Syntactic, Semantic and Information Structures of Floating Quantifiers

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Quantifiers canonically attach to nouns or noun phrases as modifiers to specify the amount or number of the entity expressed by the noun. However, since the early days of generative grammar, it has been observed that quantifiers can be positioned outside of the noun phrase as exemplified in English ((1a)), French ((1b)), German ((1c)) and Japanese ((1d)). These so-called floating quantifiers (FQs) have attracted much attention in the literature, due to their intriguing syntactic and semantic characteristics. On the one hand, they appear to have a close relationship with a noun; semantically they quantify a noun in the same way as non-floating quantifiers, and quite often they exhibit agreement with the noun as shown in (1b, c). On the other hand, their phrase structure distribution is very similar to that of sentential adverbs such as *often* in English and *souvent* 'often' in French.

(1) a. The students have *all* finished the assignment.

b. Elles sont *toutes* allées à la plage.
they.F are all.F.PL gone.F.PL to the beach
'They all went to the beach.' (French)

c. Diesen Studenten habe ich gestern *allen* geschmeichelt.
these.DAT.PL students have I yesterday all.DAT.PL flattered
'I flattered all of these students yesterday.' (German) (Bobaljik, 2003, 107–9)

d. kodomo-tati wa *minna* eiga o tanosinda.
children-PL TOPIC all movie ACC enjoy.PAST
'The children all enjoyed the movie.' (Japanese)

To capture these dual properties of FQs, there are mainly two approaches found in the previous proposals: a stranding analysis (Sportiche, 1988; Shlonsky, 1991) and a VP modifier analysis (Dowty and Brodie, 1984; Baltin, 1982; Bobaljik, 1995; Kim and Kim, 2009). In the stranded analysis, a constituent consisting of a quantifier and an NP is base-generated in the lower position in the phrase structure such as in Spec,VP position, and the NP moves up to the higher projection leaving the quantifier behind. This approach gives a straightforward account to the close relationship between the FQ and the NP such as quantification and agreement. In the VP modifier analysis, on the other hand, FQs do not form a constituent with an NP, but appear as an adverbial modifier, typically adjoined to VP. This approach explains why FQs exhibit a similar phrase structure distribution to sentential adverbs. This paper aims to extend the VP modifier analysis and present a cross-linguistic LFG account of FQs by adopting the projection architecture, in which different pieces of linguistic information are encoded in distinct structures such as c(onstituent)-structure, f(unctional)-structure, semantic structure and information structure. We show that (i) the phrase structure positions of FQs are constrained by information structure partitioning of a sentence, and (ii) semantic relations between FQs and the modified NPs are captured in semantic structure, not in c-structure or f-structure.

As often pointed out, one of the strong arguments for a VP modifier approach to FQs comes from the fact that a sentence with an FQ does not always have a corresponding sentence with a non-floating quantifier. Hence, although (2a) in French and (3a) in English are grammatical sentences with FQs, the counterpart with non-floating quantifiers are ungrammatical as in (2b) and (3b), which would make it untenable to derive FQs by stranding quantifiers after the extraction of NPs.

(2) a. Ces enfants ont *chacun* lu un livre différent.
these children have each read a book different
'These children have each read a different book.'

b. **Chacun* ces enfants a lu un livre différent.
each these children has read a book different
'Each of these children has read a different book.' (French) (Bobaljik, 2003, 123–4)

(3) a. John, Bill and Tom *all* came to the class.

b. **All* of John, Bill and Tom came to the class.

Further, languages like Dutch and Mandarin Chinese have different lexical items for non-floating and floating quantifiers as in (4) and (5), which also suggests that an FQ is not a product of a stranded nominal quantifier.

(4) a. *Alle* toeristen zullen Boston bezoeken.
all tourists will Boston visit
'All tourists will visit Boston.'

b. De toeristen zullen *allemaal* Boston bezoeken.
the tourists will all Boston visit
'The tourists will all visit Boston.' (Dutch)

(5) a. *suo you* de ren zou le
all PRT people left ASP
'All the people have left.'

b. ren *dou* zou le
people all left ASP
'The people have all left.' (Mandarin Chinese) (Dowty and Brodie, 1984, 82)

In terms of semantics, Bobaljik (2003) points out that a similarity in meaning or quantificational properties does not necessarily guarantee that a pair of sentences with an FQ and a non-floating quantifier are given the same syntactic structure at some level. Thus, the fact that (6a) and (6b) are very similar in meaning does not verify the assumption that *mostly* syntactically modifies *media experts* in (6a). The similar argument is applicable to a pair of sentences with an FQ and non-floating quantifier, namely the FQ is not necessarily encoded as a modifier of the NP in syntax.

(6) a. Media experts in the U.S. tend *mostly* to be too indoctrinated.

b. *Most* media experts in the U.S. tend to be too indoctrinated. (Bobaljik, 2003, 127)

Although the above data indicate that the alternative approach, i.e. the VP modifier analysis, may have more empirical support, there are some issues to be resolved. Firstly, although the placement of FQs is very similar to sentential adverbs, FQs can be adjoined to non-VP constituents as shown in the examples in English ((7)) and Dutch ((8)):

(7) a. I gave the kids *each* a quarter.

b. Mary put the books *all*/*both*/*each* (back) on the proper shelf. (Maling, 1976, 712)

(8) a. Marie sloeg de mannen *allebei* op het gezicht.
M. hit the men both in the face
'Marie hit the men both in the face.'

b. Ik vind de talen *allemaal* mooi.
I find the languages all beautiful
'I find the languages all beautiful.' (Dutch)

In addition, the fact that an NP is quantified distantly from an FQ and it becomes an agreement controller of the FQ in some languages does not naturally arise from the assumption that FQs are a kind of sentential adverb.

To resolve these puzzles, some researchers assume that the FQ holds some kind of predicative relation to the following constituent. For instance, based on the insight by Baltin (1995), Kim and Kim (2009) specify the requirement of a [PRD +] feature in the constituent following the FQ in their HPSG analysis. Also, Abeillé and Godard (1999) argue that a floating qunatifier functions as an adjunct and as a complement in their HPSG analysis. We alternatively propose that an FQ appears in a topic–comment structure, namely the NP quantified by the FQ is a topic and the FQ functions as part of the comment. Thus, taking (8a) for instance, we would predict that it can only be acceptable in the context where *de mannen* 'the men' is a topic, and that prediction is borne out. By adopting Neeleman and van de Koot's (2008, 146) information structure representation, (8a) can be partitioned as in (9):

(9) Marie sloeg [$_{\text{topic}}$ de mannen] [$_{\text{comment}}$ [$_{\text{focus}}$ *allebei*] [$_{\text{background}}$ op het gezicht]].

Further support comes from Japanese data. It has been reported that Japanese does not allow an FQ to quantify an NP with the dative particle *ni* or ablative particle *kara* as shown in (10a, c). However, if the dative or ablative NP is topicalised, an FQ can follow them as in (10b, d). Note that an analysis referring to the predicative relation would not work in those cases.

(10) a. *Taroo ga Hanako o sinseki ni *minna* syookai sita.
T. NOM H. ACC relatives DAT all introduce do.PAST
'Taro introduced Hanako to all of his relatives.'

b. sinseki ni wa *minna* Taroo ga Hanako o syookai sita.
relatives DAT TOPIC all T. NOM H. ACC introduce do.PAST
'As for his relatives, Taro introduced Hanako to all of them.'

c. *sono seizika ga kihukin o siensya kara *50-mei* atumeta.
that politician NOM donation ACC supporter from 50-CL collect.PAST
'That politician collected donations from 50 supporters.'

d. siensya kara wa *50-mei* sono seizika ga kihukin o atumeta.
supporter from TOPIC 50-CL that politician NOM donation ACC collect.PAST
'As for supporters, that politician collected donations from 50of them.' (Japanese)

The topic status of quantified NPs in FQ constructions is also confirmed by the well-known fact that the NPs' referents must be known by the speaker and the hearer, so the indefinite NP in (11b) makes this sentence illicit in the discourse. Similarly, Dutch example (12) is only acceptable as a statement about a generic characteristic of children.

(11) a. The children *all* visited London.
b. #Children *all* visited London.

(12) Kinderen genieten *allemaal* van de film.
children enjoy all of the film
'Children all enjoy the film.' (Dutch)

Another intriguing upshot of the proposal is correlation between topic status and agreement. As extensively disscussed in Dalrymple and Nikolaeva (2011), it is attested that a topic constituent functions as an agreement controller in many languages. It would be no surprise that an FQ agrees with a quantified NP as shown in (1b, c), if the NP is a topic and the FQ is a focus.

To formulate our proposal, we adopt Dalrymple and Nikolaeva's (2011) architecture for information structure in LFG. They postulate a function ι from semantic structures to information structure. The attributes appearing in information structure are TOPIC, FOCUS, BACKGROUND and COMPLETIVE (Butt and King, 1996), each of which takes meaning constructors as its members. Each lexical item is given a functional equation that encodes its membership in information structure like $\mathbf{John} \in (\uparrow_{\sigma\iota}\ (\uparrow_{\sigma}\ \text{DF}))$ in its lexical entry, where the bold-face label is an abbreviated notation for the meaning constructor of the item, i.e. $\mathit{john}{:}\uparrow_{\sigma}$. The value of the DF is specified as TOPIC, FOCUS, BACKGROUND or COMPLETIVE depending on the linguistic and discourse context. Hence, if *John* appears as a topic in the sentence, the meaning constructor will be $\mathit{john}{:}[\text{DF TOPIC}]$ and, as a result, it will be a member of TOPIC in the information structure, i.e. $[\text{TOPIC}\ \{\mathbf{John}\}]$. To apply this framework to Japanese example (1d), the lexical entries for *minna* 'all', *kodomo* 'child' and *tanosinda* 'enjoyed' can be posited as in (13). Note that all the entries have an equation defining their membership in information structure. As observed above, the FQ is a focus as a part of the comment in the topic–comment configuration, so we can postulate a c-structure rule as in (14), where QP represents Quantifier Phrase. A QP can be adjoined to various types of constituents, which is encoded as XP, and the annotations $(\uparrow_{\sigma}\ \text{DF}) = \text{FOCUS}$ and $(\uparrow_{\sigma}\ \text{DF}) = \text{BACKGROUND}$ ensure that the QP and the XP are given FOCUS and BACKGROUND as their respective values of the DF in the semantic structure. Combined with c-structure rules for S and VP, the c-structure for (1d) is given as in (15), and accordingly we obtain the corresponding f-structure ((16)), the semantic structures ((17)) and the information structure ((18)). The semantic structures c_{σ}, m_{σ}, a_{σ} and e_{σ} all have specifications for their values of DF. Following Dalrymple and Nikolaeva (2011, 79), we assume that the topical element is given further specifications about their activation and accessibility in the discourse with the STATUS and ACTV (activation) features whose values are IDENTIFIABLE and ACTIVE respectively. According to the values of the DF features in the semantic structures, the information structure (18) consists of **John** as a member of TOPIC, **all** as a member of FOCUS and **enjoy-movie** as a member of BACKGROUND—the meaning constructor **enjoy-movie** is deduced from the two meaning constructors **enjoy** and **movie**. This is a correct information structure configuration of the sentence. As for non-VP adjunction of QPs, we can postulate a different c-structure rule. For instance, since a quantifier can appear between OBJ and OBJ2 or OBL in English as shown in (7), the c-structure rule can be formulated as in (20). Thus, for the sentence, *John gave his twins both motorbikes*, we obtain the f-structure, the semantic structures and the information structure as in (21)–(23).

We assume that an FQ is syntactically a kind of sentential adverb, so that the f-structure corresponding to the FQ is a member of the ADJ of the sentence, not the SUBJ, as in (16) and (21). To capture the quantificational properties of FQs, we extend the glue semantics analysis of quantifiers proposed by Dalrymple et al. (1997) and Dalrymple (2001, 245–253). As shown in the second and third lines of the lexical entry (13a) for the Japanese example in (1d), all relates x to two propositions $R(x)$ (restrictive meaning) and $S(x)$ (scope meaning). The first-half of the meaning constructor requires a resource $(((\text{ADJ} \in \uparrow)\ \text{GF})_{\sigma}\ \text{VAR}) \multimap (((\text{ADJ} \in \uparrow)\ \text{GF})_{\sigma}\ \text{RESTR})$ that corresponds to R. The second-half of the meaning constructor requires a resource $\forall H.[((\text{ADJ} \in \uparrow)\ \text{GF})_{\sigma} \multimap H] \multimap H$ that corresponds to S. Crucially, the GF in both resources is specified as a grammatical function of the topic element, so that $((\text{ADJ} \in \uparrow)\ \text{GF})$ refers to the f-structure of the topic. Since these requirements match the contributions of *kodomo* 'child' and *eiga o tanosinda* 'enjoyed the movie' respectively, we obtain the correct meaning of the sentence in (1d) as illustrated in (19). Therefore, our analysis successfully captures the dual properties of FQs, namely syntactically a kind of sentential adverb and semantically a kind of noun modifier.

(13) a. *minna* Q $(\uparrow\ \text{PRED}) = \text{'all'}$
$\lambda R.\lambda S.\mathit{all}(x, R(x), S(x)) : [(((\text{ADJ} \in \uparrow)\ \text{GF})_{\sigma}\ \text{VAR}) \multimap (((\text{ADJ} \in \uparrow)\ \text{GF})_{\sigma}\ \text{RESTR})]$
$\multimap [\forall H.[((\text{ADJ} \in \uparrow)\ \text{GF})_{\sigma} \multimap H] \multimap H]$
$\mathbf{all} \in (\uparrow_{\sigma\iota}\ (\uparrow_{\sigma}\ \text{DF}))$

b. *kodomo* N $(\uparrow \text{PRED}) = \text{`child'}$

$\lambda x.\mathit{child}(x) : (\uparrow_\sigma \text{ VAR}) \multimap (\uparrow_\sigma \text{ RESTR})$

$\mathbf{child} \in (\uparrow_{\sigma\iota} (\uparrow_\sigma \text{ DF}))$

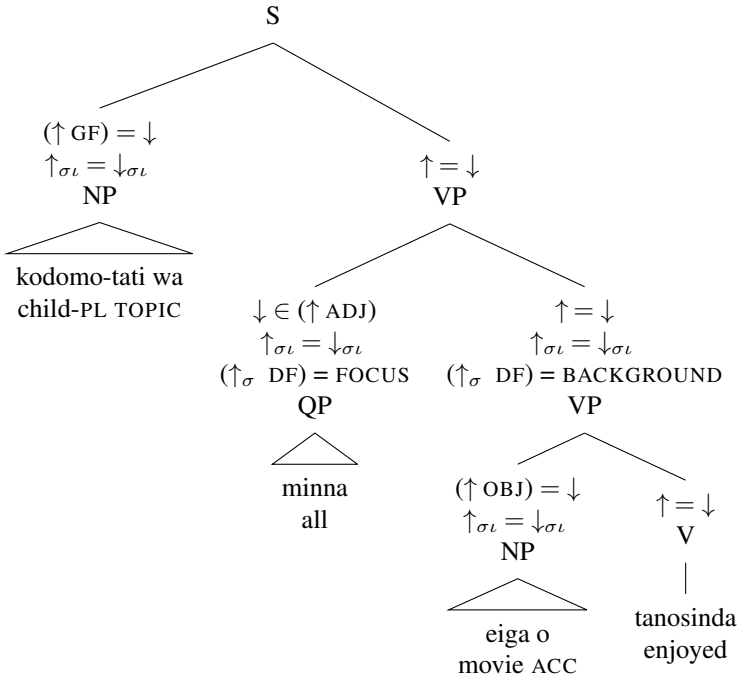
c. *tanosinda* V $(\uparrow \text{PRED}) = \text{`enjoy}\langle\text{SUBJ,OBJ}\rangle\text{'}$

$\lambda x.\lambda y.\mathit{enjoy}(x, y) : (\uparrow \text{ SUBJ})_\sigma \multimap [(\uparrow \text{ OBJ})_\sigma \multimap \uparrow_\sigma]$

$\mathbf{enjoy} \in (\uparrow_{\sigma\iota} (\uparrow_\sigma \text{ DF}))$

(14) XP $\longrightarrow$ QP ($\downarrow \in (\uparrow \text{ADJ})$, $\uparrow_{\sigma\iota} = \downarrow_{\sigma\iota}$, $(\uparrow_\sigma \text{ DF}) = \text{FOCUS}$) XP ($\uparrow = \downarrow$, $\uparrow_{\sigma\iota} = \downarrow_{\sigma\iota}$, $(\uparrow_\sigma \text{ DF}) = \text{BACKGROUND}$)

(15)



(16)

$$e : \begin{bmatrix} \text{PRED} & \text{`enjoy}\langle\text{SUBJ,OBJ}\rangle\text{'} \\ \text{SUBJ} & c : [\text{PRED} \quad \text{`child'}] \\ \text{OBJ} & m : [\text{PRED} \quad \text{`movie'}] \\ \text{ADJ} & \{\, a : [\text{PRED} \quad \text{`all'}] \,\} \end{bmatrix}$$

(17)

$$c_\sigma : \begin{bmatrix} \text{STATUS} & \text{IDENTIFIABLE} \\ \text{ACTV} & \text{ACTIVE} \\ \text{VAR} & [\,] \\ \text{RESTR} & [\,] \\ \text{DF} & \text{TOPIC} \end{bmatrix}$$

$m_\sigma : [\text{DF} \quad \text{BACKGROUND}]$

$a_\sigma : [\text{DF} \quad \text{FOCUS}]$

$e_\sigma : [\text{DF} \quad \text{BACKGROUND}]$

(18)

$$e_{\sigma\iota} : \begin{bmatrix} \text{TOPIC} & \{\, \mathbf{children} \,\} \\ \text{FOCUS} & \{\, \mathbf{all} \,\} \\ \text{BACKGROUND} & \{\, \mathbf{enjoy\text{-}movie} \,\} \end{bmatrix}$$

(19)

all	$\lambda R.\lambda S.\mathit{all}(x, R(x), S(x)) :$	$[(c_\sigma \text{ VAR}) \multimap (c_\sigma \text{ RESTR})] \multimap [\forall H.[c_\sigma \multimap H] \multimap H]$
child	$\lambda x.\mathit{child}(x) :$	$(c_\sigma \text{ VAR}) \multimap (c_\sigma \text{ RESTR})$
enjoy-movie	$\lambda x.\mathit{enjoy}(x, \mathit{movie}) :$	$c_\sigma \multimap e_\sigma$

$\mathbf{all}, \mathbf{child}, \mathbf{enjoy\text{-}movie} \vdash \mathit{all}(x, \mathit{child}(x), \mathit{enjoy\text{-}movie}(x)) : e_\sigma$

(20) VP $\longrightarrow$ V ($\uparrow = \downarrow$) NP ($(\uparrow \text{OBJ}) = \downarrow$, $\uparrow_{\sigma\iota} = \downarrow_{\sigma\iota}$, $((\uparrow_\sigma \text{ DF}) = \text{TOPIC})$) QP ($\downarrow \in (\uparrow \text{ADJ})$, $\uparrow_{\sigma\iota} = \downarrow_{\sigma\iota}$, $(\uparrow_\sigma \text{ DF}) = \text{FOCUS}$) XP ($(\uparrow \{\text{OBJ}_\theta \mid \text{OBL}_\theta\}) = \downarrow$, $\uparrow_{\sigma\iota} = \downarrow_{\sigma\iota}$, $((\uparrow_\sigma \text{ DF}) = \text{BACKGROUND})$)

(21)
$$g:\begin{bmatrix}\text{PRED} & \text{`give}\langle\text{SUBJ,OBJ,OBJ2}\rangle\text{'}\\ \text{SUBJ} & j:\big[\text{PRED}\quad\text{`John'}\big]\\ \text{OBJ} & t:\big[\text{PRED}\quad\text{`twin'}\big]\\ \text{OBJ2} & m:\big[\text{PRED}\quad\text{`motorbike'}\big]\\ \text{ADJ} & \{\,b:\big[\text{PRED}\quad\text{`both'}\big]\,\}\end{bmatrix}$$

(22)
$$t_\sigma:\begin{bmatrix}\text{STATUS} & \text{IDENTIFIABLE}\\ \text{ACTV} & \text{ACTIVE}\\ \text{DF} & \text{TOPIC}\end{bmatrix}$$
$$j_\sigma:\big[\text{DF}\quad\text{BACKGROUND}\big]$$
$$b_\sigma:\big[\text{DF}\quad\text{FOCUS}\big]$$
$$m_\sigma:\big[\text{DF}\quad\text{BACKGROUND}\big]$$
$$g_\sigma:\big[\text{DF}\quad\text{BACKGROUND}\big]$$

(23)
$$e_{\sigma\iota}:\begin{bmatrix}\text{TOPIC} & \{\,\textbf{twin}\,\}\\ \text{FOCUS} & \{\,\textbf{both}\,\}\\ \text{BACKGROUND} & \{\,\textbf{John-give-motorbike}\,\}\end{bmatrix}$$

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