The Japanese Floating Quantifier Construction with a Set Predicate[1]

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1. Introduction

This paper discusses a collective reading of the Japanese Floating Quantifier Construction (henceforth, JFQC). It has been argued that the JFQC allows a distributive reading, but not a collective reading (Terada 1990, Kitagawa and Kuroda 1992, Sasaki Alam 1997, Ishii 1999, Nakanishi 2003, 2006), as shown in (1) :

(1)	Otokonoko-ga	kinoo	san-nin	isu-o	tsukut-ta.
	boy-NOM	yesterday	three-CL	chair-ACC	make-PAST

"Three boys made a chair yesterday." ??? collective, √ distributive (Nakanishi 2006)

The sentence in (1) can have a distributive reading under which three boys individually have the property of making a chair, but it cannot have a collective reading under which a group of three boys has a property of making a chair.[2]

However, the JFQC, in fact, allows a collective reading when the matrix predicate is a collective verb, as noticed by Kobuchi-Philip (2003) and Yamashina and Tancredi (2005), as shown in (2) :

(2)	Gakusei-ga	senkyo-notameni	hyaku-nin	icchidanketsushi-ta.
	student-NOM	election-for	one hundred-CL	unite-PAST

"One hundred students united for an election." √ collective, ??? distributive

This paper extends Kobuchi-Philip's (2003) analysis of the JFQC to a collective reading of

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2 As discussed by Kobuchi-Philip (2006) and Miyagawa and Arikawa (2007), the structure of the sentence in (i) is ambiguous between (ii) and (iii) :

(i)	otoko-ga	san-nin	hon-o	kat-ta.
	man-NOM	3-CL	book-ACC	buy-PAST

"Three men bought a book."

(ii) [DP-NOM NQ-$_{SUB}$] [VP]

(iii) [DP-NOM] [NQ-$_{SUB}$ VP]

In (ii), the numeral quantifier occurs within a nominal constituent. In (iii), the numeral quantifier occurs in an adverbial position. The above structural ambiguity is disambiguated by distinctive pitch (or prosodic) patterns. The numeral quantifier in (iii) is considered as a floating quantifier.

If (i) is parsed as (iii), a pitch rise must occur on the NQ (Kobuchi-Philip 2006) or there is an intonation phrase break between the subject and the NQ (Miyagawa and Arikawa 2007). It has been argued that the sentence in (i) with the structure in (ii) allows both distributive and collective readings, whereas the sentence with the structure in (iii) allows only distributive readings. This paper concerns only with this second type.

the JFQC, based on Winter's (2001) analysis of the set/atom distinction of predicates.

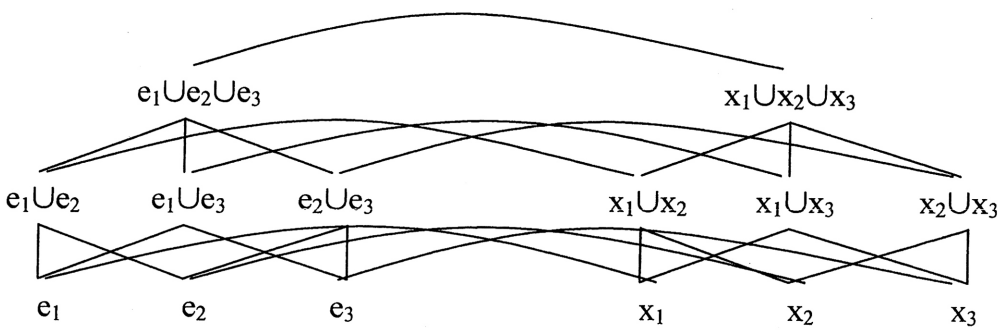
2. Prior research

In this section, I examine Nakanishi's analysis (2003, 2006) and Kobuchi-Philip's analysis (2003) of the JFQC from a perspective of a collective reading of the construction.

2.1. Nakanishi (2003, 2006)

Nakanishi (2003, 2006) argues that the floating quantifier (or, to be specific, the measure function related to the floating quantifier) in Japanese indirectly measures events by measuring individuals through events via a homomorphism *h* from the lattice of events to the lattice of individuals. Under this analysis, as illustrated in (3), the domains of individuals and events each have the following structure:

(3)



The events and individuals at the bottom in (3) are singularities. $\cup$ is a sum operator. Take, for example, $e_1 \cup e_2$ and $x_1 \cup x_2$. $e_1 \cup e_2$ is the plurality of e_1 and e_2. $x_1 \cup x_2$ is the plurality of x_1 and x_2. The lines indicate the part-of (or component-of) relation $\leq$. Thus, for example, we have the following part-of relation between $\{e_1 \cup e_2\}$ and $\{e_1 \cup e_2 \cup e_3\}$ given in (4):

(4) $\{e_1 \cup e_2\} \leq \{e_1 \cup e_2 \cup e_3\}$

Furthermore, Nakanishi argues that there is a homomorphism *h* from a lattice of events E (denoted by the verbal predicate) to a lattice of individuals I (denoted by the host noun), where $h(x \cup_E y) = h(x) \cup_I h(y)$. The thematic roles serve as homomorphism. For example, in (1), the thematic role Agent of the verb *tsukuru* "make" serves as *h*(homomorphism) from events to individuals. This homomorphism preserves a lattice from E to I, as shown in (3).

The measure function associated with the FQ picks up a sum of individuals whose cardinality is three, i.e. $x_1 \cup x_2 \cup x_3$ in the domain of I and indirectly measures events by measuring those individuals, with the help of a homomorphism from a lattice of events to a lattice of individuals.

Under this analysis, because of the homomorphism between events and individuals, each individual, namely, x_1, x_2, x_3 is the agent of events, e_1, e_2, e_3, respectively. This one-to-one

correspondence between events and individuals yields a distributive reading of the JFQC.

This analysis predicts that the JFQC cannot have a collective reading because of a homomorphism between events and individuals. However, Nakanishi (2006) also notices "collective-reading" -like phenomena of the JFQCs. She tries to account for these phenomena based on incrementality.

Nakanishi notices "collective-reading"-like phenomena of the JFQCs only with respect to a plural internal argument (but not a plural external argument), as shown in (5) :

(5) John-ga hako-o heya-ni juk-ko tumikasane-ta.
NOM box-ACC room-in ten-CL pile up-PAST
"John piled up ten boxes in the room."

According to Nakanishi, there is an inherent incremental relationship between an event and its internal argument in (5). To be explicit, as the piling up event proceeds, the number of boxes increases. Thus, a "collective-reading" -like phenomenon in (5) does not show a collective reading, but rather shows a distributive reading.

However, this analysis faces a problem. Incrementality does not hold in the verb *unite* in (2) and the verb *pile up* in (5). According to Krifka (1998), the following property in (6) needs to hold in the incremental relation:

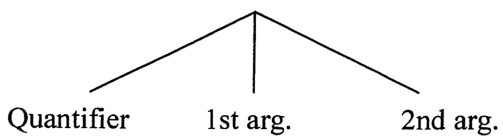
(6) θ shows *mapping to subobjects* iff
$\forall x, y \in U_P\ \forall e \in U_E[\theta(x, e) \wedge y <_P x \rightarrow \exists e'[e' <_E e \wedge \theta(y, e')]]$

(6) means that, when θ holds for an object x and an event e, and y is a part of x, then y stands in the relation θ to a part e' of e. However, concerning (2) and (5), in the cases in which "two students unite" or "John piled up two boxes", there are no proper parts of those events which have single individuals as its agent or theme.

2.2. Kobuchi-Philip (2003)

Kobuchi-Philip (2003) applies the following general scheme for quantification over objects to the distributive JFQC:

(7)



1st argument --- Domain of quantification (Restriction)
2nd argument --- Nuclear Scope

She assumes that the numeral and the classifier are separate and independent semantic entities. The classifier corresponds to the first argument of the above scheme. It is a

predicate which denotes a set of only atomic individuals. The verbal predicate corresponds to the second argument. Thus, the three components of the FNQ quantification are contained within the verbal domain, excluding the host NP.

Based on the above assumptions, Kobuchi-Philip proposes that the following interpretation for the FQ:

(8) $\lambda C \lambda P \lambda x \exists K[K \subseteq (C \cap P) \wedge |K| = n \wedge \oplus K = x]$

C is a classifier denotation such as the denotation of *-nin*. *P* is a predicate denotation, which corresponds to a verbal predicate. *K* is a set of objects in the intersection of the classifier denotation and the predicate denotation. $|K| = n$ means the set K has a cardinality of *n*.

Under Kobuchi-Philip's analysis, the interpretation in (10) is assigned to the distributive JFQC in (9).

(9) Gakusei-ga san-nin hashitta.
student-NOM 3-CL ran
"Three students ran." (Kobuchi-Philip 2003)

(10) $\exists y[\text{gakusei}'(y) \ \& \ \exists K[K \subseteq (\lambda u \exists v[\text{nin}'(v) \ \& \ u^{\bullet}\Pi v] \cap \text{hashitta}') \ \& |K| = 3 \ \& \oplus K = y]]$

The predicate *hashitta' "ran"* denotes a set of individuals. Furthermore, the classifier *-nin* quantifies over atomic individuals as illustrated by $\lambda u \exists v[\text{nin}'(v) \ \& \ u^{\bullet}\Pi v]$ in (10). Therefore, the intersection of the sets denoted by *ran* and by *-nin* consists of atomic individuals which have the property *run'*. Thus, the property *run'* must hold of each member, i.e., each individual atom of set K. This yields a distributive interpretation in the sentence in (9).

According to Kobuchi-Philip, the collective JFQC is of a different type from the distributive JFQC. To be specific, she claims that the FQ indicates the amount of an entity construed with the FQ, like the amount of a mass entity measured out in the *-ml* or *-ton* scale. For example, in (2), the amount of the relevant set of students, taken as a single entity, can be measured out as 100 in the 'nin scale'. According to Kobuchi-Philip, the licensing condition for this type of JFQC is the presence of range of amount. In other words, the collective JFQC is not allowed if the FQ cannot be another amount in a different situation. This is illustrated in (11):

(11) *Suiso-genshi-ga kono-ondo-de, futa-tsu hito-tsu-no
hydrogen-atom-NOM this-temperature-at 2-CL 1-CL-GEN
suiso-bunshi-o tsukuru.
hydrogen-molecule-ACC form
"Two hydrogen atoms form a hydrogen molecule at this temperature."

In (11), the number construed with a hydrogen atom, i.e., 2 is an invariant number. There are no other possibilities under normal circumstances. Therefore, the sentence in (11) is unacce-

ptable.

However, one problem is that, under this analysis, the licensing condition is just a stipulation and does not come from any principle or property.

3. Proposal

In this paper, I extend Kobuchi-Philip's (2003) analysis of the distributive JFQC to the collective JFQC, based on Winter's (2001) analysis of the set/atom distinction of predicates. As discussed in section 2, Kobuchi-Philip (2003) proposes the following semantic interpretation for the FQ:

(12) $\lambda C \lambda P \lambda x \exists K[K \subseteq (C \cap P) \wedge |K| = n \wedge \oplus K = x]$

C is a classifier denotation such as the denotation of *-nin*. *P* is a predicate denotation, which corresponds to a verbal predicate. *K* is a set of objects in the intersection of the classifier denotation and the predicate denotation. $/K/=n$ means the set K has a cardinality of *n*. Under this analysis, the interpretation in (14) is assigned to the distributive JFQC in (13).

(13) Gakusei-ga san-nin hashitta.
student-NOM 3-CL ran
"Three students ran."

(14) $\exists y[\text{student}'(y) \wedge \exists K[K \subseteq (\lambda u \exists v[\text{nin}'(v) \wedge u^{\bullet}\Pi v] \cap \text{ran}') \wedge |K| = 3 \wedge \oplus K = y]]$

I extend this analysis of the distributive JFQC to the collective JFQC, adopting Winter's (2001) analysis of the set/atom distinction of predicates. To be specific, I have the following two assumptions. First, the collective verb such as *unite* and *gather* is a set predicate, which denotes a set of sets. Second, type mismatches between denotations ranging over atoms and denotations ranging over sets are resolved using a type fitting rule.

On these assumptions, I propose the interpretation in (15) for the collective JFQC in (2).

(15) $\exists y[\text{student}'(y) \wedge \exists K[K \in (\lambda B[B \subseteq (\lambda u \exists v[\text{person}'(v) \wedge u^{\bullet}\Pi v])] \cap \text{unite}') \wedge |K| = 100 \wedge \oplus K = y]]$

The classifier *−nin*, as it is, cannot be conjoined with the predicate *unite'*, since *-nin* denotes a set of atomic individuals, i.e., $\lambda u \exists v[person'(v) \wedge u^{\bullet}\Pi v]$, whereas the set predicate *unite'* denotes a set of sets, i.e., $\lambda P[unite'(P)]$. Therefore, a type fitting rule, which changes the type of the predicate ⟨e,t⟩ to the predicate ⟨⟨e,t⟩,t⟩, applies to the denotation of the classifier *-nin*, and changes the basic type of *-nin*, i.e.,⟨e,t⟩to a type⟨⟨e,t⟩,t⟩. This shifted interpretation of *-nin*, i.e., $\lambda B[B \subseteq \lambda u \exists v[person'(v) \wedge u^{\bullet}\Pi v]]$ can be conjoined with the set predicate *unite'*. Furthermore, the number of elements in a set K in the intersection of the shifted denotation of *-nin* and the denotation of the predicate *unite'* is 100.

In my analysis, the JFQC with a collective verb can have a collective reading because the collective verb takes a set of individuals as its argument. The FQ shows the number of the individual atoms in the set.

Furthermore, under my analysis, Kobuchi-Philip's stipulation about the collective JFQC is derived from monotonicity. In the collective JFQC such as (1), the numeral counts the atomic individuals of a set K in the intersection of the set denoted by the classifier and the set of the verb. This means that, for example, if a set A which unites is a subset of a set B which unites, then the number of uniting people in A must be smaller that that in B. In this sense, the classifier such as *-nin* is related to a measure function (in contrast to Kobuchi-Philip (2003) and more along with Nakanishi (2003, 2006)) and must satisfy the following monotonicity condition on the measure function (Schwarzschild 2002) :

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

Thus, monotonicity must hold in the collective JFQC.

If the classifier *-nin* in (2) is replaced with the classifier *-kumi* to count group atoms, the sentence can have a distributive reading as well as a collective reading, as shown in (17) :

(17)	Gakusei-ga	senkyo-notameni	hyaku-kumi	icchidanketsushi-ta.
	student-NOM	election-for	one hundred-CL	unite-PAST

"One hundred students united for an election." √ collective, √ distributive

My analysis can also account for this ambiguity in the interpretation of the JFQC in (17). In (17), there is a type mismatch between the denotation of the classifier *-kumi*, ranging over atoms, and the denotation of the verb *unite*, ranging over sets. This type mismatch can be solved by a type-fitting rule applied to the atom predicate, as in the case of the semantic interpretation of the collective JFQC in (15). The type-fitting rule applies to the denotation of the classifier *-kumi*, and changes the type of *-kumi*, i.e., ⟨e,t⟩ to a type ⟨⟨e,t⟩, t⟩. This shifted interpretation of *-kumi*, i.e., $\lambda B[B \subseteq \lambda u \exists v[group'(v) \wedge u^{\bullet} \Pi v]]$ can be conjoined with the set predicate *unite'*, as illustrated in (18) :

(18) $\exists y[student'(y) \wedge \exists K[K \in (\lambda B[B \subseteq (\lambda u \exists v[kumi'(v) \wedge u^{\bullet} \Pi v])] \cap unite')] \wedge |K| = 100 \wedge \oplus K = y]$

The semantic interpretation in (18) expresses a collective reading in which one hundred groups of students united together.

However, there is another possibility to solve a type mismatch between the denotation of the classifier *-kumi* and the denotation of the verb *unite*. The singularity operation discussed by Winter (2002) applies to the set predicate *unite* and changes it to an atom predicate which includes only the atomic (group) elements, by taking only the singletons from the denotation

of *unite*. This atomic predicate can be conjoined with the denotation of the classifier ranging over group atoms, as shown in (19) :

(19) $\exists y[\text{student}'(y) \wedge \exists K[K \subseteq (\lambda u \exists v[\text{group}'(v) \wedge u^{\bullet}\Pi v] \cap \text{unite}_{sing}') \wedge |K| = 100 \wedge \oplus K = y]]$

This results in a distributive reading in which one hundred groups united separately. The singularity operation cannot save the ungrammaticality of (1) because the derived atom predicate *unite*' selects for a group atom whereas the classifier *-nin* selects for an individual atom.

4. Some potential extension

My analysis of the collective JFQC has some potential extension. First, it can overcome a problem which Tancredi (2005) (to my best knowledge, the only paper to give a specific analysis of a collective reading of the JFQC) faces with a collective reading of the JFQC. He discusses collective predicates such as *gather* and its Japanese counterpart *atsumaru*, and argues that those predicates select for an i-sum, but enter a group formed from such an i-sum into their event domain, as shown in (20). He also argues that this denotation of *atsumaru* "gather" accounts for a collective reading of the JFQC, as shown in (21) :

(20) $\text{gather}'/\text{atsumaru}' = \lambda X : |\downarrow(\uparrow(X))| > 1.\lambda e.\ {}^*\text{GATHER}(e) \& {}^*\text{Ag}(e) = \uparrow(X)$

(21) Gakusei-ga san-nin atsumat-ta.
student-NOM 3-CL gather-pst
"Three students gathered."

(22) $\exists e([\exists X : {}^*\text{STUDENT}(X)]({}^*\text{GATHER}(e)\ \&\ \text{Ag}(e) = \uparrow(X) \& |X| = 3))$

The semantic interpretation in (22) is given to the example in (21). In (22), the argument of the agent is a group ↑(X). This yields a collective reading of the sentence in (21).

However, this analysis predicts that in (21), *three students* should be interpreted as an atomic group and should behave as a group. However, in fact, the sentence in (21) is unacceptable if one of the three members did not come to the gathering. This is shown by a discourse incoherence caused if the sentence in (24) follows the sentence in (23).

(23) Gakusei-ga sono-kooen-ni san-nin atsumat-ta.
student-NOM the-park-in 3-CL gather-PAST
"Three students gathered in the park."

(24) Sono-uchi-no hitori-wa, kooen-ni ko-nakat-ta.
Among- one person-TOP park-to come-NEG-PAST

"One of the three students did not come to the park."

A group can gather even if one of its members is absent (Barker 1992). Therefore, if *three students* in (23) is interpreted as a group, a discourse incoherence should not be caused even if (24) follows (23).

Under my analysis, following Winter (2001), each member of a set denoted by the FQ must belong to a set denoted by the verb. Therefore, in (23), all the three members must gather.

Second, my analysis of the collective JFQC suggests an alternative analysis for the Japanese wh-*mo* construction. Tancredi and Yamashina (2005) discuss the Japanese wh-*mo* construction. The interpretation of this construction is related to the English wh+*ever* construction, as shown by the gloss of the sentence in (25).[4] Tancredi and Yamashina argue that the wh-*mo* expression denotes an i-sum and that the collective verb such as *atsumaru* "gather" selects for an i-sum because the wh-*mo* expression can be an argument of the collective verb, as shown in (25).[5]

(25) [[t_j Dono-kyoku-o_i hii-ta] sorisuto$_j$]-mo$_i$] atsumat-ta.
what-piece-ACC play-ASP soloist-MO gather-PST
"Soloists who played whatever piece gathered."

Under my analysis, this means that the wh-*mo* expression denotes a set of sets since the collective verb *atsumaru* "gather" selects for a set of sets. To be specific, following Tancredi and Yamashina (2005), I assume that *mo* is a distributive operator universally distributing over the atomic parts of a set. Furthermore, the wh-expression without the particle *mo* as well as the collective verb *atsumaru* "gather" ranges over sets. This leads to a type mismatch between the denotation of the wh-expression without the particle *mo*, which ranges over sets, and the denotation of the operator, which ranges over atoms. As discussed by Winter (2001), I assume that this mismatch is resolved by an independently motivated determiner fitting operator *dfit* (given in (26)) which maps determiners that range over atoms to determiner that range over sets

(26) $dfit = \lambda D_{(et)(ett)}.\lambda A_{ett}.\lambda B_{ett}.D(\cup A)(\cup(A \cap B))$

Crucially, under this analysis, the two sets of sets, i.e., A, B, which serve as arguments are both unioned. This analysis correctly predicts an interpretation of the example in (26) in addition to the interpretation in which all soloists gathered in a single gathering. The sentence in (26) is also true in the situation where the soloists split up into multiple gatherings and never gathered together into one large group, as discussed by Tancredi and Yamashina (2005).

4 As discussed by Yamashina and Tancredi (2005), the connection between the Japanese wh-*mo* construction and the English wh+*ever* construction is loose in several ways. The reader is referred for the details to Yamashina and Tancredi (2005).

5 Yamashina and Tancredi (2005) assume that plurals have a group interpretation as their basic interpretation and not an i-sum interpretation, in contrast to Landman (1996) and others. The consequence of this assumption can be serious, though I need further research about it.

6. Conclusion

In this paper, I discussed a collective reading of the Japanese Floating Quantifier Construction (henceforth, JFQC). Prior research on the JFQC, such as Nakanishi (2003, 2006) and Kobuchi-Philip (2003), faces a problem with a collective reading of the JFQC. In order to account for the collective reading, Nakanishi (2003, 2006) resorts to an inherent incremental relationship between an event and its internal argument. However, incrementality does not hold in the collective JFQC as discussed in section 2.1. Kobuchi-Philip (2003) proposes a licensing condition on a collective reading of the JFQC. However, this licensing condition is just a stipulation and does not come from any principle or property, as discussed in section 2.2.

In this paper, I extended Kobuchi-Philip's (2003) analysis of the distributive JFQC to the collective JFQC, adopting Winter's (2001) analysis of the set/atom distinction of predicates. Under this analysis, the JFQC with a collective verb can have a collective reading because the collective verb takes a set of individuals as its argument. Furthermore, under this analysis, Kobuchi-Philip's stipulation about the collective JFQC is derived from monotonicity (Schwarzschild 2002).

I also discussed the absence of a collective reading in the mixed-predicate JFQC and an ambiguity in the interpretation of the collective-predicate JFQC with a classifier to count group atoms.

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