Semantic Properties of (Non-)Floating Quantifiers and their Syntactic Implications[1]

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1. Introduction

It is well-known that, in Japanese, classifier phrases (ClPs) (e.g., *3-classifier*) or measure phrases (MPs) (e.g., *3 liters*) can 'float' in that they can be separated from the host noun, as in (1b) and (2b).[2] ClPs and MPs in this configuration are referred to as **floating quantifiers** (**FQs**), and their non-floated counterparts in (1a) and (2a) in which ClPs or MPs are adjacent to their host noun are referred to as **non-floating quantifiers** (**non-FQs**).

[1] I would like to thank Maribel Romero, Roger Schwarzschild, and Satoshi Tomioka for valuable discussions and their insights. Thanks are also due to the audience at J/K 12.

[2] In most of the previous studies, (i) is used as a non-FQ:

(i) [**San-nin**-no *gakusei*]-ga paatii-de odotta (koto)
[three-CL-COP student]-NOM party-at danced
'Three students danced at the party'

This construction does not show the semantic restrictions relevant to this paper. I suspect that this is because the ClPs or MPs in this construction are not quantificational elements, but modifiers in the same way as adjectives (cf. Nakanishi 2002). For this reason, I use the construction presented in (1a) as a non-FQ instead of (i) (cf. Terada 1990).

(1) a. [*host noun* + **ClP**]-CASE (**non-FQ**):
[*Gakusei* **san-nin**]-ga paatii-de odotta (koto)[3]
[student 3-CL]-NOM party-at danced (the fact that)[4]
'Three students danced at the party.'

b. *host noun*-CASE … **ClP** (**FQ**):
Gakusei-ga paatii-de **san-nin** odotta (koto)
student-NOM party-at 3-CL danced

(2) a. [*host noun* + **MP**]-CASE (**non-FQ**):
[*Mizu* **san-rittoru**]-ga tukue-nouede koboreta (koto)
[water 3-liter]-NOM table-on spilled
'Three liters of water spilled on the table.'

b. *host noun*-CASE … **MP** (**FQ**):
Mizu-ga tukue-nouede **san-rittoru** koboreta (koto)
water-NOM table-on 3-liter spilled

Given such examples, the following questions arise: What is the difference, if any, between non-FQs and FQs? What can the difference tell us about grammar? In this paper, to answer these questions, I will examine the semantics of non-FQs and FQs, and further explore their syntax.

The structure of the paper is as follows. In Section 2, I show that FQs and their non-floating counterparts are semantically different. I account for this fact by applying Schwarzschild's (2002) monotonicity constraint. In Section 3, I show that the account based on the monotonicity constraint can capture two further semantic properties of non-FQs and FQs, that is, the (in)compatibility with stage-/individual-level predicates and the (un)availability of the distributive/collective readings. In Section 4, I explore whether the current semantic analysis is compatible with syntactic structures of non-FQs and FQs. Section 5 is the conclusion.

2. The Monotonicity Constraint

In this section, I show that FQs are semantically different from their non-floating counterparts: non-FQs can occur with any verbal predicate, while not all verbal predicates can occur with FQs. As shown in (3a) and (4a), non-FQs are compatible with predicates such as *pile up* and *destroy that house*. In contrast, FQs are compatible with *pile up*, as shown in (3b), but not with *destroy that house* is not, as shown in (4b).

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[3] In Japanese, matrix sentences can be unnatural when the topic marker is not used. Such a pragmatic restriction does not occur in embedded clauses. For this reason, *koto* 'the fact that' is added to create an embedded sentence (Saito 1985).

[4] In this paper, the following abbreviations are used: ACC accusative case marker, CL classifier, DECL declarative, NM nominalizer, NOM nominative case marker, PASS passive, PAST past tense.

(3) a. [*Yuki* **san-ton**]-ga yane-noueni tumotta (koto)
[snow 3-ton]-NOM roof-on piled up
'Three tons of snow piled up on the roof.'
b. *Yuki*-ga yane-noueni **san-ton** tumotta (koto)
snow-NOM roof-on 3-ton piled up

(4) a. [*Yuki* **san-ton**]-ga kinoo sono ie-o ositubusita (koto)
[snow 3-ton]-NOM yesterday that house-ACC destroyed
'Three tons of snow destroyed that house yesterday.'
b. **Yuki*-ga kinoo **san-ton** sono ie-o ositubusita (koto)
snow-NOM yesterday 3-ton that house-ACC destroyed
(cf. Gunji and Hashida 1998:46)

I first examine the difference between *pile up* and *destroy that house*. Intuitively, *pile up* has uniform part-whole structures such that a subevent of a piling up event is still a piling up event. In contrast, *destroy that house* does not have uniform part-whole structures, since a subevent of the predicate *destroy that house* is not a destroying-John's-house event. This intuition is tied to the atelic-telic distinction (cf. Vendler 1957, Verkuyl 1972, Dowty 1979): *pile up* is an atelic predicate, that is, a predicate whose denotation has no set terminal point, while *destroy that house* is a telic predicate, that is, a predicate whose denotation includes a terminal point.

Previous studies have shown analogies between the atelic-telic distinction in verbal predicates and the mass-count distinction in nouns (ter Meulen 1984, Bach 1986, Krifka 1989, among others). For example, mass nouns such as *meat* have uniform part-whole structures, while count nouns such as *baby* do not: any smaller part of the big piece of meat is meat, while a smaller part of the baby, say a toe, is not a baby. In this way, there is a parallelism between mass nouns and atelic predicates on the one hand and count nouns and telic predicates on the other. Given this parallelism, relevant to the above contrast between *pile up* and *destroy that house* is the following contrast in so-called pseudopartitive constructions in English.

(5) a. three pounds of meat
b. *three pounds of baby
(cf. a three-pound baby) (Schwarzschild 2002)

Schwarzschild (2002) accounts for this contrast by appealing to the semantics of the measure function expressed by measure phrases. For Schwarzschild, the measure function is a measurement scheme such as 'weight' or 'temperature'. He argues that the measure function is monotonic relative to the measured element if and only if it tracks part-whole structures of the element: a measurement scheme is monotonic if and only if a measure obtained for an element x is larger than a measure obtained for a proper subpart of x. For example, 'weight' is monotonic for meat, since, if a quantity of meat has a certain weight, proper subparts of it will have lower

weights. Formally, the measure function μ is monotonic relative to the denotation of the host noun if it satisfies the following condition:

(6) The measure function μ is monotonic relative to the domain I iff:
For individuals x, y in I:
If x is a proper subpart of y, then $\mu(x) < \mu(y)$
(Schwarzschild 2002a)

Schwarzschild captures the contrast in (5) by claiming that the measure function used in pseudopartitives must satisfy the monotonicity constraint, i.e., the measure function in pseudopartitives has to be monotonic relative to the part-whole structure expressed by the noun.[5] In (5), a measure function denoted by *three pounds* with respect to *meat* or *baby* is 'weight'. 'Weight' tracks part-whole structures of *meat*, as described above. In contrast, 'weight' cannot track part-whole structures of *baby*, since *baby* does not have uniform subparts. Thus, *baby* is not an appropriate noun for pseudopartitives.

Let us go back to the two verbal predicates at issue, that is, *pile up* and *destroy that house*. Given the parallelism between the nominal domain (the mass-count distinction) and the verbal domain (the atelic-telic distinction), I propose to extend Schwarzschild's monotonicity constraint on the nominal domain to the verbal domain. In particular, I argue that FQs must satisfy the monotonicity constraint on the verbal domain, that is, a measure function expressed by FQs must track uniform part-whole structures of the verbal predicate. Formally, the measure function μ is monotonic relative to the denotation of the verbal predicate if it satisfies the following condition:

(7) The measure function μ is monotonic relative to the domain E iff:
For individuals e_1, e_2 in E:
If e_1 is a proper subpart of e_2, then $\mu(e_1) < \mu(e_2)$

The definition in (7) is parallel to the one in (6). The only difference is that the measure function in (6) measures individuals denoted by the host noun, while the measure function in (7) measures events denoted by the verbal predicate. The monotonicity constraint on the verbal predicate says that the verbal predicate must have a part-whole structure. *Pile up* has a part-whole structure in the same way as a mass noun *meat*. *Meat* is considered to have a part-whole structure in that subparts of a certain amount of meat are still meat. Furthermore, if we put together two chunks of meat, the combined chunk is meat as well. Following previous studies (Krifka 1989, among others), I assume that the same analysis holds for an atelic verbal predicate *pile up*: subparts of a piling up event are piling up events and we obtain a

[5] Schwarzschild (2002) proposes two monotonicity constraints, although I introduce only one of them in this paper. See Nakanishi (2003) for details.

piling up event by combining two piling up events. Assuming that *pile up* has a part-whole structure, it is possible for the measure function to apply monotonically. In contrast, *destroy that house* lacks a part-whole structure in that there is no proper-subpart that denotes a destroying-that-house event. As a result, monotonicity fails in the case of *destroy that house*.

I further claim that non-FQs are not subject to the monotonicity constraint on the verbal predicate. For this reason, non-FQs are compatible with any verbal predicate. This claim accounts for the fact that both (3a) and (4a) are acceptable.

Note that the current analysis applies not only to floating MPs, but also to floating ClPs, as shown in (8) and (9).

(8) a. [*Hako* **juk-ko**]-ga tukue-noueni tumiage-rare-ta (koto)
[box 10-CL]-NOM desk-on pile.up-PASS-PAST
'Ten boxes were piled up on the desk.'
b. *Hako*-ga tukue-noueni **juk-ko** tumiage-rare-ta (koto)
box-NOM desk-on 10-CL pile.up-PASS-PAST

(9) a. [*Hako* **juk-ko**]-ga kinoo sono tukue-o ositubisita (koto)
[box 10-CL]-NOM yesterday that desk-ACC smashed
'Ten boxes smashed John's desk yesterday.'
b. **Hako*-ga kinoo **juk-ko** sono tukue-o ositubisita (koto)
box-NOM yesterday 10-CL that desk-ACC smashed

In sum, I have shown that FQs, including both floating MPs and floating ClPs, must satisfy the monotonicity constraint on the verbal domain, while non-FQs are not subject to this constraint.

3. Consequences

In this section, I show that the current analysis can offer an account for the two semantic properties of FQs that are independently observed in the previous literature.

3.1. Stage-/Individual-Level Predicates

The first semantic property to be considered is the (in)compatibility with stage-/individual-level (S-/I-level) predicates.[6] It has been claimed that FQs are compatible with S-level predicates, but not with I-level predicates (Fukushima 1991, Nishigauchi and Uchibori 1991, Miyamoto 1994). In contrast, non-FQs are compatible with both predicate types.

[6] It has been established that predicates can be divided into two types, namely, S-level and I-level predicates (Carlson 1977). S-level predicates typically correspond to temporal predicates and I-level predicates correspond to more or less permanent predicates.

(10) a. [*Gakusei* **san-nin**]-ga kono kurasu-de byookidearu (koto)
[student 3-CL]-NOM this class-in sick
'Three students in this class are sick.'
b. *Gakusei*-ga kono kurasu-de **san-nin** byookidearu (koto)
student-NOM this class-in 3-CL sick [S-level]

(11) a. [*Gakusei* **san-nin**]-ga kono kurasu-de kasikoi (koto)
[student 3-CL]-NOM this class-in smart
'Three students in this class are smart.'
b. ??*Gakusei*-ga kono kurasu-de **san-nin** kasikoi (koto)
student-NOM this class-in 3-CL smart [I-level]

Although the claim in the previous studies is based on floating ClPs, examples in (12) and (13) show that the same claim holds for floating MPs.

(12) a. Koko-ni aru niku-nouti [*gyuuniku* **hyaku-guramu**]-ga
here-at be meat-among [beef 100-gram]-NOM
kusatteiru (koto)
rotten
'Of the meat here, 100 grams of beef are rotten.'
b. Koko-ni aru niku-nouti *gyuuniku*-ga **hyaku-guramu**
here-at be meat-among beef-NOM 100-gram
kusatteiru (koto)
rotten [S-level]

(13) a. Koko-ni aru niku-nouti [*gyuuniku* **hyaku-guramu**]-ga
here-at be meat-among [beef 100-gram]-NOM
kokusan-dearu (koto)
domestic-COP
'Of the meat here, 100 grams of beef are domestic.'
b. ??Koko-ni aru niku-nouti *gyuuniku*-ga **hyaku-guramu**
here-at be meat-among beef-NOM 100-gram
kokusan-dearu (koto)
domestic-COP [I-level]

The question is why FQs are incompatible with I-level predicates. Following Kratzer (1995), I assume that S-level predicates, but not I-level predicates, have a Davidsonian event argument. The current claim is that FQs must satisfy the monotonicity constraint on the verbal domain. For this purpose, the verbal domain must have part-whole structures of events. Lacking event arguments, I-level predicates cannot have such structures. Thus, the monotonicity constraint cannot be satisfied with I-level predicates, yielding an unacceptable sentences in (11b) and (13b). S-level predicates have an event argument, thus it is possible for them to satisfy the monotonicity constraint, as shown in (10b) and (12b). As for non-FQs, they are not subject to

the monotonicity constraint on the verbal domain. Not surprisingly, they are compatible with both S-level and I-level predicates.

3.2. Distributive/Collective Readings

The second semantic property to be considered is the (un)availability of the distributive/collective readings. It is well known that sentences such as the following are ambiguous between so-called 'distributive' and 'collective' readings (cf. Link 1983, Dowty 1986, Landman 1989, 1996).

(14) Three students found a book.

The sentence in (14) has the following two readings. One reading is that each of the three students found a book. Thus, there were three books found. This reading is called a 'distributive' reading. The other reading is that three students found one book together, which is called a 'collective' reading.

This ambiguity can be observed in Japanese: the sentence with a non-FQ in (15a) is ambiguous between the distributive and the collective reading. However, sentences with an FQ seem to lack the ambiguity: some previous studies claim that sentences with FQs only allow a distributive reading (Terada 1990, Ishii 1999, among others). Indeed, in (15b), only the distributive reading is available. The collective reading, if it is ever available, is very difficult to obtain.

(15) a. [*Gakusei* **san-nin**]-ga miti-de hon-o hirotta (koto)
[student 3-CL]-NOM street-on book-ACC found
'Three students found a book on the street.'
√distributive, √collective

b. *Gakusei*-ga miti-de **san-nin** hon-o hirotta (koto)
student-NOM street-on 3-CL book-ACC found
√distributive, *?collective

Following Landman (1989, 1996), I assume that a collective predication is a singular predication, and a distributive predication is a plural predication. This means that the extension of the collective reading is an atomic event without part-whole structures, while the extension of the distributive reading is part-whole structures of events. In our example, the collective reading denotes a single event of finding a book, while the distributive reading denotes a multiple events of finding a book. With these assumptions, the above contrast follows naturally from the current analysis that FQs must satisfy the monotonicity constraint on the verbal domain. The collective reading is unavailable since, in this reading, there is no part-whole structure where a measure function applies in a monotonic fashion. In contrast, the distributive reading is available since this reading has part-whole structures of events. Non-FQs are not subject to the monotonicity constraint, thus they have both distributive and collective readings.

The above observation is further supported by the examples in (16) and (17). Consider first the examples in (16). The predicate *kill John's mother* must be interpreted collectively, since it is impossible for John's mother to be killed multiple times. Thus, *kill John's mother* is an atomic event without part-whole structures. As shown in (16b), the FQ is incompatible with this predicate since the monotonicity constraint cannot be satisfied. In contrast, *try to kill John's mother* can occur multiple times, thus this predicate has part-whole structures. It follows that the FQ can satisfy the monotonicity constraint, and (17b) is therefore acceptable. Non-FQs are not subject to the monotonicity constraint, thus both (16a) and (17a) are acceptable.

(16) a. [*Gootoo* **san-nin**]-ga kinoo John-no haha-o korosita (koto)
[robber 3-CL]-NOM yesterday John's mother-ACC killed
'Three robbers killed John's mother yesterday.'
b. ??*Gootoo*-ga kinoo **san-nin** John-no haha-o korosita (koto)
robber-NOM yesterday three-CL John's mother-ACC killed

(17) a. [*Gootoo* **san-nin**]-ga kinoo John-no haha-o
[robber 3-CL]-NOM yesterday John's mother-ACC
koros-ootosita (koto)
kill-tried
'Three robbers tried to kill John's mother yesterday.'
b. *Gootoo*-ga kinoo **san-nin** John-no haha-o
robber-NOM yesterday 3-CL John's mother-ACC
koros-ootosita (koto)
kill-tried

In sum, I have shown that the present approach that FQs, but not non-FQs, must satisfy the monotonicity constraint on the verbal domain offers a unified account for the whole array of data. In particular, my approach accounts for the three contrasts presented above which do not seem to be related to each other: the contrast between (3) and (4) (*pile up* vs. *destroy that house*), the contrast with respect to S-/I-level predicates, and the contrast with respect to the distributive/collective readings.

4. Syntactic Implications

In this section, I examine syntactic implications of the current analysis.

In earlier studies on FQs, it has been observed that sentences with FQs and their non-floating counterparts are semantically equivalent. For this reason, some previous studies claim that FQs are derived from non-FQs by some syntactic transformation (Sportiche 1988, among others). For example, 'the children' in 'all the children have left' moves to a higher position than the original subject 'all the children' is, stranding 'all' behind. As a result, 'the children have all left' is derived. However, further studies revealed that the two constructions are not semantically equivalent (Dowty

and Brodie 1984, Junker 1995, Doetjes 1997, among others). Indeed, the current study presents ample data to elaborate on this point. Such data cast doubt on the transformational approach, since this approach cannot straightforwardly capture different semantic properties.

Another argument against the transformational approach comes from examples such as (18) in which the FQ is acceptable, although its non-floating counterparts is unacceptable. The transformational approach cannot account for such an example: how can we derive (18b) from (18a) if (18a) is unacceptable in the first place?

(18) a. * John-ga [*juu-mon-no mondai* **go-mon**]-o isoide toita (koto)
John-NOM [10-CL-COP question 5-CL]-ACC quickly solved
'John quickly solved five of the ten questions.'

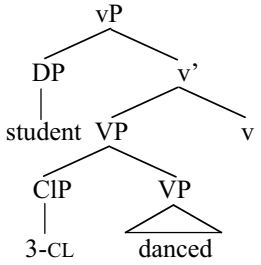
b. John-ga *juu-mon-no mondai*-o isoide **go-mon** toita (koto)
John-NOM 10-CL-COP question-ACC quickly 5-CL solved
(cf. Inoue 1978)

Alternatively, the previous studies have proposed two approaches, i.e., the secondary predicate approach (Ueda 1986, Miyagawa 1989, Miyamoto 1994, Takami 1998) and the adverb approach (Fukushima 1991, Fujita 1994; cf. Ishii 1999). Syntactically, in both the secondary predicate and adverb approaches, FQs can be considered to be adjoined to VP, as shown in (19) (cf. Koizumi 1994, Fujita 1994, among others).[7]

(19) a. *Gakusei*-ga paatii-de **san-nin** odotta (koto)
student-NOM party-at 3-CL danced
'Three students danced at the party'

(=1b)

b.



The fact that FQs are outside of the VP is attested to by VP pseudo-clefting. Japanese has a VP pseudo-cleft construction in which a VP appears in the focus position, as shown in (20).

[7] I am only concerned with the position of subject-oriented FQs. See Nakanishi (2002) for a discussion of object-oriented FQs.

(20) *John*-ga niwa-de si-ta-no-wa [$_{VP}$ ringo-o taberu] koto datta.
John-NOM garden-in do-PAST-NM-TOP [apple-ACC eat] fact was
'What John did in the garden was eat apples.'

If FQs are within VP, they should be able to appear in the focus position. In (21), the fact that the FQ can appear at a non-focus position, but not at the focus position shows that subject-oriented FQs must be outside of the VP (Fujita 1994; cf. Koizumi 1994).

(21) a. *Gakusei*-ga kinoo **san-nin** si-ta-no-wa
student-NOM yesterday 3-CL do-PAST-NM-TOP
[$_{VP}$ ringo-o taberu] koto datta.
[apple-ACC eat] fact was
'What three students did yesterday was eat apples.'
b. **Gakusei*-ga kinoo si-ta-no-wa
student-NOM yesterday do-PAST-NM-TOP
[$_{VP}$ **san-nin** ringo-o taberu] koto datta.
[3-CL apple-ACC eat] fact was
'(lit.) What students did yesterday was three eat apples.'

In sum, independently from semantics, FQs can be considered to be adjoined to VP, as in (19b). It follows that FQs directly combine with the verbal predicate in syntax. Semantically, I have claimed that FQs are subject to the monotonicity constraint with respect to the verbal predicate. Thus we can say that the current claim regarding the semantics of FQs corresponds to the syntax of FQs: FQs are subject to a semantic constraint in the verbal domain because, in syntax, FQs directly combine with the verbal predicate.[8] That is, the two components of sentence grammar, syntax and semantics, correlate with each other. This is an ideal result that agrees with the general assumption in the compositional semantics that semantic rules apply when elements are combined by syntactic rules.

5. Conclusion

In this paper, I have shown that Schwarzschild's (2002) analysis of measure phrases in pseudopartitives can be extended to FQs in Japanese. In particular, I argued that FQs have to satisfy the monotonicity constraint on the verbal domain, while non-FQs do not. I further showed that semantic properties of non-FQs and FQs observed in the previous literature naturally follow

[8] The situation is actually more complicated than is described here: although FQs combine with the verbal predicate, they seem to measure the denotation of the noun phrase somehow. For example, in (19a) above, the FQ *3-CL* does not syntactically combine with *student*. However, it is obvious that *3-CL* somehow measures *student* semantically, since a classifier denoted in *3-CL* agrees with *student*, but not with *dance.* See Nakanishi (2002, 2003) for how to deal with such a dilemma and still maintain the correlation between syntax and semantics.

from this argument. Then I discussed some syntactic implications of the current semantic analysis. If what I have argued in this paper is on the right track, it will support an ideal view that the two components of grammar, i.e., syntax and semantics are intimately related.

Finally, I would like to briefly discuss cross-linguistic implications of the present study. One very important question for a linguistic analysis is how well it stands up when applied to different languages. So far I have examined the data from Catalan, Chinese, German, and Greek, and found that they seem to behave in the same way as the Japanese data presented above (Nakanishi 2002).[9] Given this finding, it might be possible to extend the present analysis to the cross-linguistic data.

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[9] Interestingly, the data from Korean do not seem to be completely parallel to the Japanese data. What seems to be relevant is the fact that Korean, but not Japanese, allows to have a case marker on FQs, as shown in (i):

(i) *Haksayng*-I **seys-myeng(**-i) o-ass-ta.
student-NOM three-CL(-NOM) come-PAST-DECL
'Three students came.'

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