Syntax and Semantics of Numeral Classifiers in Japanese

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Abstract

This paper explores the syntax and semantics of Japanese numeral classifiers in the prenominal and postnominal positions. argue that there are two transformationally unrelated structures for numeral classifiers in Japanese: one in which a numeral and a classifier form a constituent and modify a noun as an adjunct and one in which numerals and classifiers are distinct functional heads of the extended nominal projection. Evidence comes from novel data about the optionality of classifiers. It is shown that classifiers can be omitted for certain numerals in the prenominal construction but not in the postnominal one. Some theoretical consequence and implication of the analysis are also discussed.

1 Introduction

This paper discusses the syntax and semantics of numeral classifiers in Japanese by examining the word order variation. Japanese allows numeral classifiers to appear prenominally and postnominally as shown in (1a) and (1b) respectively.[1]

(1) a. *Prenominal*

John-wa	**san-ko**-no	ringo-o	tabeta.
John-TOP	3-CL-GEN	apple-ACC	ate

'John ate three apples.'

b. *Postnominal*

John-wa	ringo	**san-ko**-o	tabeta.
John-TOP	apple	3-CL-ACC	ate

There has been a debate in the literature whether the two constructions are transformationally related. For example, Watanabe (2006) argues that the two constructions are derived from one underlying structure, namely, they are transformationally related. By contrast, Huang and Ochi (2014) claim that they are not related by any transformational rules.

This paper aims to contribute to this debate by providing novel data about the optionality of classifiers. It shows that there is an asymmetry of the optionality of classifiers between the two constructions. It is argued that the asymmetry is due to the difference in the syntax and semantics between the two constructions. Specifically, I propose that for the prenominal construction, a numeral and a classifier form a constituent and occupy an NP adjunct position, whereas for the postnominal construction, a numeral and a classifier are functional heads of the extended nominal projection. The current paper also contributes to the debate as to why classifiers are required in this language. In Krifka (1995), it is because of numerals, whereas in Chierchia (1998a), it is because of nouns. I will discuss some implications from the analysis for this debate.

The paper is organized as follows: Section 2 presents core data showing the asymmetry of the optionality of classifiers. Section 3 makes an analysis based on the semantics of Rothstein (2013) and Sudo (2016). Section 4 discusses some implications of the analysis. Section 5 concludes the paper.

[1] Quantifier float is also possible in Japanese as in (i).

(i)

John-wa	ringo-o	**san-ko**	tabeta.
John-TOP	apple-ACC	3-CL	ate

'John ate three apples.'

This paper will not discuss the floating quantifier construction, though a brief comment is made in footnote 4 and 15.

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2 Asymmetry of optionality of classifiers

Japanese is an obligatory classifier languages and classifiers are needed when numerals modify nouns.

(2) a. san*-(satsu)-no hon
3-(CL)-GEN book
'three books'

b. hon san-*(satsu)
book 3-(CL)

However, under some circumstance, classifiers can be optional. Sudo (to appear) observes that classifiers tend to be optional with numerals expressing large numbers:

(3) Daitooryoo-wa shichoosha-kara yoserareta
president-TOP viewer-from were.sent
hyaku-(ko)-no shitsumon-ni kaitooshita.
100-(CL)-GEN question-to answered
'The president answered 100 questions viewers asked.' (Sudo, to appear: 4)

Nomoto (2013) observes that relatively small numbers allow classifiers to be omitted: 9 is marginally acceptable and 15 is well-formed without classifiers.

(4) John-wa { kyuu-?(ko) / juu-go-(ko) }-no
John-TOP 9-(CL) / 10-5-(CL) -GEN
gengo-o shirabeta.
language-ACC investigated
'John investigated { nine / fifteen } languages.'
(Based on Nomoto, 2013: 16)

In addition to the case of large numbers, classifiers can be optional for non-specific numbers.[2]

(5) a. John-wa juu-suu-(ko)-no shima-o
John-TOP 10-some-(CL)-GEN island-ACC
otozureta.
visited
'John visited a dozen islands.'
(Based on Nomoto, 2013: 16)

b. John-wa suu-juu-(ko)-no shima-o
John-TOP some-10-(CL)-GEN island-ACC
otozureta.
visited
'John visited dozens of islands.'

Admittedly, it is not totally clear exactly when classifiers are optional. However, the observations suggest that the optionality depends on numerals.

So far, we have seen the examples in the prenominal construction. A novel observation, however, shows that the optionality does not hold in the postnominal construction. Consider the following examples, all of which are the same as (3–5) except the position of the numeral classifiers relative to the head nouns.

(6) *Large numbers*

a. Daitooryoo-wa shichoosha-kara
president-TOP viewer-from
yoserareta shitsumon hyaku-*(ko)-ni
were.sent question 100-(CL)-to
kaitooshita.
answered
'The president answered 100 questions viewers asked.'

b. John-wa gengo juu-go-*(ko)-o
John-TOP language 10-5-(CL)-ACC
shirabeta.
investigated
'John investigated fifteen languages.'

(7) *Non-specific numbers*

a. John-wa shima juu-suu-*(ko)-o
John-TOP island 10-some-(CL)-ACC
otozureta.
visited
'John visited a dozen islands.'

b. John-wa shima suu-juu-*(ko)-o
John-TOP island some-10-(CL)-ACC
otozureta.
visited
'John visited dozens of islands.'

In the examples in (6), which contain the large numbers, the classifiers cannot be omitted.[3] Similarly, the examples in (7) containing the non-specific numbers are considerably degraded without the classifiers.

As we have seen, on the one hand, the prenominal construction shows the optionality of classifiers for

[2]In (5b) and (7b), when the classifier appears, the final sound of *juu* 'ten' assimilates to the first consonant of the classifier, resulting in *suu-juk-ko*.

[3]Yasutada Sudo (p.c.) pointed out to me that classifiers can be omitted in the postnominal construction as in (i).

the particular types of numerals. The postnominal construction, on the other hand, does not admit the optionality and classifiers are always required. The contrast between the two constructions shows that the optionality also depends on the construction.[4]

3 Analysis

I propose that the asymmetry of the optionality and obligatoriness of classifiers in Japanese is due to the syntactic and semantic difference between the prenominal and postnominal constructions. Specifically, I suggest that in the prenominal construction, a numeral and a classifier form a constituent but in the postnominal construction, they are distinct heads of the extended nominal projection. In the following, I first analyze the prenominal construction based on Rothstein (2013) and Sudo (2016) and then move on to the postnominal construction.

3.1 Prenominal constructions

Rothstein (2013) proposes that numerals are analyzed as properties. In property theory as in Chierchia (1985), properties have multiple functions which are related via type-shifting operations. In the case of numerals, they are predicated of arguments and in this case, numerals are of type ⟨e,t⟩ just like adjectives as in (8a) with the cardinality function defined in (8b), where x ranges over plural individuals.

(8) a. $[\![\text{three}_{\langle e,t\rangle}]\!] = \lambda x.|x| = 3$

b. $|x| = n \leftrightarrow |\{y : y \sqsubseteq_{\text{ATOMIC}} x\}| = n$

Predicates have the corresponding individual property correlate of the set in (8a). Thus, numerals are also of type n, a type of numbers. This is derived by the $^{\cap}$ operation.

(9) $[\![\text{three}_{n}]\!] = 3 = {}^{\cap}(\lambda x.|x| = 3)$

On the other hand, the $^{\cup}$ operator can apply to type-n objects, deriving the corresponding predicates of type ⟨e,t⟩.

(10) ${}^{\cup}3 = {}^{\cup\cap}(\lambda x.|x| = 3) = \lambda x.|x| = 3$

Having said that, let us turn to the Japanese data. In Sudo (2016), denotations of nominals in Japanese are equivalent to English count nouns, except the number specification. They contain both singular and plural individuals. Plural individuals are sums of singular individuals (Link, 1983; Sauerland, 2005). Thus, the noun *gakusei* 'student' is true of both singular and plural entities consisting of students as indicated by the *-operator.[5]

(11) $[\![\text{gakusei}]\!] = [\![\text{students}]\!] = \lambda x.{}^{*}\text{STUDENT}(x)$

Sudo assumes that the default type of numerals is of type n.

(12) $[\![\text{san}_{n}]\!] = 3$

Numerals cannot directly modify nouns since they are type-n objects. Sudo proposes that the role of classifiers is to turn the type-n object into a modifier

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(i) John-wa hohei sen-(nin)-o hiki-tsureta.
John-TOP foot.soldier 1000-(CL)-ACC took
'John took 1000 foot soldiers.'

The judgments are delicate and seem to vary among speakers, indicating that several factors seem to be involved to make classifiers optional. I should leave for future research whether there are rules governing the optionality or examples such as (i) are exceptions.

It should be noted, however, that when we make postnominal numerals vague-quantity by addition some element, classifiers would tend to be optional. Tomoyuki Yoshida (p.c.) notes that when *ijoo* 'greater than or equal to' is attached, a classifier may be omitted.

(ii) Daitooryoo-wa shichoosha-kara yoserareta shitsumon 100-(ko)-ijoo-ni kaitooshita.
president-TOP viewer-from were.sent question hundred-(CL)-greater.than.or.equal.to-to answered
'The president answered greater than or equal to 100 questions viewers asked.'

An anonymous review provides the following example, in which an approximate expression *oyoso* 'about' is used.

(iii) Kanshuu oyoso ichi-man-(nin)-ga tsumekaketa.
spectator about 1-10000-CL-NOM crowded
'About 10000 spectators crowded.'

Though it is not straightforward to capture what factors are responsible for the optionality in the postnominal construction, what is clear at this point is that there is a contrast between the prenominal and postnominal construction with regard to the acceptability of numerals without classifiers as shown in (3–7).

[4] In the floating construction, when classifiers are omitted, the acceptability varies across speakers.

(i) a. John-wa gengo-o juu-go-?/??(ko) shirabeta.
John-TOP language-ACC 10-5-(CL) investigated
'John investigated fifteen languages'

An anonymous reviewer observes that when *juu-go* 'fifteen' is replaced with *juu* 'ten', the acceptability improves. The reviewer suggests that this may have to do with some sort of phonological weight. I would like to thank the reviewer for drawing my attention to the phonological factor.

[5] *P(x) is the closure of P(x) under i-sum formation $^{\sqcup}$.

of type ⟨e,t⟩. In addition, each classifier has a sortal restriction. For example, *-nin* is used for counting humans and humans only. This sortal restriction is assumed to be a presupposition.

(13) $[\![\text{-nin}]\!] = \lambda n.\lambda x : {*}\textsc{human}(x).|x| = n$

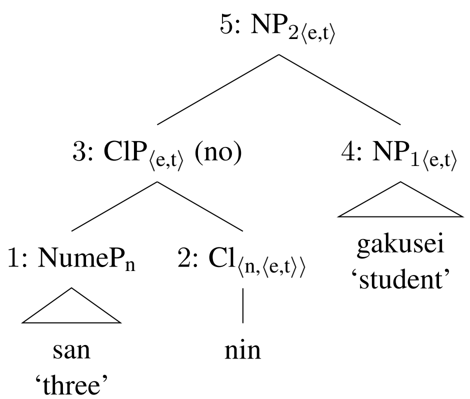
Due to the sortal presupposition, the classifier *-nin* ensures that x is a single human or an i-sum consisting of humans and counts the number of singular humans in x. A classifier and a numeral are combined via Functional Application, resulting in a function of type ⟨e,t⟩.

(14) $[\![\text{san-nin}]\!] = \lambda x : {*}\textsc{human}(x).|x| = 3$

The numeral classifier, then, combines with a noun via Predicate Modification or a type-shifting operation.

Sudo assumes that a numeral and a classifier form a constituent to the exclusion of the noun phrase. I adopt this analysis and propose the structure in (15) for the prenominal construction.[6]

(15)



In this structure, a numeral and a classifier combine first and form a constituent, ClP, which then modifies NP (the genetive marker *-no* is considered as having no semantic effects). The derivation of (15) is given in (16).

(16) a. $1 : [\![\text{NumeP}]\!] = 3$
b. $2 : [\![\text{Cl}]\!]$
$= \lambda n.\lambda x : {*}\textsc{human}(x).|x| = n$
c. $3 : [\![\text{ClP}]\!] = \lambda x : {*}\textsc{human}(x).|x| = 3$
d. $4 : [\![\text{NP}_1]\!] = \lambda x.{*}\textsc{student}(x)$
e. $5 : [\![\text{NP}_2]\!]$
$= \lambda x.|x| = 3 \;\&\; {*}\textsc{student}(x)$

[6] I assume that DP is located above the highest NP.

In non-classifier languages such as English, the $^{\cup}$ operator is applicable to type-n numerals as in (17a). The $^{\cup}$ shifted numerals can modify a noun directly just like adjectives as in (17b).

(17) a. $^{\cup}[\![\text{three}_{\text{n}}]\!] = [\![\text{three}_{\langle e,t\rangle}]\!] = \lambda x.|x| = 3$
b. $[\![\text{three students}]\!]$
$= \lambda x.|x| = 3 \;\&\; {*}\textsc{student}(x)$

Following Chierchia (1998a; 1998b), Sudo claims that the $^{\cup}$ operation is considered as a last resort option. When a language has overt lexical items whose function is equivalent to the $^{\cup}$ operator, the use of such lexical items is mandatory and consequently the application of the $^{\cup}$ operation is blocked. As we have seen, classifiers do the job of the $^{\cup}$ operator. Thus, in classifier languages, due to the existence of classifiers, the $^{\cup}$ operation is not applicable.

Regarding optionality of classifiers, Sudo acknowledges that his analysis cannot straightforwardly account for languages in which classifiers are optional. He notes that in optional classifier languages, the application of the $^{\cup}$ operator is not blocked, though it remains unanswered how this works.

To capture the optionality in Japanese, I suggest that the $^{\cup}$ operation is applicable in Japanese, contra Sudo (2016).[7] The application of $^{\cup}$ is, however, restricted to a subset of numerals. As seen, classifiers become optional for large numbers and non-specific numbers. As mentioned, it is not clear exact when classifiers are optional, but it is safe to say that the $^{\cup}$ operation is applicable to those numerals that express large numbers and non-specific numbers. To distinguish from the ordinary $^{\cup}$, I introduce $^{\Cup}$, a partial function version of $^{\cup}$, defined in (18).[8]

(18) Let n be a number in the domain of type n.
$^{\Cup}n$ is defined only if n expresses a "large" number or a "non-specific" number.
If defined, $^{\Cup}n = \lambda x.|x| = n$

Let us see a concrete example. The numeral *hyaku* 'hundred' can combine directly with a noun without a classifier (as in (3)). Thus, when it combines with a

[7] Recently, however, Yasutada Sudo (p.c.) has noted that the type-shifting with $^{\cup}$ should be available in Japanese.

[8] As pointed out by a reviewer, the treatment of the $^{\Cup}$ operation contains several issues. Particularly, what counts as "large" or "non-specific" numbers is vague. I have to leave this issue for future research.

noun *hon* 'book', two forms are possible: without a classifier (*hyaku-no hon*) and with a classifier *-satsu* (*hyaku-satsu-no hon*). Compare the derivations of the two forms. First, the numeral of type n forms a constituent with the classifier *-satsu* and modifies the noun *book* as shown in (19).

(19) a. $[\![\text{hyaku}_{\text{n}}]\!] = 100$
b. $[\![\text{-satsu}]\!] = \lambda n.\lambda x : {}^{*}\textsc{book}(x).|x| = n$
c. $[\![\text{hon}]\!] = \lambda x.{}^{*}\textsc{book}(x)$
d. $[\![\text{hyaku}_{\text{n}}\text{-satsu-no hon}]\!]$
$= \lambda x.|x| = 100 \ \& \ {}^{*}\textsc{book}(x)$

When the numeral modifies the noun without the classifier, the $^{\Cup}$ operator applies to the numeral of type n and the corresponding predicate of type ⟨e,t⟩ is derived as in (20a), with the assumption that the $^{\Cup}$ operation is defined for *hyaku*. The numeral can combine with the noun without the classifier as in (20b).

(20) a. $^{\Cup}[\![\text{hyaku}_{\text{n}}]\!] = [\![\text{hyaku}_{\langle \text{e,t}\rangle}]\!]$
$= \lambda x.|x| = 100$
b. $[\![\text{hyaku}_{\langle \text{e,t}\rangle}\text{-no hon}]\!]$
$= \lambda x.|x| = 100 \ \& \ {}^{*}\textsc{book}(x)$

When $^{\Cup}$ is applied, ClP is not projected, since Cl is not needed. That is, NumeP directly combines with NP just in non-classifier languages.

For non-large and non-non-specific numerals, the $^{\Cup}$ operation is undefined and hence the corresponding predicts are not derived. Thus, those numerals always require classifiers to modify nouns. Further, type-shifted numerals cannot combine with classifiers as illustrated in (21).

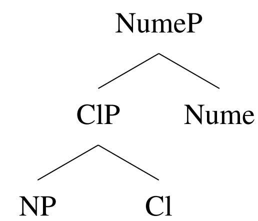
(21) $[\![\text{hyaku}_{\langle \text{e,t}\rangle}\text{-satsu}_{\langle \text{n},\langle \text{e,t}\rangle\rangle}]\!] \rightarrow$ type mismatch

The combination results in a type mismatch. As a result, when a classifier appears, the only possible way to modify a noun is to use a numeral of the default type (type n) which a classifier turns into predicates.

3.2 Postnominal constructions

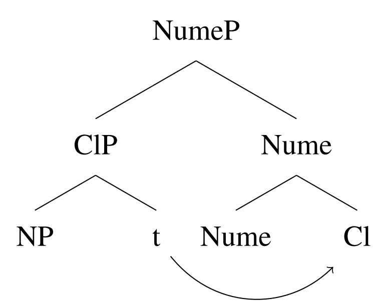
Now let us turn to the postnominal construction. As we have seen in the previous section, in the postnominal construction, classifiers are obligatory. I propose that the obligatoriness is due to the syntactic structure of the postnominal construction which is different from the one of the prenominal construction. Specifically, the obligatoriness of classifiers is due to the selectional requirement of numerals.

I follow Cheng and Sybesma (1999), Jenks (2017), Tang (1990) and among others, assuming that nominal phrases contain functional projections above NP. The extended nominal projection in Japanese has the following structure.[9]

(22)


In this structure, classifiers and numerals are heads of their own projections, ClP and NumeP, respectively. I further postulate that Nume^0 selects for ClP. This ensures that whenever numerals are present, classifiers are present.

One may notice that the liner order derived by the structure in (22) is not a correct surface order. (22) produces an NP-Cl-Nume sequence but it should be NP-Nume-Cl. I suggest that Cl^0 is moved to Nume^0 obligatory.

(23)


I propose that the motivation of Cl^0-to-Nume^0 movement is the affixal status of numerals in Japanese. Nume^0 may contain a strong feature, which attracts Cl^0. A piece of evidence for the affixal nature is found in some numerals. In Japanese, there are two types of numerals: native and Sino-Japanese numerals. Native Japanese numerals, which are limited to number 1–10, cannot stand independently, except 4, 7 and 10 as shown in Table 1. Although Sino-Japanese numerals can be used independently, native Japanese numerals would suggest

[9] Similar to the prenominal construction, I assume that DP is located above NumeP. In both the construction, Case is assigned to DP. I thank an anonymous review for drawing my attention to the case assignment.

	1	2	3	4	5	6	7	8	9	10
Native	hito-	futa-	mi-	yo(n)	itsu-	mu-	nana	ya-	kokono-	too
Sino-Japanese	ichi	ni	san	shi	go	roku	shichi	hachi	kyuu	juu

Table 1: Numerals in Native and Sino-Japanese

that Japanese numerals are affixal in nature.

The result of the obligatory head movement is a complex head which behaves as a single word. In fact, the combination of numerals and classifiers shows some morpho-phonological effects. For example, the form of some classifiers alters depending on the preceding numerals. Consider the following examples, in which *-hon*, a classifier for counting cylindrical objects such as pens or fingers, shows the alternations *-pon* and *-bon*.

(24) a. ichi + hon → ip-**p**on
1 CL

b. ni + hon → ni-hon
2 CL

c. san + hon → san-**b**on
3 CL

In addition, the forms of numerals also change depending on the following classifiers. The following examples are the combination of numerals 1, 6, and 8 and a classifier *-ko*, which is used to count inanimate objects.

(25) a. ichi + ko → ik-ko
1 CL

b. roku + ko → rok-ko
6 CL

c. hachi + ko → hak-ko
8 CL

In this case, the forms of the numerals assimilate the first consonant of the classifier, yielding geminates. The morpho-phonological effects found in the combination of numerals and classifiers indicate that the tight connection between the two heads exists.[10] Kobuchi-Philip (2007) claims that the morpho-phonological effect such as (24) is accounted for by the head movement analysis.[11]

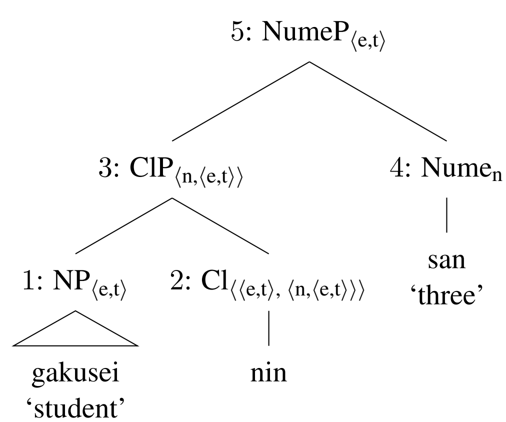
Given the syntactic structure, one may wonder whether the semantic analysis of Sudo (2016) is extendable to the postnominal construction. The biggest issue, however, is that combining Cl^0 with NP leads to a type mismatch since, in Sudo, classifiers are of type ⟨n,⟨e,t⟩⟩ and nouns are of type ⟨e,t⟩. To solve this issue, I suggest that classifiers of type ⟨n,⟨e,t⟩⟩ as in (26a) are to be type-shifted to type ⟨⟨e,t⟩, ⟨n,⟨e,t⟩⟩⟩ as in (26b).[12]

(26) a. $[\![\text{nin}_{\langle n,\langle e,t\rangle\rangle}]\!]$
$= \lambda n.\lambda x : {*}\textsc{human}(x).|x| = n$

b. $[\![\text{nin}_{\langle\langle e,t\rangle,\langle n,\langle e,t\rangle\rangle\rangle}]\!]$
$= \lambda P.\lambda n.\lambda x : {*}\textsc{human}(x).|x| = n$
$\& \; P(x)$

The derivation with the shifted classifier in (26b) is shown in (27) and (28).

(27)



(28) a. $1 : [\![\text{NP}]\!] = \lambda x.{*}\textsc{student}(x)$

b. $2 : [\![\text{Cl}]\!]$
$= \lambda P.\lambda n.\lambda x : {*}\textsc{human}(x).|x| = n$
$\& \; P(x)$

c. $3 : [\![\text{ClP}]\!]$
$= \lambda n.\lambda x : {*}\textsc{human}(x).|x| = n$

[10]As noted by a reviewer, the head movement is expected to occur in the prenominal construction as well. Given the affixal nature of numerals, Cl^0 moves to $Nume^0$ by lowering (Arregi and Pietraszko, 2018).

[11]Kobuchi-Philip (2007) proposes a similar head movement analysis but different semantics for numerals and classifiers.

[12]It is possible to assume that the lower type is derived from the higher type. In addition,

& $*$STUDENT(x)

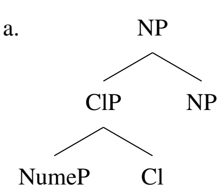
d. $4 : [\![\text{Nume}]\!] = [\![\text{san}]\!] = 3$

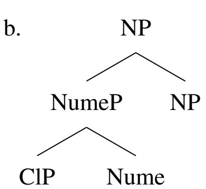
e. $5 : [\![\text{NumeP}]\!]$
$= \lambda x.|x| = 3$ & $*$STUDENT(x)

Unlike the prenominal construction, Cl first combines with NP to form ClP.[13] NumeP has the denotation by combining ClP and Nume. The resultant denotation is identical to the one of the prenominal construction. In this analysis, the Cl^0-to-Nume^0 movement happens at PF. Thus, the head movement does not affect the interpretation.

What is crucial in the postnominal construction is the assumption that Nume^0 selects for ClP. This forces the presence of both numerals and classifiers. Thus, the presence of classifiers is obligatory in the postnominal construction. The current proposal suggests that there are two syntactic types of numerals: one selects for ClP (as in the postnominal) and the other does not (as in the prenominal). Note that while syntactically numerals are different between the prenominal and postnominal constructions, semantically, when $\mathbb{U}$ is not applied, they are identical, namely, they are type-n objects (cf. Bale and Coon, 2014). The difference in the semantic type of NumeP between the two constructions (type n in the prenominal construction and type ⟨e,t⟩ in the postnominal one) is the result of the derivation.[14]

[13] A review raises a question why in the prenominal construction, Cl^0 selects for NumeP as in (ia) , not the other order way round as in the postnominal construction, namely, Nume^0 selects for ClP as in (ib) with the Cl^0-to-Nume^0 movement.

(i) a.


b.


It seems that the alternative structure (ib) works fine just like the structure proposed in the paper (ia). One potential challenge for the alternative structure, however, is how the optionality of classifiers is captured. As in the postnominal construction, it is assumed that the structure requires that classifiers always appear, because of the syntactic selection. We thus need to stipulate a syntactically different type of numerals which does not take ClP as its complement. In addition, the alternative structure will contain another NP in the complement of ClP. It is not obvious how we treat this NP. I leave it open to future work which structure is empirically and theoretically plausible.

[14] I would like to thank an anonymous reviewer for making the point explicit.

4 Some implications

4.1 Two structures for numeral classifiers

In the current analysis, the prenominal and postnominal constructions have different syntactic structures. This difference accounts for the asymmetry of the optionality. In contrast, in the previous literature, it has been argued that the two constructions are transformationally related (Watanabe, 2006). The transformational analysis, however, faces the difficulty of accounting for the asymmetry: since the two constructions are transformationally related, when a classifier is optional/obligatory in one construction, the same should hold in the other construction. As we have seen, classifiers are optional for the particular types of numerals in the prenominal construction, whereas obligatory in the postnominal construction. Thus, we need to hypothesize that a classifier can be dropped only in the prenominal construction. It seems not straightforward to defend this hypothesis in principled manner.[15]

The current analysis is also compatible with cross-linguistic observations on the numeral-noun constructions (Danon, 2012; Ionin and Matushansky, 2018). Danon (2012) examines a wide variety of languages, arguing that numerals are located in at least two syntactic positions: a head position and a specifier position. Though my analysis for Japanese numeral classifiers differs from Danon in that the prenominal numeral classifiers are adjuncts, what is crucial is that both the proposals assume that UG makes it possible for numerals and numeral classifiers to occupy a head and non-head positions.

4.2 The role of classifiers

There is a debate as to why classifiers are required in classifier languages. Krifka (1995) and Chierchia (1998a) provide different accounts. In Krifka (1995), classifiers are for numerals: they are needed

[15] In Watanabe (2006), floating numerals are also transformationally related to the two constructions discussed in this paper. As mentioned in footnote 4, it is not obvious whether classifiers can be optional in the floating quantifier construction. If classifiers are optional in the floating quantifier construction, it is not inconsistent with the idea that the prenominal and floating quantifier constructions are transformationally related. If, on the other hand, classifiers are obligatory in the floating construction, the postnominal and the floating constructions might be related as in Huang and Ochi (2014).

to make numerals to be able to specify which types of things that the numerals count (e.g., long and round things, flat things, inanimate things, humans etc.). Sudo's (2016) analysis is along the line of Krifka's, though in Sudo, classifiers supply numerals with a way to modify nouns by changing the type of numerals. By contrast, in Chierchia (1998a), classifiers are for nouns: they are required to enable nouns to be countable and modifiable by numerals.

Bale and Coon (2014) distinguish the two accounts by examining data from Mi'gmaq (Algonquian) and Chol (Mayan). They show that the presence/absence of classifiers in these languages depends on numerals. Bale and Coon argue that the pattern of the optionality is compatible with Krifka's classifiers-are-for-numeral analysis but not with Chierchia's classifiers-are-for-nouns one. Jenks (2017), on the other hand, observes that in Dafing (Mande: Burkina Faso), certain nouns do not appear with classifiers, concluding that in Dafing, classifiers are for nouns, not for numerals, that is, the pattern is consistent with Chierchia (1998a). The analyses of Bale and Coon, and Jenks suggest that two types of classifier languages exit.

The optionality of classifiers in the prenominal construction in Japanese indicates that the language is categorized as a classifiers-are-for-numeral language, since the presence/absence of classifiers depends on numerals. In addition, the syntactic structure for the prenominal construction reflects the assumption that classifiers are for numerals, since classifiers combine with numerals. However, the proposed structure for the postnominal construction looks as if it contradicts Krifka's theory, since Cl^0 selects for NP and is interpreted at the base position. Thus, the proposed structure for the postnominal construction appears to fit Chierchia's theory that classifiers are for nouns.

Nonetheless, I argue that the proposed analysis for the postnominal construction does not deviate from Krifka's theory. In the current analysis, as in Sudo (2016), the role of classifiers is to turn type-n objects into predicates and consequently numerals can modify nouns. This role remains intact after classifiers of type $\langle n,\langle e,t\rangle\rangle$ is shifted to type $\langle\langle e,t\rangle,\langle n,\langle e,t\rangle\rangle\rangle$. Even though a classifier combines first with a noun, the classifier turns a numeral of type n into a predicate. Thus, the proposed analysis for the postnominal is compatible with Krifka's theory.

An implication of this discussion is that whether classifiers are for numerals or for nouns seems independent of syntactic structures. In other words, syntactic aspects would not be a deciding factor for the types of languages in terms of the role of classifiers. Given this discussion, it is not surprising that there are classifiers-are-for-noun languages in which syntactically a classifier combines first with a numeral before the constituent of the numeral and classifier combines with a noun. It is expected that classifiers can make nouns countable, even though classifiers and nouns are not directly combined. Further typological investigations are called for to check the prediction.

5 Concluding remarks

This paper has analyzed the syntax and semantics of numeral classifiers in Japanese. We have seen that the asymmetry of the optionality of classifiers in Japanese between the two constructions is captured by the differences in the syntax structure. Specifically, in the prenominal construction, numerals and classifiers form a constituent, modifying a noun. In this construction, the type-shifting operation with the $^{\mathbb{U}}$ operator is applicable if it is defined, resulting in the optionality of classifiers for large and non-specific numerals. In contrast, in the postnominal construction, numerals and classifiers are heads of the extended nominal projection and $Nume^0$ selects for ClP, which forces the presence of classifiers whenever numerals appear. The consequence of the analysis is that the two constructions are not transformationally related. I have also discussed some implications of the current analysis regarding the role of classifier. It is suggested that syntactic facts would not always reflect whether classifiers are for numerals or for nouns.

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