THE POSSIBILITY OF LICENSING FLOATING QUANTIFIERS IN PURELY SEMANTIC TERMS*

1 INTRODUCTION

A Floating Quantifier (FQ) has been the focus of extensive study in both syntactic and semantic literature.[1] The kind of FQs dealt with in this paper is the type that occurs outside the phrase headed by a case-marker, but is associated with the NP within it:

(1) *Gakusei-ga* **san-nin** *kita.*
students-Nom 3-Cl came
'Three students came.'

In (1), the numeral quantifier *san-nin* occurs outside the *ga*-phrase, and is associated with the host NP *gakusei*. The majority of the studies on FQs have been devoted to this type of FQs, namely, Numeral+Classifier; however I extend the range of the current study to other types of floating expressions such as container phrases:

(2) *John-wa* *mizu-o* **botoru-san-bai-bun**[2] *nonda.*
John-Nom water-Acc bottle-3-Cl-amount drank.
'John drank three bottles of water.'

The Container-Number-Classifier configuration occurs rightward to the accusative

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[1] Although, as will be clear, I take the position that what is called a 'floating' quantifier does not float from some nominal domain but is base-generated in a VP-modifier position, I use the term FQ throughout this paper for expository purposes.

[2] In this paper, I deal only with container phrases with *-bun*, because in many cases, if a container phrase does not accompany *-bun*, the sentence sounds unnatural (while (2) is not such a case and completely acceptable even if it does not contain *-bun*). Although it is certain that *-bun* has some semantic contribution, I would like to leave it to future research.

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case-marker *-o*, while being associated with its host *water*, which occurs in the case-phrase. I treat this floating container phrase as a kind of floating quantifiers, because, as we will see, it behaves quite similarly to FQs of type (1). In fact, Watanabe (2006) treats both types in almost the same fashion.

There have been two positions about the status of FQs: the combinatorial view and the base-generated view. The former claims that an FQ and its host enter into the syntax in combination and then the former moves outside the case phrase (Miyagawa (1989)). The latter, on the other hand, claims that the two items are base-generated separately (Kawashima (1998), Nakanishi (2003)). As for the association between the two items, it can be said that the syntactic factor plays a more significant role in the former position than in the latter; the latter position allows an FQ to occur in an arbitrary position. Still, the advocates for the latter position have resorted to some syntactic notion such as the c-command relation in order to interpret the FQ as associated with its host NP.

The gist of this paper is that there is a possibility that we can treat the association between an FQ and its host without resorting to any syntactic notions; the association of two items is just a semantic matter. This argument may appear quite radical, because it says that as far as FQs are concerned, we do not rely on syntax for the position and interpretation. This has not been done even by advocates of the base-generated view.

My argument is based on Nakanishi's (2007) study, which treats FQs as event predicates. However, my argument is different from it in that whereas she proposes the requirement that an FQ must be c-commanded by its host in order to be interpreted as associated with it, I do not employ such a syntactic requirement. Instead, I will argue that what is crucial is the property of the homomorphism involved in the semantics of FQs, and posit a semantic constraint that h must return an atomic individual when it takes an atomic event.

The rest of this paper is structured as follows. Section 2 discusses the range of data the combinatorial view captures, and points out that it goes against the cases where FQs are associated with their host in some syntactic islands. Section 3 introduces the semantics analysis of FQs proposed by Nakanishi (2007), which accounts for the semantic property of FQs by assuming that they involve the measure function μ and the homomorphism h. Then I claim that her syntactic constraint is empirically inadequate. Section 4 provides the new semantic constraint that captures the (un)availability of the association between FQs and their hosts. Section 5 offers the conclusion.

2 THE COMBINATORIAL VIEW

This section presents the empirical problems for the combinatorial analysis of FQs (Miyagawa (1989) and Watanabe (2006), among others). This kind of analyses has an important point in common: An FQ and its host are introduced into the same domain, and the former moves outside. This view is motivated by various kinds of data about movement, some of which will be shown in Section 2.1., after which, I will present problematic data in Section 2.2.

2.1. Motivation for the combinatorial view

It is well known that FQs cannot be associated with NPs in adjunct phrases. Consider (3). In (3a), the FQ *yo-nin* 'four people' is associated with the subject, whereas the FQ in (3b) *yon-dai* cannot be associated with the NP in the *by*-phrase (and the classifier *dai* implies that the numeral *yon* measures the number of cars, which causes a kind of contradiction):

(3) a.	*Gakusei-ga*	[*kuruma-de*]	*yo-nin*	*kita.*
	Student-Nom	car-by	4-Cl	came.
	'Four students came by car.'			
b. *	*Gakusei-ga*	*kuruma-de*	*yon-dai*	*kita.*
	Student-Nom	car-by	4-Cl	came.
	(Intended) 'Students came with four cars'			

This observation can be straightforwardly accounted for by the combinatorial view. Suppose that in (3b), the host NP *kuruma* 'car' and the FQ *yon-dai* 'four-classifier' are in the same domain, (for example, [$_{DP}$[$_{NP}$ *kuruma*] *yon-dai*]) namely, the complement of the *by*-phrase, when they are introduced to the syntax. Then, the FQ must be extracted from the postpositional adjunct phrase in order to occur in the floating position in (3b). However, this movement is the extraction from adjuncts, which is generally said to be impossible. Thus, (3b) is out since it involves an impossible movement.

Positing that an FQ undergoes the movement from some domain where it and its host are base-generated, we will predict that an FQ is island-sensitive. This prediction appears to be borne out:

(4) a. *	*Taro-ga*	[*Mary-ga*	*hon-o*	*yonda-toiu*]		*uwasa-o*
	Taro-Nom	Mary-Nom	book-Acc	read-that		rumor-Acc
	san-satu	*kiita*.				
	3-Cl	heard				
	(Intended) 'Taro heard the rumor that Mary read three books.'					
b. *	*Taro-ga*	[*hon-o*	*yonda*]	*hito-ni*	*san-satu*	*atta.*
	Taro-Nom	book-Acc	read	person-Dat	3-Cl	met
	(Intended) 'Taro met a person that read three books.'					

In (4), the FQ *san-satu* is intended to be associated with the NP *hon*, which occurs inside the content *that*-clause in (4a) and the relative clause in (4b), both of which are known to be syntactic islands, extraction from which is prohibited. Thus the combinatorial view, according to which the FQ is base-generated within those islands, correctly predicts the unacceptability of sentences in (4).

While Miyagawa (1989) deals only with the FQ of the Numeral+Classifier type, Watanabe (2006) argues that container phrases, as with the Numeral+Classifier type, are base-generated within the same DP as their host NPs. Thus it is predicted that the same pattern as the above is observed as for container phrases, and this is borne out.

(5) a. Extraction from adjuncts

*_Taro-ga_ [_mizu-de_] _baketu-san-bai-bun_
Taro-Nom water-with bucket-3-Cl-amount
mado-o huita.
window-Acc wiped
(Intended) ‘Taro washed the window with three buckets of water.’

b. Extraction from content clauses

*_Taro-ga_ [_Mary-ga mizu-o nonda-toiu_] _uwasa-wo_
Taro-Nom Mary-Nom water-Acc drank-that rumor-Acc
baketu-san-bai-bun kiita.
bucket-3-Cl-amount heard
(Intended) ‘Taro heard the rumor that Mary drank three buckets of water.’

c. Extraction from relative clauses

*_Taro-ga_ [_mizu-o nonda_] _hito-ni_ _baketu-san-bai-bun_
Taro-Nom water-Acc drank person-Dat bucket-3-Cl-amount
atta.
met
(Intended) ‘Taro met a person who drank three buckets of water.’

Thus, the combinatorial view appears successful in accounting for the above data that involve adjuncts and syntactic islands.

2.2. Problems

From the observations in the previous subsection, it seems that an FQ is island-sensitive and cannot be associated with any NP occurring within islands. Considering a broader set of data, however, we find cases where such association holds, particularly for adjuncts and relative clauses:

(6) a. _Ano-isha-wa_ [_gakusei-no_] _me-o_ _30-nin_ _shirabeta_.
that-doctor-Top student-Gen eye-Acc 30-Cl examined
‘That doctor examined 30 pupil’s eyes’ (Kikuchi (1994: 82))

b. _Sensei-ga_ [_jibun-no-gakusei-ga_ _totta_] _tensuu-o_
teacher-Nom self-Gen-student-Nom got mark-Acc

san-nin *kirokusita*.
3-Cl recorded
'The teacher recorded the marks that three of her student got'

In both examples, the FQs, *30-nin* in (6a) and *san-nin* in (6b) are associated with the NP inside the adjunct postpositional phrase and the relative clause, respectively. This association is unexpected in the combinatorial view.

As for container phrases, a similar pattern is observed:

(7) a. *Taro-ga* [*sooko-no* *booru-no*] *joutai-o*
Taro-Nom warehouse-Gen ball-Gen condition-Acc
kago-san-ko-bun *kakuninshita.*
basket-3-Cl-amount checked
'Taro checked the condition of three baskets of balls in the warehouse.'

b. *Rabo-de* *Taro-ga* [*ekitai-ga* *motsu*] *tokusei-o*
lab-in Taro-Nom liquid-Nom have characteristics-Acc
biikaa-san-ko-bun *shirabeta.*
beaker-3-Cl-amount investigated
'In the lab, Taro investigated the characteristics of three beakers of liquid'

As with the cases of the Numeral+Classifier type, the FQs in (7), *kago-san-ko-bun* and *biikaa-san-ko-bun*, are interpreted as measuring the amount of the NPs inside syntactic islands

One might argue, as Murasugi (1991) does, that certain relative clauses in Japanese are not islands. Particularly, see the following:[3]

(8) [[t_i t_j *mensetsu-o* *uketa*] *gakusei*$_i$*-ga* *mina* *ukaru*] *kaigisitsu*$_j$
interview-Acc had student-Nom all pass meeting.room
'an meeting room such that all the students who have an interview there pass it' (Murasugi (1991: 132))

In (8), the head NP *meeting room* seems to be extracted from the relative clause *who have an interview*. Therefore it raises the possibility that Japanese does not have relative clause islands. However, the same kind of extraction is impossible in the relative clauses in (6b) and (7b):

(9) a. *[[t_i t_j *totta*] *tensuu*$_j$*-o* *sensei-ga* *kirokushita*] *gakusei*$_i$
got mark-Acc teacher-Nom recorded student
'the student such that the teacher recorded the mark she got

[3] Akitoshi Maeda and Ryota Nakanishi (p.c.) told me that there are examples like (8). I would like to thank both of them.

b. *[[t_i t_j *motsu*]	*tokusei-o*	*Taro-ga*	*shirabeta*]	*ekitai*$_j$
have	characteristics-Acc	Taro-Nom	examined	liquid

'liquid such that Taro examined the characteristics it has'

In these examples, the head nouns *student* and *liquid* are extracted from the relative clauses, but the results sound awkward. This means that at least relative clauses in (9) are islands and extraction from them is prohibited.

It still might be claimed that what makes extraction from relative clauses possible is the property of the extracted element. Indeed, as in (8), extraction from relative clauses is observed particularly when what is extracted is a noun of time or location. Thus it can be said that examples in (9) are deviant because the extracted nouns are not in those categories. However, both of the Numeral+Classifier and Container types clearly do not belong to them. Moreover, if the possibility of extraction is dependent on the property of what is extracted, it is odd that (4b) and (5c) are unacceptable, where the extracted elements should have the same status as (6b) and (7b). Thus I conclude that at least relative clauses in (6b) and (7b) are islands and we retain the claim that the combinatorial view wrongly predicts that they are ungrammatical.

Association between FQs and their hosts in adjunct positions is observed when the hosts are in adverbial phrases, as well as when they are in nominal-modifying phrases like genitives and relative clauses:

(10) a. Numeral+Classifier type

Sensei-ga	[*gakusei-kara*]	*tesuto-no*	*tensuu-o*	*san-nin*
teacher-Nom	student-from	test-Gen	mark-Acc	3-Cl
kiita.				
heard				

'The teacher were informed of the marks of three students.'

b. Container type

Taro-ga	[*kami-ni*]	*kangaeteiru-koto-o*	*fairu-mit-tsu-bun*
Taro-Nom	paper-on	thinking-thing-Acc	file-3-Cl-amount
kaita.			
wrote			

'Taro wrote what he was thinking on paper in three files.'

In these examples, the FQs *san-nin* and *fairu-mit-tsu-bun* are associated with their hosts, which occur in the adverbial adjunct phrases *kara* and *ni*.

From these observations, we conclude that the whole picture is not so simple. The fact that the examples seen in the last subsection are unacceptable cannot be attributed simply to the unavailability of extraction; we need another factor responsible for the (un)acceptability of the data examined in this section.

3 THE SEMANTICS OF AN FQ

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This section is partially related to the base-generated view, the view that an FQ is base-generated outside the nominal domain containing its host NP (Kawashima (1998, note 2) and Nakanishi (2003, Section 4), among others). Their syntactic arguments are not directly related to the present purpose. I will introduce the semantic analysis proposed for FQs located in a VP-modifier position.[4]

3.1. Nakanishi (2007)

Nakanishi (2003, 2007) points out that an FQ has a notable semantic property that a non-floating one does not possess. The first is the incompatibility of an FQ with a once-only predicate such as *kill Peter*:[5]

(11) a.	*Gakusei*	*san-nin-ga*		*kinoo*	*Peter-o*	*koroshita*.
	student	3-Cl-Nom		yesterday	Peter-Acc	killed.
	‘Three students killed Peter yesterday.’					
b.??	*Gakusei-ga*	*kinoo*	*san-nin*	*Peter-o*	*koroshita*.	
	student-Nom	yesterday	3-Cl	Peter-Acc	killed	
	‘(Intended) Three students killed Peter yesterday.					

(Nakanishi (2007: 243))

The example in (11b), but not in (11a), sounds odd, where an FQ co-occurs with the once-only predicate *kill Perter*. The second property of an FQ is that a sentence with an FQ lacks collective reading:

(12) a.	*Tekkyu*	*mi-ttu-ga*	*omoi.*
	iron.ball	3-Cl-Nom	heavy
	‘Three iron balls are heavy.’		
b.	*Tekkyu-ga*	*mi-ttu*	*omoi..*
	iron.ball-Nom	3-Cl	heavy.
	‘Each of the three iron balls is heavy.’		

The sentence in (12a) is ambiguous: It can mean either that three iron balls are heavy when weighed as one group, or that each one of them is heavy. On the other hand, the example in (12b) lacks the former interpretation; that is, the predicate *is heavy* is applied to each ball. As a result, sentences containing FQs are interpreted as distributive, but not as collective.[6]

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[4] Maeda and Hirayama (2017) explicitly argues that FQs of the container phrase type are base generated in the VP-domain.

[5] The container type does not pattern with the Numeral+Classifier type, although my attempt is to propose a semantic constraint for the association between FQs and their host that is applicable to both of them. I will address this issue in the end of Section 4

[6] Nakanishi (2007) presents one more difference between FQs and their non-floating counterparts;

Nakanishi (2007) proposes that the semantics of an FQ involves the homomorphism h and measure function μ. The homomorphism h is a function from an event to an individual involved with that event. The measure function μ measures some dimension (length, weight, temperature, etc.) of its argument, specifically, the range of h. She proposes further that the range of μ must be *monotonic* relative to the domain of events:

(13) Monotonicity Constraint[7]
A measure function μ is monotonic relative to some domain D iff:
a. there are two elements x and y in D such that $x \sqsubset y$, and
b. $\mu(x) < \mu(y)$
('$\sqsubset$' stands for 'is a proper subpart of')
(Adapted from Nakanishi (2007: 245))

The example in (13) says that the value obtained by measuring an element must retain its original part-whole structure: The smaller part μ measures, the smaller value it returns. Nakanishi assumes that (13) is operative to the range of h. That is, if $h(e_1) \sqsubset h(e_2)$, then $\mu(h(e_1)) < \mu(h(e_2))$.

The homomorphism h is a mapping between events and individuals with a certain restriction, in that h must be structure-preserving. In other words, h must preserve the part-whole structures of events and individuals:[8]

(14) h is a homomorphism iff $h(e_1) \oplus h(e_2) = h(e_1 \oplus e_2)$.

For example, consider whether the agent function Ag, which takes an event and returns its agent, is homomorphic. Suppose that Mary danced in e_1 and John danced in e_2. Then $Ag(e_1) \oplus Ag(e_2) = m \oplus j$. Since the agent of the sum of the two events, namely $Ag(e_1 \oplus e_2)$, is $m \oplus j$, then $Ag(e_1) \oplus Ag(e_2) = Ag(e_1 \oplus e_2)$. Therefore, Ag is homomorphic. Nakanishi (2007) argues that FQs can employ any homomorphic function as their relevant homomorphism.

With these notions, the truth condition of (15) is represented as in (16). Figure 1 schematically describes the contribution of h and μ.

(15) *Gakusei-ga* *san-nin* *odotta.*
student-Nom 3-Cl danced.
'Three student danced.'

FQs are incompatible with individual-level predicates (Carlson 1977). However, I do not share the judgments about those sentences; therefore I did not present them in this section.

[7] Schwarzchild (2002) is the first one that posits this constraint. He propose it only for the nominal domain.

[8] Following Nakanishi (2007), I adopt a part-whole, or lattice structure of individuals for the denotation of NPs (as in Link (1983)), and that of events for the denotation of verbal predicates (Bach (1983)).

(16) ⟦(15)⟧ = ∃e[Ag(e) = students ∧ dance(e) ∧ μ(h(e)) = 3 individuals], where μ: Cardinality, and h = Ag.
Presupposition: μ is monotonic relative to the range of h.

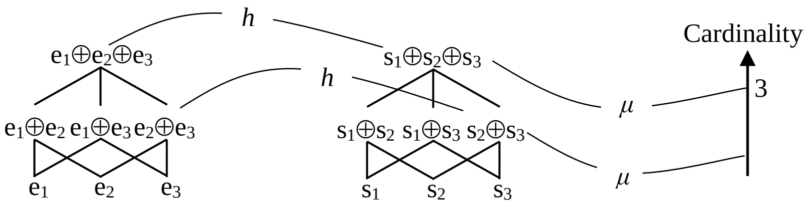

Figure 1: Contribution of h and μ

In (16), μ(h(e)) is interpreted as CARDINALITY(*students*), and it is true when students danced and the cardinality of the agent of the dancing event equals 3 individuals. Note that the monotonic presupposition is met in Figure 1; if μ takes a part of $s_1 \oplus s_2 \oplus s_3$, it returns a smaller value than three individuals. This is partly due to the presence of the part-whole structure in the denotation of *students*. Given that the input of μ is the range of h and that h is homomorphic, the input of h, that is, the dancing event, must have the part-whole structure.

The combination of (14) and the definition of h explains why contrasts in (11a) and (15) arises. As for the incompatibility with once only predicates, their denotation is a singleton set of events (a reasonable assumption, given that the event denoted by them occurs only once), which means that it lacks the part-whole structure. By h, the lack of such a structure in the event domain leads to the lack of the one in the individual domain. Therefore (13) is not fulfilled, and the sentence becomes unacceptable. Let us turn to the unavailability of collective reading in (12b). Following Landman (2000), Nakanishi (2007) assumes that collective reading occurs when the individual taken by the predicate is grouped by the ↑-operator, and such a grouped individual has no internal structure like an atomic one. This goes against the monotonicity constraint in (13). Thus collective reading does not occur with FQs.

3.2. The unsatisfactory syntactic constraint

Nakanishi (2007) captures the property of FQs with two contextually salient functions h and μ and the monotonicity constraint. However, in her account, what individual is chosen as the host of an FQ is partially syntactically-driven. Nakanishi argues that h in the semantics of FQs must be homomorphic, but as Krifka (1992) and Landman (2000) argue, (almost) all thematic functions are homomorphic. Therefore, the semantics plays few roles in associating an FQ and its host. Nakanishi argues that considering the following data, the constraint that the host must c-command an FQ is necessary:

(17)	**John-ga*	*sono*	*ki-o*	*syoberu-de*	*kinoo*	*mit-tu*	*ueta.*
	John-Nom	that	tree-Acc	shovel-with	yesterday	3-Cl	planted

‘John planted the tree with three shovels yesterday.’

(Nakanishi (2007: 271)

She argues that the instrument function is homomorphic; therefore what makes (17) deviant is not the lack of a homomorphism, but rather the lack of a c-command relation; the host NP *shovel* does not c-command the FQ *mit-tu*. Indeed, the instrument function is homomorphic. Suppose that John planted a tree with a shovel$_1$ in e$_1$, and he did so with a shovel$_2$ in e$_2$. Then it follows that he used shovel$_1$$\oplus$shovel$_2$ in e$_1$$\oplus$e$_2$.[9] This means that the constraint that only homomorphic functions can be employed by FQs does not capture the deviance in (17). Instead, Nakanishi relies on the syntactic notion, c-command, in order to capture the full range of data.

The example (17) is where an FQ is associated with its host in an adjunct position. We have seen in Section 2 that such association is possible in a certain cases, as in (7) and (8). If Nakanishi’s (2007) c-command constraint is at work, those examples are predicted to be ruled out, contrary to the fact. Moreover, it is unclear when the c-command constraint operates. She seems to assume that it operates at the stage of the surface order, but it predicts the following example to be unacceptable:

(18)	*San-nin*	*Mary-ga*	*gakusei-o*	*nagutta.*
	3-Cl	Mary-Nom	student-Acc	hit

‘Mary hit three students.’

In its surface order, *san-nin* does not c-command *student*, but the sentence sounds natural, which is not predicted by the c-command constraint.

Thus, Nakanishi’s (2007) semantics of FQs explains the interpretive effect observed with FQs, but it is not enough when it comes to the association between FQs and their hosts. The syntactic constraint she adopts in order to avoid this problem is also empirically inadequate. Among the cases involving association with hosts in adjunct phrases, the acceptable cases such as (6), (7), and (8) should possess the same syntactic environment as the unacceptable ones such as (3a), (4), (5), and (17); it is unreasonable if their adjunct structures are different. Given this, it seems that the way to go is to explore the possibility that the (un)availability of the association is a semantic matter.

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[9] In suggesting that the instrument function in (15) is a homomorphism, Nakanishi (2007: 271) gives the following statement: “Suppose that there is a planting-a-tree event that consists of three subevents; John dug a hole with a shovel, Mary carried a tree with a cart, and Bill covered the roots with a scoop. Then we can say that the sum of a shovel, a cart, and a scoop is the instruments of the planting event”. This explanation seems inadequate, at least as far as FQs are concerned. If we are allowed to construct subevents in such a manner, we could say that the *killing-Peter* event involved in (9) is divided into several substates such as ‘John planted a bomb in a room’, ‘Mary lured Peter into the room’, and ‘Bill pressed the button to explode the bomb’. Therefore the denotation of *kill Peter* could possess the internal part-whole structure. However, it is assumed that the denotation of once-only predicate is a singleton set and has no internal structure, which is supported by the deviance in (9a).

4 A SEMANTIC CONSTRAINT FOR THE FQ-HOST ASSOCIATION

This section is an attempt to derive the (un)availability of the FQ-host association from a semantic constraint that is extended from the definition of the homomorphism. The gist of my proposal is that the homomorphism *h* employed by FQs is more restricted than the definition in (14).

4.1. Correlation between individuals and events matters

To construct a new constraint, let us start with its intuitive picture. Consider (18) again, where the FQ *mit-tsu* is intended to be associated with its host *shovel* in the instrument phrase. As is seen in the last section, the instrument function in this case is homomorphic. Now consider the following case, where the relevant event is a *plant-a-tree* event. Given that *shovel* is an instrument of that event, it is conceivable that John needed more than one shovel to plant a tree. If John needed two shovels in e_1 and one in e_2, then $\text{Inst}(e_1) = s_1 \oplus s_2$, $\text{Inst}(e_2) = s_3$. In this case, too, the definition of homomorphism in (14) allows Inst to be a homomorphism, since $\text{Inst}(e_1) \oplus \text{Inst}(e_2) = \text{Inst}(e_1 \oplus e_2)$. What is noted is that, in this case, it is not guaranteed that the more shovels are employed, the more trees are planted, that is, even if the set of shovels involved in the event, then the set of events does not automatically get larger. This is because the mapping by *h* in the case just described is represented as follows:

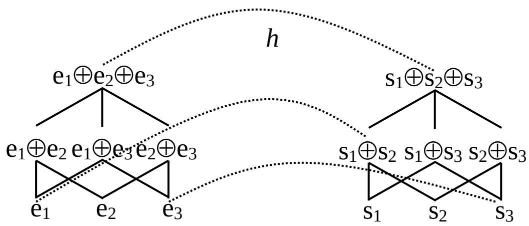

Figure 2: Representation of the 'one event-to-two shovels' case

Consider s_1 and s_2. Even if s_2 is added to s_1 and $s_1 \oplus s_2$ results, the event corresponding to it does not become larger. In other words, *h* in Figure 2 does not guarantee that the larger output domain results in that of the larger input.

However, this property is not seen in the Agent function. Consider (1), repeated as (19).

(19)	*Gakusei-ga*	*san-nin*	*kita.*
	students-Nom	3-Cl	came
	'Three students came.'		

In examples like (19), the relevant event is a *student-coming* event, so there must be a single agent for each atomic subevent. Thus, if a set of agents becomes larger, the set of events involved will be larger accordingly, and the other way around; if the relevant set of students is smaller, it automatically follows that the *coming* event occurs less often. The same thing can be said of the Theme function:

(20) *John-ga* *ringo-o* *mit-tsu* *tabeta*.
John-Nom apple-Acc 3-Cl ate
'John ate three apples.'

Given that *eating-an-apple* events are involved, the number of apples eaten directly affects that of the eating events; each *eating* event is associated with a single apple. Thus, it is probable that the relevant homomorphic functions in (19) and (20) are different from that in (18) in this respect, and the property of *h* to make its domain larger when its range does so is the key notion of the successful association.

Now consider other examples. Below I revisit the cases of the Numeral+Classifier type. The verification of those of the container phrase type is left to the reader. First, let us start with unacceptable cases, that is, (3a), (4a), and (4b), repeated as (21a) to (21c):

(21) a. **Gakusei-ga* *kuruma-de* *yon-dai* *kita*
Student-Nom car-by 4-Cl came.
(Intended) 'Students came with four cars'
b. **Taro-ga* [*Mary-ga* *hon-o* *yonda-toiu*] *uwasa-o*
Taro-Nom Mary-Nom book-Acc read-that rumor-Acc
san-satu kiita.
3-Cl heard
(Intended) 'Taro heard the rumor that Mary read three books.'
c. **Taro-ga* [*hon-o* *yonda*] *hito-ni* *san-satu* *atta*.
Taro-Nom book-Acc read person-Dat 3-Cl met
(Intended) 'Taro met a person that read three books.'

The relevant events are a *student-coming* event in (21a), a *hearing-rumor* event in (21b), and a *meeting-person* event in (21c), respectively. In (21a), another event does not have to occur even if more cars are involved; a single student may come to her destination by changing cars several times. Therefore a single *coming* event may contain two or more cars. As for (21b), how many books Mary read is not related to how many times Taro heard a rumor. More than one book read by Mary can be associated with a single *hearing-rumor* event. Finally, how many times Taro met a person is independent of the number of books she read. Taro can meet a person who read several books. Thus in all these examples, the set of events involved does not necessarily get larger when the denotation of the host does so, because a single event in those examples can be associated with more than one host.

Let us turn to acceptable cases, repeated here as (22a) to (22c):

(22) a. *Ano-isha-wa* [*gakusei-no*] *me-o* 30-*nin* *shirabeta.*
that-doctor-Top student-Gen eye-Acc 30-Cl examined
'That doctor examined 30 pupil's eyes' (Kikuchi (1994: 82))

b. *Sensei-ga* [*jibun-no-gakusei-ga* *totta*] *tensuu-o*
teacher-Nom *self-Gen-student-Nom* *got* *mark-Acc*
san-nin *kirokusita.*
3-Cl recorded
'The teacher recorded the marks that three of her student got'

c. *Sensei-ga* [*gakusei-kara*] *tesuto-no* *tensuu-o* *san-nin*
teacher-Nom student-from test-Gen mark-Acc 3-Cl
kiita.
heard
'The teacher were informed of the marks of three students.'

First, in (22a), the relevant event is the *examining-students'-eye* event. If more students participate in that event, the number of eyes to be examined will increase, and accordingly the set of event involved must become larger. In other words, each event is associated with one pair of eyes. The same reasoning can be applied to (22b). The number of students engaged corresponds to that of the marks they got. Given this, each of the events is connected with one mark, and thus with one student. Therefore, the more students get involved, the more marks are to be recorded and the larger the set of events becomes. Finally, consider (22c). Given that there is one-to-one correspondence between students and their marks, as in (22b) and those marks are correlated with the events, the increase in the number of students indirectly makes the set of events larger.

With the discussion so far, we can say that the association between FQs and their host is possible only in the following condition: When the denotation of the host NP becomes large, the set of events involved does so as well. This requirement is fulfilled if the homomorphism involved maps an atomic event to an atomic individual. In fact, in Nakanishi's (2007) framework, this condition is automatically met, since she assumes that "atomic verbal predicates never take sums in their extension. (Nakanishi (2007: note 23))", that is, *h* always maps atomic events to atomic individuals, not to any sums of them.[10] With this assumption, a mapping like the one described in Figure 2 is excluded and if the range of *h* gets larger, its domain will also automatically do so. Nakanishi leaves this property of *h* out of account when discussing the deviance in examples such as (18), and focuses only on the general definition of homomorphism in (14).

The reason Nakanishi assumes that *h* employed by FQs maps an atomic event to an atomic individual is that she attributes to this property the observation that FQs

[10] Not every author assumes a homomorphism to have this property. As Nakanishi (2007: note 23) implies, Link (1983) assumes a homomorphism that maps an atomic element to a sum of elements in another domain. Specifically, his homomorphism is a mapping from the domain of count nouns to that of mass nouns; it takes an individual and returns the materialized version of it, a process so-called *materialization*. Given that atomic elements in mass domains are hard to define, as per Champollion and Krifka (to appear), he allows mappings such as $h(x) = m_1 \oplus m_2$, where x is an individual contained in the denotation of a count noun, and m_i is an element in the denotation of the materialized noun.

shows distributivity as in (12b), as Landman (1989, 2000) does. In Landman's framework, distributivity is not expressed by a certain distributive operator, but distributive reading occurs in the normal fashion of predication (instead, collective reading requires the ↑-operator, which changes a sum of individuals into a group that has no internal part-whole structure). Under this analysis, predication between a verb and its argument must target atoms in the denotation of the latter. If *h* employed by FQs were allowed to map an atomic event to an individual-sum, it would follow that there are sums of individuals that participate in the (distributive) predication. This would go against Landman's assumption. Therefore Nakanishi concludes that *h* in her framework must map atomic event to atomic individuals.

Furthermore, allowing *h* to map an atomic event to a sum of individuals would predict that FQs were compatible with once only predicates. Recall that the denotation of those predicates is a singleton set of events. If such mapping were allowed, that single event would be associated with a plural individual like $s_1 \oplus s_2 \oplus s_3$, thus resulting in the range of *h* possessing the part-whole structure. This would fulfill the monotonicity constraint in (13), resulting in the prediction of examples like (11b) to be acceptable.

Thus, there are independent motivations for arguing that the *atom-to-atom* property of *h* is crucial to the (un)availability of association between an FQ and its host. This property is necessary for deriving the distributivity and the incompatibility with once-only predicates.

Given the discussion in this section, I propose a semantic constraint on the homomorphism employed by FQs:

(23) An FQ can employ a homomorphism *h* if $\forall e[\mathrm{At}(e) \rightarrow \mathrm{At}(h(e))]$, where $\mathrm{At}(x)$ is true iff x is an atomic element.

This semantic constraint is not a paraphrase of the distinction between argumenthood and adjuncthood. Argument functions such as Agent and Theme seem to always meet this condition but adjunct ones like Inst do not. As seen above, there are examples where the host NP is located in adjunct phrases and (23) is fulfilled. In this respect, we can say that the constraint in (23) is purely semantic, since the distinction between arguments and adjuncts seems to rest to some extent on the syntactic position in which a noun occurs.

Gunji and Hashida (1999) make a similar proposal. They argue that the host NP must be the incremental theme in the sense of Dowty (1991). They do not give a formal definition of their homomorphism, so I refer to that by Dowty. According to Dowty (1991: 567), an entity *x* is the incremental theme of an event if *x* is related to e by a structure-preserving homomorphism. The reader might claim that this is the same as (23). However, Dowty (1991: Note 14) states "A homomorphism can be a many-one function. Thus the claim that *eat* denotes a homomorphism from its object argument denotation to an event is not counterexemplified by a situation in which I eat a whole sandwich in one gulp (all parts of the sandwich mapped onto the same event) instead of the more usual one in which different parts of the sandwich are mapped by the eating event into the distinct subevents of eating the respective parts."

Therefore, Dowty’s homomorphism allows a sum of individuals to be associated with an atomic event. As I mentioned above, this mapping will go against the semantic properties of FQs.

4.2. What about the containers?

Let me close this section with some comments on the Container type. As I alluded to in Note 5, the Container type does not pattern with the Numeral+Classifier type, when it comes to the incompatibility with once-only predicates and the lack of collective reading. First, as for the incompatibility with once-only predicates, see the following:

(24) a.	*Chuushaki-ni-hon-bun-no*	*mayaku-ga*		*John-o*	*koroshita*.
	syringe-2-Cl-amount-Gen	drug-Nom		John-Acc	killed.
	‘Two syringes of drug killed John.’				
b. *	*Mayaku-ga*	*chuushaki-ni-hon-bun*		*John-o*	*koroshita.*
	drug-Nom	syringe-2-Cl-amount		John-Acc	killed.
	‘(Intended) Two syringes of drug killed John’				

One might argue that the contrast in (24) is observed because the container FQ *chuushaki-ni-hon-bun* is incompatible with the once-only predicate *killed John*. However, the container FQ cannot co-occur with the predicate *kill* in the first place, even if the theme is not a proper noun:

(25) *	*Mayaku-ga*	*chuushaki-ni-hon-bun*	*hito-o*	*koroshita.*
	drug-Nom	syringe-2-Cl-amount	person-Acc	killed.
	‘(Intended) Two syringes of drug killed people.’			

In (25), what was killed is not a proper noun, but unspecified people, so the predicate *kill a person* occurs more than one time; it should co-occur with the container FQ, but it does not. On the other hand, the Numral+Classifier type goes with predicates like *kill a person*:

(26)	*Gakusei-ga*	*kinoo*	*san-nin*	*hito-o*	*koroshita.*
	student-Nom	yesterday	3-Cl	person-Acc	killed
	‘Three students killed people yesterday.’				

Therefore the Container type is different in this respect from the Numeral+Classifier one.

With respect to the lack of collective reading, the Container type shows different behavior that is not seen in the case of the Numeral+Classifier type. The Container type FQ is incompatible with predicates like *be heavy* in the first place.

(27) a. *Koppu-2-hai-bun-no* *mizu-ga* *omoi.*
cup-2-Cl-amount-Gen water-Nom heavy
'Two cups of water are heavy.'
b. **Mizu-ga* *koppu-2-hai-bun* *omoi*.
water-Nom cup-2-Cl-amount heavy
'(Intended) Two cups of water are heavy'

In (27b), the FQ *koppu-2-hai-bun* is intended to be associated with the subject *water*, but the sentence sounds terribly awkward. Meanwhile, the Numral+Classifier type can co-occur with the predicate *be heavy* as long as the sentence is interpreted as distributive. What causes the deviance in (24b), (25) and (27b) is not that the host NPs are in the subject position, since if we combine a container phrase with an adequate predicate, it can be associated with an NP in the subject position:

(28) *Mizu-ga* *koppu-2-hai-bun* *koboreta.*
water-Nom cup-2-Cl-amount spilled
'Two cups of water spilled.'

I argue that what causes these differences is the material property of the Container type. Unlike the Numeral+Classifier type, the Container type FQ seems to measure the mere amount of its host, rather than the cardinality. This means that the host of container phrases is interpreted as a certain kind of mass nouns, whose denotation is a partially ordered set of material parts. Then the homomorphism employed by container phrases, which is supposed to fulfill the requirement in (23), maps each atomic event to a material atom.[11]

With this in mind, consider (25). Due to the container phrase, each *killing-people* event is associated with an atomic material of *drug* by the Agent function. It is pragmatically odd that an atomic material part of *drug* is engaged in killing a person. The same reasoning is applied to (27b). The Agent function maps each atomic *being-heavy* event to each atomic materials of *water*, but it is not conceivable that we can judge whether an atomic part of water is heavy or not. Meanwhile, it can move. Therefore, in (28), each *spilling*-event can be associated with an atomic water material, hence its acceptability.

Therefore, assuming that (23) is at work even with the Container type, we can account for the behavioral difference from the Numeral+Classifier type.

[11] As Champollion and Krifka (to appear) suggest, it is controversial what a material atom is (is it a molecule of H2O in the case of *water*? But an H2O molecule consists of two Hs and one O). Here I assume that there is a linguistically salient level where atomic material parts are recognized, and linguistic matters are independent of what the atomic materials actually are.

5 CONCLUSION

This paper was an attempt to raise the possibility that the association between FQs and their host is driven by semantic factors but not by syntactic ones. I first introduced the combinatorial view, that is, the position in which an FQ and its host are base-generated in the same syntactic domain, and demonstrated their empirical inadequacy. The view predicts that if an FQ occurs in a position distant from its host, it must involve some kind of movement; therefore the association between an FQ and its host occurring in a syntactic island will be prohibited. However, observing a wide range of data revealed that there are examples where such extraction is possible. Then I presented the semantics of FQs proposed by Nakanishi (2007), which captures their semantic properties (i.e., incompatibility with once-only predicates and lack of collective reading) by making use of the measure function μ and the homomorphism h. Then I pointed out that she employs the syntactic constraint for the association between FQs and their hosts, and such method goes against some of the data shown in Section 2. Alternatively, I proposed a semantic constraint on h employed by FQs, which states that for atomic events, h must return an atomic individual. This constraint is independently motivated by the mechanism of how distributivity of FQs arises. Finally, with the semantic constraint, I accounted for the difference between the Numeral+Classifier type and the Container type.

As a final remark, let me make a comment on the pragmatic effect. Consider (3b) again. In my account, the deviance in (3b) is due to the characteristics of the host *car*; a student may come with more than one car, and each atomic *student-coming* event is not guaranteed to be mapped to an atomic car. However, even if we assume the context where each student came with a single car, (3b) is still judged unacceptable. This means that pragmatic factors do not rescue sentences like (3b), and that the property of h employed by an FQ (Vehicle or something like that in the case of (3b)) is fixed semantically, but not subject to any pragmatic consideration. We have to assume that this applies also to the relevant homomorphism in complicated examples that contain a prenominal or relatives. For example, in (6b), the relevant (and tentative) homomorphism employed by the FQ will be a function that take an event and returns a students whose mark was recorded by the teacher. It does not seem that such homomorphic functions are primitive thematic functions such as Agent and Theme among others that are contained inherently in the grammar; they are created tentatively. If we adopt the assumption about pragmatic immunity, the property of such tentative functions is predicted to be determined semantically. The conceptual adequacy of this assumption is to be examined in future research.

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