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How many answers to a *how many* question are possible?

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1. Introduction

Japanese is a classifier language and numerals must appear with a classifier to modify a noun. Japanese numeral classifiers can appear in three positions, as shown in (1).

- (1) a. *Taro-wa sono hi [san-nin-no gakusei]-o hometa.*
Taro-TOP that day three-CLS-GEN student-ACC praised
'Taro praised three students that day.' [Pre-nominal numeral classifier]
- b. *Taro-wa sono hi [gakusei san-nin]-o hometa.*
Taro-TOP that day student three-CLS-ACC praised
'Taro praised three students that day.' [Post-nominal numeral classifier]
- c. *Taro-wa [gakusei]-o sono hi [san-nin] hometa.*
Taro-TOP student-ACC that day three-CLS praised
'Taro praised three students that day.' [Floating numeral classifier]

In (1a), a numeral classifier appears in the pre-nominal position. In this position, numeral classifiers must appear with the genitive linker *no*. Numeral classifiers can follow a noun, as shown in (1b). In the post-nominal position, numeral classifiers precede an overt case particle. Numeral classifier can be separated from a noun as in (1c). Floating numeral classifiers are different from post-nominal numeral classifiers in that the former immediately precedes an overt case particle. Floating numeral classifier, on the other hand, follows a case-marked noun, and other items like adjunct phrases can intervene between a noun and a floating numeral classifier, as in (1c). This study investigates a difference regarding possible answers to *how many* questions containing these numeral classifiers. The main observation is that only when a wh-quantifier appears in the pre-nominal position, the resulting *how many* question can be answered by listing names of individuals. I argue that only *how many* questions containing a pre-nominal wh-quantifier exhibit this property, because covert movement of a pre-nominal wh-quantifier can create a trace interpreted as a variable for individuals.

2. Issues

In Japanese, when a numeral is replaced by a wh-item, the resulting sentence is interpreted as a *how many* question. Japanese has three positions for numeral classifiers as in (1), and *how many* questions also have three variants, as shown in (2).

- (2) a. *Taro-wa sono hi [nan-nin-no gakusei]-o home-ta no?*
Taro-TOP that day WH-CLS-GEN student-ACC praise-PAST Q
'How many students did Taro praise that day?' [Pre-nominal numeral classifier]

(6)

	Numeral answer	Listing answer
Pre-nominal wh-quantifier	✓	✓
Post-nominal wh-quantifier	✓	*
Floating wh-quantifier	✓	*

One caveat is that as for pre-nominal wh-quantifiers such as (3), native speakers prefer A1 over the listing answer A2. However, my consultants judged (3A2) as acceptable. In particular, they found the listing answer is available in (3), when they compare it with (4) and (5).

The listing answer is impossible in other languages. English, Spanish and German do not allow the listing answer, as shown in (7), (8) and (9).

(7) Q. *How many students did John praise in the class yesterday?* [English]
A1. *Three.* A2. *#Alex, Bill, and Chris.* (Nicolaus Schrum p.c.)

(8) Q. *¿Cuántos estudiantes elogió Juan en la clase de ayer?* [Spanish]
how.many students praised Juan in the class of yesterday
‘How many students did Juan praise in the class yesterday?’
A1. *Tres.* A2. *#Alex, Bill y Chris.*
three *Alex Bill and Chris*
‘Three.’ *‘Alex, Bill, and Chris.’* (Gabriel Martinez Vera p.c.)

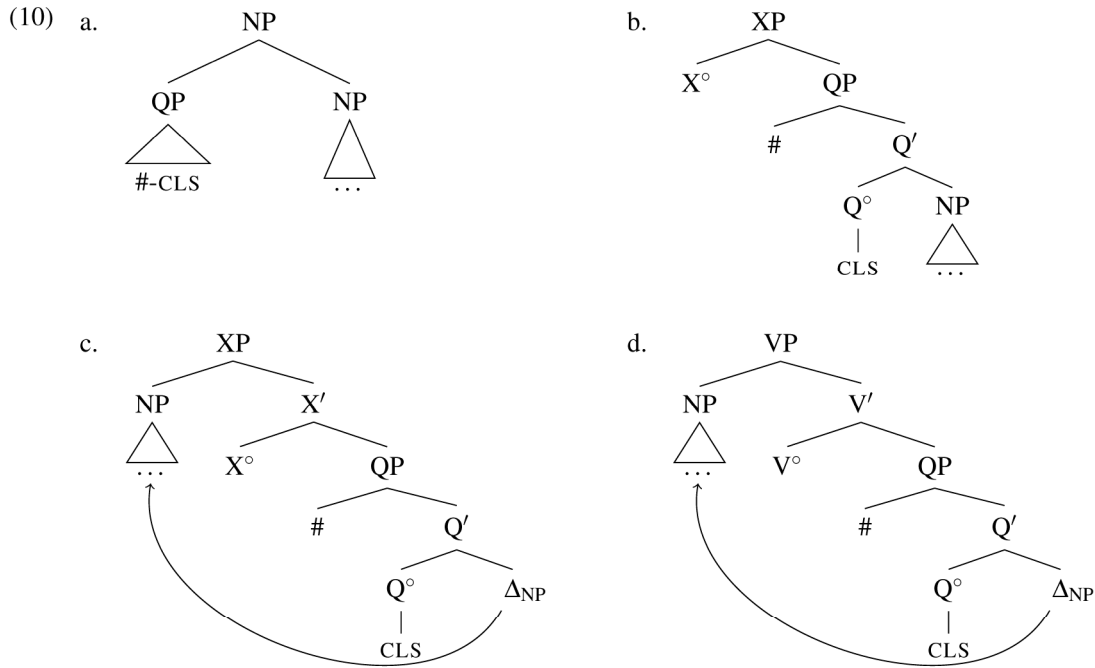
(9) Q. *Wie viele Studenten hat Otto gestern in der Klasse gelobt?* [German]
how many students has Otto yesterday in the class praised
‘How many students did Otto praise in the class yesterday?’
A1. *Drei.* A2. *#Alex, Bill und Chris.*
three *Alex Bill and Chris*
‘Three.’ *‘Alex, Bill, and Chris.’* (Sabine Laszakovits p.c.)

In these languages, the listing answer is infelicitous as an answer to a *how many* question. However, the listing answer can be used, when the listing answer is followed by a numeral. For example, the *how many* question in (7) can be answered by saying “Alex, Bill, and Chris. So three students”. In this case, the speaker counts individuals out loud. Without the following numeral, the listing answer is infelicitous.

3. Analysis

3.1. Syntax

As for syntactic structures of Japanese numeral classifiers, I adopt Huang & Ochi’s (2014) analysis. Huang & Ochi (2014) assume that Japanese pre-nominal numeral classifiers adjoin to a head noun, as shown in (10a). They argue that post-nominal numeral classifiers and floating numeral classifiers are derivationally related to each other. To be more precise, they are derived from the same underlying structure represented in (10b). (10c) is a derivation of the post-nominal numeral classifier. Here, X stands for a functional head in the extended projection of a noun. (10d) represents a derivation of the floating numeral classifier.



In (10a), the quantifier phrase (QP) adjoins to the noun phrase. In (10b), the classifier head (CLS) takes a noun phrase as its complement, and a numeral appears in the specifier position of a QP headed by the classifier. Importantly, the classifier projects its own phrase in (10b), including both a noun and a numeral. A noun phrase in (10b) can move to the specifier position of XP, as in (10c). If there is no higher functional head in the extended projection of a noun, the noun phrase can move to a verbal domain, as shown in (10d), resulting in a floating numeral classifier.

3.2. Semantics

Rullmann (1995) proposes that *how many* questions contain the Maximality Operator *max*, as shown in (11). Here, *n* stands for a variable for numbers, and it is bound by the question operator.

- (11) *How many books did John read?*
 $\rightsquigarrow ?n[n = \max(\lambda n' \exists x [\text{book}(w)(x, n') \wedge \text{read}(w)(j, x)])]$ (Rullmann 1995: 172)

The presence of *max* ensures that an answer must denote the maximal number in context. For example, if John praised 3 students in a given situation, it implies that John also praised 2 students or 1 student. Even in this situation, it will be false if one answers the question by saying “two”. The maximal number must be selected in answers to a *how many* question, due to the presence of *max*. According to Rullmann’s analysis, the *how many* question in (3), in which a wh-quantifier occurs in the pre-nominal position, will have the LF representations given in (12).

- (12) a. $[_{QP} \text{ nan-nin-no }]_1 \text{ Taro-wa } [_{\Delta_1} [_{NP} \text{ gakusei}]-o] \text{ home-ta no?}$ (LF)
 $\rightsquigarrow ?n[n = \max(\lambda n' \exists x [\text{student}(x) \wedge \mu_{\text{person}}(x) = n' \wedge \text{praise}(\text{Taro}, x)]]$ [listing answer: *]
- b. $[_{NP} [_{QP} \text{ nan-nin-no }] [_{NP} \text{ gakusei }]-o]_1 \text{ Taro-wa } \Delta_1 \text{ home-ta no?}$ (LF)
 $\rightsquigarrow ?y[y = \max(\lambda x \exists n' [\text{student}(x) \wedge \mu_{\text{person}}(x) = n' \wedge \text{praise}(\text{Taro}, x)]]$ [listing answer: OK]

I adopt a pied-piping approach to covert wh-movement in Japanese. (12a) is a structure in which only a pre-nominal wh-quantifier covertly moves, leaving the modified noun in situ. If only a QP covertly moves, the QP leaves a trace interpreted as a variable of type n , which ranges over numbers, as shown in (12a). I assume that (12a) is the representation of a *how many* question answered by using a numeral, such as (3A1). In this representation, the number of students that John praised is questioned, and an answer to this type of *how many* question must contain a number. (One reviewer notes that the maximality operator in (12a) might be redundant due to the presence of the measure function μ . In Rullmann's (1995) original denotation of *how many* questions in (11), the maximality operator is used to ensure that a relevant answer contains the maximum number in a given context. However, the measure function in (12a) would have a similar effect, and we could obtain the same meaning without the maximality operator in (12a). I would like to use the denotation in (12a) in this paper, to capture a difference between classifier languages and non-classifier languages. I assume that classifiers introduce the measure function μ in classifier languages (Krifka 1995). Nouns in non-classifier languages can be associated directly with a numeral without a classifier, as shown in (11). On the other hand, nouns in classifier languages need the measure function μ introduced by a classifier to be associated with a numeral.)

(12b) is a structure in which a pre-nominal wh-quantifier pied-pipes the modified noun. Although covert movement is motivated by the pre-nominal wh-quantifier, the moving element is a whole noun phrase containing the numeral classifier in this case. I assume that the pied-piped noun in (12b) leaves a trace which is interpreted as a variable for individuals (type e). In (12b), a variable ranging over numbers is closed by an existential operator. I propose that the listing answer is available only for this representation. In (12b), the variable in the scope of the question operator is of type e , which is associated with a variable for numbers via the measure function μ . *How many* questions with a pre-nominal wh-quantifier can be answered by the listing answer because (12b) is available as an LF representation.

Now let us think about *how many* questions containing a post-nominal wh-quantifier. Following Huang & Ochi (2014), I assume that post-nominal numeral classifier projects its own phrase taking a noun as its complement, as shown in (10c). After covert wh-movement, the *how many* question in (4) will have the following LF representations.

- (13) a. $[_{QP} \text{ nan-nin }]_1 \text{ Taro-wa } [_{XP} \text{ gakusei } \Delta_1]-o \text{ home-ta no?}$ (LF)
 $\rightsquigarrow ?n[n = \max(\lambda n' \exists x [\text{student}(x) \wedge \mu_{\text{person}}(x) = n' \wedge \text{praise}(\text{Taro}, x)]]$ [listing answer: *]
- b. $[_{XP} \text{ gakusei } [_{QP} \text{ nan-nin }]-o]_1 \text{ Taro-wa } \Delta_1 \text{ home-ta no?}$ (LF)
 $\rightsquigarrow ?n[n = \max(\lambda n' \exists x [\text{student}(x) \wedge \mu_{\text{person}}(x) = n' \wedge \text{praise}(\text{Taro}, x)]]$ [listing answer: *]

In (13a), a QP alone moves to the edge of the clause, and the moving QP leaves a trace which is interpreted as a variable of type n . In this representation, what is moved is a wh-quantifier but not a noun phrase, and it creates a variable ranging over numbers. Like pre-nominal wh-quantifiers, a post-nominal wh-quantifier can pied-pipe XP, as shown in (13b). I assume that X° does not change the semantic type of its complement. In (13b), the trace of XP is interpreted as a variable for numbers, just like QP. A *how many* question which derives the representation in (13b) must be answered by numbers.

Importantly, there is no way to leave a trace which is interpreted as a variable of type e in *how many* questions containing a post-nominal wh-quantifier. To obtain a variable for individuals, an element headed by a noun must be moved. However, a noun phrase is located in the specifier of XP in post-nominal wh-quantifier constructions as in (10c), and the noun phrase is not the head of the whole nominal phrase. Covert movement is motivated by the wh-feature in a wh-quantifier and a noun phrase in the specifier of XP cannot independently undergo covert movement. Therefore, the listing answer cannot be used for *how many* questions containing a post-nominal wh-quantifier. According to Huang & Ochi (2014), floating numeral classifiers and post-nominal numeral classifiers share the same underlying structure, as illustrated in (10b). Given this, it will be predicted that *how many* questions containing a floating wh-quantifier behave like *how many* questions containing a post-nominal wh-quantifier, regarding the availability of the listing answer. This prediction is borne out, as in (5)

4. Support: Chinese

Huang & Ochi (2014) argues that Japanese pre-nominal numeral classifiers have the adjunction structure represented in (10a), but Chinese numeral classifiers have the structure in (10b). According to their analysis, the complement NP in (10b) covertly moves to Spec,XP in Chinese, whereas the relevant movement overtly takes place in Japanese. This is one way to capture the fact that Chinese numeral classifiers do not freely appear in the post-nominal position, unlike Japanese. According to their analysis, it will be expected that Chinese wh-quantifiers behave like Japanese post-nominal and floating wh-quantifiers. This prediction is borne out, as shown in (14). (I would like to thank Shengyun Gu, Shuyan Wang, Ting Xu, and Muye Yang for their judgements and discussion on Chinese data.)

(14) Q. *Zhangsan kuajiang le [ji ge xuesheng]?*
 Zhangsan praise ASP WH CLS student
 ‘How many students did Zhangsan praise?’

A1. <i>san-ge (xuesheng).</i> three-CLS student ‘Three student.’	A2. <i>#Alex, Bill he Chris.</i> Alex Bill and Chris ‘Alex, Bill, and Chris.’
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In Chinese, a wh-item does not undergo overt wh-movement like Japanese. However, *how many* questions cannot be answered by listing names of individuals, unlike Japanese. The unavailability of the listing answer in (14) can be captured under the current analysis. According to Huang & Ochi’s (2014) analysis, Chinese numeral classifiers have the structure (10b). A wh-quantifier is a QP headed by a classifier, and

a noun is base-generated in the complement position of the classifier head. Like Japanese post-nominal and floating numeral classifiers, there is no way to create a variable for individuals along with this type of structure, regardless of the availability of covert pied-piping. Remember that in English, Spanish, and German, *how many* questions cannot be answered by the listing answer. I suggest that the listing answer is unavailable in these languages because a quantifier projects its own phrase. Wh-quantifiers in these languages are quantifier phrases but not noun phrases, and a wh-quantifier cannot leave a trace interpreted as a variable for individuals. On the other hand, Japanese pre-nominal wh-quantifiers can be answered by the listing answer because a pre-nominal wh-quantifier syntactically adjoins to the modified noun, instead of projecting its own projection.

5. *How many* questions and long-distance scrambling

As shown in (15), when a noun modified by a pre-nominal wh-quantifier undergoes long-distance scrambling, the listing answer becomes impossible.

- (15) Q. [*nan-nin-no gakusei*]-*o*₁ *Hanako-wa* [*Taro-ga sono hi* Δ_1 *home-ta to*] *itta*
 WH-CLS-GEN student-ACC Hanako-TOP Taro-NOM that day praise-PAST C said
no?
 Q
 ‘For which *n*: Hanako said that Taro praised *n* students that day.’
- | | |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <p>A1. <i>san-nin desu yo.</i>
 three-CLS COP SFP
 ‘Three (students).’</p> | <p>A2. #<i>Alex to Bill to Chris desu yo.</i>
 Alex and Bill and Chris COP SFP
 ‘Alex, Bill, and Chris.’</p> |
|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|

The unavailability of the listing answer in (15) can be captured by assuming the base-generation analysis of long-distance scrambling proposed by Bošković & Takahashi (1998). According to their base-generation analysis, the noun phrase modified by the wh-quantifier in (15) is base-generated in the edge of the matrix clause. It is well-known since Saito (1989) that Japanese long-distance scrambling exhibits the radical reconstruction property, as shown in (16).

- (16) a. *nani-o*₁ *Taro-ga* [*Hanako-ga* Δ_1 *katta ka*] *sitteiru.*
 what-ACC Taro-NOM Hanako-NOM bought Q know
 ‘Taro knows what Hanako bought.’
- b. **dare-ga* [*Hanako-ga hon-o katta ka*] *sitteiru.*
 who-NOM Hanako-NOM book-ACC bought Q know
 ‘Who knows that Hanako bought a book.’

In (16a), the scrambled object wh-item is interpreted in the embedded clause headed by a [+wh] complementizer. (16b) shows that a wh-item requires a clausemate [+wh] complementizer. If the scrambled wh-item in (16a) remains in the edge of the matrix clause at LF, the resulting sentence is predicted to be ungrammatical like (16b), contrary to the fact. To capture the radical reconstruction property, Bošković & Takahashi (1998) propose that a base-generated item undergoes covert movement to the position where it

receives a θ -role. This covert movement is obligatory because in the base-generated position, the item does not receive any θ -role. After the covert movement to a θ position, the *how many* question in (15) will have the following LF representation.

(17) a. MOVEMENT TO A θ POSITION

$\frac{[NP [QP nan-nin-no] [NP gakusei]]-o}{to} H.-wa [T.-ga [NP [QP nan-nin-no] [NP gakusei]]-o hometa$
 $] itta no?$ (LF)

b. PARTIAL DELETION

$\frac{[NP [QP nan-nin-no] [NP gakusei]]-o}{to} H.-wa [T.-ga [NP [QP nan-nin-no] [NP gakusei]]-o hometa$
 $] itta no?$ (LF)

$\rightsquigarrow ?n[n = \max(\lambda n' \exists x[\text{student}(x) \wedge \mu_{\text{person}}(x) = n' \wedge \text{praise}(\text{Taro}, x)]]$ [listing answer: *]

In order to receive a θ -role from the verb *hometa* ‘praised’, the base-generated noun phrase must covertly move to a θ position, as shown in (17a). However, this requirement does not hold for a *wh*-quantifier. Instead, it must remain in the matrix clause to be licensed by a [+*wh*] complementizer. In (17b), I assume that both requirements are satisfied by applying partial deletion at LF. Importantly, the resulting LF representation in (17b) is similar to (12a) in the sense that only a *wh*-quantifier has an operator-variable structure. The variable in (17b) is of type *n* because it is associated with a quantifier, and it derives the LF representation incompatible with the listing answer. Takahashi (1993) independently observes that long-distance scrambling of an embedded *wh*-item to the edge of a clause headed by a [+*wh*] complementizer behaves like *wh*-movement. For example, (18a), has a structure of long-distance scrambling, is interpreted as a *wh*-question. If the same *wh*-item stays in an embedded clause, the resulting sentence is ambiguous, as in (18b). (18b) can be interpreted as an yes-no question.

(18) a. *nani-o*₁ *John-wa* [*Mary-ga* Δ_1 *tabeta ka*] *siritagatteiru no?*

what-ACC John-TOP Mary-NOM ate Q want.to.know Q

‘What is x such that John wants to know whether Mary ate x?’

‘*Does John want to know what Mary ate?’

[Takahashi 1993: 657]

b. *John-wa* [*Mary-ga* *nani-o* *tabeta ka*] *siritagatteiru no?*

John-TOP Mary-NOM what-ACC ate Q want.to.know Q

‘What is x such that John wants to know whether Mary ate x?’

‘Does John want to know what Mary ate?’

[Takahashi 1993: 657]

The present analysis of the *how many* question in (15) can be seen as an example of Takahashi’s generalization about long-distance scrambling of a *wh*-item. Long-distance scrambling of a *wh*-quantifier to the matrix clause headed by a [+*wh*] complementizer is counted as a *wh*-movement, and the *wh*-quantifier does not show the radical reconstruction property. It may be worth noting here that if the matrix clause is not headed by a [+*wh*] complementizer, a *wh*-quantifier exhibits the radical reconstruction property. The noun phrase modified by a *wh*-quantifier in (19a) is interpreted in the same way as the one in (19b).

- (19) a. [*nan-nin-no gakusei*]-*o*₁ *Hanako-wa* [*Taro-ga sono hi* Δ_1 *hometa ka*] *siritagatteiru*
 WH-CLS-GEN student-ACC Hanako-TOP Taro-NOM that day praised Q want.to.know
 ‘Hanako wants to know how many students Taro praised that day.’
- b. *Hanako-wa* [*Taro-ga sono hi* [*nan-nin-no gakusei*]-*o* *hometa ka*] *siritagatteiru*
 Hanako-TOP Taro-NOM that day WH-CLS-GEN student-ACC praised Q want.to.know
 ‘Hanako wants to know how many students Taro praised that day.’

In (19a), the matrix clause is headed by a [-wh] complementizer, and there is no need for the wh-quantifier to remain in the edge of the matrix clause. I assume that in this case the wh-quantifier also undergoes covert movement to a θ position, in tandem with the modified noun. Importantly, (19b) can be associated with the listing answer, as shown in (20).

- (20) a. *Hanako-wa* [*Taro-ga sono hi* [*nan-nin-no gakusei*]-*o* *hometa ka*] *siritagatteiru*
 Hanako-TOP Taro-NOM that day WH-CLS-GEN student-ACC praised Q want.to.know
 ‘Hanako wants to know how many students Taro praised that day.’
- b. *sono kotae-wa Alex to Bill to Chris da.*
 that answer-TOP Alex and Bill and Chris COP
 ‘The answer is Alex, Bill, and Chris.’

Though judgements are subtle, the same seems to hold for (19a), as shown in (21).

- (21) a. [*nan-nin-no gakusei*]-*o*₁ *Hanako-wa* [*Taro-ga sono hi* Δ_1 *hometa ka*] *siritagatteiru*
 WH-CLS-GEN student-ACC Hanako-TOP Taro-NOM that day praised Q want.to.know
 ‘Hanako wants to know how many students Taro praised that day.’
- b. *sono kotae-wa Alex to Bill to Chris da.*
 that answer-TOP Alex and Bill and Chris COP
 ‘The answer is Alex, Bill, and Chris.’

Of importance here is that even those who judge the listing answers in (20) and (21) as marginally acceptable find that the listing answers in (20) and (21) are better than the one in (22), where a wh-quantifier appears in the post-nominal position. The listing answer is impossible in (22).

- (22) a. *Hanako-wa* [*Taro-ga sono hi* [*gakusei nan-nin*]-*o* *hometa ka*] *siritagatteiru*
 Hanako-TOP Taro-NOM that day student WH-CLS-ACC praised Q want.to.know
 ‘Hanako wants to know how many students Taro praised that day.’
- b. #*sono kotae-wa Alex to Bill to Chris da.*
 that answer-TOP Alex and Bill and Chris COP
 ‘The answer is Alex, Bill, and Chris.’

The availability of the listing answer in (20) and (21) indicates that a wh-quantifier exhibits the radical reconstruction property if there is no independent motivation for remaining in the base-generated position. Notice also that short-distance scrambling does not change the availability of the listing answer, as in (23).

- (23) Q. [*nan-nin-no gakusei*]-*o*₁ *Taro-wa sono hi* Δ_1 *home-ta no?*
 WH-CLS-GEN student-ACC Taro-TOP that day praise-PAST Q
 ‘How many students did Taro praise that day?’ [Pre-nominal numeral classifier]

A1. *san-nin desu yo.*
 three-CLS COP SFP
 ‘Three (students).’

A2. *Alex to Bill to Chris desu yo.*
 Alex and Bill and Chris COP SFP
 ‘Alex, Bill, and Chris.’

It has been observed that short-distance scrambling is not always undone, in contrast to long-distance scrambling. Due to the limitation of space, I do not discuss the landing site of short-distance scrambling in this paper, but it is not unreasonable to assume that short-distance scrambling may target a position below the CP domain (Saito 1989). Under this assumption, the availability of the listing answer in (23) can be captured. After short-distance scrambling, a *wh*-quantifier can optionally pied-pipe the modified noun phrase on the way to Spec,CP, as represented in (24b).

- (24) a. $[_{CP} [_{QP} \textit{nan-nin-no}]_I [\Delta_I [\textit{Taro-wa} [\Delta_I [_{NP} \textit{gakusei}]_o] \textit{home-ta no}]]]]$ (LF)
 $\rightsquigarrow ?n[n = \max(\lambda n' \exists x [\textit{student}(x) \wedge \mu_{\textit{person}}(x) = n' \wedge \textit{praise}(\textit{Taro}, x)])]$ [listing answer: *]
- b. $[_{CP} [_{NP} [_{QP} \textit{nan-nin-no}] [_{NP} \textit{gakusei}]_o]_I [\Delta_I [\textit{Taro-wa} \Delta_I \textit{home-ta no}]]]$ (LF)
 $\rightsquigarrow ?y[y = \max(\lambda x \exists n' [\textit{student}(x) \wedge \mu_{\textit{person}}(x) = n' \wedge \textit{praise}(\textit{Taro}, x)])]$ [listing answer: OK]

The listing answer is possible in (23) because the LF representation in (24b) is available.

6. Summary

The main observation of this paper is that only when a *wh*-quantifier appears in the pre-nominal position, the resulting *how many* question can be answered by listing names of individuals. I pursued an analysis in which Japanese pre-nominal *wh*-quantifiers adjoin to a noun and can optionally pied-pipe the modified noun. When a *wh*-quantifier pied-pipes a noun phrase, covert movement of the *wh*-quantifier creates a trace that is interpreted as a variable for individuals.

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