translated below.

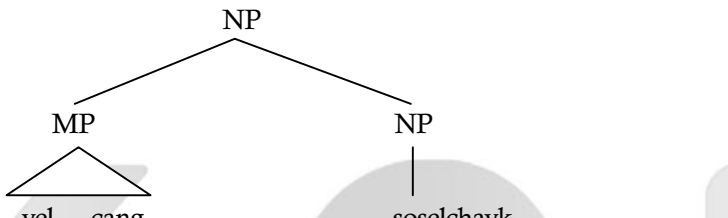
(52)



⟦yel cang⟧ '10-CL(page)'= $\lambda x \lambda y$ [PAGE(x)(y) =10]
⟦soselchayk yel cang⟧
= λy [PAGE(THE NOVEL)(y) = 10]
= λy[$y \leq$ THE NOVEL $\wedge$ PAGE (y) = 10 $\wedge$ $\forall v$[$v \leq$ THE NOVEL $\rightarrow$ PAGE (v) $\leq$ PAGE (x)]]

Such a part-whole reading is not allowed for the prenominal quantifier construction. That is, (51a) is ungrammatical because the prenominal quantifier is interpreted as the NP modifier; [*yel cang-uy soselchayk*] is translated as a 10-page novel as represented in (52).

(53)



⟦yel cang⟧ '10-CL(page)' = $\lambda P \lambda x$ [P(x) $\wedge$ PAGE (x) = 10]
⟦soselchayk⟧ 'novel' = λx [NOVEL (x)]
⟦yel cang –uy soselchayk⟧ = λx [NOVEL (x) $\wedge$ PAGE (x) = 10]

In other words, (51a) is infelicitous since a novel is normally longer than 10 pages.

This analysis can predict the contrast between (51a) and the following sentence (54), where the associated noun 'novel' in (51a) is replaced by *pyenci* 'letter.'

(54) cheli-ka ecey [yel cang-uy (kin) pyenci]-lul ss-ess-ta
Cheli-Nom yesterday [10 page-Gen (long) letter]-Acc write-Pst-Dec
'Cheli wrote a 10-page letter, which is long.'

We can expect that the prenominal quantifier in (54) is interpreted as modifying the following noun *pyenci* 'letter': The letter Cheli wrote consists of 10 pages. Clearly, this interpretation is in accord with common knowledge. The contrast between (51a) and (54) tells us that (51a) is ruled out for a pragmatic reason. In fact, (51a) becomes acceptable if we imagine that there is a 10-page novel. The proposed analysis has an advantage over the uniform approach in that the former accounts for constraints on numeral quantifiers in both prenominal and postnominal quantifier constructions.

The proposed analysis can also explain the difference between prenominal and postnominal quantifier constructions in terms of selectional restrictions:

(55) a. ?? cheli-ka silswulo [twu kamani-uy polissal]-ul ccic-ess-ta
Cheli-Nom accidently [2 CL(sack)-Gen barley]-Acc tear-Pst-Dec
b. cheli-ka silswulo [polissal twu kamani]-lul ccic-ess-ta
Cheli-Nom accidently [barley 2 CL(sack)]-Acc tear-Pst-Dec
'Cheli accidently tore two sacks of barley.'

Under the base-generation analysis, we can explain (55b) by assuming that the classifier in the postnominal quantifier construction is semantically ambiguous. That is to say, the classifier *kamani* 'sack' in the postnominal quantifier construction has two meanings as in (56), i.e., 'substance in a container' and 'a container which is filled with substance', and hence it can be compatible with both 'break' and 'eat' in the postnominal quantifier construction (K Shin 2006, 2008).

(56) a. $\lambda n\, \lambda x\, \lambda y\, [\text{SACK}^{R}_{\text{SUB}}\,(x)(y) = n]$
b. $\lambda n\, \lambda x\, \lambda y\, [\text{SACK}^{R}_{\text{CON}}\,(x)(y) = n]$

The classifier *kamani* 'sack' can be interpreted as either an abstract measure noun or a concrete object. (56a) is the common interpretation of the classifier as a measure noun: *y* is a substance such that *y* is *n* sacks of *x*. The classifier has this meaning in the following sentence.

(57) cheli-ka caknyeney [polissal twu kamani]-lul mek-ess-ta
Cheli-Nom last year [barley 2 CL(sack)]-Acc eat-Pst-Dec
'Cheli ate two sacks of barley last year.'

The classifier *kamani* can denote the object 'sack' as well as indicating the quantity as in (56b). In this case, the classifier has the semantics in (56b) where *y* is a container that is filled with *x* and the number of *y* is *n*. This lexical ambiguity approach is possible for the postnominal quantifier construction because the postnominal quantifier is treated as a relational noun taking the associated nominal as its argument, and this allows the classifier to function as a lexical head, which has a meaning independent of the associated noun.

But this kind of interpretation is not possible for the prenominal quantifier construction. Given that the prenominal numeral quantifier is analyzed as an NP adjunct, it is predicted that the verb always exercises its selectional restrictions on the associated noun, modified by the numeral quantifier, and hence the verb 'tear' is not allowed in the prenominal quantifier construction in (55a). For the sake of the concreteness, let me compare the prenominal quantifier

nominal phrase (55a) and the postnominal counterpart (55b), which are translated in (58a) and (58b), respectively.

(58) a. $[\![\text{twu kamani-uy polissal}]\!] = \lambda Q \exists x\,[\text{BARLEY}(x) \wedge \text{SACK}(x) = 2 \wedge Q(x)]$
b. $[\![\text{polissal twu kamani}]\!] = \lambda Q \exists y\,[\text{SACK}^{R}_{\text{CON}}(\cap \text{BARLEY})(y) = 2 \wedge Q(y)]$

Both (58a) and (58b) state that there is barley whose amount measures two sacks. In addition to this, the postnominal quantified phrase (58b) asserts the existence of two sacks: (58b) means that there are two sacks that are filled with barley. But the prenominal numeral quantifier (54a) never gives rise to such an assertion. (58a) does not tell us whether a sack exists at all. Note that the lexical head is not 'barley,' but 'sack' in (58b). So if (58b) combines with a verbal predicate, then the container 'sack' is the lexical head noun that satisfies the selectional restrictions posed by the verb, and it predicts that the verb 'tear' is allowed in the postnominal quantifier construction as in (56b). Therefore, the assumption that the postnominal quantifier takes the associated nominal as its argument correctly captures the fact that the classifier plays the role of a lexical head of the nominal phrase as a whole.

5. Conclusion

Korean allows the numeral quantifier composed of a numeral and a classifier to either precede or follow a noun. It has been generally assumed that prenominal and postnominal quantifier constructions have the same underlying structure and that numeral quantifiers in both constructions are treated the same. In this paper, I have argued that prenominal and postnominal quantifier constructions are structurally different. Numeral quantifiers are NP modifiers of type <<e, t>, <e, t>> in prenominal quantifier constructions, while numeral quantifiers are shifted to relational quantity nominals of type <e, <e, t>> in postnominal quantifier constructions. The numeral quantifier simply modifies the following NP in the prenominal quantifier construction, whereas the numeral quantifier is a relational quantity nominal takes the associated DP as its argument and forces a monotonic interpretation in the postnominal quantifier construction. This approach is able to account for various differences between the two quantifier constructions, which pose problems for the previous uniform approach.

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