English Floating Quantifiers and Lexical Specification of Quantifier Retrieval

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Eun-Jung Yoo. 2001. English Floating Quantifiers and Lexical Specification of Quantifier Retrieval. *Language and Information 5.1*, 1–15. Floating quantifiers (FQs) in English exhibit both universal and language-specific properties. This paper discusses how such syntactic and semantic characteristics can be explained in terms of a constraint-based, lexical approach to the floating quantifier construction within the framework of Head-Driven Phrase Structure Grammar (HPSG). Based on the assumption that FQs are base-generated VP modifiers, this paper proposes an account in which the semantic contribution of FQs consists of a "lexically retrieved" universal quantifier taking scope over the VP meaning.(**Seoul National University**)

1. Introduction

This paper deals with floating quantifiers (FQ) in English, such as *all*, *each*, and *both*, and investigates how the syntactic and semantic characteristics of floating quantifiers can be explained within the framework of the Head-Driven Phrase Structure Grammar. In contrast to Maling (1976), Sportiche (1988), McCawley (1998), and Haegemann & Guéron (1999), who posit the movement of either the quantifier or the host noun phrase, a floating quantifier is presented to be base-generated as a VP modifier. The view that floating quantifiers are VP modifiers is well motivated in Dowty & Brodie (1984). However, unlike Dowty & Brodie, who provide a "rule-to-rule" model-theoretic interpretation for each phrase structure rule employed in floating quantifier constructions, I present an analysis of floating quantifiers within a theory where "syntactic" and "semantic" components are contained as subparts of structural representations that are defined by recursive feature constraints. The proposed analysis employs a lexical approach in the sense that the syntactic and semantic characteristics of the construction are encoded as part of the lexical information that floating quantifiers have. Furthermore, in order to account for the fact that the floating quantifier *all* takes scope over the VP that it modifies, the retrieval of the quantifier is lexically specified. Lexical specification of quantifier retrieval is necessary in accounting for the scope facts in other constructions as well.

2. Properties of English FQ Constructions

Floating quantifiers in English are illustrated in (1):

(1) a. The children have all read the books.
    b. The students have each arrived.
    c. John's brothers have both read the book.

As shown in (1), in English, only the quantifiers *all*, *each*, and *both* can "float." This contrasts to FQ constructions in languages like Japanese and Korean which permit floating of a wider range of quantifiers, including numeral quantifiers.

Floating quantifiers show characteristics that differ from normal quantificational determiners. First, floating quantifiers in English are subject-oriented. In (2), for example, the quantifier can be construed with the subject NP, but not with the object NP.

(2) The children have all introduced their friends to us.

Thus (2) is not interpreted as 'The children have introduced all of their friends to us.' While some languages such as French, Japanese, and Korean allow quantifiers to "launch" from objects,[1] no language permits floating quantifiers hosted by adjuncts, which should be predicted in a proper analysis of floating quantifiers.

Second, they appear in front of a VP or AP.[2]

(3) a. The computers all will have been moved to the new office.
    b. The computers will all have been moved to the new office.
    c. The computers will have all been moved to the new office.
    d. The computers will have been all moved to the new office.
    e. *The computers will have been moved all to the new office.
    f. *The computers will have been moved to the new office all.

(4) a. We were all fast asleep. (Quirk et al. 1985:382)
    b. The children are all healthy.

Third, floating quantifiers are hosted by (more or less) definite plural NPs. The following (5)-(6) from Dowty & Brodie exhibit what kind of NPs the floating quantifier can semantically depend on:

(5) a. John, Mary and Susan all left.
    b. John and Mary both left.
    c. The students all left.
    d. (?) Five students have all turned in their exams.
    e. Five contestants, who were selected as finalists by the judge yesterday, will all perform again tomorrow.

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1. The relevant Korean example is shown in (i):
  (i) Ai-tul-i   wuri-eykey chinkwu-tul-ul   sey   myeng(-ul)   sokayhay-ss-ta.
      Child-PL-NOM   we-to   friend-PL-ACC   three CL-ACC   introduce-PST-DECL
  'The children introduced three friends to us.'
2. As one of the reviewers points out, FQs may precede a PP (with a transitive or intransitive P) in copular sentences:
  (i) The students are all in (the room).
  Since this happens only in copular sentences, I assume that the FQ in (i) is a VP modifier, not a PP modifier. I conjecture that the post-copular position of *all* is related to the tendency that finite copular verbs precede adverbs (e.g. *They are often in their office*).

(6) a. *John, Mary or Susan all left.
   b. *Few students all left.
   c. *No students all left.
   d. *At least five students all left.

NPs like *five students* usually have an interpretation equivalent to 'at least five students'. However, as Ladusaw (1982) and Dowty & Brodie have suggested, they may also have an interpretation corresponding to 'exactly five particular students'. Example (5d) supports such view that in a certain context, NPs like *five students* may have a definite interpretation. Thus when indefinite NPs have definite interpretations, they can be a semantic target of FQs.

Finally, unlike ordinary quantificational NPs, floating quantifiers do not exhibit scope ambiguity with respect to other scopal elements such as negation adverbs and modals (Dowty & Brodie 1984:77).

(7) a. The students all didn't leave.
   a'. $[\forall x|$ student$'(x)]$ not$'($leave$'(x))$
   b. The students didn't all leave.
   b'. not$'([\forall x|$ student$'(x)]$ leave$'(x))$

(8) a. The contestants all can win.
   a'. $[\forall x|$ contestant$'(x)]$ can$'($win$'(x))$
   b. The contestants can all win.
   b'. can$'([\forall x|$ contestant$'(x)]$ win$'(x))$

With floating quantifiers, scope ambiguity is not observed in raising verb constructions, either (McCawley 1998:631).

(9) a. His conclusions all appear to be incorrect.
   b. His conclusions appear to all be incorrect.

(10) All his conclusions appear to be incorrect.

While (10) is ambiguous with regard to which takes wide scope, *appear* or *all*, in (9), the surface order between the two decides relative scope.

McCawley (1998) points out that examples like (8b) and (11) have an extra interpretation in which the auxiliary verb is within scope of the quantifier.

(11) The boys must all have gotten drunk.

He claims that when a floating quantifier immediately follows a tensed auxiliary verb, the latter may take narrow scope. However, such additional interpretations, if truly available, seem to be a consequence of logical interactions between modal operators and quantifiers, because the following entailment relations hold between the two:

(12) a. $\Diamond \forall x P(x) \rightarrow \forall x \Diamond P(x)$
   b. $\Box \forall x P(x) \leftrightarrow \forall x \Box P(x)$

In (12), the left hand side formulas express the basic readings of (8b) and (11). Therefore, the possible additional readings of (8b) and (11), indicated by the right hand side formulas, can be obtained by the entailments in (12a) and (12b), respectively.[3]

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3. In order to deal with these examples, McCawley proposes the 'Attraction-to-tense' rule in addition to the 'Quantifier-float' and 'Q-lowering' rules. While he claims that the former rule is needed for all FQ sentences with a tensed auxiliary verb, it is not clear whether ordinary tense/aspect must be treated as operators that raise scope ambiguity.

Actually, the sentence (7a) also has an additional reading in which negation takes wide scope. Following Dowty & Brodie's suggestion, however, I will take this additional reading to be an outcome of metalinguistic negation.

3. Previous Analyses

3.1 Derivational Approaches

Within transformational grammar, it is generally assumed that there is syntactic dependency between the host NP and the floating quantifier. Thus the following FQ sentences in (13) are presumed to be related to the ones in (14) via movement.

(13) a. The children all left.
b. John believes the reporters both to have left.

(14) a. All (of) the children left.
b. John believes both (of) the reporters to have left.

There have been largely two approaches with respect to the syntactic dependency. The first is to posit rightward movement of the quantifier, deriving (13) from (14), as in Postal (1974), Mailing (1976), and McCawley (1998). As Haegeman & Guéron (1999) note, however, such a downward derivation increases the overall complexity of the grammar since the generalization can no longer hold that the moved constituent c-commands its trace. Another approach, which is proposed in Sportiche (1988), is to posit leftward movement of the NP, under the assumption that the phrase Q NP is in the [SPEC, VP] in the deep structure. While Sportiche mainly deals with French FQ constructions, the possibility of extending his analysis to English examples is also discussed. The sentences in (14) are derived, if the whole Q NP sequence is moved to [SPEC, IP], whereas the ones in (13) are generated when only the NP is moved to [SPEC, IP]. The latter option that derives (13) is described schematically in (15).

(15) NP^ ... [$_{x^n}$ Q [$_{NP}$* e] XP]

In (15), Q is adjacent to NP*, an NP trace, and there is an anaphoric relation between NP^, the overt antecedent of Q, and the trace. Thus the anaphor-like behavior between the host NP and Q is captured via movement. However, as Sportiche himself notes, such an analysis raises a question for the examples where Q appears before the first auxiliary verb:

(16) a. The carpets will ^have ^been ^being ^dusted for two hours.
b. The carpets all will have been being dusted for two hours.

In (16a), at least one empty NP position can be postulated in front of each verb, so that the occurrence of Q in ^-marked positions is explained by (15). On the other hand, in (16b), the occurrence of *all* in front of the finite auxiliary verb is problematic, if the subject NP is in [SPEC, I]. This is because there is no position available for the empty NP* in (16b). Sportiche claims that this problem can be solved if the trace is assumed to be in [SPEC, I] and the subject NP^ is topicalized. However, the assumption that the subject NP in (16b) is in the topic position is problematic, because topicalization of an object is still possible with an FQ in the pre-Infl position.

(17) a. An office this large, the students all will desire.
b. To the opera, the students all have been.

Given that multiple topicalization is not allowed in English, examples like (17) show that the subject NP is not in the topic position in (16b).[4]

Another problem with Sportiche's (and other derivational approaches) is that it cannot explain why English permits quantifier floating only for a few quantifiers (i.e., *all*, *each*, and *both*). It cannot be said that quantifier floating is allowed only for universal quantifiers, since *every* does not float. Given that some languages permit a wider range of quantifier floating (and that the characterization of the permitted range is not clear), we would need to introduce some constraints to the grammar in order to prevent the derivation (15) from applying to non-floating quantifiers in examples like (18).

(18) a. *The students three will leave.
     b. *The children most will leave.

Furthermore, as noted in Sportiche, this analysis provides no explanation as to why floating quantifiers do not appear before a *wh*-trace.

(19) a. How angry do you think they all were ___?
     b. *How angry do you think they were all ___?

Since nothing prohibits the NP* in (15) from being a *wh*-trace, Sportiche's analysis cannot account for the contrast in (19).

3.2 Dowty & Brodie's Non-Derivational Analysis
Dowty & Brodie (1984) propose that floating quantifiers are base-generated as VP modifiers. Thus in their analysis, FQs are introduced by the following syntactic rule:

(20) <1, [$_{VP}$ Q VP], Q'(VP')>.

Their analysis focuses on providing formal semantics for FQ constructions. According to them, FQs, as VP quantifiers, belong to the semantic type distinct from that of determiners. More specifically, FQs map VP-denotations into argument NP denotations. Such a semantic function of FQs accounts for why quantifiers float only from arguments, but not from adjuncts. Furthermore, since the semantic rule for VP quantifiers depends on the non-empty intersection of all the sets in the NP denotation, it will require that the host NPs should be the class of definite plurals.

Dowty & Brodie's analysis naturally explains the properties discussed in section 2, without positing any transformation process. However, since it relies heavily on rule-to-rule semantic interpretations, it is hard to be incorporated into a syntactic framework that does not assume a compositional model-theoretic semantics that accompanies each expression. In what follows, I will present an alternative non-derivational analysis of FQ constructions, in which both syntactic and semantic aspects of these sentences can be accounted for via interactions with each other within a feature structure.

4. FQs and Quantifier Retrieval

In this section, a lexical approach to floating quantifiers will be presented, providing explanations for the aforementioned characteristics. In describing the semantic component of floating quantifier sentences, a variant of Cooper's (1983) quantifier storage technique

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4. Sportiche also mentions an alternative analysis that postulates a separate movement rule for the cases like (16b). However, it is not clear what this rule will look like and whether this pre-Infl position is distinctive enough to be treated separately.

that is developed in Pollard & Sag (1994) and Pollard & Yoo (1998) will be adopted. This section claims that in addition to the ordinary cases where quantifier retrieval is intrinsically free at any lexical or phrasal node, there are cases where quantifier retrieval is lexically determined. It demonstrates how the semantics of floating quantifier sentences can be accounted for by lexical specification of quantifier retrieval.

4.1 Lexical Representations of FQs

In presenting an analysis of floating quantifiers, we must first consider what kind of logical forms can be assigned to the sentences with floating quantifiers. Since the host NPs are plural NPs, how to deal with their semantic representation should be decided. Following Link (1983), I assume that collective and mass entities are contained in the model as individuals.

Link (1983) and Dowty (1986) argue that the addition of *all* to plural NPs invokes universal quantificational force, and has an effect dubbed as the Maximizing Effect, requiring the predicate in question to be true of every member of the group. Incorporating this generalization, the logical form of (21a) can be expressed by (21b), using an informal restricted quantificational logic notation:

(21) a. The students all sneezed.
      b. [the y| students$'$(y)]([$\forall$x| constituent-of$'$(x,y)] (sneezed$'$(x)))

In (21b), 'const(ituent)-of' is a function that resembles Link's (1983) relation 'atomic-part-of', and identifies each member x of the group y which is contextually salient.

On the other hand, in the case of a collective predicate, it is semantically abnormal that the predicate holds for each member of the given group. Accordingly, the group entity itself should be predicated.

(22) a. The students all gathered.
      b. [the y| students$'$(y)]([$\exists$x | group$'$(x) & ([$\forall$z | constituent-of$'$(z,y)]
         (constituent-of$'$(z,x)))] (gathered$'$(x)))

The logical representation (22b) may look complicated. However, such complexity seems to be unavoidable in order to take into the account the group reading in examples like (23).

(23) Most of the 20 students gathered.

In the latter, the logical form can be described as '[the y| students$'$(y) & |y|= 20]([$\exists$x | group$'$(x) & ([most z | constituent-of$'$(z,y)](constituent-of$'$(z,x)))] (gathered$'$(x)))'.

As (21b) and (22b) indicates, the logical representations of floating quantifier sentences vary depending on the distributive/collective interpretation of the predicate. Furthermore, when the FQ *all* is used with a collective predicate, an existential quantifier arises in the interpretation. We take this fact to support a lexical approach to the FQ construction, because, in such approach, two different lexical descriptions of the FQ may result in different logical interpretations.

Now let us consider how the informal logical representation discussed so far can be expressed in our theory. Our representation of quantifier scope is based on that of Pollard & Sag (1994), in which the semantic contribution of a word or phrase is represented as the value of the CONT(ENT) attribute in the feature structure. In the CONT value of a type *psoa* (*parameterized-state-of-affairs*), the quantifier in the QUANT(IFIER)S list is taken to have scope over the NUC(LEUS) value. Accordingly, the CONT of (21a) can be described by (24). When there is more than one quantifier in the QUANTS, the preceding member is taken to have scope over the preceded one(s).

(24)

$$
\begin{bmatrix}
\text{QUANTS} < \boxed{2} \begin{bmatrix} \text{DET } \textit{the} \\ \text{IND } \boxed{6} \\ \text{RST } \left\{ \begin{bmatrix} \textit{students} \\ \text{INST } \boxed{6} \end{bmatrix} \right\} \end{bmatrix}, \boxed{4} \begin{bmatrix} \text{DET } \textit{forall} \\ \text{IND } \boxed{8} \\ \text{RST } \left\{ \begin{bmatrix} \textit{const-of} \\ \text{CONST } \boxed{8} \\ \text{SUM } \boxed{6} \end{bmatrix} \right\} \end{bmatrix} > \\
\text{NUC } \boxed{3} \begin{bmatrix} \textit{sneeze} \\ \text{SNEEZER } \boxed{8} \end{bmatrix}
\end{bmatrix}
$$

In (24), the numeral tag $\boxed{6}$ indicates a plural entity, while $\boxed{8}$ expresses a constituent member of the plural entity. Likewise, based on (22b), the CONT of (22a) can be described as a structure whose QUANTS contain a definite quantifier followed by an existential quantifier, and whose NUCLEUS consist of the psoa *gather*.

4.2 Lexical Specification of Quantifier Retrieval

In Pollard & Sag's (1994) theory of quantifier scope, a variant of Cooper's (1983) quantifier storage technique is employed, so that the meaning of a quantifier 'starts out in storage' in the QSTORE and is 'inherited' into a larger phrase in the structure, and then 'retrieved' to take scope over a certain phrase or sentence. This theory is revised and extended in Pollard & Yoo (1998) in order to account for scope phenomena in raising verb constructions and unbounded dependency constructions. It contains a set of new assumptions for the account of quantifier scope: i) the QSTORE feature is relocated as a LOCAL attribute, ii) a new feature POOL is introduced as an additional LOCAL attribute, iii) "ordinary" lexical heads "collect" all the QSTORE values of their "selected arguments," iv) QSTORE values are inherited only from the semantic daughter of a phrase, and v) quantifier retrieval is possible either at a lexical head or at a phrase. Among the QSTORE, POOL, and RETRIEVED values, the following constraint holds:

(25) For a sign, the RETRIEVED value is a list whose set of elements forms a subset S of the POOL value; and the QSTORE value is the relative complement of the set S.

As in Pollard & Sag, the element in the RETRIEVED also appears in the QUANTS value to take its scope.

When considering how to represent the floating quantifier *all* in the lexicon, the most natural assumption that we can make is that *all* introduces a quantifier in its POOL, just like quantificational determiners. In Pollard & Yoo, the words that give rise to a quantifier meaning are classified as *quant(ifier)-word*, and their POOL and QSTORE values are lexically specified. These words are distinguished from ordinary lexical heads in that their QSTORE values are not the union of all the QSTORE values of their arguments. Such distinction is expressed in the partition of the type *word*.

(26) *word* → *ord-head* ∨ *quant-word* ∨ *sem-vac*[5]

What I will further propose in this paper is that the RETRIEVED value of certain quantifier-introducing words should be lexically specified as well. Thus I claim that in addition to ordinary cases where a quantifier is retrieved at some structural node, obeying

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5. The subtype *sem-vac (semantically vacuous word)* refers to the words whose CONT and QSTORE values are structure-shared with those values of one of their complements.

a set of constraints on the features POOL, QS(TORE), RET(RIEVED), and QUANTS, it is necessary to specify the RET (and thus QUANTS) values lexically for some quantifier-introducing words.

Besides the case of English FQs, there are other examples where lexically specified quantifier retrieval is necessitated. Consider the following example from Carpenter (1994):

(27) Every kid's favorite toy broke.

Example (27) is ambiguous between the wide scope interpretation and the narrow scope interpretation of the universal quantifier. Disregarding the adjective to avoid unnecessary complication, the two readings can be rendered as in (28).

(28) a. $[\forall y|$ kid$'(y)]$ $([$the x$|$ toy$'(x)$ & poss$'(y,x)]$ broke$'(x))$
     b. $[$the x$|$ toy$'(x)$ & $([\forall y|$ kid$'(y)]$ poss$'(y,x))]$ broke$'(x)$

In Pollard & Sag (1994), 's is an unsaturated determiner which subcategorizes for a nonpronominal NP as its specifier, and introduces a definite quantifier in its QS. This assumption, combined with Pollard & Yoo's theory of quantification, can account for the wide scope reading in (28a), since both the universal quantifier '$[\forall y|$ kid$'(y)]$' and the definite quantifier '$[$the x$|$ toy$'(x)$ & poss$'(y,x)]$' can be stored and retrieved at an appropriate node in the structure. We take the QP in (27) to have the structure in (29), and the determiner 's to have the lexical entry in (30).
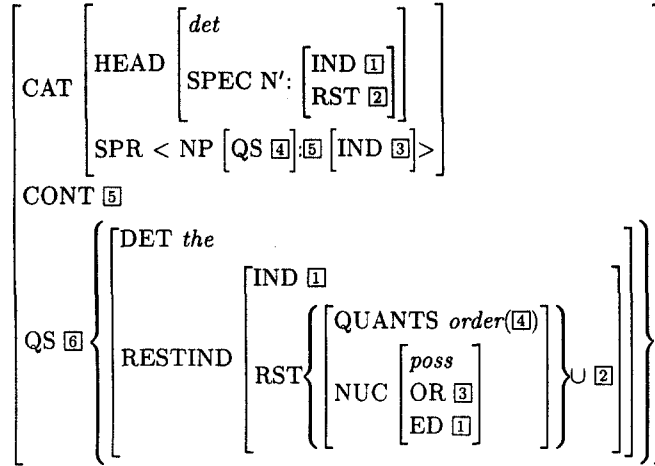
(29)
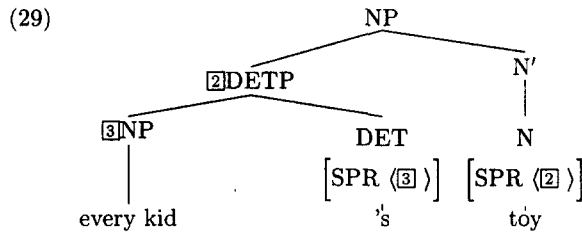
(30) 's (revised entry 1)
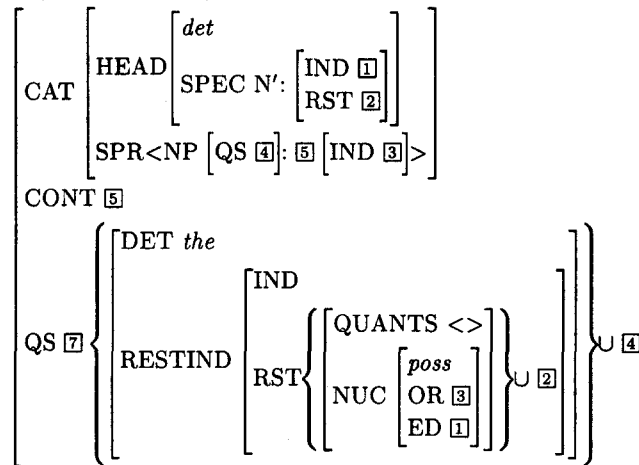
On the other hand, the narrow scope reading cannot be obtained in this way, since we need to retrieve the universal quantifier to scope over the *psoa* of *poss*, but this *psoa* is not

realized as any node in the phrase structure. In order to solve this problem, we can posit a second lexical entry of 's wherein its QS has only the definite quantifier, but already contains the universal quantifier associated with its specifier within the restriction of the definite quantifier.

(31) 's (revised entry 2)

$$
\begin{bmatrix}
\mathrm{CAT} \begin{bmatrix} \mathrm{HEAD} \begin{bmatrix} det \\ \mathrm{SPEC}\ \mathrm{N'}\colon \begin{bmatrix} \mathrm{IND}\ \boxed{1} \\ \mathrm{RST}\ \boxed{2} \end{bmatrix} \end{bmatrix} \\ \mathrm{SPR} < \mathrm{NP}\begin{bmatrix} \mathrm{QS}\ \boxed{4} \end{bmatrix}\!\colon\!\boxed{5}\begin{bmatrix} \mathrm{IND}\ \boxed{3} \end{bmatrix} > \end{bmatrix} \\
\mathrm{CONT}\ \boxed{5} \\
\mathrm{QS}\ \boxed{6} \left\{ \begin{bmatrix} \mathrm{DET}\ the \\ \mathrm{RESTIND} \begin{bmatrix} \mathrm{IND}\ \boxed{1} \\ \mathrm{RST}\left\{ \begin{bmatrix} \mathrm{QUANTS}\ order(\boxed{4}) \\ \mathrm{NUC} \begin{bmatrix} poss \\ \mathrm{OR}\ \boxed{3} \\ \mathrm{ED}\ \boxed{1} \end{bmatrix} \end{bmatrix} \right\} \end{bmatrix} \cup \boxed{2} \right\}
\end{bmatrix}
$$

In (31), the elements in the QS of the N', indicated by $\boxed{4}$, are retrieved and appear in the QUANTS of the R(E)ST(RICTION) value within the QS of 's. Thus the retrieval of the quantifier associated with the specifier is lexically specified. Accordingly, this independently motivates our claim that lexical specification of quantifier retrieval is possible for certain quantifier-introducing determiners.

4.3 Analysis and Explanations

Based on the foregoing discussion on lexically specified quantifier retrieval, I propose that the quantifier scoping in English FQ sentences can be accounted for by specifying retrieved quantifiers in the lexical entry of the FQ *all*. As discussed in 4.1, the quantifiers arising in the FQ sentences vary depending on the semantic type of the predicates. Accordingly, two lexical entries are provided for the floating quantifier *all*. The first entry in (32) is for the sentences with a distributive predicate.

(32) all_1 (for distributive predicates)

$$
\begin{bmatrix}
\text{MOD} & \text{VP} \vee \text{AP} \left[\text{SUBJ} <\text{NP} \left[\text{QS} \left\{ \boxed{2} \right\} \right] > \right] : \boxed{3} \\[2mm]
\text{CONT} \begin{bmatrix} \text{QUANTS } \boxed{5} \\ \text{NUC } \boxed{3} \left[\text{ARG } \boxed{8} \right] \end{bmatrix} \\[2mm]
\text{POOL} \left\{ \boxed{2} \right\} \cup \left\{ \boxed{4} \right\} \\[1mm]
\text{QS} \{\} \\[2mm]
\text{RET } \boxed{5} < \boxed{2}\begin{bmatrix} \text{DET } the \\ \text{IND } \boxed{6} \end{bmatrix}, \boxed{4}\begin{bmatrix} \text{DET } forall \\ \text{IND } \boxed{8} \\ \text{RST} \left\{ \begin{bmatrix} const\text{-}of \\ \text{CONST } \boxed{8} \\ \text{SUM } \boxed{6} \end{bmatrix} \right\} \end{bmatrix} >
\end{bmatrix}
$$

In (32), the CONT value represents the logical form in (24). The QUANTS list which has the same value $\boxed{5}$ as the RET contains two quantifiers, $\boxed{2}$ and $\boxed{4}$. The quantifier $\boxed{2}$ indicates the restricted quantifier part '[the y| students'(y)],' and $\boxed{4}$ corresponds to '[∀x| constituent-of'(x,y)].' When the FQ appears in a sentence, the quantifier will scope over the NUC(LEUS) value, which is the CONT of the VP. As noted, the example (21a) will have the CONT in (24).

The second lexical entry of the FQ *all* is described in (33).

(33) all_2 (for collective predicates)

$$
\begin{bmatrix}
\text{MOD} & \text{VP} \vee \text{AP} \left[\text{SUBJ} <\text{NP} \left[\text{QS} \left\{ \boxed{2} \right\} \right] > \right] : \boxed{3} \\[2mm]
\text{CONT} \begin{bmatrix} \text{QUANTS } \boxed{5} \\ \text{NUC } \boxed{3} \left[\text{ARG } \boxed{8} \right] \end{bmatrix} \\[2mm]
\text{POOL} \left\{ \boxed{2} \right\} \cup \left\{ \boxed{4} \right\} \\[1mm]
\text{QS} \{\} \\[2mm]
\text{RET } \boxed{5} < \boxed{2}\begin{bmatrix} \text{DET } the \\ \text{IND } \boxed{6} \end{bmatrix}, \\[2mm]
\boxed{4}\begin{bmatrix} \text{DET } exists \\ \text{IND } \boxed{8} \\ \text{RST} \left\{ \begin{bmatrix} group \\ \text{INST } \boxed{8} \end{bmatrix}, \begin{bmatrix} \text{QUANTS } <forall\boxed{7}| const\text{-}of(\boxed{7},\boxed{6}) > \\ \text{NUC} \begin{bmatrix} const\text{-}of \\ \text{CONST } \boxed{7} \\ \text{SUM } \boxed{8} \end{bmatrix} \end{bmatrix} \right\} \end{bmatrix} >
\end{bmatrix}
$$

I assume that the choice between (32) and (33) is made on semantic ground. Thus, for instance, to analyze collective reading examples like (22a) with the entry (32) will yield semantic anomaly, because it is not the case each constituent member of the group 'gathers'.

Moreover, as Sag & Fodor (1994) argue, if FQs are treated as VP-adjoined modifiers, then the ungrammaticality of (19b) can be elegantly explained employing a traceless approach to extraction available in HPSG. If we treat extraction by lexical rules (Pollard & Sag 1994) or by the Argument Realization constraint (Bouma *et al.* 2000), then traces need not be posited in (19). Consequently, examples like (19b) are ruled out, simply because there is no VP/AP that FQs can combine with.

Next, the generalization that floating quantifiers are hosted by (contextually) definite NPs is accounted for, because, according to (32) and (33), the SUBJ element of the VP that *all* modifies has a QS member whose DET is *the*. Therefore, if the host NP is an indefinite NP like *some students*, the DET value of the NP's QS is *exists*, which conflicts with the constraint imposed on the descriptions (32) and (33).

Furthermore, the use of the relation *constituent-of* predicts that a singular entity cannot be the host of a floating quantifier. Since there is no plural (or group) entity from which its constituents can be extracted, the following examples are correctly ruled out:

(35) a. *The student has all/each arrived.
     b. *Each student had all arrived.

Finally, in (32) and (33), the universal quantifier associated with the floating quantifier is required to be retrieved lexically and take scope over the VP that it modifies. Thus the quantifier associated with *all* does not inherit into a larger phrase or the lexical head that selects the phrase. Consequently, when the modified VP contains a modal or negation, *all* has wide scope over such scopal elements. This explains the interpretations of (7a) and (8a). Likewise, when *all* is lower than the modal or negation element in the structure, as in (7b) and (8b), it takes narrow scope.

So far our discussion has been focused on the quantifier *all*. The analysis proposed for *all* can be easily extended to the discussion of *each* or *both*. As Dowty & Brodie note, unlike *all*, *each* and *both* are restricted to individual-level NPs and do not have group reference.

(36) a. *Each (of the) student(s) gathered in the stadium.
     b. *Both students are a happy couple.

This implies that, between the two types of logical forms, (21b) and (22b), only the (21b) type is available. Thus for *each* and *both*, the following type of representation would hold:

(37) [the y| P(y)]([∀x| constituent-of'(x,y)] Q(x)).

The distinction between *each* and *both* will, of course, come from the fact that *both* is limited to an NP whose cardinality is 2. Since the FQ *each* does not occur with collective predicates, its lexical entry will look like the first entry of *all*.

(38) *each*

$$
\begin{bmatrix}
\text{MOD} & \text{VP} \vee \text{AP}\begin{bmatrix}\text{SUBJ} <\text{NP}\begin{bmatrix}\text{QS} \{[2]\}\end{bmatrix}> \end{bmatrix}: [3] \\[2em]
\text{CONT} & \begin{bmatrix}\text{QUANTS } [5] \\ \text{NUC } [3]\,[\text{ARG } [8]]\end{bmatrix} \\[2em]
\text{POOL} \{[4]\} \cup \{[2]\} \\[1em]
\text{QS} \{\} \\[1em]
\text{RET } [5] < [2]\begin{bmatrix}\text{DET } the \\ \text{IND } [6]\end{bmatrix}, [4]\begin{bmatrix}\text{DET } forall \\ \text{IND } [8] \\ \text{RST} \left\{\begin{bmatrix}const\text{-}of \\ \text{CONST } [8] \\ \text{SUM } [6]\end{bmatrix}\right\}\end{bmatrix} >
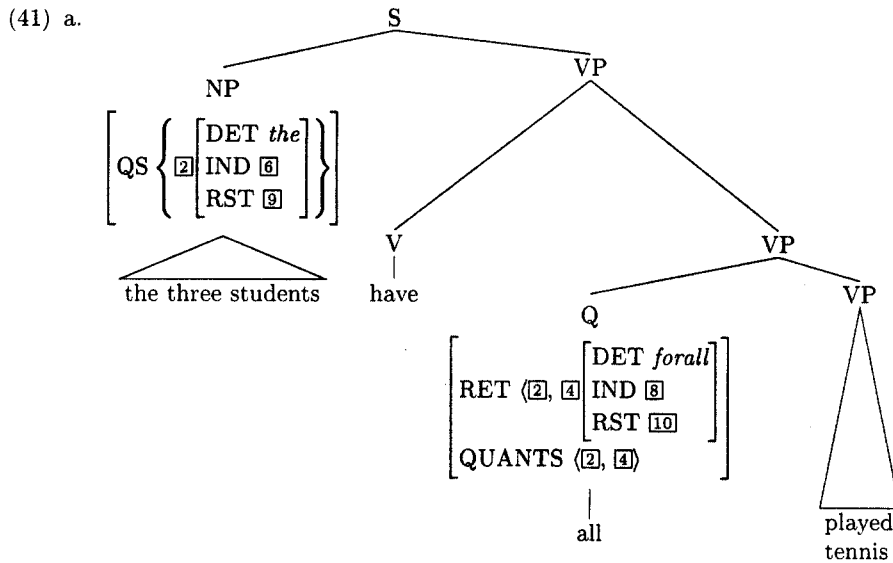\end{bmatrix}
$$

The present analysis can also account for the examples like (39)-(40) where the host NP contains a quantifier with a more complex RST value.

(39) The three students have all played tennis.

(40) John's students all came to the party.

In (39), we take the quantifier in the QS(TORE) value of the subject NP to be '[the $y|$ students'(y) & $|y| = 3$],' in which $|y|$ indicates the cardinality of y. As (32) imposes, this quantifier, indicated by $\boxed{2}$ in (32), cannot be retrieved or inherited into a larger VP. Instead, it is retrieved lexically, together with the universal quantifier arising from *all*. Consequently, in (39), there will be two quantifiers in the QUANTS list of the sentence, i.e., '[the $y|$ students'(y) & $|y| = 3$]' and '[$\forall x|$ constituent-of'(x,y)]'. This is shown in the structure (41).

(41) a.

(38) *each*

$$
\begin{bmatrix}
\text{MOD} & \text{VP} \vee \text{AP}\begin{bmatrix}\text{SUBJ} <\text{NP}\begin{bmatrix}\text{QS} \left\{\boxed{2}\right\}\end{bmatrix}>\end{bmatrix} : \boxed{3} \\[2mm]
\text{CONT} & \begin{bmatrix}\text{QUANTS } \boxed{5} \\ \text{NUC } \boxed{3}\,\begin{bmatrix}\text{ARG } \boxed{8}\end{bmatrix}\end{bmatrix} \\[2mm]
\text{POOL} \left\{\boxed{4}\right\} \cup \left\{\boxed{2}\right\} \\[1mm]
\text{QS} \{\} \\[2mm]
\text{RET } \boxed{5} < \boxed{2}\begin{bmatrix}\text{DET } \textit{the} \\ \text{IND } \boxed{6}\end{bmatrix},\ \boxed{4}\begin{bmatrix}\text{DET } \textit{forall} \\ \text{IND } \boxed{8} \\ \text{RST} \left\{\begin{bmatrix}\textit{const-of} \\ \text{CONST } \boxed{8} \\ \text{SUM } \boxed{6}\end{bmatrix}\right\}\end{bmatrix} >
\end{bmatrix}
$$

The present analysis can also account for the examples like (39)-(40) where the host NP contains a quantifier with a more complex RST value.
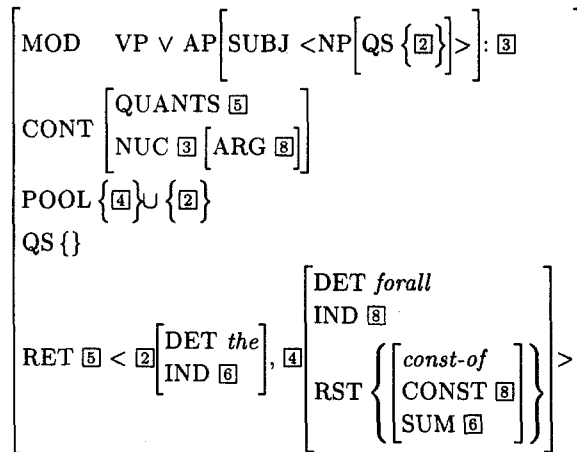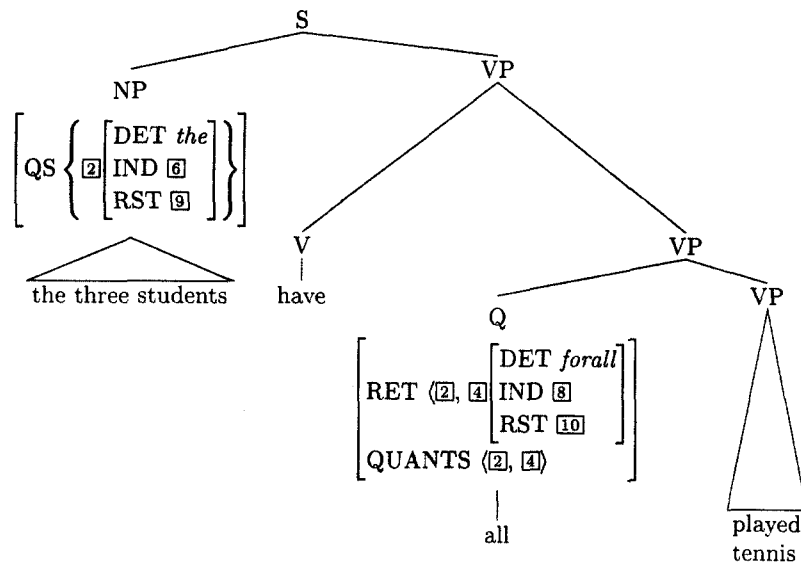
(39) The three students have all played tennis.

(40) John's students all came to the party.

In (39), we take the quantifier in the QS(TORE) value of the subject NP to be '[the y| students'(y) & |y| = 3],' in which |y| indicates the cardinality of y. As (32) imposes, this quantifier, indicated by $\boxed{2}$ in (32), cannot be retrieved or inherited into a larger VP. Instead, it is retrieved lexically, together with the universal quantifier arising from *all*. Consequently, in (39), there will be two quantifiers in the QUANTS list of the sentence, i.e., '[the y| students'(y) & |y| = 3]' and '[∀x| constituent-of'(x,y)]'. This is shown in the structure (41).

(41) a.

```
                              S
                 ┌────────────┴────────────┐
                NP                          VP
   ┌──────────────────────┐      ┌──────────┴──────────┐
  [QS {[2][DET the          ]     V                     VP
          IND [6]          ]     │            ┌─────────┴─────────┐
          RST [9]         }]    have          Q                  VP
   ┌────────┴────────┐                  ┌─────┴─────┐            /\
   the three students                   [RET ⟨[2],[4][DET forall  played
                                              IND [8]          tennis
                                              RST [10] ]]
                                          QUANTS ⟨[2],[4]⟩ ]
                                              │
                                             all
```

13

b.
$$\boxed{9}=\left\{\begin{bmatrix} students \\ \text{INST } \boxed{6} \end{bmatrix}, \begin{bmatrix} count\text{-}cardinality \\ \text{GROUP } \boxed{6} \\ \text{CARDINALITY } 3 \end{bmatrix}\right\}$$

c.
$$\boxed{10}=\left\{\begin{bmatrix} const\text{-}of \\ \text{CONST } \boxed{8} \\ \text{SUM } \boxed{6} \end{bmatrix}\right\}$$

Likewise, in (40), the quantifier in the RET and QUANTS list of *all* is the definite quantifier associated with the subject NP and the universal quantifier arising from *all*. The QS of the subject NP *John's students* looks like (42).

(42)
$$\begin{bmatrix} \text{QS}\left\{\begin{bmatrix} \text{DET } the \\ \text{RESTIND } \begin{bmatrix} \text{IND } \boxed{6} \\ \text{RST } \boxed{9}\left\{\begin{bmatrix} students \\ \text{INST } \boxed{6} \end{bmatrix}, \begin{bmatrix} possess \\ \text{POSSESSOR } \boxed{0} \\ \text{POSSESSED } \boxed{6} \end{bmatrix}\right\} \end{bmatrix} \end{bmatrix}\right\} \end{bmatrix}$$

Thus the two quantifiers in the QUANTS list of the sentence will be '[the y| students'(y) & possess'(john, y)]' and '[∀x| constituent-of'(x,y)]].' Accordingly, complicated examples such as (39-40) can also be handled by the lexical entries in (32) and (33).

5. Concluding Remarks

In this paper, a constraint-based, lexical approach to English floating quantifier constructions has been presented. Based on Dowty & Brodie's assumption that floating quantifiers are base-generated as a VP modifier, I have focused on providing an appropriate CONTENT value for the sentences containing floating quantifiers. I have also shown that various properties of floating quantifiers, with respect to syntactic distributions, the types of host NPs, and scope interaction with adjacent elements, can be accounted for by a precise description of the lexical entry of the floating quantifiers.

In representing the semantic contribution of the floating quantifiers, I have proposed that both "quantifier storage" and "quantifier retrieval" take place lexically at their sites. Accordingly, a floating quantifier, as an adjunct daughter of the larger VP, carries all the necessary semantic information, including the quantifier meaning. The mechanism of lexical specification of quantifier retrieval has been independently motivated. As shown in the discussion of the example containing a quantificational possessive, certain quantifier words need to be specified with a nonempty QUANTS value.

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