THE QUANTIFICATIONAL FUNCTION OF THE JAPANESE NUMERAL CLASSIFIER

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Abstract

This paper presents a new quantificational analysis of the Japanese numeral quantifier (NQ) construction. It is proposed that the classifier within the NQ functions as the domain of quantification for the numeral, denoting a set of atomic individuals. This accounts for the predominant distributive reading of the floating NQ sentence, both with object classifiers and event classifiers, as a direct consequence of the atomicity condition of the classifier denotation. The analysis correctly predicts that, unlike the floating NQ, the non-floating NQ will show a collective/distributive ambiguity because it forms a plural term, which can always be interpreted as a group individual or as a sum of individuals. The analysis also provides a semantic account of the well-known classifier-NP agreement phenomenon.

1. The Japanese Numeral Quantifier

The Japanese numeral quantifier (NQ) consists of a numeral and a classifier in that order, as the following exemplifies:

(1) a. san-nin — 3-$CL_{human\ individual}$ b. san-kumi — 3-CL_{group} c. ni-hon — 2-$CL_{long\ object}$ d. ni-hai — 2-$CL_{glass/cup}$

In semantic interpretation, the NQ is associated with an NP ('host NP'). For example, (1a) *san-nin* can be construed with a common noun such as *gakusei* 'student' to yield the meaning 'three students'. The Japanese NQ occur either inside the DP that contains its host NP, i.e. as a 'DNQ', or syntactically associated with a predicate, i.e. as an 'FNQ'. (2a) and (2b) are sentences with a DNQ construed with a subject NP and an object NP, respectively. (3a) and (3b) are sentences with an FNQ construed with a subject NP and an object NP, respectively:

(2) a. **san-nin**-no **gakusei**-ga hon-o katta. 'Three students bought a book'
3-CL-GEN student-NOM book-ACC bought
b. John-ga **san-satsu**-no **hon**-o katta. 'John bought three books.'
J-NOM 3-CL-GEN book-ACC bought

(3) a. **gakusei**-ga **san-nin** hon-o katta. 'Three students bought a book.'
student-NOM 3-CL book-ACC bought
b. John-ga **hon**-o **san-satsu** katta. 'John bought three books.'
J-NOM book-ACC 3-CL bought

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2. Classifier-Host NP Agreement

As is well-known, the Japanese classifier must agree with the host NP. This is illustrated in the following sentences:

(4) a. **gakusei**-ga **san-nin** kita. 'Three **individual** students came.'
student-NOM 3-CL came

b. #**gakusei**-ga **san-gen** kita (lit.)'Three **buildings** of students came.'
student-NOM 3-CL came

c. **gakusei**-ga **san-kumi** kita. 'Three **groups** of students came.'
student-NOM 3-CL came

(5) a. John-ga **biiru**-o **ni-hon** nonda. 'John drank two **bottles** of beer.'
J-NOM beer-ACC 2-CL drank

b. #John-ga **biiru**-o **ni-mai** nonda (lit.)'John drank two **sheets** of beer.'
J-NOM beer-ACC 2-CL drank

c. John-ga **biiru**-o **ni-hai** nonda. 'John drank two **glasses** of beer.'
J-NOM beer-ACC 2-CL drank

(4a) is well-formed because *nin* is the classifier for human beings and *gakusei* is a kind of human being. In contrast, (4b) is ill-formed because *ken* is the classifier for buildings, and students cannot easily be taken to have building properties. Likewise, (5a) is well-formed because *hon* is the classifier for long slender objects and a beer bottle fits this description, but (5b) is ill-formed because *mai* is the classifier for flat, sheet-like objects and beer does not usually come in flat, sheet-shaped packages. Japanese classifier-host NP agreement is often analyzed as syntactic agreement (e.g. Kitahara 1992). However, there are two basic observations that argue strongly against such an analysis. First, consider the grammatical minimal pairs (4a)-(4c) and (5a)-(5c). These contrasts illustrate a very general fact about Japanese classifier-host NP agreement, namely that the classifier has a meaning. This is not a property of syntactic agreement affixes. Consider, for example, a real case of syntactic agreement such as adjective-noun agreement in the Spanish NP *casa roja* 'red house'; the agreement affix has no semantic content. Similarly, the syntactic agreement affix in cases of subject-verb agreement, e.g. English *John walks*, is completely inert semantically. Secondly, classifier selection is context-sensitive and the ill-formedness of a classifier-host NP mismatch is exactly analogous to a selectional restriction violation. For example, whether (5a) or (5c) is pragmatically licensed depends entirely on the speaker's beliefs about the vessel John used to drink beer. Moreover, there are conceivable, albeit unlikely, contexts in which (5b) could be perfectly well-formed, e.g. aboard a spacecraft where beer was stored in freeze-dried wafers. Given these basic observations, Japanese classifier-host NP agreement does not appear to be syntactic. Rather, it appears to be semantic. This raises a first question: What role does syntax play in this evidently semantic agreement phenomenon?

3. Semantic Difference between DNQ and FNQ Sentences

It has been observed that the Japanese FNQ sentence generally requires a distributive reading. In contrast, the DNQ sentence is always ambiguous between distributive and collective readings.[1] This is seen in contrasts such as the following:

(6) a. **san-nin**-no **gakusei**-ga peepaa-o kaita (DNQ)
3-CL-GEN student-NOM paper-ACC wrote
'Three students together/each wrote a paper.
b. **gakusei**-ga, **san-nin** peepaa-o kaita (FNQ)
student-NOM 3-CL paper-ACC wrote
'Three students each wrote a paper.'

(7) a. **futa-tsu**-no **suiso-genshi**-ga kono ondo-de
2-CL-GEN hydrogen-atom-NOM this temperature-at
hito-tsu-no suiso-bunshi-o tsukuru (DNQ)
1-CL-GEN hydrogen-molecule-ACC form
'Two hydrogen atoms form a hydrogen molecule at this temperature.'
b. #**suiso-genshi**-ga kono ondo-de
hydrogen-atom-NOM this temperature-at
futa-tsu hito-tsu-no suiso-bunshi-o tsukuru (FNQ)
2-CL 1-CL-GEN hydrogen-molecule-ACC form
'(lit.) Two hydrogen atoms each form a hydrogen molecule at this temperature.'

The sentences in (6) contain a mixed predicate *peepaa-o kaita* 'wrote a paper'. The DNQ sentence (6a) is ambiguous between distributive and collective readings as shown in the English glosses, while the FNQ sentence (6b) can only be interpreted with a distributive reading. The FNQ sentence's association with a distributive reading is even clearer in (7) with the predicate *hitotsu-no suiso-bunshi-o tsukuru* 'form a (single) hydrogen molecule'. This collective predicate forces the DNQ sentence (7a) to have a collective reading, but leads to ill-formedness in (7b) because FNQ requires a distributive reading.[2] The ill-formedness here is parallel to that of an English sentence such as **Each boy gathered in the classroom*. Thus, we face a second question: Why does the FNQ sentence generally require a distributive reading while the DNQ sentence does not.

4. Previous Analyses

Let us look at some previous analyses to see whether they can address these two questions. We will focus on the second one first. Let us begin by considering the traditional analysis of an English sentence such as (8a):

[1] To be precise, this ambiguity holds when the DNQ sentence has a mixed predicate. Needless to say, the DNQ sentence with a collective predicate must be interpreted under a collective reading, and the DNQ sentence with a distributive predicate must be interpreted under a distributive reading.

[2] There is a special type of collective predicate that can occur with an FNQ. In such cases, the FNQ functions as an amount term, rather than an object quantifier. See Kobuchi-Philip (2003) for details.

(8) a. Three students wrote a paper.

b.

Q	A	B
Num	NP	VP
3	student	wrote a paper

c. $|[[NP]] \cap [[VP]]| \geq 3$

This sentence can be quantificationally analyzed as in (8b). The numeral, the host NP, and the VP function as the quantifier, the domain of quantification, and the nuclear scope, respectively. The sentence is analyzed as an assertion that the cardinality of the intersection of the NP denotation and the VP denotation is three, as shown in (8c). This basic approach is what Fukushima (1991) adopts for Japanese. Fukushima's analysis of the Japanese FNQ sentence is illustrated in (9):

(9) a. **gakusei**-ga, **san-nin** peepaa-o kaita 'Three students wrote a paper.'
student-NOM 3-CL paper-ACC wrote

b.

Q	A	B
NQ	NP	VP
3-nin	gakusei	peepaa-o kaita
3-CL	student	wrote a paper

c. $(|\lambda x[\text{gakusei}'(x)] \cap \lambda x[\text{peepaa-o kaita}'(x)]| \geq 3) \wedge (\lambda x[\text{gakusei}'(x)] \cap \lambda x[\text{nin}'(x)])$

student — wrote a paper — student — CL

(NP-denotation) (VP-denotation) (NP-denotation) (CL-denotation)

(9a) is quantificationally analyzed as in (9b). The NQ *san-nin* '3-CL', the host NP *gakusei* 'student', and the VP *peepaa-o kaita* 'wrote a paper' function as the quantifier, the domain of quantification, and the nuclear scope, respectively. The meaning of (9a) under this analysis is represented as (9c). Notice that (9c) consists of two parts. The left conjunct captures the quantification proper, expressing the proposition that the cardinality of the intersection of the NP denotation and the VP denotation is three. The right conjunct captures the relationship between the NP denotation and the classifier denotation, describing it as a subset relation, i.e. the former is a subset of the latter. Fukushima's analysis works for basic FNQ sentences like (9a). However, several objections can be raised. First, under this analysis the classifier does not participate in the quantification proper, despite the fact that it is syntactically, if not morphologically, composed with the numeral. Thus, we have a mapping problem. Secondly, the analysis treats the interpretation of an FNQ sentence on a par with that of a DNQ sentence, failing to capture the essential semantic difference as regards the unavailability of a collective reading for the FNQ sentence. Third, the type of Japanese FNQ sentence containing what I call an 'event classifier' such as *hatsu* 'blast/shot' poses a severe empirical problem. Consider the application of Fukushima's analysis to a sentence such as (10a):

(10) a. John-ga **pisutoru**-o, **san-patsu** utta. 'John shot three shots of a pistol.'
J-NOM pistol-ACC 3-CL shot
b. |∃y[pisutoru'(y)] ∧ ∃x[utta'(x)(j)]| ≥ 3 ∧ ∃y[pisutoru'(y)] ∧ hatsu'
'pistol' 'shot' 'pistol' CL_{shot}

First, (10b) asserts that there are three pistols which John shot (with). But this does not have to be the case: (10a) is also true if John shot a single pistol three times. Second, the event classifier *hatsu* denotes blast/shot units. This is a type of event rather than a type of object; consequently, the subset relationship in the right conjunct of (10c) never holds, making the entire proposition (10c) necessarily false. Thus, Fukushima's analysis cannot capture FNQ sentences with an event classifier, which means that we need a completely distinct analysis for such sentences.

Let us now consider the Distributivity operator (D-operator) approach. Link (1987) argues that an English floating quantifier (FQ) such as *all* converts a VP denotation such as (11a) into (11b) with a D-operator. Under this analysis, the distributive reading of (12a) would be as shown in (12b).

(11) a. VP: λx[VP(x)] b. ^{D}VP: λx∀y[y ≤ x → VP(y)]

(12) a. Three men all lifted a piano.
b. ∃x[(3 men)'(x) ∧ ∀y[y ≤ x → ∃z[piano'(z) ∧ lifted'(y,z)]]]

Applying this approach to the Japanese FNQ sentence, modifying it slightly to take into account the classifier, the logical representation of (13a) would be as shown in (13b):

(13) a. **otoko**-ga, **san-nin** piano-o hakonda.
man-NOM 3-CL piano-ACC carried
'Three men carried a piano.'
b. ∃x[(3 nin)'(x) ∧ otoko'(x) ∧ ∀y[y ≤ x → ∃z[piano'(z) ∧ hakonda'(y,z)]]]
CL 'man' 'piano' 'carried'

(13b) accurately captures the meaning of (13a). However, the D-operator approach is not satisfactory since it only meets the condition of descriptive adequacy. It does not provide an explanation of why a D-operator obligatorily occurs with an FNQ sentence but only optionally with a DNQ sentence. Furthermore, this analysis faces the same problem as Fukushima's analysis with respect to the event classifier sentence. Under a D-operator approach, (14a) would be analyzed as (14b):

(14) a. John-ga **pisutoru**-o **ni-hatsu** utta. 'John shot two shots of a pistol.'
J-NOM pistol-ACC 2-CL shot
b. ∃x[(2 hatsu)'(x) ∧ pisutoru'(x) ∧ ∀y[y ≤ x → [utta'(j,y)]]]
'shot' 'pistol' 'shot'

The variable x is required to have both the property of being two shots (an event property) and of being a pistol (an object property). Since this is semantically incoherent, (14a) is falsely predicted to be ill-formed.

Finally, let us consider the analysis recently proposed by Nakanishi (2002a, b). Nakanishi sheds new light on the semantic difference between Japanese DNQ and FNQ sentences when this NQ functions as an amount term and is subject to Schwarzschild's (2002) 'monotonicity constraint'. Generalizing this to all NQs, she attempts to account for the obligatory distributive reading of the FNQ sentence as a consequence of this monotonicity constraint. Consider first the DNQ sentences in (15), in which the DNQ functions as an amount term rather than quantifying over objects:

(15) a. **mizu san-rittoru**-ga koboreta. 'Three liters of water spilled.'
water 3-CL-NOM spilled
b. ***mizu san-do**-ga koboreta. (intended) 'Water whose temperature is
water 3-CL-NOM spilled three degrees spilled.'

(15a) is well-formed because it obeys the monotonicity constraint in the nominal domain: There is a correlation between a subpart of 3 liters and a subpart of water. In contrast, (15b) is ill-formed because it violates the monotonicity constraint: It is not the case that a subpart of water has a lower degree. On the basis of this kind of data, Nakanishi persuasively argues that the DNQ functioning as an amount term obeys the monotonicity constraint in the nominal domain. Now consider the FNQ sentences in (16), where the FNQ is also an amount term:

(16) a. **yuki**-ga kinoo **san-ton** John-no ie-no yane-ni tsumotta
snow-NOM yesterday 3-CL J-GEN house-GEN roof-on piled up
'Three tons of snow piled up on the roof of John's house yesterday.'
b. ***yuki**-ga kinoo **san-ton** John-no ie-o oshitsubushita
snow-NOM yesterday 3-CL J-GEN house-ACC destroyed
(intended) 'Three tons of snow destroyed John's house yesterday.'

Here, Nakanishi insightfully observes that well-formedness depends on satisfaction of the monotonicity constraint with respect to events denoted by the predicate. (16a) is well-formed since there is a correlation between a subpart of 3 tons and a subevent of piling-up-event. In contrast, (16b) is ill-formed since there is no correlation between a subpart of 3 tons and a subevent of destroying John's house. (The subevents of destroying John's house are not themselves events of destroying John's house.) This shows, Nakanishi persuasively argues, that an amount term FNQ is subject to the monotonicity constraint in the verbal domain. Given this general observation, Nakanishi then attempts to account for the obligatory distributive reading of the Japanese FNQ sentence by treating the FNQ as a kind of amount term. Consider (17):

(17) a. **gakusei**-ga, **san-nin** peepaa-o kaita. 'Three students wrote a paper.'
student-NOM 3-CL_{human} paper-ACC wrote
b. e_1 = student s_1 wrote a paper
e : e_2 = student s_2 wrote a paper
e_3 = student s_3 wrote a paper

According to Nakanishi, an FNQ sentence such as (17a) can be well-formed only under a distributive reading because only under a distributive reading is the monotonicity constraint satisfied in the verbal domain. That is, assuming that the distributive reading entails the presupposition of subevents, as represented in (17b), the monotonicity constraint is obeyed in the verbal domain since a subpart of *3-nin* (e.g. s_1) can be correlated with a subevent of e represented in (17b) (e.g. e_1). Under a collective reading, in contrast, there is only one event so there is no subevent with which a subpart of *3-nin* may be correlated, violating the monotonicity constraint. Since the monotonicity constraint can never be violated, the collective reading is ill-formed.

As elegant as it is, Nakanishi's analysis faces some severe empirical problems. First, consider the case of a DNQ sentence such as (18), which must obey the monotonicity constraint in the nominal domain, according to Nakanishi's proposal:

(18) **gakusei san-nin**-ga peepaa-o kaita. 'Three students wrote a paper.'
student 3-CL-NOM paper-ACC wrote

To satisfy the monotonicity constraint in the nominal domain, there must be a correlation between a subpart of *3-nin* and a subpart of students. There is such a correlation under a distributive reading of (18). But now the problem is that the monotonicity constraint will not be obeyed in the nominal domain under a collective reading of (18). The minute the students are taken as a group, there are no longer any subparts of students. A group of people is an individual object just as much as a collective action is an individual event. Thus, just as the monotonicity constraint rules out a collective reading for the FNQ sentence in (17a), it will rule out a collective reading for the DNQ sentence in (18). Clearly, this is a very false prediction. Moreover, it is unclear how the theory could be modified to capture the facts since what is needed seems to be a stipulation that the monotonicity constraint sometimes need not apply in the nominal domain, in which case, the theory becomes incoherent.

Another problem for Nakanishi's analysis derives from its dependence on an exclusively event-based semantic analysis of FNQ quantification. This leads to a problem capturing the fact that the numeral indicates the cardinality of objects rather than events in sentences such as (19c):

(19) a. e_1 = John danced yesterday at time t_1.
e_2 = John danced yesterday at time t_2.
e_3 = John danced yesterday at time t_3.
b. gakusei-ga kinoo san-kai odotta. 'A student danced three times.'
student-NOM yesterday 3-CL_{time} danced
c. **gakusei**-ga kinoo **san-nin** odotta 'Three students danced.'
student-NOM yesterday 3-CL danced

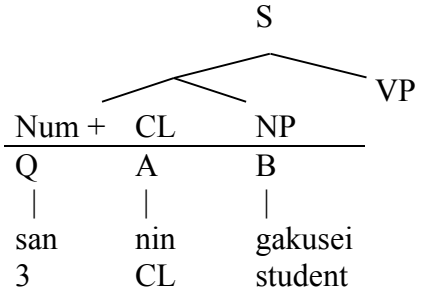
In the situation represented in (19a), a single student, John, dances on three different occasions. (19b) precisely describes this situation. In contrast, (19c) is false of this situation. However, under Nakanishi's account, (19c) is predicted to be true of (19a). If the numeral of (19c) is replaced with a large number, say 300, then it could in principle

true of a situation similar to (19a) under Krifka's (1990) event related reading.[3] (In that case the adverb *kinoo* 'yesterday' should also be replaced with another adverbial indicating a longer period of time.) However, it seems to be extremely difficult to interpret (19c) under the event related reading, if possible at all. Apparently, the event related reading requires the cardinality to be very large, i.e. too large for verification under an object related reading.[4]

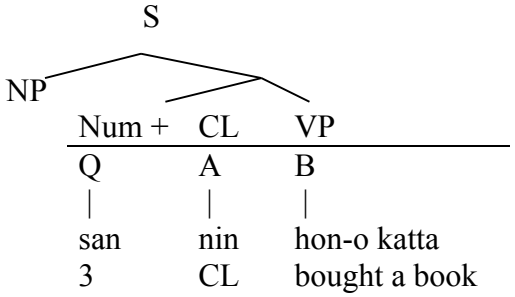
5. An Alternative Analysis

Given the problems of the analyses reviewed in the precious section, I propose an alternative quantificational analysis which pays special attention to the classifier. Following the general consensus in the semantics literature on the Japanese FNQ and on FQs in general (Fukushima 1991, Nakanishi 2002a,b, Dowty and Brody 1984, Link 1987, Roberts 1986, Doetjes 1997), I will assume that the Japanese FNQ is syntactically an adverb which forms a constituent with a predicate, while the Japanese DNQ forms a constituent with the host NP (see Kobuchi-Philip 2003 for a review of the empirical arguments). Assuming this simple syntax, I propose that the basic quantificational structure of the Japanese NQ sentence is as shown in (20):

(20) a. DNQ



b. FNQ



This analysis receives primary support from conservativity tests, as demonstrated in (21). In each case, the entailment indicated by an arrow holds:

(21) Conservativity Tests

a. subject-oriented FNQ
gakusei-ga, **san-nin** peepaa-o kaita.
student-NOM 3-CL paper-ACC wrote
'Three students wrote a paper.'

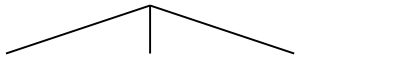
⇒ Three nin are nin that wrote a paper.

[3] For example, an English sentence such as (i) can be interpreted under an ordinary object oriented reading, as paraphrased in (ii), or under a special event related reading, as paraphrased in (iii):

(i) 4000 ships passed through the lock last year.
(ii) There were 4000 ships and they passed through the lock.
(iii) There were 4000 passages of a ship through the lock.

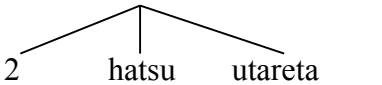
[4] The only type of context licensing an event related reading that I can think of is one in which a large number of dancings are being counted, for example, in some statistical population study.

b. object-oriented FNQ
John-ga **piza**-o, **ni-mai** tabeta.
J-NOM pizza-ACC 2-CL ate
'John ate two slices of pizza.'



□ Two mai are mai that John ate.

c. event classifier (FNQ only)
pisutoru-ga, **ni-hatsu** utareta.
pistol-NOM 2-CL was shot
'A pistol was shot twice.'



□ Two hatsu are hatsu that were shot.

A crucial aspect of this proposal is a special semantic constraint on the classifier denotation which I call the ATOMICITY CONDITION. This is a requirement that the lexical denotation of a classifier only consist of a set of atoms. Unlike ordinary nouns, it cannot also contain sums. To clarify what is intended here, let us first look more closely at the Japanese common noun. I will assume that a Japanese common noun such as *gakusei* 'student' denotes a set containing both sums and atoms. The basic motivation for this is the fact that a Japanese bare noun can be interpreted either as singular or plural, as illustrated in (22). A similar claim has been made for Korean by Kang (1994). Thus, we may represent the denotation of the Japanese common noun *gakusei* as shown in (23):

(22) gakusei-ga kita 'A(/the) student came.' or
student-NOM came 'Some(/the) students came.'

(23) gakusei 'student' :
{$a \sqcup b \sqcup c$, (------ san-nin-no gakusei 'three students')
$a \sqcup b$, $a \sqcup c$, $b \sqcup c$, (------ futa-ri-no gakusei 'two students')
a, b, c} (------ hito-ri-no gakusei 'one student')

Now, let us consider the denotation of the classifier. As we mentioned in the outset, each classifier has its own meaning. For example, the classifier *nin* is a unit for human individuals. Therefore, this must be a part of the lexical content of this classifier. That is, the classifier *nin* denotes a set of objects each of which has the property of being a human being.[5] Now, if the classifier denotation also included both sums and atoms like the common noun denotation, we would face a tremendous difficulty capturing the basic truth conditions of Japanese NQ sentences. Suppose that there were four human individuals a, b, c and d in the domain of discourse and that the denotation of the classifier *nin* included both sums and atoms. Then, the set denoted by the classifier *nin* 'human individuals' would include the following elements:

[5] To be precise, the property is that of being a whole human being, i.e. being a person, not merely the property of being human. Thus, the denotation of *nin* does not include, for example, individual human fingers or human muscle tissue, etc. For the clarification of this point I thank Arnim von Stechow (p.c).

(24) {a⊔b⊔c⊔d,
a⊔b⊔c, a⊔b⊔d, a⊔c⊔d, b⊔c⊔d,
a⊔b, a⊔c, a⊔d, b⊔c, b⊔d, c⊔d,
a, b, c, d}

Now, if the quantifier were 'three', the quantification computation would have to select three elements from this domain. However, no constraints are placed on which elements are selected. Consider, then, the hypothetical situations (25a) and (25b):

(25) a. {a⊔b⊔c⊔d,
a⊔b⊔c, a⊔b⊔d, a⊔c⊔d, b⊔c⊔d,
a⊔b, a⊔c, a⊔d, b⊔c, b⊔d, c⊔d,
a, b, c, d}

b. {a⊔b⊔c⊔d,
a⊔b⊔c, a⊔b⊔d, a⊔c⊔d, b⊔c⊔d,
a⊔b, a⊔c, a⊔d, b⊔c, b⊔d, c⊔d,
a, b, c, d}

If the three underlined elements in (25a) were picked, then the number of elements would indeed be three, yet the number of human individuals would only be two, namely a and c. Worse, if the three underlined elements in (25b) happened to be picked, then the number of elements would be three, but the number of human individuals would now be as many as four, namely, a, b, c and d. Clearly, there is a major problem here: We are not capturing the basic meaning of the NQ. The problem has a simple solution, though. To capture the basic truth conditions of the NQ, each element selected from the classifier denotation must be exactly one human being. This is guaranteed if the classifier denotation lexically only contains atoms, as represented in (26):

(26) {a, b, c, d}

This is what the atomicity condition does. Given the effect of the atomicity condition, which I assume applies in the lexicon, we can guarantee that the elements selected by the quantifier will always be a set of distinct individuals. Note that our assumption here simply reaffirms Kratzer's (1989) and Chierchia's (1998) general observation that the domain of numeral quantification must be atomic. Given the atomicity condition, then, the lexical denotation of an object classifier and of an event classifier can be represented as in (27). The difference between these two types of classifier is that one denotes a set of atomic objects while the other denotes a set of atomic events.

(27) a. Object classifier (type <e,t>)
nin ($CL_{\text{human individuals}}$): $\lambda x_e \lambda y_e$[nin'(y) $\wedge$ x° y]
'human'
satsu (CL_{volume}): $\lambda x_e \lambda y_e$[satsu'(y) $\wedge$ x° y]
'volume' (=bound paper)

b. Event classifier (type <s,t>)
hatsu (CL_{shot}): $\lambda e_{1s} \lambda e_{2s}$[hatsu'($e_2$) $\wedge$ $e_1{}^{\circ}$ e_2]
'blast/shot'

Given such classifier denotations, the logical representation of the Japanese NQ sentence in (28a), (29a), and (30a) is, under my proposal, as shown in (28b), (29b) and (30b), respectively:

(28) DNQ sentence with object classifier
a. **san-nin**-no **gakusei**-ga peepaa-o kaita. 'Three students wrote a paper.'
3-CL-GEN student-NOM paper-ACC wrote
b. ∃y∃K[K∈(λu∃v[nin'(v)∧u⊔v]∩gakusei') ∧ |K|≥3∧⊔K=y] ∧ peepaa-o kaita'(y)]
'nin' 'student' 'wrote a paper'

(29) FNQ sentence with object classifier
a. **gakusei**-ga, **san-nin** peepaa-o kaita. 'Three students wrote a paper.'
student-NOM 3-CL paper-ACC wrote
b. ∃y[gakusei'(y) ∧ ∃K[K∈(λu∃v[nin'(v)∧u⊔v]∩ peepaa-o kaita')∧|K|≥3∧⊔K=y]]
'student' 'nin' 'wrote a paper'

(30) FNQ sentence with event classifier
a. **pisutoru**-ga, **san-patsu** utareta. 'Three shots of a pistol were shot.'
pistol-NOM 3-CL were shot
b. ∃e3∃K[K∈(λe1∃e2[hatsu'(e2)∧e1⊔e2]∩ ∃e4∃y[pisutoru'(y) ∧ utareta'(y)(e4)])
'hatsu' 'pistol' 'were shot'
∧|K|≥3∧⊔K=e3]

Given this analysis, the obligatory distributive reading of the FNQ sentence is a direct consequence of the atomicity condition imposed by the classifier denotation after application of the most basic syntactic operation of all, namely function composition (or 'merge' in the Minimalist framework). As seen in (29b), the classifier denotation and the predicate denotation intersect, and, since the elements in the classifier denotation are all atomic, each element must be atomic and must have the property denoted by the predicate. A distributive reading results as a consequence of elementary principles of set theory. The same mechanism is applicable with the FNQ sentence that contains an event classifier. In (30b), quantification is over events instead of objects. Here, the NP *pisutoru* 'pistol' denotes a property of one of the participants of the event type denoted by the predicate, and is not directly involved in the quantification proper. This set of events denoted by the predicate intersects with the set of events denoted by the classifier *hatsu*, namely, a set of blasting-events. Again, these blasting-events are all atomic. Therefore, the sentence asserts that there are three atomic blasting-events which are pistol-shooting-events (rather than arrow-shooting-events or such). As noted earlier, (30b) can be true even when a single pistol is involved. The semantic interpretation in (30b) readily accommodates this fact since the FNQ is not directly associated with *pisutoru*. Such FNQ sentences actually have no host NP.

Now, it might seem that the analysis faces a problem since it would seem to falsely predict that the DNQ sentence also cannot have a collective reading, one of the problems for Nakanishi's proposal. That is, for sentence (28a), the atomicity constraint has its usual effect in composition with the NP denotation, and so the sum K is a sum of three individual students. However, note that the sum K has exactly the same structure

and content as the denotation of the English plural term *three students*: As indicated in (31a) below, a plural term is always ambiguous in that it can be construed either as an individual sum or as a group atom, the latter derived from the former by an application of a group operator, as discussed by Link (1984) and Landman (2000). Analogously, the sum generated in the computation of the Japanese DNQ may optionally be reanalyzed as a group atom via application of the group operator as shown in (31b):

(31) a. three students: $a \sqcup b \sqcup c$ or $\uparrow(a \sqcup b \sqcup c)$ (Link 1984, Landman 2000)
b. san-nin-no gakusei : $a \sqcup b \sqcup c$ or $\uparrow (a \sqcup b \sqcup c)$
3-CL-GEN student
'three students'
c. $\lambda y \exists K[K \wedge (\exists u \exists v[nin'(v) \wedge u^{\cup} \wedge v] \wedge gakusei') \wedge |K| \geq 3 \wedge \uparrow(\sqcup K)=y]$
$\wedge$ peepaa-o-kaita'(y)]
'nin' 'student' | 'wrote a paper'
Group operator

Thus, the distributive/collective ambiguity of the Japanese DNQ sentence is captured by a general mechanism that applies to all plural terms in all languages. No additional stipulation is necessary. It is important to note that the same operation cannot be performed on an FNQ sentence to yield a collective reading. Consider the FNQ sentence in (32a), analyzed as shown in (32b). Suppose a group operator applied to the sum K, as shown in (32c):

(32) a. **gakusei**-ga, **san-nin** peepaa-o kaita. 'Three students wrote a paper.'
student-NOM 3-CL paper-ACC wrote
b. $\lambda y[gakusei'(y) \wedge \exists K[K \wedge (\exists u \exists v[nin'(v) \wedge u^{\cup} \wedge v] \wedge peepaa\text{-}o\text{-}kaita'(y) \wedge |K| \geq 3 \wedge \sqcup K)=y]]$
'student' 'nin' 'wrote a paper'
c. $\lambda y[gakusei'(y) \wedge \exists K[K \wedge (\exists u \exists v[nin'(v) \wedge u^{\cup} \wedge v] \wedge peepaa\text{-}o\text{-}kaita'(y) \wedge |K| \geq 3 \wedge \uparrow(\sqcup K)=y]]$
'student' 'nin' 'wrote a paper'

This would have no effect on the atomicity of the individuals in the intersection of the classifier and the predicate denotations. So, it could not eliminate the distributive reading. In (32c), the effect of the group operator is, if anything, only that the three individual paper-writers may also be taken as a group, as a kind of independent after-thought. Furthermore, note that quite generally, the group operator may not optionally apply in the verbal domain. This is demonstrated by the fact that a lexically distributive predicate such as *walk* cannot possibly be assigned a collective reading. If it could, (33a) would be as invalid as (33b):

(33) a. Three boys walked. --> One boy walked.
b. Three boys carried it -/-> One boy carried it.

6. Agreement between CL and NP

Let us return now to our first question concerning the classifier-host NP agreement phenomenon, illustrated again in (35) and (36). We may now see what role syntax plays in this phenomenon. Just like selectional restrictions, the semantic agreement of the classifier-host NP relation is based on the basic syntactic operation of function composition. That is, syntactic composition is conditioned by a lexical semantic requirement, i.e. selectional restrictions must be satisfied.

(35) a. **san-nin**-no **gakusei**-ga kita. ‘Three **person-units** of students came.’
3-CL-GEN student-NOM came
b. #**san-biki**-no **gakusei**-ga kita ‘Three **animal-units** of student came.’
3-CL-GEN student-NOM came

(36) a. **gakusei**-ga **san-nin** kita. ‘Three **person-units** of students came.’
student-NOM 3-CL came
b. #**gakusei**-ga **san-biki** kita. ‘Three **animal-units** of student came.’
student-NOM 3-CL came

The Japanese classifier-host NP agreement observed in (35) and (36) is directly analogous to that seen in the English minimal pairs in (37) and (38):

(37) a. **A handful of students** disobeyed the teacher.
b. #**A liter of students** disobeyed the teacher.

(38) a. **A branch suddenly** hit the car.
b. #**A branch deliberately** hit the car.

In (37) *handful* and *liter* are inside the subject DP and must compose with the NP *students* to yield a combined meaning for the subject. While *handful* is semantically compatible with *students*, *liter* is not. This directly determines the well-formedness of (37a) and the ill-formedness of (37b). Likewise, in (35), the composition of *gakusei* and the DNQ must yield a coherent combined meaning. This happens in (35a) but not in (35b). In (38), the adverbs *suddenly* and *deliberately* must compose coherently with the predicate *hit the car* and then the adverb+predicate constituent must coherently compose with the subject. The composition of *suddenly* and *hit the car* yields a coherent combined meaning, as does the composition of *a branch* and *suddenly hit the car*, so (38a) is well-formed. In contrast, in (38b), although *deliberately* composes coherently with *hit the car*, the composition of *a branch* and *deliberately hit the car* violates the selectional restrictions of *deliberately*, causing the sentence to be ill-formed (except in fairly tales). Likewise, in (36), the FNQ must first compose coherently with the predicate, and subsequently, this complex predicate must compose coherently with the subject. This happens in (36a) but not in (36b). In (36b), the composition of *san-biki* and *kita* is well-formed; but the subsequent composition of *gakusei* and *san-biki kita* violates the selectional restrictions of *hiki*. The denotation of *san-biki kita* is a set of three objects each of which has the property of being an animal (not a person) and of arriving. This

cannot intersect with the subject denotation, which does not contain any animal. Thus, (36b) is ill-formed in ordinary contexts of use. It is necessarily false if taken literally and can only be used as a joke.

7. Conclusion

Aside from the possibility of an application of the D-operator approach, there are two basic types of quantificational analyses for the Japanese FNQ construction in the literature. In one, the domain of quantification is the NP. In the other, the domain of quantification is the event denoted by the predicate. Both types of analyses, as well as the D-operator approach, are descriptively inadequate. I propose an alternative quantificational account in which the classifier functions as the domain of quantification for the numeral. The atomicity constraint of the classifier denotation is a logically necessary requirement. Due to this constraint, the analysis straightforwardly accounts for the obligatory distributive reading of the FNQ sentence, both for the sentence with an object classifier and for the sentence with an event classifier. The generation of a plural term in DNQ quantification leads to the observed collective/distributive ambiguity of DNQ sentences due to a general phenomenon concerning plural term interpretation in all languages. Thus, the analysis captures the truth conditions of Japanese DNQ and FNQ sentences in a unified fashion. Furthermore, the agreement between the classifier and the NP in Japanese falls out naturally from the proposal as an instance of another very general, universal, phenomenon, namely selectional restriction.

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