Split Quantifiers and Collectivity [1]

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1. Introduction

This paper discusses the interpretation of split quantifier constructions as shown in (2). It has been observed in previous literature that split quantifier constructions in Japanese allow only distributive readings (Terada 1990, Kitagawa and Kuroda 1992, Ishii 1999, Kobuchi-Philip 2003, Nakanishi 2004, to appear, among others), as illustrated in (2):

(1) [Otokonoko **san-nin**]-ga kinoo isu-o tsukut-ta.
[boy three-CL]-NOM yesterday chair-ACC make-PST
"Three boys made a chair yesterday." √collective, √distributive
(Nakanishi, to appear)

(2) Otokonoko-ga kinoo **san-nin** isu-o tsukut-ta.
boy-NOM yesterday three-CL chair-ACC make-PST
"Three boys made a chair yesterday." ??collective, √distributive
(Nakanishi, to appear)

In order to account for the absence of a collective reading in the split quantifier construction (henceforth, SQC), Nakanishi (2004, to appear) argues that the SQC involves the measurement of events. To be specific, the measure function in the SQC indirectly measures events by measuring individuals. The mechanism of event measurement requires a homomorphism h (a structure-preserving function) from events to individuals. This homomorphism relation leads to the absence of a collective reading in the SQC.

However, Nakanishi's account of SQCs cannot be extended to SQCs whose verbs are so-called "collective" verbs, since the collective-predicate SQC has a collective reading. In this paper, I argue that, in the collective-predicate SQC, the split quantifier measuring the individuals of the set denoted by the host NP does not trigger the sum operation over events and individuals. The quantifier shows the number of individuals in the set denoted by the host NP in the collective-predicate SQC. Thus, the split quantifier cannot yield a homomorphism between the lattice of events and the lattice of individuals. In the collective predicate SQC, we have a function which maps the set of events without any lattice structure into the set of individuals without any lattice structure.

[1] I am grateful to Satoru Kuroda, Yukiko Oguchi, and Ralph Rose for their comments and suggestions.

2. Nakanishi's analysis of the absence of the collective reading

Nakanishi (2004, to appear) argues that the SQC involves the measurement of events. To be specific, the split quantifier, called measure phrase (MP), in the SQC measures events denoted by the verbal predicate. However, the classifier of the split quantifier correlates with the host NP, and not the verbal predicate. Therefore, the split quantifier cannot directly measure the events. In order to solve this mismatch, Nakanishi proposes that the measure function indirectly measures events by measuring individuals, with the help of a homomorphism from a lattice of events to a lattice of individuals. She calls this mechanism of measuring events the Indirect Measure Function as opposed to the Direct Measure Function. Nakanishi argues that this mechanism accounts for the absence of the collective reading in the SQC.

2. 1. Nakanishi (2004)

The Direct Measure Function applies to a set of individuals and gives measured amounts, as shown in (3):

(3) three liters of water (Nakanishi 2004)

In (3), the measure function *liters* applies to water and maps an individual in the extension of *water* to a number.

The measure function associated with split MPs in SQCs agrees with the host NP. This relation is shown by the classifier marking the host NP, as shown in (4) and (5):

(4) Gakusei-ga paatii-de go-**nin** utat-ta.
student-NOM party-at five-CL sing-PST
"Five students sang at the party." (Nakanishi 2004)

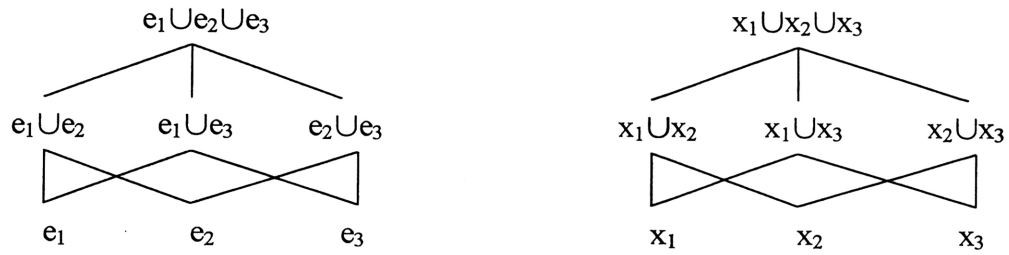
(5) go-**nin**-no gakusei
five-CL-GEN student
"five students"

As illustrated in (5), the classifier *-nin* expresses the cardinality of the students. However, Nakanishi argues that the measure function such as the cardinality of individuals *-nin* in (4) indirectly measures events by measuring individuals related to the events. She calls this kind of measure function the Indirect Measure Function.

The relation between individuals and events is based on a homomorphism *h* (a structure-preserving function) from a lattice of events E denoted by the verbal predicate to a lattice of individuals I denoted by the host noun, as illustrated in (6).

(6) $E \xrightarrow{h} I$ where $h(x \cup_E y) = h(x) \cup_I h(y)$

(7)

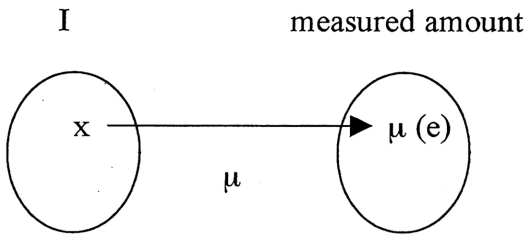


The domain of events and individuals is a semilattice which is a partially ordered set with a join operation and a part-of relation without any bottom element, as shown in (7). The homomorphism given in (6) preserves a lattice from E to I, as shown in (7).

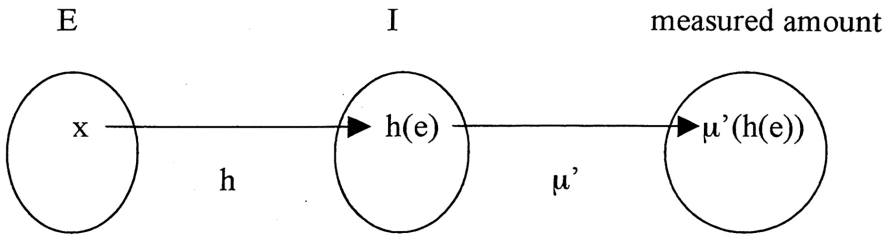
With the help of this homomorphism, the Indirect Measure Function **μ'** for events can apply to h(e), namely, a set of individuals which is related to a set of events by a homomorphism h. Furthermore, it indirectly measures events by measuring individuals.

In sum, the mechanisms of the Direct Measure Function and the Indirect Measure Function are illustrated in (8) and (9), respectively.

(8) Direct Measure Functions



(9) Indirect Measure Functions



The Direct Measure Function in (8) measures individuals directly. The Indirect Measure Function in (9) indirectly measures events by measuring individuals related to the events with the help of a homomorphism from E to I.

2. 2. The absence of a collective reading in the SQC

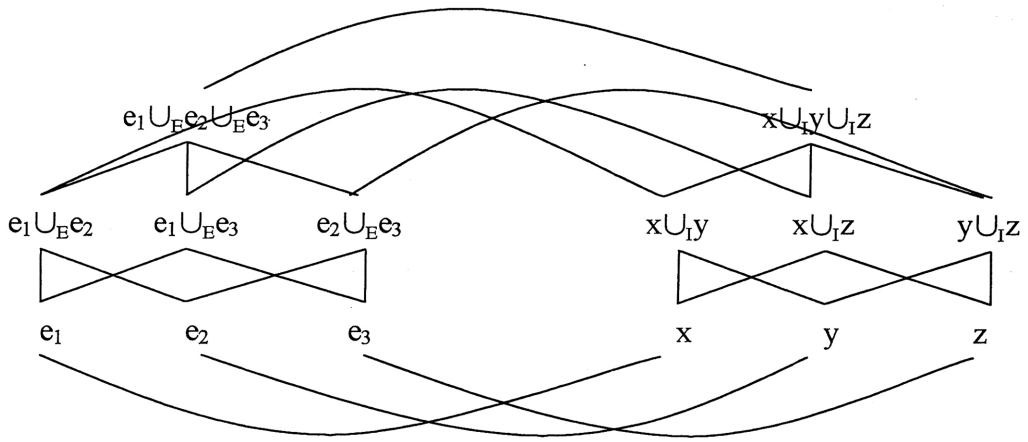
As mentioned in the Introduction, it has been observed in the previous literature that only distributive readings obtain in the Japanese SQC (Terada 1990, Kitagawa and Kuroda 1992, Ishi 1999, Kobuchi-Philip 2003, Nakanishi 2004, among others), as illustrated in (10) :

(10)	Otokonoko-ga	kinoo	**san-nin**	isu-o	tukut-ta.
	boy-NOM	yesterday	three-CL	chair-ACC	make-PST
	"Three boys made a chair yesterday."			??collective, √distributive	
				(Nakanishi, to appear)	

Nakanishi's analysis accounts for the absence of the collective reading of the SQC based on the mechanism of a homomorphism from events to individuals.

Under Nakanishi's analysis, in (10), the extension of *making a chair* is a lattice of events. The lattice of making-a-chair events is mapped to a lattice of boys denoted by the host NP *otokonoko* "boy" by a homomorphism *h*. The neo-Davidsonian agent function serves as *h* from events to individuals. Thus, the homomorphism Agent (e) preserves a lattice from making-a-chair events to boys, as illustrated in (11):

(11)



$[\![*\text{make a chair}]\!] = \{ e_1, e_2, e_3, e_1 \cup_E e_2, e_1 \cup_E e_3, e_2 \cup_E e_3, e_1 \cup_E e_2 \cup_E e_3 \}$

$[\![*\text{boy}]\!] = \{ x, y, z, x \cup_I y, x \cup_I z, y \cup_I z, x \cup_I y \cup_I z \}$

The split quantifier picks out the member whose cardinality is three, i.e. $x \cup_I y \cup_I z$. $x \cup_I y \cup_I z$ consists of x, y, and z, each of which is an agent of an atomic event e_1, e_2, and e_3. This yields a distributive interpretation since $e_1 \cup_E e_2 \cup_E e_3$ is a sum of three events, each of which is done by x, y, z, respectively.

Nakanishi (2004, to appear) discusses three ways of obtaining collective readings, which are ruled out by her analysis. [2]

First, suppose that there is a homomorphism from a singleton making-a-chair event e to the sum of three students $x \cup_I y \cup_I z$ as shown in (12). This mapping is ruled out, since a measure function cannot apply in a monotonic fashion since the extension of *making a chair* is a singleton.

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[2] The first two possibilities are discussed in Nakanishi (2004) and the third one is discussed in Nakanishi (to appear).

(12) e $x \cup_I y \cup_I z$

According to Nakanishi (2004), split MPs are subject to the following two monotonicity constraints on the verbal domain :

(13) Monotonicity Constraints on the Verbal Domain
  a. The Constraint on the Verbal Domain
  The verbal predicate must have a part-whole structure, i.e., the extension of the verbal predicate must be a lattice of events.
  b. The Constraint on Measure Functions
  The measure function μ must be monotonic relative to the given part-whole structure, i.e., a lattice of events.

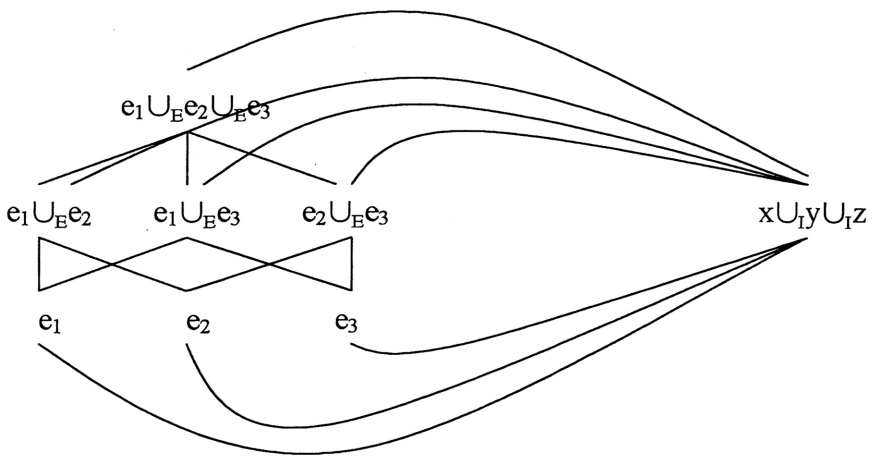
Furthermore, she defines a measure function which is monotonic relative to ⟦VP⟧ as follows :

(14) The indirect measure function μ' is monotonic relative to the domain E iff :
  For events e_a, e_b in E :
  If $h(e_a)$ is a proper subpart of $h(e_b)$, then $\mu'(h(e_a)) < \mu'(h(e_b))$,
  where h is a homomorphism from E to I such that $h(e_1 \cup_E e_2) = h(e_1) \cup_E h(e_2)$

Under this first analysis, as shown in (12), the extension of the host NP in the SQC is the sum of three students $x \cup_I y \cup_I z$. However, in (12), the extension of *making a chair* is a singleton. Therefore, it cannot satisfy the monotonicity constraints on the verbal Domain given in (13). In other words, the measure function cannot apply in a monotonic way.

Second, suppose that three atomic making-a-chair events e_1, e_2, e_3 are mapped to the sum of three boys $x \cup_I y \cup_I z$ and an extension of boys is a singleton containing $x \cup_I y \cup_I z$, as shown in (15) :

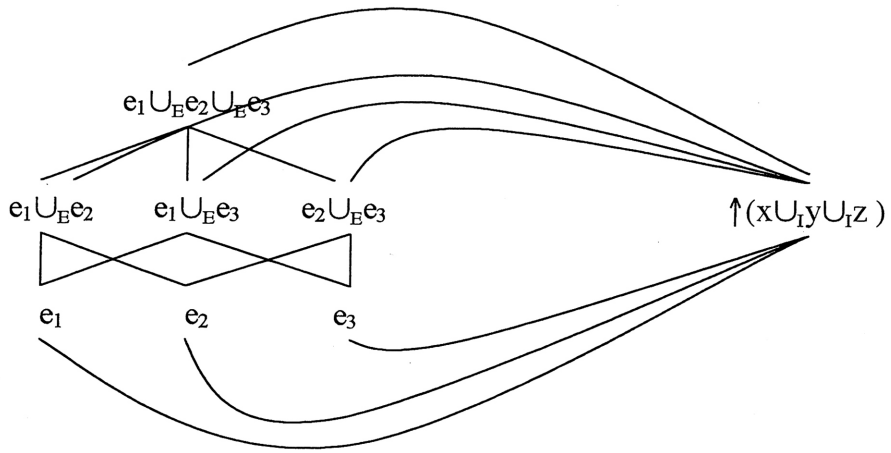
(15)



Because of a homomorphism $h(e_1 \cup_E e_2) = h(e_1) \cup_E h(e_2)$, the sums of the atomic events $e_1 \cup_E e_2$, $e_1 \cup_E e_3$, $e_2 \cup_E e_3$, $e_1 \cup_E e_2 \cup_E e_3$ are also mapped to $x \cup_I y \cup_I z$. However, this mapping is also ruled out by the monotonicity constraint on measure functions. In (15), the measure function cannot be monotonic because there is no part-whole structure in the extension of *boys*.

Third, suppose that a collective reading obtains when a predicate is not pluralized and it takes a group individual as an agent, following Landman (2000). In this case, we need *h* which maps a singleton containing an atomic making-a-car event to the group of three students $\uparrow(x \cup_I y \cup_I z)$. However, in this case, the split quantifier cannot pick out the member whose cardinality is three, since there is no such element in the range of *h*. The range of h only has $\uparrow(x \cup_I y \cup_I z)$ whose cardinality is one, as illustrated in (16):

(16)



3. Problems for Nakanishi (2003, 2004, to appear)

As discussed in the Introduction, it has been observed in the previous literature that SQC's in Japanese allow only for distributive readings. However, in fact, if the verb is a collective verb such as *atsumar* "gather", the SQC has a collective reading, as shown in (17):

(17)	Gakusei-ga	kino	kooen-ni	san-nin	atsumat-ta.
	student-NOM	yesterday	park-in	three-CL	gather-PST

"Three students gathered in the park yesterday."

Following Nakanishi (to appear), I assume that a collective reading obtains when a predicate is not pluralized and it takes a group individual as an agent.[3] Nakanishi's analysis incorrectly predicts that the sentence in (17) cannot have a collective reading. In this case, we need *h* which maps a singleton containing an atomic gathering event to the group of three students $\uparrow(x \cup_I y \cup_I z)$. However, as discussed in Nakanishi (to appear), even though the split

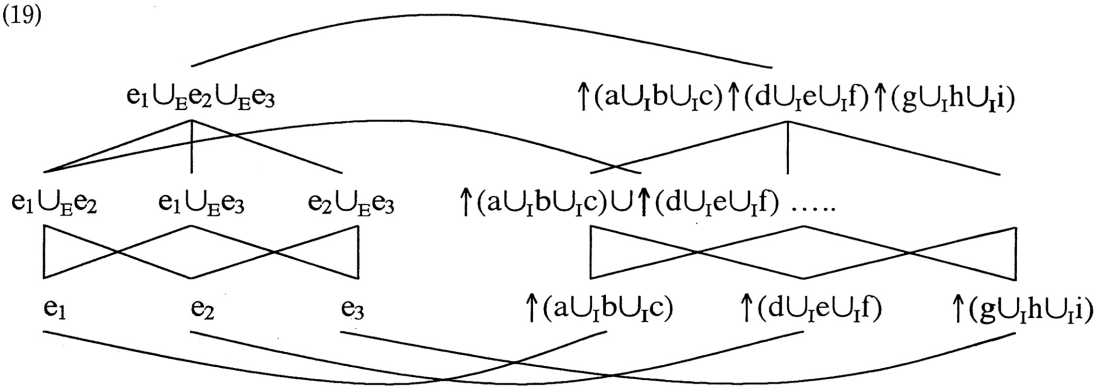
[3] This assumption originally comes from Landman (2000).

quantifier needs to pick out the plural individual whose cardinality is three in (17), there is no such element in the range of h. The sentence in (17) has only $\uparrow(x \cup_I y \cup_I z)$ in the range of h. However, in fact, the sentence in (17) can have a collective reading.

Even though Nakanishi (to appear) basically agrees with the observation that a collective reading is ruled out in the SQC, she discusses some cases in which SQCs seem to have a collective reading. One of the cases is relevant to the current discussion. With regard to the example in (18), Nakanishi assumes the following homomorphism from events to groups:

(18) Otokonoko-ga kino san-nin issyoni isu-o tsukut-ta.
boy-NOM yesterday three-CL together chair-ACC make-PST
"Three boys made a chair together yesterday." (Nakanishi to appear)

(19)



The example in (18) includes the so-called "collectivizing" adverb *issyoni* "together". Because of this collectivizing adverb, the example in (18) only has a collective reading as shown in the Japanese translation. Nakanishi assumes that the collectivizing adverb serves as a group formation operator $\uparrow$ proposed by Landman (2000). It maps a sum of individuals, e.g. $a \cup_I b \cup_I c$ into an atomic group individual, e.g. $\uparrow(a \cup_I b \cup_I c)$. In this case, the split quantifier indicates the cardinality of individuals in the group.

Suppose Nakanishi's analysis of (18) can be applied to the example in (17). Then we would have the same homomorphism from events to groups for (17) as that given in (19). However, this analysis has at least two problems. First of all, the measure function *-nin* in the SQC in (17) is a function which applies to a set of individual atoms, but not to a set of group atoms. Furthermore, in contrast to the example in (18), the example in (17) does not have a collectivizing adverb which yields group atoms. In the collective-predicate SQC, the agent function (e.g. the agent of e_1 is $h(e_1)$) should serve as *h* from events to group atoms. Thus, under the analysis given in (19), the MP cannot indirectly measure events by measuring non-group individuals. This is illustrated in (20) and (21):

(20) Gakusei-ga kooen-ni san-nin atsumat-ta
student-NOM park-in three-CL gather-PST

"Three students gathered in the park yesterday."

(21) Gakusei-ga kooen-ni roku-nin atsumat-ta.
student-NOM park-in six-CL gather-PST
"Six students gathered in the park yesterday."

Under the analysis given in (19), the measure function needs to measure group individuals. However, *-nin* cannot measure group individuals. According to the Constraint on Measure Functions, the measure function μ must be monotonic relative to the given part-whole structure, i.e., a lattice of events. On this assumption, together with the condition on Indirect Measure Function given in (14), suppose that the sentences in (20) and (21) express the events e_a and e_b, respectively. In these sentences, $\mu(h(e_b))$ is larger than $\mu(h(e_a))$. This means that h (e_a) is a proper subpart of h (e_b). Furthermore, in the SQCs in (20) and (21), it is assumed that there is a homomorphism from E to I. Thus, event e_a is a proper subpart of e_b. This incorrectly predicts that the examples in (20) and (21) each cannot express only a one-occurrence event. However, in fact, both of them can do so.

Second, there is another piece of evidence for my claim that Nakanishi's analysis of the example in (18) cannot be applied to the example in (17). In this analysis, the extension of the host NP is a lattice which has groups consisting of three individuals as atomic elements. This analysis incorrectly predicts that the sentence in (22) is not compatible with the first sentence in (23):

(22) gakusei-ga kooen-ni roku-nin atsumat-ta.
student-NOM park-in six-CL gather-PST
"Six students gathered in the park yesterday."

(23) Danshi-gakusei-wa yo-nin-de ki-ta. Jyoshi-gakusei-wa huta-ri-de ki-ta.
male-student-TOP four-CL-COP come-PST female-student-TOP two-CL-COP come-PST
"Male students came by four (as a group). Female students came by two (as a group)."

Under the analysis given in (19), a plural event denoted by the VP in (22) is the sum of two three-occurrence events. Thus, the sentences in (23) should not be compatible with the sentence in (22). In (23), four (male) students came to the park as a group and two (female) students came as another group. However, in fact, the sentences in (23) do not have any contradiction in meaning with the sentence in (22). This means that the sum of the students in (22) does not have to be the sum of two group atoms consisting three students. This fact is against the analysis given in (19).

4. Proposal

As discussed in section 3, Nakanishi's analysis (2003, 2004, to appear) cannot be extended to the collective-predicate SQC. Under Nakanishi's analysis, the neo-Davidsonian agent func-

tion (e.g. the agent of e_1 is $h(e_1)$) serves as h (homomorphism) from events to individuals. Thus, the homomorphism Agent (e) preserves a lattice of events denoted by the verbal predicate in the extension denoted by the host noun, as illustrated in (11).

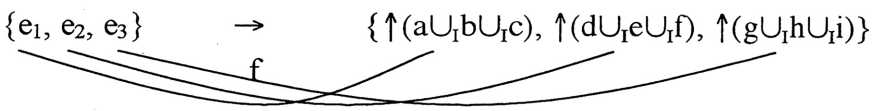
Adopting Nakanishi's analysis, I assume that the neo-Davidsonian agent function maps events into individuals. However, concerning the collective-predicate SQC, I propose that the homomorphism proposed by Nakanishi does not have to hold between events and individuals. To be specific, adopting Landman's idea of singularity constraint on thematic roles, I assume the following constraint on thematic roles for collective verbs.

(24) Singularity constraint on thematic roles for collective verbs
  (1) Thematic roles are only defined for atomic events.
  (2) Thematic roles only take atomic groups as values.

Under this assumption, the collective verb takes the host NP associated with the split quantifier as a group individual.

Furthermore, I assume that there is a one-to-one (injective) mapping from events denoted by the collective verbal predicate to group individuals denoted by the host NP, as illustrated in (25).

(25)



The above relation holds as long as the collective predicate is not pluralized.

Under this analysis, if the verbal predicate takes a non-group individual as its argument, the split quantifier measuring the individuals is assumed to be a pluralizer of events and individuals. In this type of SQC, the homomorphism relation holds between events and individuals.

However, in the case of the collective-predicate SQC, the split quantifier measuring the non-group individuals in the set denoted by the host NP does not trigger the sum operation over individuals. [4] The quantifier shows the number of the non-group individuals in the set denoted by the host NP. However, in the collective-predicate SQC, the Agent function maps events to group individuals. The split quantifier measuring non-group individuals cannot measure group individuals. Thus, the split quantifier measuring the non-group individuals in the set denoted

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[4] However, I assume that, even in the collective-predicate SQC, it can have a homomorphism proposed by Nakanishi if the split quantifier measures group individuals denoted by the host NP, as shown in (i):

(i) Shoobooshi-ga kororado-de yonhyaku-kumi kaji-o keshi-ta.
firefighter-NOM Colorado-in 400-CL fire-ACC put out-PST
"400 groups of firefighters put out the fires in Colorado."

by the host NP cannot pluralize the collective predicate and make sums of group individuals under an operation of sum-operation.

Furthermore, the lattice structure is defined if a binary operation such as the sum operation applies to the members of a set and the partial order is determined among them. However, under my analysis, the sum operation does not apply to the set denoted by the collective verbal predicate in the SQC if the split quantifier measures non-group individuals in the set denoted by the host NP instead of measuring group individuals. Thus, the split quantifier cannot yield a homomorphism between the lattice of events and the lattice of individuals. In the SQC construction such as (16), we have a function which maps between the set of events without any lattice structure into the set of individuals without any lattice structure.

5. The split quantifier in the collective-predicate SQC

In this section, I discuss how my proposed analysis accounts for the problems in Nakanishi's (2004) analysis.

First of all, as discussed in Section 3, the MP cannot indirectly measure events by measuring non-group individuals in the collective-predicate SQC, as shown in (26) and (27):

(26) Gakusei-ga kooen-ni san-nin atsumat-ta
student-NOM park-in three-CL gather-PST
"Three students gathered in the park yesterday."

(27) Gakusei-ga kooen-ni roku-nin atsumat-ta.
student-NOM park-in six-CL gather-PST
"Six students gathered in the park yesterday."

According to the Constraint on Measure Functions proposed by Nakanishi (2003), the measure function μ must be monotonic relative to the given part-whole structure, i.e., a lattice of events. On this assumption, suppose that the sentences in (26) and (27) express the events e_a and e_b, respectively. In these sentences, $\mu(h(e_a))$ is larger than $\mu(h(e_b))$. This means that $h(e_a)$ is a proper subpart of $h(e_b)$. Furthermore, in these split quantifier constructions, it is assumed that there is a homomorphism given in (10) from E to I. Thus, event e_a is a proper subpart of e_b. This incorrectly predicts that the examples in (26) and (27), each, cannot express only one event. However, in fact, both of them can do so.

On the other hand, the present analysis accounts for the fact that the examples in both (26) and (27) expresses only one event. As discussed in Section 5, under the present analysis, the split quantifiers *san-nin* "three-CL" and *roku-nin* "six-CL" in (26) and (27) show the number of the non-group individuals in the set denoted by the host NP. However, in the collective-predicate SQC, there is a one-to-one (injective) mapping from events E denoted by the collective verbal predicate and group individuals denoted by the host NP, as shown in (25). Thus, the split quantifiers in (26) and (27) are not related to the number of the occurrence of events. Therefore, the sentences in (26) and (27) can express only one event.

Second, one potential extension of Nakanishi's analysis to the example in (17) is to assume that the extension of the VP is a lattice of events, each of which is mapped into an atomic group consisting of three boys, as discussed in Section 3. However, this analysis incorrectly predicts that the sentences in (29) are not compatible with the sentence in (28):

(28) gakusei-ga kooen-ni roku-nin atsumat-ta.
student-NOM park-in six-CL gather-PST
"Six students gathered in the park yesterday."

(29) Danshi-gakusei-wa yo-nin-de ki-ta. Jyoshi-gakusei-wa huta-ri-de ki-ta.
male-student-TOP four-CL-COP come-PST female-student-TOP two-CL-COP come-PST
"Male students came by four (as a group). Female students came by two (as a group)."

Under the analysis given in (19), six students should be the sum of two group atoms consisting of three boys. Therefore, the sentences in (29) should not be compatible with the first sentence in (28). In the situation expressed by (28) and (29), the set consisting of six students is the sum of the set consisting of four male students and the set consisting of two female students.

On other hand, my analysis does not have any problem with the examples in (28) and (29). Under my analysis, the split quantifier counts the number of the individuals in the set denoted by the host NP. Furthermore, the numbers of the split quantifiers in the sentences in (29) show the numbers of the subsets of the individuals who gathered in the park yesterday. Therefore, the sentence in (29) is compatible with the sentence in (28).

6. Conclusion

In this paper, I discussed the split quantifier construction whose verbal predicate is a collective predicate. As discussed in Section 3, Nakanishi's (2003, 2004, to appear) analysis of the split quantifier construction cannot be extended to the collective-predicate split quantifier construction.

In this paper, the collective verb takes the host NP associated with the split quantifier as a group individual. Furthermore, I assume that there is a one-to-one (injective) mapping from events E denoted by the collective verbal predicate and group individuals denoted by the host NP. However, in the case of the collective-predicate split quantifier construction, the split quantifier measuring non-group individuals does not trigger the sum operation over the individual members in the set denoted by the host NP. The split quantifier shows the number of the members in the set denoted by the host NP. This analysis does not face the problem that faces Nakanishi's analysis, namely, the fact that the split quantifier cannot indirectly measure events by measuring non-group individuals in the collective-predicate split quantifier construction.

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