

Floating Quantifiers and Lexical Specification of Quantifier Retrieval

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Abstract

Floating quantifiers (FQs) in English exhibit both universal and language-specific properties, and this paper shows that such syntactic and semantic characteristics can be explained in terms of a constraint-based, lexical approach to the 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.

1 Introduction

This paper deals with floating quantifiers (FQ) in English 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, this paper presents an analysis in which a floating quantifier is 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, this paper presents 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. I will show that 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, 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.

- (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 contestants, who were selected as finalists by the judge yesterday, will all perform again tomorrow.
- (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 contestants* usually have an interpretation equivalent to 'at least five contestants'. However, as (5d) illustrates, in a certain context, they may have a definite interpretation, i.e., 'exactly five particular contestants', and host a floating quantifier.

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'. $(\forall x (\text{student}'(x))) \text{not}'(\text{leave}'(x))$
b. The students didn't all leave.
b'. $\text{not}'((\forall x (\text{student}'(x))) \text{leave}'(x))$
- (8) a. The contestants all can win.
a'. $(\forall x (\text{contestant}'(x))) \text{can}'(\text{win}'(x))$
b. The contestants can all win.
b'. $\text{can}'((\forall x (\text{contestant}'(x))) \text{win}'(x))$

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 of *appear* and *all* takes wide scope, 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 they are 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. $\square \forall x P(x) \leftrightarrow \forall x \square P(x)$

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.¹

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 in that the generalization can no longer hold that the

¹ 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.

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 as in (15):

(15) NP[^] ... [_{XP} 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).²

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), something must be said in 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).

² 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.

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:

$$(20) \langle 1, [{}_{VP} Q VP], Q'(VP) \rangle$$

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 crucially focuses 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 in Pollard & Sag (1994) will be adopted, as developed in Pollard & Yoo (1998). 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, it has to be first considered what kind of logical forms can be assigned to the sentences with floating quantifiers. Since the host NPs are plural NPs, it should be decided how to deal with plural NPs in the semantic representation. 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 as in (21b), using an informal restricted quantificational logic notation:

- (21) a. The students all sneezed.
b. $(\forall x (\text{students}'(y) \ \& \ \text{a-constituent}'(x,y))) \text{ sneezed}'(x)$

In (21b), 'a(tomic)-constituent' is a function that resembles Link's (1983) function '*' forming a join semi-lattice, 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. $(\forall x (\text{students}'(y) \ \& \ \text{a-constituent}'(x,y))) \text{ gathered}'(y)$

Although (22b) introduces vacuous binding of a variable, it does not do any harm; rather it helps us to collapse the logical forms in (21b) and (22b) into (23), in which ‘x/y’ indicates the choice between x and y. (See also Kang (1998) for the claim that the distributivity vs. collectivity distinction is only reflected on predicate parts, not on the quantifiers.)

$$(23) (\forall x (P(y) \& \text{a-constituent}'(x,y))) Q(x/y)$$

When Q is a distributive predicate, Q(y) is semantically abnormal, so only Q(x) applies. On the other hand, when Q is a collective predicate, Q(x) is semantically abnormal, so only Q(y) applies. When Q is ambiguous between distributive and collective readings, both Q(x) and Q(y) are possible.

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 as in (24).

$$(24) \left[\begin{array}{l} \text{QUANTS} < \boxed{4} \left[\begin{array}{l} \text{DET } \textit{forall} \\ \text{RESTIND} \left[\text{IND } \boxed{8} \right. \\ \left. \text{RESTR} \left\{ \left[\textit{students} \right. \right. \right. \\ \left. \left. \left. \text{INST } \boxed{6} \right\}, \left[\begin{array}{l} \textit{a-constituent} \\ \text{CONSTITUENT } \boxed{8} \\ \text{SUM } \boxed{6} \end{array} \right\} \right] \right] > \\ \text{NUC } \boxed{3} \left[\begin{array}{l} \textit{sneeze} \\ \text{SNEEZER } \boxed{8} \end{array} \right] \end{array} \right]$$

In (24), the numeral tag $\boxed{6}$ indicates a plural entity, while $\boxed{8}$ expresses a constituent member of the plural entity.

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:

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

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*:

$$(26) \text{ word} \rightarrow \text{ord-head} \vee \text{quant-word} \vee \text{sem-vac}^3$$

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 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.

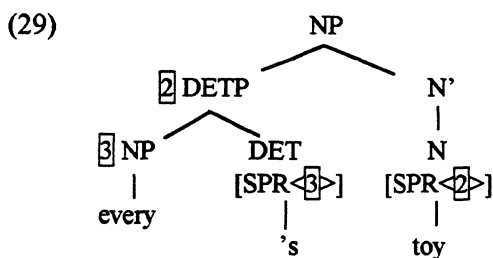
Besides the case of English FQs, there are other examples where lexically specified quantifier retrieval is necessitated. Consider the following example from Carpenter (1994):

(27) Every kid's favorite toy broke.

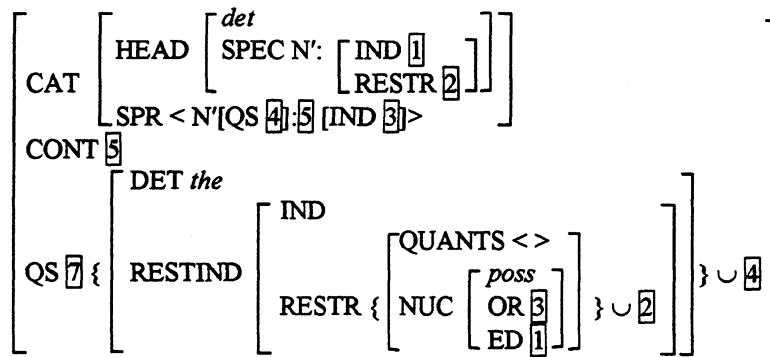
Example (27) is ambiguous between the wide scope interpretation and the narrow scope interpretation of the universal quantifier. Disregarding the adjective to avoid unnecessary complication, the two readings can be rendered as in (28):

- (28) a. $(\forall y (\text{kid}'(y))) (\text{the } x (\text{toy}'(x) \ \& \ \text{poss}'(y,x))) \text{ broke}'(x)$
 b. $(\text{the } x (\text{toy}'(x) \ \& \ ((\forall y (\text{kid}'(y))) \text{ poss}'(y,x)))) \text{ broke}'(x)$

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 '[$\forall y (\text{kid}'(y))$]' 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).



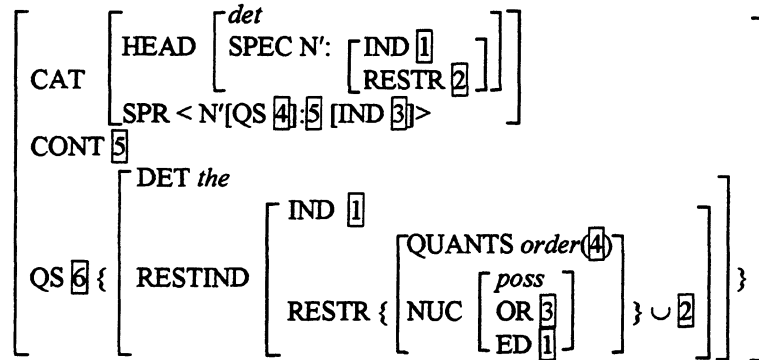
(30) 's (revised entry 1)



³ 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.

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)

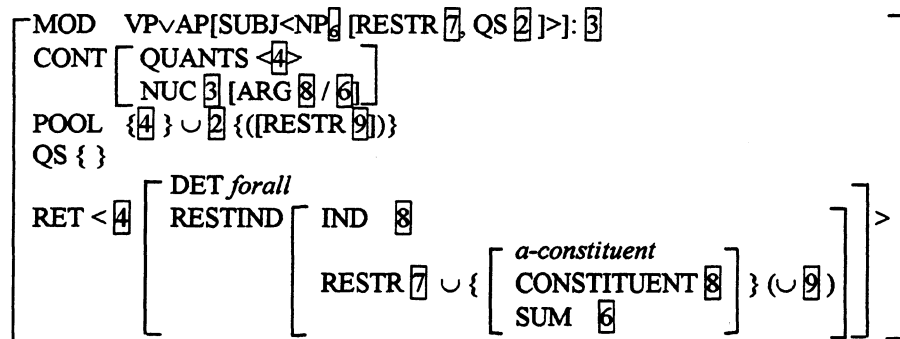


In (31), the elements in the QS of the N', indicated by $\boxed{4}$, are retrieved and appear in the QUANTS of the RESTR value within the QS of 's. Thus the retrieval of the quantifier associated with the specifier is lexically specified. Accordingly, this independently motivates our claim that lexical 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 lexical entry of the floating quantifier *all* be described as in (32):

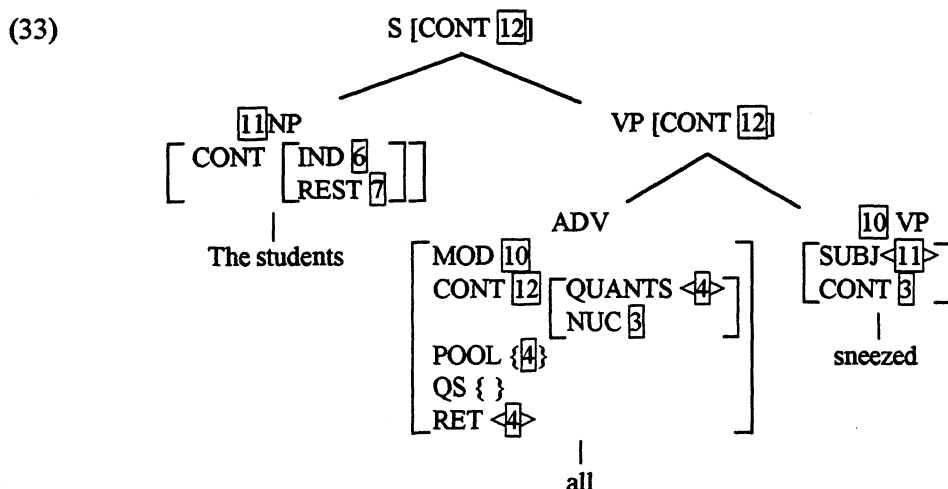
(32) *all*



In (32), the CONT value represents the logical form in (23). The quantifier $\boxed{4}$ in the QUANTS list corresponds to the restricted quantifier part ' $\forall x (P(y) \ \& \ \textit{a-constituent}'(x,y))$.' 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), for instance, will have the CONT in (24).

There is another technical detail to note. In the POOL value, the description ' $\boxed{2} \left\{ \left(\text{[RESTR } \boxed{9}] \right) \right\}$ ' should be taken to indicate either an empty set or a set containing a member whose RESTR value is $\boxed{9}$. In the RET, $\boxed{9}$ is added in the RESTIND|RESTR value only when $\boxed{2}$ is a nonempty set. This additional POOL value is necessary when we deal with an example involving a host NP which itself contains a

quantifier. This type of examples will be discussed at the end of this section. Given the lexical entry in (32), the following structure can be assigned to the sentence in (21a):



Now let us consider how the lexical entry in (32) provides explanations for the properties of FQs discussed in section 2. First of all, the fact that only three words, *all*, *each*, and *both*, are used as floating quantifiers is easily explained, since only these three will have a lexical entry that looks like (32). Other quantifiers in English will only have the entry of determiners.

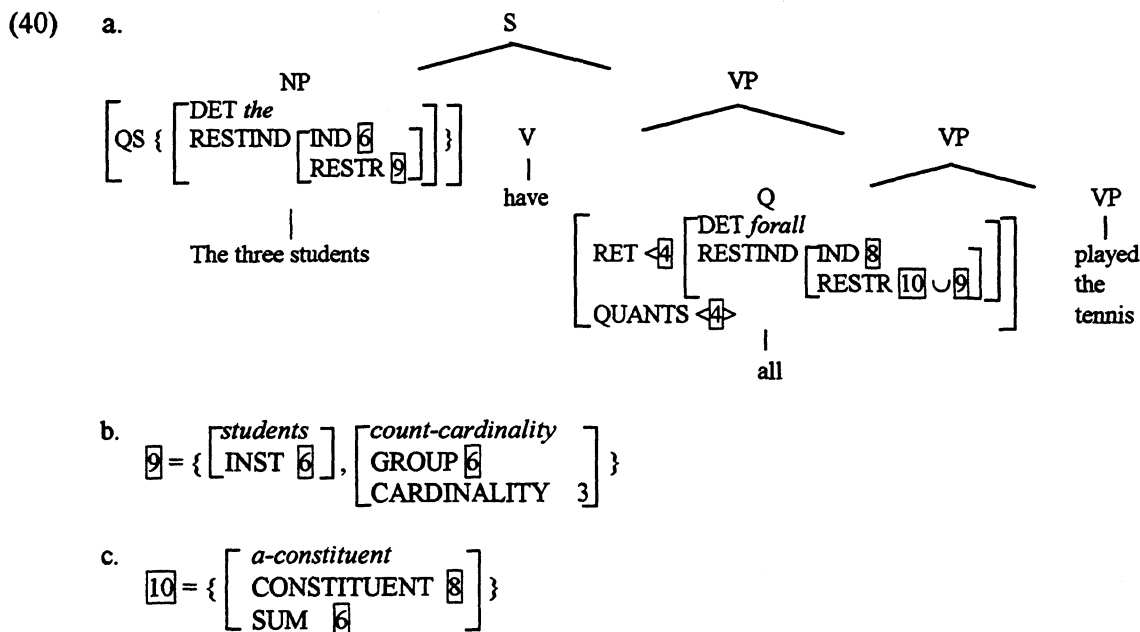
Second, the subject-oriented property of floating quantifiers is accounted for, since the index of the quantifier 8 is related to that of the VP or AP subject, i.e. 6, via the relation *a(tomic)-constituent*. This analysis also can be extended to account for FQs in the languages allowing both subjects and objects to have corresponding floating quantifiers. This is because the FQ may access the arguments of the verb that it modifies via the ARG(UMENT)-ST(RUCTURE) feature (or the SUBJ and COMPS features) of the verb.

Third, as *all* selects a VP or AP via its MOD feature, it appears as a modifier of a VP or AP in the structure. In other words, *all*, as a adjunct daughter, combines with a VP or AP, constituting a head-adjunct phrase. Yet it remains to be answered why the modifier does not appear in the post-VP positions, as (3e-f) illustrate. There seem to be two ways to account for this. One solution is to posit a Linear Precedence (LP) rule that holds between “light” modifiers like FQs and a modified VP/AP. (See Abeille & Godard (1999:92) for the same type of the LP rule proposed for French.) In the LP rule, we can specify that a “light” non-head daughter must precede the head daughter. Alternatively, if we adopt Bouma et al.’s (2000) proposal that post verbal adjuncts are added to the DEPENDENTS list by a lexical rule, then we can specify that certain adverbs such as *all*, *both*, *each*, *only*, *never*, *certainly*, and *probably* are not added by this lexical rule. The only way these adverbs are introduced in a sentence is via a head-adjunct structure in which the head comes after the adjuncts.

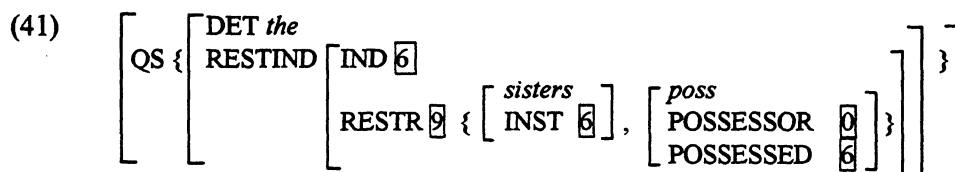
Moreover, as Sag & Fodor (1994) argue, if FQs are treated as VP-adjoined modifiers, then the ungrammaticality of (19b) can be elegantly explained, employing a traceless approach to extraction available in HPSG. If we treat extraction by lexical rules (Pollard & Sag 1994) or by the Argument Realization 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, in the present analysis, the generalization that floating quantifiers are hosted by (contextually) definite NPs is explained in terms of the relation *a(tomic)-constituent*. We assume that this relation holds only when it is possible to single out each constituent (or member) of the given entity, in this case, a specific plural entity. If the group entity is not contextually determined, it is not possible to pick out its constituent members. Therefore, if the host NP is an indefinite NP like *some students*, it cannot be an argument of the relation *a-constituent*, thus making the sentence in question semantically anomalous. Furthermore, the use of the relation *a-constituent* 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

structure:



Likewise, in (39), the quantifier in the RET and QUANTS list of *all* is the universal quantifier whose restriction partly comes from that of the QS associated with the subject NP. The QS of the subject NP *John's sisters* looks like (41).



Since the RESTR value 9 in (41) will be added to the RESTR value of the universal quantifier, the quantifier in the RET and QUANTS list will have the form, '[$\forall x$ (sisters'(y) & poss'(john,y) & a-constituent'(x,y))]'.' Accordingly, complicated examples such as (38-39) can be also handled by the lexical entry (32).

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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