FLOATING QUANTIFIERS, PARTITIVES AND DISTRIBUTIVITY[*]

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1. Floating Quantifiers

Commonly, the quantifier expressions of natural language are *arguments* of the verb, such as subjects, direct objects or objects of prepositions. In this respect, they differ crucially from the free-standing quantifier prefixes of first-order logic, as has often been observed by the proponents of generalized quantifier theory (Barwise and Cooper (1981)). This theory treats quantifiers such as *every student* or *most teachers* on a par with prototypical argument expressions such as proper names and pronouns (following Montague's (1973) innovation to employ 'lifted' types <<e,t>,t> for proper names and other referring terms). At the same time, it must also be acknowledged that nominal arguments are not the only elements with quantificational force and in some languages not even the most frequent or central ones. Thus, there are adverbs of quantification, such as e.g. *often* in (1a) below (see Lewis (1975) and De Swart (1991) for discussion). Quantifiers may also be (pro-) nominal expressions used as modifiers, such as *all* in sentence (1b) and *none of them* in sentence (1c).

(1) a. Australian terriers are often good mouse-catchers.
     b. We were all wounded at Wounded Knee.
     c. The deans were none of them fond of jeans.

In sentence (1b), the quantifier *all* is neither in an argument position, nor is it selected by any expression within the sentence. Consequently it is entirely optional. Compare this with the use of *all* in (2), where it is neither optional nor in a nonargument position.

(2) a. All were wounded at Wounded Knee.
     b. He destroyed all to save himself.
     c. One for all and all for one!

A quantifier expression used in the way *all* is used in (1b) is said to be a *floating quantifier*. The adjective *floating* is meant to indicate that its position is not necessarily fixed, but variable. Compare the three positional variants in (3).

(3) a. We all should have been drinking tea.
     b. We should all have been drinking tea.
     c. We should have all been drinking tea.

This variability has been the main topic of discussion in the smallish literature on floating quantifiers. How is it to be accounted for? Must we assume a movement transformation (and if so, of what kind?), or is it perhaps preferable to base-generate floating quantifiers? However, there are more questions that demand an answer, before a reasonable understanding is gained of the phenomenon of quantifier flotation. For example, what is the semantic status of floating quantifiers? What kinds of quantifiers float? And what are the syntactic category and the internal structure of a floating quantifier? It is a basic assumption of this paper that all these questions are related and ought to be answered together, in an integrated theory of the syntax and semantics of floating quantifiers. It is further assumed that it will be useful to

compare floating quantifiers across a number of languages. The more data points we have at our disposal, the easier it will be to decide among alternative theories. In this paper, most of the data come from English, Dutch and German, but I hope it will be possible to extend the analysis to other unrelated families of languages.

2. Floating Quantifiers and Bound Anaphora

The general distribution of floating quantifiers shows strong similarities with that of bound anaphora such as reciprocals and reflexives (as noted for example in Oosthuizen 1989). Thus, they require an appropriate antecedent within the same clause:

(4)   a.   The kids were all happy that their parents had left.
       b.   The kids were happy that their parents had all left.

For example, in sentence (4b), the floating quantifier *all* must have the expression *their parents* as its antecedent, and not *the kids*. This is obvious from the meaning of the sentence (4b cannot be read as equivalent to 4a), but it can also be demonstrated on the basis of more tangible criteria, such as the possibility of substitution one of the plural elements in (4b) by a singular expression:

(5)   a.   The kid was happy that the parents had all left.
       b.   *The kids were happy that a parent had all left.

Since the antecedent of *all* must be plural[1], only the non-antecedent plural term in (4b) can be replaced by a singular term. As the examples in (5) show, this term is the matrix subject, and not the embedded subject, since only the former can be so replaced.

In addition to the clause-mate condition familiar from the study of bound anaphora, we can also show the existence of a c-command condition on the antecedent-floating quantifier relation. The sentences in (6) are ungrammatical, because the floating quantifier is not c-commanded by a possible antecedent, although each clause has a plural noun phrase which could serve as such.

(6)   a.   *The kid all liked his friends.
       b.   *The kid has all invited them.
       c.   *My parents' dog was all cute.

Compare this with the grammatical sentences in (7).

(7)   a.   The kids all liked his friends.
       b.   The kids have all invited them.
       c.   My parents' dogs were all cute.

However, the following examples from Dutch seem to shed doubt on the c-command requirement, since in each case the floating quantifier is structurally more prominent than its antecedent.

(8)   a.   Geen van allen waren ze   tevreden.
             None of all   were they content
             "They were none of them content"

      b.   Allemaal heb ik ze   uitgenodigd.
                All   have I them invited
                "I have invited them all"
      c.   Allebei hebben we teveel   gedronken.
                All-both have   we too much drunk
                "We have both of us drunk too much"
      d.   Geen van tweeën kenden we Turks.
                None of two's knew   we Turkish
                "We knew neither of us Turkish"

Here, the floating quantifiers appear in sentence-initial position, a position that is structurally more prominent than any other and asymmetrically c-commands all other positions, including those of the antecedents of the floating quantifiers.

      However, this particular set of examples does not in itself destroy the parallelism between floating quantifiers and bound anaphora such as reflexives, since it is well-known that the c-command condition on bound anaphora is lifted precisely for topicalized anaphora. Some Dutch examples to illustrate this point are given in (9).[2]

(9)   a.   Zichzelf vindt Evert niet opwindend.
                Himself finds Evert not exciting
                "Himself, Evert does not find exciting"
      b.   Voor zichzelf heeft Nellie geen tijd.
                For herself has   Nellie no   time
                "For herself, Nellie has no time"

Fronted floating quantifiers can also be found in German:

(10)   a.   Alle haben sie gelogen.
                All have they lied
                "They all lied"
      b.   Beide waren sie dabei.
                Both were they present
                "They were both present"

Again this can be shown (although no examples will be given here) to correlate with the possibility of fronting reflexives. More puzzling in this regard is the fact that English floating quantifiers are resistant to topicalization, unlike their Dutch and German counterparts. For example, the following examples are all rather bad.

(11)   a.   *All, they were very happy.
      b.   *Each, I had given them flowers.
      c.   *Most of them, the boys were asleep.
      d.   *Neither of them were they pleased.
      e.   *Both, the gangsters were deceived.

This resistance to topicalization is not reflected in the behaviour of reflexives and reciprocals, since the latter may be fronted.

(12)   a.   For himself, Fred would never ask this favour.
      b.   In each other's arms they found perfect bliss.
      c.   At herself, Helen directed her sharpest barbs.
      d.   Even themselves, they cannot trust.

In general, then, Oosthuizen's hypothesis is not quite consonant with the available evidence. The distribution of floating quantifiers, while showing strong similarities with that of bound anaphora, cannot be equated with it. This point can be strengthened if we consider long extraction. It is well-known that bound anaphora can be fronted out of embedded clauses, which then may lead to ambiguities in binding. For example, sentence (13) below can be read either as (14a) or as (14b).

(13)   For himself, Fred thought Harry would not ask this favour.

(14)   a.   Fred thought Harry would not ask this favour for himself.
      b.   Fred thought Harry would not ask this favour for him.

Here, the data are no different in Dutch, as illustrated by the two readings of (15), indicated here by indices.

(15)   Voor zichzelf$_{ij}$ dacht   Fred$_i$ dat Harry$_j$ nooit deze gunst zou vragen.
      For   himself   thought Fred that Harry never this favour would ask

Long extraction of floating quantifiers, however, is awkward at best and does not yield ambiguities of binding.

(16)   a.   *?Allemaal dacht ik dat ze   ziek waren.
          All   thought I that they sick were
      b.   *Geen van allen wou   ik dat ze   bleven.
          None of all   wanted I that they stayed
      c.   Allebei$_i$/*$_j$ wouden we$_i$ dat ze$_j$ bleven.
          All-both   wanted we that they stayed
          "We both wanted that they stayed"

In English, where no fronting of floating quantifiers is allowed, long movement is of course ruled out a forteriori. To conclude this section: The remarkable similarities in distribution between floating quantifiers and bound anaphora are partly disturbed by differences having to do with fronting to clause-initial position (in English) and by long fronting out of the clause (in Dutch and English).[3] It will be argued later on in this paper that the similarities in question are not accidental, but stem from the basic properties of bound anaphora and floating quantifiers as modifiers of predicates.

3. Movement Accounts of Floating Quantifiers

3.1. The traditional account

The traditional generative analysis of floating quantifiers is that they float off some NP-host:

(17)   All these kids are potential criminals. ==>
        These kids are all potential criminals.

This kind of analysis does not seem to have any recent endorsements, however, because of a number of basic problems that it leads to. First of all, the rule would be an instance of a lowering rule, which is capable of moving a quantifier element from subject position into the VP. Such lowering rules are often considered to be ruled out by general principles.[4] Second, sometimes there are simply too many floating quantifiers per host:[5]

(18)   These kids are all potential criminals and have each received several warnings already.

Here, it is inconceivable that both *all* and *each* have floated off the same subject NP. A third problem arises with plural agreement (as noted e.g. in Partee 1971):

(19)   a.   Each of these men shaves himself.
        b.   These men each shave themselves.

The putative source for (19b), (19a), has singular number agreement, whereas (19b) itself has plural agreement. Unless we allow transformations to globally change syntactic features, this kind of effect is very difficult to deal with.
        A fourth problem that arises has to do with restrictions on partitive noun phrases. As discussed in Hoeksema (1984), and Reed (1988, this volume), partitives with a conjunction following *of* are not good: *each of Tom, Dick and Harry*, *none of Fred, Ed, and Ned*. However, conjunctions can be hosts/triggers of floating quantifiers:

(20)   a.   Tom, Dick and Harry have each had a BLT sandwich.
        b.   Fred, Ed and Ned have all been to France.

3.2. Sportiche's (1988) account

Some of the problems raised above for the traditional movement account of floating quantifiers are countered in the alternative transformational theory of Sportiche (1988). According to Sportiche, the so-called floating quantifier is syntactically inert. What moves is its host. This entails that the subject originates inside the VP, and not just for passive and ergative predicates, as previously thought. Sportiche's proposal immediately solves the first problem. The movement operation in question is no longer a lowering rule. Similarly, the second problem disappears. Cases such as (18) above are now seen as involving extraction-across-the-board, a well-attested phenomenon whereby multiple gaps are satisfied by a single filler (cf. Ross 1967). The third problem, involving the pair of sentences in (19), may or may not be solved, depending on whether one treats the agreement after or before movement. If agreement is marked at surface structure, the particular problem of (19) might go away, although non-local versions of this problem remain. Consider the following pair of sentences:

(21)   a.   Each of the men left after he had been insulted.
        b.   *The men each left after he had been insulted.

The only way to account for the ill-formedness of (21b) on Sportiche's theory would be to show that neither the NP *[each t]* cannot be an antecedent of *he* nor the NP *the men*. The

latter part is easy: mismatch in number features prevents any direct link between *the men* and *he*. However, the first part of the task is more difficult. One might suppose that *[each t]* is too low to c-command the adverbial clause headed by *after*, but this is incorrect, since it is possible for quantifiers even when they occur in object position to bind pronouns in *after-* clauses:

(22)   Fred kissed each girl after she kissed him.

Another alternative might be to suggest that expressions containing traces cannot bind pronouns. But the examples in (23) show that expressions containing traces may bind pronouns.

(23)   a.   Which students did you obtain [the phone number of t]$_i$ after it$_i$ had become obsolete?
        b.   What city could you remember [the name of t]$_i$ only after it$_i$ had been changed by the revolutionaries?

I conclude that the problem involving the binding of singular pronouns raised by Partee (1971) still poses a major obstacle for modern transformational accounts. One might note that Sportiche's paper concentrates on French *tous* and English *all*, both of which are plural floating quantifiers and do not create the kind of problem that *each* creates here.

    The fourth problem for the traditional account, which involves the examples in (24), also still stands, although Sportiche (1988: 440) dismisses it as no more than the sort of complication that any theory of floating quantifiers must face. But rather than dismiss this problem, one could also say that it is no more than one case of a very general problem for any movement account, which is that the moved element and the stranded element do not really fit together in their putative source. For example, there is the problem of partitive floating quantifiers which have a pronoun instead of a gap:

(24)   a.   These guys were neither of them very smart.
        b.   We were all of us really delighted to come.
        c.   They were all of them trained linguists.
        d.   You are none of you in very good shape.

A simple movement account would have to postulate the following ungrammatical strings as the underlying forms for these sentences:

(24')   a.   [e BE [neither of them these guys very smart]]
        b.   [e BE [all of us we really delighted to come]]
        c.   [e BE [all of them they trained linguists]]
        d.   [e BE [none of you you in very good shape]]

Sportiche (1988: 445) supposes that the pronouns in (24) are spelled-out gaps, resumptive pronouns in other words. Thus, (24a) could be derived as follows:

(24")   [e BE [neither of these guys very smart]] ==> movement
        [these guys BE [neither t very smart]]   ==> trace spelling
        [these guys BE [neither them very smart]] ==> of-insertion
        [these guys BE [neither of them very smart]]

This suggestion lacks plausibility, however. There is no great similarity between the pronouns in the floating partitive quantifiers and the types of resumptive pronouns that are otherwise found in English. In particular, there is no evidence for resumptive pronouns in so-called A-dependencies (to use the basic concepts and terminology of Sportiche's framework) such as passive or raising constructions in English:

(25)   a.   This problem was talked about on Thursday.
        b.   *This problem was talked about it on Thursday.
        c.   This problem seems to be unsolvable.
        d.   *This problem seems it to be unsolvable.

And even if one can find a way around this problem, there is the additional problem of partitive quantifiers in Dutch. These do not contain personal pronouns and thus cannot be given a treatment in terms of resumptive pronouns. Yet they, too, indicate that floating quantifiers and their 'hosts' do not in fact need to be able to form a well-formed NP constituent:

(26)   a.   De vrouwen waren geen van allen verlegen.
              The women were none of all   shy
              "The women were none of them shy"
        b.   *Geen van allen de vrouwen waren/was verlegen.

(27)   a.   De decanen waren geen van drieën optimistisch.
              The deans   were none of threes optimistic
              "None of the three deans were optimistic"
        b.   *Geen van drieën de decanen waren optimistisch.

(28)   a.   Wij waren elk van beiden koppig.
              We were each of both   stubborn
              "We were both of us stubborn"
        b.   *Elk van beiden wij/ons waren/was koppig.
              Each of both we/us were/was stubborn

The type in (27), with a plural form of the numeral, is especially interesting. Normally, numerals cannot occur after partitive 'of' unless they are either accompanied by a definite determiner, usually *de* 'the', or else specific indefinites (cf. Abbott, 1995). Here however, they must appear without a determiner:

(27')   *De decanen waren elk van de drieën koppig.

Similar problems with partitive floating quantifiers arise in French (cf. Kayne 1975):

(29)   Ces hommes avaient tous les trois connu Garbo.
       Those men   had   all the three known Garbo
       "Those men had all three of them known Garbo"

Again, there is no possible source NP for a movement account, since *tous les trois ces hommes* is not grammatical.

      In German, the evidence is hardly better for a movement account. Giusti (1990a,b) extends Sportiche's theory to German, and argues for example that the neuter pronoun *alles*

"all, everything" can be stranded by a moved NP, as in

(30)   Wer is heute abend alles da?
        Who is tonight   all   there
        "Who will all be there tonight?"

And indeed, *wer alles* "who all" can form a nominal constituent, as shown by example (31):

(31)   Wer alles war da?
        Who all   was there

Nevertheless, it is easy to find cases where floating quantifier and "host" cannot be pieced together like two parts of the same jigsaw puzzle. For example:

(32)   Es war alles gelogen.
        It was all   lied
        "It was all a lie"
(33)   *Es alles war gelogen.
(34)   *Alles es war gelogen.

Indeed, there are floating quantifiers that never function as determiners or predeterminers in the way required by the movement theory. Such a quantifier is Dutch *allemaal* "all".[6] [7] This expression must float (as in sentence a below) or else sink (as in sentences b-e).

(35)   a.   De boeren hadden allemaal hooikoorts.
                The farmers had   all   hay-fever
                "The farmers all had hay-fever"
        b.   *De boeren allemaal hadden hooikoorts.[8]
        c.   *Allemaal de boeren hadden hooikoorts.
        d.   *Allemaal van de boeren hadden hooikoorts.
        e.   *Allemaal hadden hooikoorts.[9]

        Parallel cases can be found in the Groningen dialect of Dutch. This dialect makes a morphological distinction between pronouns and determiners. Pronouns are frequently derived from the determiners by adding the suffix *-ent*, cf. e.g. *baaide* "both" (determiner) and *baaident* "both" (pronoun). The floating quantifier use turns out to involve the pronominal form, not the determiner form, cf. *Baaide/*baaident kiender gingen mit* "Both children came along" versus *Dij kiender gingen baaident/*baaide mit* "Those children both came along".
        Yet other classes of examples in which floating quantifiers cannot form a constituent with their 'host' involve full quantificational NPs. In earlier stages of English, an NP such as *every man* could serve as a floating quantifier. Instances of this use can be found for instance in the King James (or Authorized) translation of the Bible. Some examples are given in (36) below, together with a similar one from the Book of Mormon:[10]

(36)   a.   (..) then shall they give every man a ransom for his soul unto the Lord (Exodus
                30:12)
        b.   For they cast down every man his rod, and they became serpents: but Aaron's
                rod swallowed up their rods. (Exodus 7:12)
        c.   Then they speedily took down every man his sack to the ground, and opened
                every man his sack. (Genesis 44: 11)

d.   Then they rent their clothes, and laded every man his ass, and returned to the
            city. (Genesis 44: 13)[11]
    e.   they shall eat every man the flesh of his own arm (2 Nephi 19:20)

One may also note here cases with *every one* as a floating quantifier:

    f.   all the Dutch fleet, man-of-war and merchant East India ships, are got every
            one in from Bergen (S.Pepys, Diary, 9 Sept 1665)

There is no reason from either distribution or meaning not to call such quantificational NPs
floating quantifiers, and the fact that they are complete, and not to be analyzed as remnants
stranded by some fronting operation, makes it highly doubtful that Sportiche's theory can be
extended to account for them.
        If floating-quantifier constructions derive from partitives through movement, then we
would expect to find more floating quantifiers than we actually do. For instance, just as we
derive *The boys all left* from *All (of) the boys left*, we can derive **The boys three left* from
Three of the boys left. Indeed, there are no universal laws barring numerals from functioning
as floating quantifiers, as languages such as Japanese shows (cf. Miyagawa 1989, Fukushima
1991):

(37)   Otoko-ga go-nin ki-ta
        man-nom five come-past
        "Five men came"

Hence we must conclude that Sportiche's approach sometimes overgenerates (in the case of
floating numerals in English) and sometimes undergenerates (in the case of floating
quantifiers which do not have a source as a determiner or predeterminer (as we saw in the
case of Dutch *allemaal*).
        A final problem which needs to be mentioned here involves the use of floating
quantifiers in absolute constructions. These constructions, which have the subject-predicate
structure of regular sentences but lack verbs and inflection, may also contain floating
quantifiers:

(38)   a.   With these enemies both on the same planet, it was too dangerous to beam
                Kirk down.
        b.   Only with his enemies each on a different planet would he stand a chance,
                Kirk realized.
        c.   With his crew members not all ready to beam down, Kirk had to play for time.

The point about these examples is that they lack a VP out of which the subject of the absolute
construction could have moved. To the best of my knowledge, there is no evidence
whatsoever for movement in these constructions. While movement could always be
postulated here, it would only be an ad-hoc move to save the theory.[12]
        To sum up: The evidence for a local movement account of floating quantifiers along
the lines of Sportiche (1988), Giusti (1990a,b) and others is weak. The stranding evidence
crucial to such an analysis is available only for a small number of floating quantifiers.[13] In
many other cases a movement analysis is forced to postulate impossible phrases as underlying
sources. There are additional problems with Sportiche's theory that have been discussed in
Doetjes (1992).[14] Doetjes' account of the French data assumes that floating quantifiers are
adverbial in nature and is therefore compatible with my analysis as sketched below.

4. Floating quantifiers as predicate modifiers

The last type of account I will discuss in this paper is the adverbial or modifier account of floating quantifiers. According to this type of analysis, which can be found in one form or another in Dowty and Brody 1984, Roberts (1987), Fukushima (1991), and Van der Does (1992), floating quantifiers are essentially adverbial elements which serve as operators on the verb phrase or parts thereof.

The adverbial theory of floating quantifiers immediately explains why floating quantifiers in English may show up in sentence-medial position (see the examples in (3) above), a position where otherwise only adverbials and parentheticals occur.[15] Other positional aspects of floating quantifiers are a bit harder to account for, perhaps, and need a more detailed investigation than I can offer here.[16] If floating quantifiers are really adverbials, one would also expect them to coordinate with other adverbials. While floating quantifiers do not tend to conjoin much, it is possible to come up with a few conjunctions that do not sound too bad:

(39)   a.   De kinderen hebben allemaal en binnen 14 dagen het zwemdiploma gehaald.
               the children have   all   and within 14 days the swimming diplom earned
       b.   We komen of   allemaal of helemaal niet
               we come either all   or totally not
               "We will either all come, or not at all"

4.1. The principal-filter condition

4.1.1. Restricting quantifier floating by semantic filtering

On the other hand, it would seem that it is harder on the adverbial theory to capture the local relation between the floating quantifier and the noun phrase from which, in the traditional transformational analysis, it has floated away. As Dowty and Brody (1984) have argued, however, a proper formulation of the semantics of floating quantifiers might suffice to express all relevant properties of this relationship. In their analysis, a floating quantifier restricts the domain of a functional expression. A verb phrase, for instance, can be viewed as a mapping from generalized quantifiers to truth-values (cf. Keenan and Faltz (1985) for a detailed proposal). Adding a floating quantifier may restrict this mapping to a subset of the original class of quantifiers. They suggest that this subset is the class of principal filters. Principal filters are defined as follows:

(40)   *Definition*

      Let Q be a collection of subsets from the domain of discussion E. Then if there is a subset A of E, such that for all X in Q, $A \subseteq X$, we say that Q is a principal filter, more precisely, the principal filter generated by A.[17]

In set notation: the principal filter generated by A is $\{X \subseteq E \mid A \subseteq X\}$. In Barwise and Cooper (1981), principal filters are denoted by definite NPs and universally quantified NPs, such as *the students, those of us who knew Freud, we the people, all nations, every corner,*

each moment. The definition in (39) would shed light on the difference in acceptability between the examples in (41) below and those in (41') (all examples taken from Dowty and Brody 1984)).

(41) a.   John, Mary and Susan all left.
      b.   John and Mary both left.
      c.   The students all left.
      d.   ?All students in my class must all turn in their exams on Friday.

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

The fact that the subject *no students* and the floating quantifier *all* are mutually exclusive now follows from the semantic properties of *all* as a verb-phrase modifier and not from the illformedness of a putative underlying string *all (of) no students*. An immediate advantage of this is that the grammaticality of sentences such as (41a) and (41b) is no longer a problem. Semantically, a conjunction such as *John, Mary and Susan* corresponds to a principal filter. The fact that there is no corresponding partitive *all of John, Mary and Susan* is irrelevant.

The local nature of the relation between floating quantifier and its host is also explained. By affecting the domain of a verbal predicate, the floating quantifier can only have effects on the direct arguments of that predicate. It cannot have similar effects on noun phrases that are not clause-mates. In the same fashion, the floating quantifier can have no effects on any modifiers of the verbal predicate, which explains observations in the literature (e.g. Seiter 1979) that modifiers are not suitable hosts for floating quantifiers.[18]

In a similar way, superiority effects are captured. If a floating quantifier modifies a transitive verb, it may have effects on the choice of the direct object; if it modifies a verb phrase, it may affect the choice of the subject. However, it cannot combine with a verb phrase and still have effects on the selection of the direct object. This immediately accounts for the Dutch data below.

(42) a.   voordat ze   allemaal ons vernederen
            before they all   us humiliate
            "before they all humiliate us"
      b.   voordat ze   ons allemaal vernederen
            before they us all   humiliate
            "before they humiliate us all"
      c.   *voordat hij allemaal ons vernedert
            before he all   us humiliates
            "before he all humiliates us"[19]

If we view reflexives and reciprocals semantically as relation-reducers, that is, operators on predicates which affect their argument structure, the similarities in distribution between floating quantifiers and bound anaphors such as reflexives and reciprocals are easy to account for. Reciprocals are especially close to floating quantifiers, because they likewise restrict the domain of a function to a certain semantic class, in this case the class of plural quantifiers. The differences in distribution, which were discussed in section 2, are in fact harder to account for. Perhaps it is the fact that fronted anaphors can also be analyzed either

as arguments or as contained in arguments, while floating quantifiers are strictly modifiers, which accounts for the greater ease with which the anaphors can be fronted or extracted out of a subordinate clause. However, before such a claim can be accepted, it will be necessary to gain a deeper understanding of the factors influencing the fronting of adverbials. This problem is beyond the scope of the present paper, but see Szabolcsi and Zwarts (1990), among others, and the literature cited there, for discussion.

4.1.2. The empirical evidence for the principal-filter condition

The principal-filter restriction proposed by Dowty and Brody for hosts of floating quantifiers is reminiscent of a similar constraint proposed in Barwise and Cooper (1981) for partitive noun phrases. The noun phrase following partitive *of* is required to be a definite noun phrase. Definite noun phrases are defined by Barwise and Cooper as denoting proper principal filters.

Despite similarities, the two classes of expressions are by no means identical. I have already mentioned the fact that conjunctions of singular terms may serve as the host to floating quantifiers, yet do not appear after partitive *of*.[20]

Before considering Dowty and Brody's proposal in more depth, let us make a brief detour to look at some cases which I believe are only superficially a problem for the Dowty/Brody approach, because they actually represent a different construction than the one we have been concerned with so far. Consider the examples below (examples a,b), where the initial constituent and apparent host of the floating quantifier is a bare noun and cannot denote a principal filter. These examples represent a construction which is archaic in English, but somewhat more alive in Dutch and fairly productive in German (cf. examples c,d below):

(43) a. Friends have I none.
      b. But answer made it none (Hamlet, Act 1, Scene 2, line 215)
      c. Bücher habe ich keine.
          books have I none
      d. Freunde hat sie sehr viele.
          friends has she very many

Here the host of the 'floating quantifier' has to be indefinite (in most dialects of German, also bare, that is, without an overt determiner), compare (45).

(44) *Die Bücher hatte ich keine.

For these cases, I believe that an analysis in terms of movement (or some nonderivational equivalent thereof) is more nearly correct. This is not the place to go into the many difficult problems that arise, but it is enough for the purposes of this paper if it can be argued that the construction involved here is a different one from the regular floating quantifier construction. Of course, this is not hard to argue, since the fact that one construction became obsolete in English whereas the other one is alive and well suggests very strongly that they should not be viewed as the same. To mention one other difference, note that the host of the floating quantifier is typically topicalized in the construction exemplified in (43-44), whereas hosts in subject position are not usually acceptable, as the following German examples indicate:

(45) *weil   Bücher keine dem Herrn gewidmet waren
        because books none the Lord dedicated were

Compare this with

(46) weil   diese Bücher alle dem Herrn gewidmet sind
      because these books all the Lord dedicated are

It is not clear to me how movement theories of quantifier floating such as Sportiche's can make a proper distinction between regular quantifier floating as in (46) and the kind of quantifier split found in (43). What would prevent the element *BÜcher* in (45) to move into subject position, while allowing it to move into the slot for topicalized elements? Standard devices such as case marking or theta-assigment can't be relied on since they would not distinguish between (45) and (46).

    Leaving aside now cases of quantifier split, let us take another look at the principal-filter restriction. It appears that this restriction is a good first approximation of the data, since it is compatible with the vast majority of cases. As for indefinite subjects, Dowty and Brody allow them just in case they are specific indefinites, following earlier suggestions by Ladusaw (1982) regarding indefinites in partitive constructions. Thus for Dowty and Brody, specific indefinites are semantically (and not just pragmatically) distinct from nonspecific indefinites. They give an example with a nonrestrictive relative clause, to force a specific interpretation:

(47) Five contestants, who were selected as finalists by the judge yesterday, will all
      perform again tomorrow.

To test this claim, I have done a little empirical investigation, checking through all occurrences of *all* in a 6 million word corpus collected mainly from postings on the various Internet bulletin boards. I found the following cases of floated *all* with indefinite subjects (I discarded all cases where in indefinite subject clearly had a generic reading, but some doubtful cases remain):

(48) a.   Buildings, docks, vessels, and details of the Artic landscape are all clearly
            visible.
      b.   The operation of the kiln during the trial burn was controlled and monitored
            far more carefully than under routine daily operation, when variations in waste
            type and quantity, human error, equipment malfunction, and combustion
            upsets all lead to increased emissions.
      c.   "Nations like Liechtenstein (24,000 people), Turks and Caicos Islands (7,000
            people), and Tuvalu (6,000 people) all have representatives in the United
            Nations General Assembly.
      d.   And a great many voices all said together (`like the chorus of a song,' thought
            Alice), `Don't keep him waiting, child!' (Lewis Carroll)
      e.   Unfortunately 4 starters, Brantley, Robinson, Henderson, and Minnesota
            recruit Ryan Wolf all fouled out in a span of two minutes (the Russians fouled
            out three players also but they had much more depth) and the Russians took
            over at the end.
      f.   Horses, riders, people, were all blown about like ships at sea.
      g.   Plaintiff demonstrated a probability of 1 in 4,000, by computing the chance
            that 12 consecutive mistakes would all fall against him.
      h.   Unusual noises on the phone, intensifying whenever UFOs are mentioned, and
            voices breaking in on conversations, have all led many people to suspect that
            their phones are being tapped.
      i.   Israeli historian Yehuda Bauer and Jewish-American historians like Raul

Hilberg and Deborah Lipstadt all state that this anti-German hate story is untrue.

j.   Names like Ngozi (Blessing), Obianuju (One who comes at the time of plenty), Nwa-amaka ("There is nothing as sweet as a child") are all popular girls names.

k.   Student demonstrations, guerrilla theatre, and strong faculty support were all used to counteract the last attempt by the administration to use threats of eviction to modify the relationship between the co-ops and the university.

l.   The reason is obvious: factionalism, policy problems, leadership problems have all rendered the ANC unready.

Some of these cases are best viewed as involving specific readings. This probably includes indefinites with an added *like* (quite a few of the above examples are of this type). Certainly an expression such as *nations like Liechtenstein, Turks and Caicos Islands, and Tuvalu* appears more "specific" than an otherwise contextually equivalent expression such as *miniature nations*. In the case of (48e), it is even more obvious that we are dealing with a specific indefinite. In (48b) we might be dealing with a generic indefinite subject. Other cases, however, are genuine counterexamples. For example, (48g) can't be interpreted as being about 12 specific consecutive mistakes. The same is true for the subjects of (48d,f,h,k,l).

In the same corpus, I found one example with *each* floating off an indefinite (and nonspecific) subject and two with *both*:

(49)   a.   A mathematician, scientist, and engineer are each asked: "Suppose we define a horse's tail to be a leg."

b.   Early research results and practical experience both suggest that clarithromycin is much more promising than any of the standard treatments.

c.   How could it be, I wondered, that two seemingly upstanding, highly regarded people could both be speaking of such diametrically opposed scenarios?

On the other hand, cases of *all* or *each* floating off regular quantifiers, such as *no student* or *every administrator*, were not found,[21] and it is here that we find the part of Dowty and Brodie's condition which seems robustly confirmed by empirical evidence. I note, however, that even here, some cases appear to be better than others. In particular, I'd like to suggest that when *no* is used to quantify over groups, rather than individuals, the result seems better than expected, cp.:

(50)   a.   No two consecutive numbers are both divisible by two.

b.   No three consecutive numbers are each prime.

c.   *No students have each baked a pie.

d.   *No administrators have each/all made a difference.

Brame (1979: 134) offers the following sentence which is likewise problematic for the Principal Filter-condition:

(51)   Of the five boys, only John and Bill both shouted at each other simultaneously.

Somewhat borderline are cases with two *all*'s. Dowty and Brodie give the a question mark, and in the corpus, such examples are much rarer than one would expect if they were fully acceptable. On the other hand, I did find some examples of this type, which suggests they are

not ungrammatical.

(52)   a.   All the beautiful women you find in Bond movies were all drooling over these fat old guys with pot bellies and seventeen underchins!
        b.   All the nice looking guest-hotels are all full
        c.   all the DRUMS and SPACE segments I witnessed all had interesting moments

It is probably the redundancy of the floating quantifier, together with a stylistic resistance to the double use of the same word in a single clause which is responsible for the low numbers of such cases and the intuition that these sentences are less than perfect.

      Combined, the data suggest the following explanation: When the subject is a quantified NP, with a distributive quantifier, there is no need for a distributive quantifier in the VP. In the case of 'semi-distributive'[22] determiners such as *all*, the result is only a mild deviation from the norm. When the determiner is strictly distributive, such as *each*, the addition of a floating quantifier makes the sentence more clearly unacceptable.

(53)   a.   Each student had a proposal.
        b.   *Each student each/all/both had a proposal.

Even here, it seems that there are some subtle difference. It seems that floating *each* is somewhat better in (53b) than floating *all*: while the first strikes one as overly redundant, the use of *all* gives the feeling of a clash between the individuals quantified over by *each student* and the groups required for the proper use of *all*.[23]

      To conclude, it is evident that Dowty and Brody's filtering approach to the distribution of floating quantifiers is too restrictive. It rules out fairly infrequent but acceptable use of floating quantifiers with nonspecific indefinites and the interactions of quantified subjects with quantifier floating which it correctly rules out can also be explained by means other than the filtering approach. Apart from these empirical concerns, there is also a theoretical reason to favor a slightly different approach.

4.1.3. Scope and higher-order types

The higher-order types (VPs take their denotation in the type <<<e,t>,t>,t> of functions from generalized quantifiers to truth-values) which Dowty and Brody (1984) postulate for verb-phrase denotations can also be found in Keenan and Faltz (1985) as well as Montague's UG (Montague 1970). On a descriptive level, where one is concerned primarily with the correct statement of the truth-conditions of the sentence, there is no harm in using higher-order types instead of lower-order ones. However, from a more theoretical point of view, they raise the question if these types are ever crucially needed. In the case of noun phrases, some could be interpreted in the simple type <e> of entities, whereas others crucially take their interpretation in the type <<e,t>,t> of generalized quantifiers. Is there similar evidence that some VPs crucially have to be interpreted as sets of generalized quantifiers, one may ask. The answer to this question seems to be "No", at least if one disregards for the time being predicates with floating quantifiers.

      For example, if we could find a predicate which only applies truth-fully to generalized quantifiers that are closed under intersection we would have an argument that some predicates must crucially take their interpretation in type <<<e,t>,t>,t>. However, no such predicate appears to exist.

      Keenan and Faltz (1985) impose a number of conditions on VP-denotations which

serve to constrain the possible VP-denotations to only those which can be derived from denotations in type <e,t> by type-lifting. As Van Benthem (1987) has stressed, it then becomes more attractive to view <e,t> as the basic type of VPs, because under that assumption it follows automatically, without stipulating any meaning postulates or semantic universals, why there are no essential <<<e,t>,t>,t> denotations for VPs. And indeed Keenan's more recent work has dropped the higher-order types for predicates (cf. Keenan 1987).

For the treatment of monotonicity properties, it is necessary to view subject and object as functions over one-place and two-place predicate denotations, respectively. To show this, I need a few definitions. First, and elementary, let *entailment* be a relation '<' among members of t, such that

(54)   0 < 0
        0 < 1
        1 < 1

but not 1 < 0. Using entailment as our basic notion, we can define in terms of it a notion of *generalized entailment* which holds between functions of the same type (cf. Keenan and Faltz 1985):

(55)   f < g iff f(a) < g(a) for any a in the domain of f and g.

For example, if f and g are members of <e,t>, '<' will correspond to the subset relation among the sets associated with these characteristic functions. In this generalized sense, *terrier* entails *dog*, and *munch* entails *eat*.

We say that a function f is *monotone increasing* (mon↑) just in case whenever a < b, we also have f(a) < f(b), for all a,b in the domain of f. Likewise, a function f is monotone decreasing (mon↓) just in case f(b) < f(a) whenever a < b. If a function is neither mon↑ nor mon↓, we call it nonmonotone.[24]

Let xyz be an expression with denotation ||xyz||, then we say that y has a *positive occurrence* in xyz just in case ||y|| < ||y'|| implies that ||xyz|| < ||xy'z||, and that y has a *negative occurrence* in xyz just in case ||y|| < ||y'|| implies that ||xy'z|| < ||xyz||.

Consider now the case where z is the empty string, x is the main functor and y its argument. Then ||xy|| = ||x||(||y||). The expression y occurs positively in xy just in case x denotes a mon↑ function and negatively in xy just in case x denotes a mon↓ function. Note however that the functional expression x has a positive occurrence regardless of the denotation of y, since ||x|| < ||x'|| is defined as ||x||(a) < ||x'||(a) for any a in the domain of ||x|| and ||x'||, and hence ||xy|| < ||x'y|| by definition.

The upshot of the above is that there is a basic asymmetry between functions and arguments vis-à-vis monotonicity properties: the main functor of an expression always has a positive occurrence in that expression, whereas the argument only has a positive occurrence when the functor denotes a mon↑ function.

Negative polarity items must have a negative occurrence,[25] positive polarity items must have a positive occurrence (cf. Ladusaw 1979, Zwarts 1981, 1986, Hoeksema 1983). We find here that a subject can trigger a negative polarity item in the VP (or block a positive polarity in that position) but not vice versa. We also find that a direct object may trigger a polarity-sensitive verb, but not vice versa (see Hoeksema 1983 and for some qualifications Hoeksema 1994). The following examples serve to illustrate this point.

(56)   Negative-polarity items in VPs triggered by the subject.
        a.   Nobody/*Jim *budged an inch*.
        b.   Few people/*many people had *ever* seen him.
        c.   Neither/*either student *lifted a finger*.
        d.   Not everybody/*Everybody *need* apply.

(57)   Polarity-sensitive verbs triggered by the direct object.
        A: Dutch
        a.   Ik geloof dat we niemand/*Jan *hoeven* te wekken.
                I believe that we nobody/*Jan need   to wake up
                "I believe that we don't need to wake up anybody/Jan"
        b.   Ik kan geen/*elk van hen *uitstaan*.
                I can none/each of them stand
                "I can stand none/each of them"

        B: English
        a.   You *need* say nothing.
        b.   He *could stand* none of them.

This is predicted, given that the subject has a monotonicity effect on the verb phrase, but not vice versa, and that the direct object has a similar one on the verb. For illustration, consider the following inferences with *nobody*:

(58)   Nobody ate or drank --> Nobody ate
(59)   John likes or respects nobody --> John likes nobody

In each case we may replace a disjunction by one of its members. This is possible only in mon↓ environments. In spite of common usage, which calls the subject and the direct object the arguments of the verb, we have to consider them functors, which take verbal elements as their arguments. More precisely, they are functors which send n-place predicates to n-1 place predicates.

        To return now to our main topic, we see that the higher-order treatment of Dowty and Brody (1984) a view of function-argument structure which goes against our current understanding of monotonicity phenomena. Note also that negative floating quantifiers do not trigger polarity items in subject position, something which one would expect on the Dowty/Brody analysis, cf.:

(60)   a.   *The parents of any students were none of them very pleased.
        b.   None of them knew the parents of any students.

This concludes our argument that for purposes of scope, it is best not to give the VP a higher-level interpretation which makes it a functor with scope over the subject. For further discussion and additional problems which arise if NPs are not treated as functors over n-place predicates, I refer the reader to Keenan (1987) and Hoeksema (1989).

4.2. The semantics of floating quantifiers

4.2.1. The operators of Van der Does (1992)

Van der Does (1992), partly following earlier proposals by Roberts (1987), Link (e.g. 1991)

and others, introduces a number of operators which model the meaning of various natural language floating quantifiers. These operators are of type $\langle\langle\langle e,t\rangle,t\rangle, \langle\langle e,t\rangle,t\rangle\rangle$, the type of functions which send collections of sets of individuals to collections of sets of individuals. The type $\langle\langle e,t\rangle,t\rangle$ itself, which is usually reserved for the generalized quantifiers which serve as NP-denotations, is used by Van der Does to provide interpretations for plural VPs, in order to capture the intuition that a plural VP is interpreted not a property of individuals but as a property of sets.[26] The operators (Van der Does calls them "modifiers", a term which I will reserve for their natural-language counterparts) are called α, τ, δ, and π, and are defined as follows:

(61)   *Definition of four operators.*

$\alpha := \lambda X \lambda Y. X(Y) \ \& \ |Y| = 1$ (pure) atomic

$\tau := \lambda X \lambda Y. X(Y) \ \& \ |Y| > 1$ collective

$\delta := \lambda X \lambda Y. AT(Y) \subseteq X$ distributive

$\pi := \lambda X \lambda Y. Y \subseteq \cup X$ partaking in

The α-operator "selects the pure atoms or individuals from the denotation of a VP" (Van der Does 1992: 61). According to Van der Does, there does not appear to be an exact English counterpart to α, although it might seem at first blush that expressions such as *alone, on his/her own, all by him/herself* would have the same force. Van der Does warns against any such presumption, explaining that when Perdeck buys a book all by himself, we not only understand this to entail that the singleton {perdeck} is in the set of entities which buy a book, but also, that he is not a member of a larger set which also buys that book. On this matter, it seems to me, Van der Does is wrong. The fact that Perdeck cannot be part of a larger group which buys a book if he buys the book all by himself, while hard to deny, must not be ascribed to the semantics of the adverbial expression *all by himself*, but rather to the lexical semantics of the verb *buy*. Like other verbs of its kind, it resists multiple agents (at least per buying event): if a buys a book, then b cannot also buy it, unless we have a sequence of buying events. If we consider a different type of predicate, such as *weigh more than 300 pounds*, the situation changes. Clearly, Perdeck could weigh more than 300 pounds on his own, while belonging to a club of weight-watchers whose collective weight is also more than 300 pounds. However, there is a more compelling reason why *alone* or *on his own* is not quite synonymous with α: while α is purely quantificational, *alone*, like its counterpart *together*, also has an important spatio-temporal meaning component (see Lasersohn 1990 for a proposal on the proper treatment of *together*). Thus when we hear that Brad sleeps alone, we not only understand that {Brad} is in |sleep|, but also that his bedpartner Janet is spatio-temporally removed from him. If we ignore this aspect, we can view *alone* etc. as the English counterparts to α.[27]

The τ-operator marks predicates for collectivity. Again, there is no precise counterpart to τ in English, although *together* could be used if one ignores its spatio-temporal aspects or in contexts where space/time plays only a minor role. Thus two writers can write a novel together without having to overlapping in either space or time.

The δ-operator, borrowed from Link and defined here in terms of AT, the set of atoms (within $\langle\langle e,t\rangle,t\rangle$, AT is the set of singletons), can be expressed in English by means of the floating quantifier expression *each*. Often, natural language leaves δ unexpressed, because the meaning of the verb or verb phrase is such that a collective reading is ruled out or because the subject add distributive force (cf. the discussion of the principal-filter constraint above). Thus in Van der Does' example below, the use of *each* appears somewhat redundant:

(62)   The Mitarios each admire the Montagues.

The effect of *each* here is to force each singleton {x} such that x is a Mitario to be included in |admire the Montagues|.

The π-operator expresses the notion of partaking in. Van der Does illustrates this operator with the following example:

(63) The Mormons spread the Word.

Besides a distributive and a collective reading, this example also has a mixed reading, such that various groups (perhaps partly overlapping) of Latter Day Saints are involved in missionary activities. It is this reading that the operator π is intended to capture. Van der Does does not suggest a natural-language counterpart for π.

The operators defined by Van der Does have a great many noteworthy formal properties. For example, they are all idempotent, which is to say that for any of these operators $O(O(X)) = O(X)$. (Hence $O(X)$ is a *fixed point* for O.) This property might explain why iteration of the same floating quantifier is not found in natural language: If iteration does not affect the meaning of the predicate, then it is more economical to apply the operator only once.

Combinations of operators are often equivalent to just one of the operators. Thus Van der Does remarks that the composition of δ and π equals π (i.e. that function h such that $h(X) = \delta(\pi(X))$ equals π) while the composition of π and δ equals δ (hence the innermost operator "wins" in these combinations). Perhaps more interesting for us is the interaction of δ and τ. Here we note the following:

(64)   a. $\delta(\tau(X)) = \lambda Z[AT(Z) \leq \lambda Y[X(Y) \wedge |Y| > 1]] = \{0\}$
        b. $\tau(\delta(X)) = \tau(X)$

From (64a) we see, that applying δ to the result of applying τ to an arbitrary set *X* leaves us with a trivial result. On the other hand, if we apply both operators in reverse order, the result is equivalent to just applying τ. This goes a long way toward explaining why the distributive operator *each* and the collective operator *together* normally do not occur together:

(65)   a.   *The students each lifted the sofa together.
        b.   *The students together each lifted the sofa.

4.2.2. Tinkering with the types

Sometimes, we want to distribute a predicate over groups which are members of a collection, without distributing it over the members of those groups themselves. Consider for instance the following example:

(66)   The Beatles and the Stones both have recorded this song.

Intuitively, it is appealing to interpret the subject of this example as a pair {b,s}, where b and s are themselves groups of individuals. What *both* does in this example is to distribute the predicate *have recorded this song* over these two groups, without entailing that each individual Beatle and each individual member of the Rolling Stones also have recorded the song.

Lest it be thought I make the example up, let me present a collection of examples which I culled from my corpus. In each case, the total number of individuals or events involved is more than two, but there is a two-way partition in the subject denotation corresponding to the conjuncts.

(67)   a.   In the church, men and women are both called to minister to the saints, but God only permits men to teach and exercise authority over other men.

           b.   Fox executives and ``Home Alone'' producer John Hughes have both indicated they want to do a sequel.

           c.   Hitler's successes and later downfall were both dependent on making illogical (and therefore unexpected) military moves.

           d.   The mighty and the humble are both counted as one.

Sentences of this kind are not so easy to capture in an approach such as the one offered by Van der Does. If the VP is of type <<e,t>,t>, then it should take as its argument an element of type <e,t>, which is to say, a set of individuals. Taking, for the moment, the groups b and s to constitute sets, not individuals, then one is forced to interpret the conjunction *The Beatles and the Stones* as the union of b and s (see Schwarzschild 1990 for a spirited defense of such a treatment). However, after taking the union of b and s, there is no obvious way in which the floating quantifier *both* could distribute the predicate over two elements: instead of the two elements b and s, we have the eight members of b ∪ s.

One might suppose at this point that a contextually-provided partition of the subject denotation could provide us with the means to interpret cases like the above (cf. e.g. Gillon 1987, Schwarzchild 1990). However, there is no evidence that such an approach is correct. Quite on the contrary. If the context were to provide a partition, one would expect discourses such as the following to be acceptable:

(68)   The animals were separated by sex. #The pigs, the cows and the sheep were both sold to out-of-towners.

Given that the first sentence sets up a partition of the animals in two groups, male and female animals, the second sentence should be interpretable as saying that both the male and the female pigs, cows and sheep were sold to out-of-towners, but the phrasing is definitely odd. The three-way partition of the animals suggested by the syntactic form of the subject clearly overrides the effects of context. Taking this as a hint, I propose to adopt my earlier treatment in Hoeksema (1983b, 1988), in which the domain of quantification, where the expressions of type <e> find their denotation, is enlarged to contain not just individuals, but also groups of individuals, groups of groups of individuals and so on.[28] Predicates can then retain their familiar type <e,t>, rather than take a denotation in <<e,t>,t>. The latter type is now reserved once again for non-referring or quantificational NPs (cf. Partee and Rooth 1983, Hoeksema 1988). Floating quantifiers have the type of adverbs, <<e,t>,<e,t>>.

The distributivity operator δ may be given the following definition in this general setting:

(69)   δ(P)(X) iff for all x∈X: P(x)[29]

Unlike Van der Does' δ, this distributivity operator does not have the property of idempotency, since the predicate is distributed only over the members of its argument, not the members of the members (of the members etc.). We could define an idempotent version of the distributivity operator in the present setting (simply replace ε in def. (69) by its transitive

closure ε*), but I consider it better not to do so. Earlier on, in my discussion of Van der Does' work, I have suggested why the idempotency property is a nice one from a linguistic point of view (besides its obvious mathematical elegance), because it explains why iteration of *each*, for instance, is not normally found in natural language: the iteration would be redundant, hence otiose. However, if we ask ourselves what the truth-conditions are of the following sentence, we note an apparent ambiguity, related to distributivity:

(70)   The Beatles and the Stones each made many hit records.

We can take this to mean that each band made many hit records, or, perhaps, in some contexts, that each individual member of these bands made many hits. Note that both readings involve the distributivity operator. If we were to take δ to be idempotent, then we should always be able to distribute the predicate over the individual band members, but this does not appear to be correct.

    Moreover, the argument from noniteration loses some of its force when we consider cases where two similar distributivity operators combine. While it does not seem possible to combine two occurrences of *each*, it does not seem to be quite as bad to combine *both* and *each*:

(71)   (a)   The Stones and the Beatles both each made over a million $.[30]
        (b)   #The Stones and the Beatles each both made over a million $.

While (71a) is awkward but grammatical, (71b) is not good. Thus we see that *both* and *each* do not commute. Given our semantics, it is easy to see why only the order in (71a) is correct. Let P stand for the predicate *make over a million $*, E and B for *each* and *both*, respectively, and b and s for the Stones and the Beatles, respectively. Then (71a) is interpreted as follows:

(72) $B(E(P))\{b,s\} = E(P)(b) \& E(P)(s) = $ For all $x \, \varepsilon \, b$: $P(x)$ & for all $y \, \varepsilon \, b$: $P(y)$.

whereas (71b) is interpreted as:

(73) $E(B(P))\{b,s\} = B(P)(b) \& B(P)(s)$.

However, the formulas B(P)(s) and B(P)(b) incorrectly presuppose that s and b have exactly two members.

    The reader may wonder about any cases where a predicate is clearly distributed over the urelements of some group. Can they be handled with the present definition of δ? The answer to this question is "No, but don't worry". In such cases, the full distributivity is due to the lexical semantics of the predicate in question. Consider for instance the following sentence:

(74)   The Beatles and the Stones are all male.

Here the property of being male is distributed over John, Paul, Ringo etc. all the way down to Bill Wyman. Even without the floating quantifier *all*, this predicate may only hold of a group iff it holds of all of its members. Hence a sentence such as (75) can only be seen as a falsehood:

(75)   The Mama's and the Papa's are male.

We can enforce this property in our semantics by means of meaning postulates:[31]

(76)   For any X: be-male(X) iff for all x: xεX -> be-male(x)

Note that this definition entails distributivity all the way down to the urelements of X, but also the inverse property of closure under group formation: if X and Y are in the denotation of be-male, then so will {X,Y}, and similarly for larger collections of groups. This seems justified, because the only way a group of individuals can have the maleness-property is by inheriting it from its members.

We are now ready to define the semantic import of the various floating quantifiers of English, such as the ones occurring in the following definitions:

(77)   *Semantics of English floating quantifiers.*

$\|$each$\|$(P)(X) = for all xεX: P(x), where $|X| \geq 2$
$\|$both$\|$(P)(X) = for all xεX: P(x), where $|X| = 2$
$\|$all$\|$(P)(X) = for all xεX: P(x), where $|X| \geq 2$[32]
$\|$all$\|$(P)(X) = for all x@X: P(x) (mass reading)
$\|$neither of them$\|$(P)(X): for all xεX: ¬P(x), where $|X| = 2$
$\|$none of them$\|$(P)(X): for all xεX: ¬P(x), where $|X| \geq 2$
$\|$all n of them$\|$(P)(X) = for all xεX: P(x), where $|X| = n$
$\|$most of them$\|$(P)(X) = $|\{x εX: P(x)\}| > |\{x εX: ¬P(x)\}|$

These definitions ensure the equivalence of such statements as *Each of the students wrote a paper* and *The students each wrote a paper*, without requiring us to derive the one sentence from the other.

5. Floating quantifiers as a linguistic category

The lexical treatment of floating quantifiers has a number of consequences that have not been spelled out in detail yet. First of all, it is necessary to lexically mark items for use as floating quantifiers. In other words, the class of floating quantifiers is not entirely predictable by general rule. This is of course obvious in the case of words such as Dutch *allemaal*, which are only used as floating quantifiers, but the assumption of lexical marking is also needed to ensure that expressions which in one language may function as floating quantifiers do not automatically get classified in the same way in another language. Thus we have seen that in English, partitive expressions with pronouns are used as floating quantifiers, e.g. *neither of them, none of them, all three of them, most of them*, yet in Dutch the self-same constructions do not have this use at all:

(78)   a.   *Zij waren geen van hen tevreden.
              They were none of them content
         b.   *Zij waren elk van hen gelukkig
              they were each of them happy

And while some determiners/pronouns double as floating quantifiers, others shun such usage. Thus consider the following paradigms:

(79) *All*   *None*
      a.   All of them were happy.   a.   None of them were happy.
      b.   All were happy.   b.   None were happy.
      c.   They were all happy.   c.   *They were none happy.

Among English partitive expressions, we must distinguish among the cases that are grammatical floating quantifiers and those which are not, such as *few of them* and *a few of them*:

(80)   a. *They were few of them at ease.
        b. *They were a few of them happy.

Again, lexical marking will have to be invoked, since they does not appear to be any general reason why these items should not be used as floating quantifiers. Lexical marking is of course expected under the adverbial theory advanced here, since the use of noun phrases as adverbial elements in general requires that the items involved be given a separate category (say VP/VP in categorial terms). The existence of arbitrary gaps is not explained, but is no more unexpected than, say, the existence of intransitive verbs which cannot be used transitively, or the existence of lexical exceptions to the dative alternation: whenever lexical items may occur in more than one category, we tend to find these idiosyncracies.
    Considering the class of all floating quantifiers as a whole, we note that, at least in such closely related languages as Dutch, German, English and French, there is a tendency to recruit floating quantifiers from a small number of classes: determiners and numerals (sometimes with added morphology, cf. the Dutch suffix *-maal*), and partitive constructions. On the whole, the most common and most frequently studied floating quantifiers are simple determiners, whereas the partitives appear to form a more peripheral class. The partitives involved are different in English and Dutch. In English, they are of the form *Det of Pronoun* (where the pronoun in question is a personal pronoun), in Dutch, of the form *Det1 van det2*, where *Det2* is an intransitively used determiner or numeral. In the English cases, one may wonder why the pronouns in question are not reflexives. One might suppose here that this has an historical explanation: At the time when the use of partitives as floating quantifiers was grammaticized, the personal pronouns could still have local antecedents. At some point in its development (as attested e.g. by the examples cited in (36) from the King James Version of the Bible), also regular NPs of the form *every N* could be used as floating quantifiers with pronominal subjects. In categorial terms, this would require the category (VP/VP)/(NP/N) for the determiner *every*.[33]
    Besides the need for distinguishing floating quantifiers as a class from determiners and quantificational pronouns, there is also a need to distinguish floating quantifiers from other types of adverbs. It is an understatement to say that adverbs do not form a homogeneous class. There are adverbs which are really ad-adjectives, and adverbs which are really ad-sentences, and adverbs which are really ad-XPs (like some of the focus adverbs such as *only* and *even*). Floating quantifiers stand out as a special class, with some properties of their own. For instance, they coordinate only among themselves:

(81)   a.   Je moet ze of allemaal of geen van allen uitnodigen.
                you must them either all or none of all   invite
                "you must either invite all of them or none of them"
        b.   *Je moet ze en allemaal en zo spoedig mogelijk uitnodigen
                you must them and all   and as soon as possible invite
                "You must invite them both all and as soon as possible"

Similarly in English:

(82)   a.They were either most of them or all of them Republicans.
       b.*They were most of them and secretly Republicans.[34]

This might be argued to be a semantic property, comparable to other restrictions on coordinating adverbs: e.g. manner adverbs and temporal adverbs do not always combine well either.

Within the class of floating quantifiers, special reference has to be made for those items which combine with pronouns directly and those which combine with numeral expressions (e.g. so-called *binominal each*, cf. Safir and Stowell (1987) for some discussion). An expression which only has the latter use is *apiece*.[35] Thus we have:

(83)   We were all invited/We all were invited
       We were none of us invited/*We none of us were invited

(84)   We each received $25/We received $25 each
       We all received $25/*We received $25 all
       *We have apiece paid $25/We have paid $25 apiece.

Similar data can be found in Dutch, as the following pronoun data show: the lexical item *tweeën* can modify a pronoun but not a verb phrase, whereas *geen van tweeën* can modify a verb phrase but not a pronoun. (Yet other expressions, such as *allemaal* can be used in both fashions.)

(85)   a.   Wij tweeën waren aanwezig.
               we two's were present
       b.   *Wij waren tweeën aanwezig
       c.   Wij waren geen van tweeën aanwezig
               we were none of two's present
       d.   *Wij geen tweeën waren aanwezig

In this paper, the special properties of pronominal and numeral modifiers will not be discussed any further.

6. Conclusions

After comparing various approaches to the treatment of floating quantifiers, the adverbial theory of Dowty and Brody (1984) was adopted as best suited to account for the local dependency between the floating quantifier and its host as well as the adverbial character of the floating quantifier (evident in its word-order properties). A number of differences between the distribution of floating quantifiers and bound anaphora such as reflexives were pointed out and the transformational accounts of quantifier floating (both the old kind that lowers the floating quantifier into the VP and the new kind, due to Sportiche, that raises the host while leaving behind the floating quantifier) where rejected on a number of grounds, using evidence from English (including older stages of English), Dutch, French and German.

In the final part of the paper, the semantic properties of floating quantifiers were treated in light of current proposals dealing with plurality and plural quantification. It was argued that conjunctions must be interpreted through the mechanism of set formation and not set union to account for the use of the floating quantifier *both* with subjects such as *the boys*

and the girls, where the cardinality of the union of both sets (boys and girls) is not or not necessarily two, but the cardinality of number of conjuncts is.

   The principal-filter constraint proposed by Dowty and Brodie (1984) was rejected on empirical grounds: A study of floating quantifiers in a large corpus revealed too many exceptions.

Notes

1. I am assuming that we can distinguish the use of *all* in (4) from its use in (i) below, were it means something like *completely* and can have a singular antecedent:
   (i) John was all wet.
In Dutch, the two uses of *all* are distinguished by two expressions, *allemaal* and *helemaal*:
   (ii) De jongens waren allemaal nat.
      The boys were all (of them) wet
   (iii) De jongens waren helemaal nat.
      The boys were all (completely) wet

2. Another case where the distribution of floating quantifiers does not appear to mirror that of anaphoric expressions is that of verb-projection fronting. Floating quantifiers do not topicalize along with a nonfinite verb:

(i) *Allemaal zingen doen we niet
   all sing do we not
   "We don't all sing"

(ii) *Geen van allen gedanst hebben we
   none of all danced have we
   "We have none of us danced"

In this respect, floating quantifiers appear to differ from both anaphoric elements and adverbials, which are happy to front along with the verb:

(iii) Snel gedanst hebben we niet
   fast danced have   we not
   "We have not danced fast"

(iv) Zichzelf belonen mag ie niet
   himself reward may he not
   "He may not reward himself"

(v) Elkaar vliegen afvangen doen ze graag
   each-other flies off-catch do they eagerly
   "They are eager to score off each other"

However, there is a similarity here with sentence adverbs, which likewise appear to resist fronting as part of a verbal group:

(vi) *Helaas gedanst hebben we
   unfortunately danced have we

(vii) *?Nooit geweten heb ik het (cf. Nooit heb ik het geweten/Geweten heb ik het nooit)
   never known have I it

(ix) *Volgens Ada gefaalt heeft Karel.
   according to Ada failed has Karel

3. Another difference between reflexives and floating quantifiers is that reflexives may sometimes exhibit long-distance binding by antecedents in higher clauses, whereas floating quantifiers never seem to have hosts in higher clauses (excepting cases of scrambling where constituency is no longer fixed). A well-known example of a reflexive which permits long-distance binding is Icelandic *sig*, but one could also recall the case of English picture-noun reflexives (cf. Kuno 1987 for example), or reflexives in exception phrases (cf. Keenan 1988):

(i)   The teacher knew that he would ask anybody except herself.
(ii)   We were wondering whether pictures of ourselves would sell.

4. In GB, this follows if all movement creates traces and traces have to be bound by c-commanding elements (which are structurally superior). But see Stowell (1981) for a proposal which allows lowering. In GPSG, lowering is ruled out by the slash mechanism, which calls for elimination of the slash feature at some higher level.

5. Cf. Dowty (1986). Van der Does (1992) calls sentences such as (18) *Dowty-sentences*.

6. There is actually a determiner *allemaal*, but this is not semantically related to the floating quantifier *allemaal*.   The determiner does not mean "all" or "every", like the floating quantifier, but something like "a lot", and unlike universal quantifiers, it is weak in the sense of Barwise and Cooper (1981), which entails that it can be used in existential sentences:

(i)   Er   waren allemaal problemen.
         There were alot-of problems

Perhaps it is best compared to English phrases like *all kinds of*, which also have the property of being weak. The distribution of the determiner *allemaal* is peculiar. For instance, it does not appear in measure-objects, just as English *all kinds of* doesn't appear there:

(ii)   *Het feest duurde allemaal uren (OK: vele, verscheidene)
        *the party lasted all-kinds-of hours (OK: many, several)
(iii) *Het boek kostte allemaal guldens (OK: vele, verscheidene)
        *the book cost all-kinds-of guilders (OK: many, several)

7. In this respect Dutch *allemaal* differs somewhat from its Afrikaans cognate and counterpart *almal* which can head a partitive construction (Oosthuizen 1989: 2):

(i)   a.Sy haat almal van hulle.
         She hates all of them
         b.Sy haat hulle almal. (with floated *almal*)
         She hates them all

It can also occur as a pronominal argument (Oosthuizen 1989: 156) and so it has the distribution of English *all* rather than that of Dutch *allemaal*:

(ii)   Almal blyk ongelukkig te wees.
         All   seem unhappy   to be

8. Note however that *allemaal* is grammatical as a postmodifier of a pronoun, as in:

(i)   Wij allemaal hebben gefaald.
        we all   have   failed
(ii)   Een geschenk van ons allemaal
        a   present of us all

However, unlike the floating quantifier *allemaal*, the postmodifier does not cooccur with a weak (unstressed or clitic) pronoun, cf. the following contrast (*we* is the weak variant of *wij*):

(iii)   We hebben allemaal hard gewerkt
        we have   all   hard worked
        "We have all worked hard"
(iv)   *We allemaal hebben hard gewerkt.

This makes it unlikely that (iii) is to be derived from the same source as (iv), unless an independent explanation can be found for the grammaticality of (iii).

9. There is one use of *allemaal* as a pronominal element of which I am aware, and this use appears to be idiosyncratic, given that the expression otherwise lacks the distributional properties of pronouns. This is the use of *allemaal* in superlative constructions:

(i)   Freddie is het mooist   van allemaal.
        Freddie is the pretties of all
cf.:
(ii)   *Freddie is zat van allemaal
        Freddie is tired of all

10. It is striking that all examples have a singular pronoun which is bound by *every man*. If this is indeed significant, and not accidental, a different analysis might be called for which exploits the presence of the pronoun.

11. Note the stereotyped character of these examples, all of which involve pronominal subjects and the fixed expression *every man*.

12. A somewhat similar problem arises in connection with the following example from Lewis Carroll:

(i)   Another Rule of Battle, that Alice had not noticed, seemed to be that they always fell
        on their heads, and the battle ended with their both falling off in this way, side by side:
        when they got up again, they shook hands, and then the Red Knight mounted and
        galloped off.

Here the element serving as the antecedent to the floating quantifier *both* is the possessive pronoun *their*. To accomodate this example in Sportiche's theory, it is necessary to assume movement of the pronoun *they* into the specifier slot of the NP, where it is assigned genitive case. But then it is unclear how to treat the corresponding Acc-ing case:

(ii)   the battle ended with them both falling off in this way

13. Not even all cases of French *tous* are accounted for by Sportiche's movement analysis, such as cases where *tous* precedes the complementizer *que* (examples from Kayne 1975: 63):
(i)   Il faut toutes qu'elles s'en aillent.
        it must all that they   go away
        'It is necessary that they all go away'
(ii)   It faut tous qu'on se tire
        it must all that one refl beat-it
        'It is necessary we all beat it'
However, I will assume with Kayne that these cases present a special case (there is variation in acceptability among speakers concerning these cases, and there are curious restrictions on the morphological forms which may appear before the complementizer, as well as on the embedding verb).

14. One such problem is the lack of evidence for stranding from object position in English, something that Sportiche's theory would predict to occur. As a matter of fact, sentence (i) below (taken from Doetjes 1992: 328) is out but predicted to be OK on a stranding account, while (ii), is rather better, but predicted to be out, since the position of the floating quantifier is not the deep structure position of the moved object.
(i)   *The books, which I will have to read all, are interesting.
(ii)   ?The books, which I will all have to read, are interesting.

15. Link (1974) notes that the set of positions for floating quantifiers in German is a subset of the set of positions for parentheticals. One position where parenthicals and some adverbs (usually adverbs with a parenthetical intonation) may occur is that between the first constituent of a main clause and the finite verb, which normally occupies the second position in German main clauses. Here floating quantifiers and most adverbial expressions may not occur. Similar observations can be made for Dutch, cp. the following sentences:
(i)   De mannen zijn gisteren allebei gearresteerd.
        the men   are yesterday both   arrested
        "the men were both arrested yesterday"
(ii)   De mannen zijn allebei gisteren gearresteerd.
        the men   are both   yesterday arrested
        "the men were both arrested yesterday"
(iii)   De mannen echter/*allebei zijn gisteren gearresteerd
        the men   however/both   are yesterday arrested
        "the men however/both were arrested yesterday"
(iv)   Allebei zijn de mannen gisteren gearresteerd
        both   are the men   yesterday arrested
        "Both men were arrested yesterday"

16. Johnson (1992) notes that floating quantifiers may occur inside the VP in nonfinal positions:
(i)   a.   I put the bottles all on the table.
        b.   I looked the numbers all up.
        c.   I read the numbers all quickly.
        d.   John believes the men all liars.
        e.   John gave the men all a letter.
In this respect, floating quantifiers appear to differ from VP-adverbs such as *quickly*, which

may easily occupy the sentence-final position. Johnson also notes that it is not enough if some material follows the floating quantifier: expressions which are arguable not VP-constituents do not accept an immediately preceding floating quantifier:

(ii)   a.   *I met the boys all surely.
         b.   *So many men met the boys all that they grew weary.
         c.   *I met the boys all nude. (subject predication reading)

One may add to these observations that in Dutch, floating quantifiers may occur sentence-finally, but not following the VP. Sentence-final occurrence is shown in (iii):

(iii)   Ad kende de studenten allemaal.
        Ad knew the students all

while the impossibility of post-VP occurrence is shown by (iv):

(iv)   *Ad wilde de studenten kennen allemaal
        Ad wanted the students know   all

(Sentence iv is OK when there is a heavy intonational break before *allemaal* and this expression is interpreted as an afterthought.)

17. Dowty and Brody (1984) use a slightly different definition: a principal filter is a collection of sets with a nonempty intersection. This rules out so-called non-proper principal filters which correspond to the powerset of E, the universe (because the supersets of the empty set include every subset of E). For universal quantifiers, which are commonly assumed to have no existential presuppositions (but see Verkuyl and De Jong (1985) for an opposing view), this means that they can only cooccur with floating quantifiers when their noun denotation is nonempty. In other words, the floating quantifier will add an existential presupposition, according to Dowty and Brody's proposal. When that presupposition is violated, ungrammaticality ensues. This may well be incorrect, but I won't pursue this matter here.

18. Some accounts, such as Sportiche's movement theory, would restrict things even further and exclude all cases where the host is not a noun phrase argument. On the whole, this is correct, although I am aware of one case, where the host is a prepositional phrase, thereby providing an additional refutation of Sportiche's theory. This concerns the floating quantifier *allemaal* in Dutch:

(i)   Waarover   heeft hij allemaal zitten praten?
        where-about has   he all   sit   talk
        "What all has he been talking about?"

Note that it is also possible to have *allemaal* joined to the wh-word:

(ii)   Waar allemaal heeft hij over zitten praten?

19. For English, we must assume, in order to exclude (i), that the adverb occurs in a right-branching structure:

(i)   *He all humiliates us.

Otherwise, a bracketing as in (ii) would predict that (i) is possible.

(ii)   He ((all humiliates) us)

20. This includes coördinations with *as well as*, judging from the following example:

(i)   his own restless bisexual bohemianism as well as the bitter tears of his films were both of them products of his chronically disturbed psyche
        (from: John Ardagh, 'Germany and the Germans', Penguin, p. 294)

21. As a matter of fact, one such case was found, but it seems to me a likely error, because the

intended reading appears to be one where the subject of the VP *will both be fine* is understood to be *they* rather than *neither of them*.

(i)   He says neither of them want Kim to be in jail any longer than is necessary and will both be fine when Kim is home.

22. See Dowty (1986) for discussion of the semantic properties of *all*. This determiner distributes certain properties over each member of a group, but at the same time it allows for group predicates, unlike true distributive quantifiers. Thus, *All boys gathered in the park* is grammatical, whereas *Each boy gathered in the park* is semantically deviant.

23. These examples should get better when instead of *student* a collective noun is used such as *jury* or *group*. With definite determiners, I have found some cases of floated *all* in my corpus:

(i)   a.   The jury all wrote down on their slates, `SHE doesn't believe there's an atom of meaning in it,' but none of them attempted to explain the paper. (Lewis Carroll, Alice in Wonderland)
       b.   The jury all brightened up again.
       c.   The jury all looked puzzled.
       d.   The flora is all continuously changing as we watch and the land continues to move much as rolling waves on the ocean do.
       e.   Do staff all have CPR/First Aid training?
       f.   Today's managerial and scientific elite of the Biosphere 2 project can all be traced directly back to John Allen's so-called "Theatre of All Possibilities":

Along the lines of example f, say, we could construct similar sentences with quantifiers in subject position, which are more acceptable than they would have been with non-collective nouns.

(ii)   a.   Neither elite can be all traced back to the Theatre of All Possibilities.
       b.   Can any/each elite be all traced back to the Theatre of All Possibilities?

24. Note that it only makes sense to speak of the monotonicity properties of functions whose domain has a proper (nontrivial) entailment relation. For example, functions of type <e,t> are trivially mon↑, because their arguments never entail one another.

25. That is to say, a negative polarity item x occurring in an expression wxy must have a negative occurrence in wxy or in some subexpression of wxy. Consider for example the sentence *Nobody left without any clothes on*. In this sentence, the negative polarity item *any clothes* has a positive occurrence, because the two negative functors *nobody* and *without* cancel out. However, it is acceptable in this sentence, because it has a negative occurrence in the subexpression *without any clothes on*.

26. Hoeksema (1983) on the other hand, treats VPs as denoting functions in <e,t>, but has a different conception of the basic type <e>: besides individuals, also groups (that is, sets of individuals, or sets of (sets of)* individuals) are taken to be of type <e>.

27. Perhaps a closer analogue, in English, to α than *alone* or *all by himself* is the use of the singular. Van der Does (1992: 61) states: "One should be cautious, though, in using α to capture the syntactic number of the VP. In (5d) the VP is singular, but the predication is collective." Example (5d) is:

(5) d. The quartet makes music.

One could quibble here and treat the quartet as an individual similar in ontological status to Perdeck (cf. Landman 1989 for discussion). If one does not like this, one could move to those British dialects which would assign a plural to the verb in (5d) and say that singular number in those dialects corresponds to α. However, one should note that the use of number in these dialects is somewhat haphazard and influenced by matters of animacy.

28. More precisely, we can derive the domain of quantification E from some set of individuals I by iterated finite group formation in the following manner, due to Johan van Benthem (cf. Hoeksema 1983, note 1):
(i)   Let $E_0 = I$
(ii) $E_{n+1} = E_n \cup POW_{\geq 2}(E_n)$ (where $POW_{\geq 2}(X)$ denotes the set of all subsets of X with cardinality ≥2)
(iii) $E = \cup_n E_n$

29. I am assuming here (as in Hoeksema 1988, Schwarzschild 1991, following Quine 1937) that singletons are equated with their members (hence a = {a}). Thus we will not be able to conclude that any nonset individual is in the denotation of a distributed predicate for the trivial reason that it has no members (hence all of its members would be in the predicate's denotation). I should point out that the definition given here differs from the one that can be derived from the distributivity meaning postulate in Hoeksema (1983). See also the discussion of example (75) in the text.

30. Sentences such as (70a) are by no means wonders of style, but they improve if the distibutor *each* is moved to the end of the sentence:

(i) The Beatles and the Stones both made over a million $ each.

Notice that this does not change the semantics of the VP, it just avoids the awkward piling up of adverbs in preverbal position. Also when one distributor is non-overt, the result is just fine, as in the reading of (ii) where each individual lifted the chair (and not just each of the groups s and p of students and professors).

(ii) The students and the professors each lifted the chair.

31. The use of meaning postulates for the expression of distributivity has been rightly criticized by Roberts (1987) for cases where distributivity is an optional property of a predicate, such as in one reading of (i):

(i) The students solved the trigonometry problem.

If we are to avoid the inconsistency of letting meaning postulates be optional, we would be forced to impose lexical ambiguity on the verb for such cases, which is intuïtively unattractive. For such cases, I would now prefer an invisible distributivity operator à la Link and Roberts. However, as neither Roberts nor Link would deny, the use of a distributivity operator does not circumvent the need for lexical statements pertaining to the meaning of

certain predicates.

32. The floating quantifier *all* prefers cardinalities greater than two. An investigation of the use of *all* with conjoined subjects in an electronic corpus of English texts (at the time about 6 million word tokens) revealed the following distribution:

# of conjuncts	# instances of *all*
2	8
3	42
4	21
5	12

We see from 3 onwards the expected distribution: the number of instances is a monotone decreasing function of the number of conjuncts. However, the numbers for two conjuncts are much lower than we would expect, given that among conjunctions the ones with two conjuncts prevail. This is in part due to competition from *both* and in part to competition from *each*. One may note here that *each* generally does not shy away from quantification over two individuals, unlike *every* and *all*, as the following examples which involve nonfloating use illustrate:

(i) Two girls entered. Each was wearing a grey dress.
(ii) Two girls entered. ??Every one was wearing a grey dress.
(iii) Two girls entered. ??All were wearing a grey dress.

33. The restriction to pronominal subjects is presumably not a grammatical one, but plausibly stems from pragmatic principles. Thus it would seem needlessly cumbersome to say *The men had each man left* when it is possible to leave out the repeated noun, and simply say *The men had each left*. Only when the subject is pronominal would the noun in the floating-quantifier expression have information value.

34. With parenthetical intonation, these conjunctions are better:

(i)   They were most of them (but secretly) Republicans.

Presumably, these arise not through regular coordination of constituents, but as the result of an ellipsis-rule. Note that we must appeal to ellipsis anyway to deal with stripping cases:

(ii)   They were most of them Republicans--albeit secretly.

35. Note the following paradigm:

(i)   John and Mary received two books apiece
(ii)   John and Mary received one book apiece
(iii)   John and Mary received a book apiece
(iv)   *John and Mary received the book apiece

(v)   *John and Mary received each book apiece
(vi)   *John and Mary received no book apiece
(vii)   *John and Mary received the two books apiece

I will assume that for the purposes of *apiece*, the indefinite article *a(n)* is equivalent to the numeral *one*. Note that we have a more restricted paradigm here than we usually expect to find. Note for instance that the use of the floating quantifier *each* is not blocked by a singular definite object in the same way that *apiece* is blocked in (iv), as long as we understand the sentence to be about two copies of the same book, or if two separate events of receiving are involved.

(viii) John and Mary each received the book

Note also that the claim in Quirk, Greenbaum, Leech and Svartvik (1972:614), that *apiece* requires a direct object, is an error due to a lack of understanding of the restriction to numeral contexts. The examples given by these authors are:

(ix)   John and Mary have won a prize apiece
(x)   *John and Mary are in New York apiece

The oddness of (x) is not due to the lack of a direct object, but to the absence of a numeral expression. Other examples of sentences without direct objects are acceptable, as long as there is a numeral around:

(xi)   The Bible and the Koran are $12 apiece
(xii)   The Beatles signed on for a million pounds apiece

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