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Determining Determiner Sequencing: A Syntactical Analysis for English

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Abstract
Most work on determiners has been concerned with purely semantic properties, the occurrence of particular determiners in certain syntactic environments such as existential-there sentences, determiners as heads of phrases (the DP hypothesis, Abney 1987) or quantifier scoping. One question that has not been extensively discussed in the literature is how the various English determiners order with respect to each other.

This paper presents a syntactic account of determiner sequencing using a set of nine semantically based features. Each determiner carries with it a set of feature values that represent its properties, and a set of values for the properties of any determiners it may modify. These features also play a crucial role in deciding which determiners can participate in constructions such as the number system, genitives, and partitives, as well as which determiners can be modified by adverbs. This analysis of determiner ordering was developed as part of the XTAG project and is presented within the framework of Feature-Based Tree Adjoining Grammar.

Comments
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1 Introduction

Most work on determiners has been concerned with purely semantic properties, the occurrence of particular determiners in certain syntactic environments such as existential-*there* sentences, determiners as heads of phrases (the DP hypothesis (Abney, 1987)), or quantifier scoping.

One question that has not been extensively discussed in the literature is how the various English determiners order with respect to each other. For example, the determiner sequences in the examples marked a. of (1)-(5) are acceptable, while those in b. are not acceptable. These examples pose several interesting problems for an account of determiner sequencing. In example (1), we see that although *many* and *several* are often grouped together semantically (Barwise and Cooper, 1981;henceforth B&C-81), the determiner sequencing analysis must capture some difference between the two to account for the fact that *the* can precede one but not the other.

Another interesting problem is presented by examples (2)-(4); one might have expected *all* and *every* to be positioned similarly in a determiner sequence. In (5), we see that agreement also seems to be crucially involved in correctly ordering determiners.

(1) a. **The many** women that contributed to the company's growth were honored last evening.

b. ***The several** women that contributed to the documentary were properly thanked by the director.

(2) a. **Every few** minutes an annoying bell sounds.

b. ***All few** minutes I receive another e-mail message.

(3) a. **All her** supplies were accounted for in last week's analysis.

b. ***Every her** supplies were utilized for the project.

(4) a. **Her every** effort was put toward the success of that magazine.

b. ***Her all** effort was important for our success.

(5) a. **These five** members are most crucial to our success.

b. ***This five** members are the ones I was mentioning to you yesterday.

We have identified a set of determiner features seven of which were developed by semanticists for their accounts of semantic phenomena (Keenan and Stavi, 1986, B&C-81, Partee *et al.*, 1990), another which was developed for a semantic account of determiner negation by one of the authors (Mateyak, 1997), and the last is the familiar agreement feature. We found that when used together these semantically motivated features also benefit the syntax by providing an account of determiner sequencing. Although we do not claim to have exhaustively covered the complex determiner system of English, we do cover a large subset, both in terms of the phenomena handled and in terms of corpus coverage. Most of the analysis presented in this paper is implemented as part of a Feature-Based, Lexicalized Tree Adjoining Grammar (FB-LTAG) for English (Doran *et al.*, 1994, Joshi *et al.*, 1975, Schabes, 1990).

A strictly descriptive account of determiner ordering (e.g. (Quirk *et al.*, 1985) is to divide determiners into sub-categories (e.g. predeterminer, determiner, postdeterminer). As an example, Quirk et al classify *all* as a "predeterminer", *what* as a "determiner" and *no* as a "postdeterminer" allowing the ungrammatical sequence ∗*all what no*. Clearly in allowing such ungrammatical sequences, this type of approach is inadequate even as a description. This is not a result of errors in this particular classification; in fact, we feel that any attempt to describe the determiner ordering data by means of grouping determiners in classes and providing rules for the ordering of these groups will be too coarse or far too specific in its divisions and will fail to elegantly capture the more subtle distinctions among particular determiners. The necessary distinctions are modeled very naturally in a lexicalized grammar formalism such as FB-LTAG in which pieces of syntactic structure and features representing linguistic properties are associated with individual lexical items, thus allowing an account of much finer and if necessary, idiosyncratic variation.

In our account of determiner sequencing, there is a set of nine semantically based features that form the core of the system. Each determiner carries with it a set of feature values that represent its properties, and a set of values for the properties of any determiners it may modify. These features also play a crucial role in deciding which determiners can participate in constructions such as the number system, genitives, and partitives, as well as which determiners can be modified by adverbs. Before we consider our account in greater detail, we will discuss our criteria for classifying items as determiners.

2 What is a determiner anyway?

Determiners have several semantic and syntactic properties that argue for their treatment as a class and differentiate them from other syntactic categories, such as Adjective and Adverb, that seem to have similar syntactic positions and similar interpretations in some cases. As an informal semantic description, determiners contribute something quantitative or identificational to the NP interpretation (e.g. *many dogs, few dogs, this dog*) which is quite different from Adjectives which contribute qualitative information to the interpretation of NPs in which they appear (e.g. *red dogs, big dogs, fast dogs, hungry dogs*). In more formal terms, B&C-81 take generalized quantifiers to have structure parallel to that of NPs as shown in figure(2).

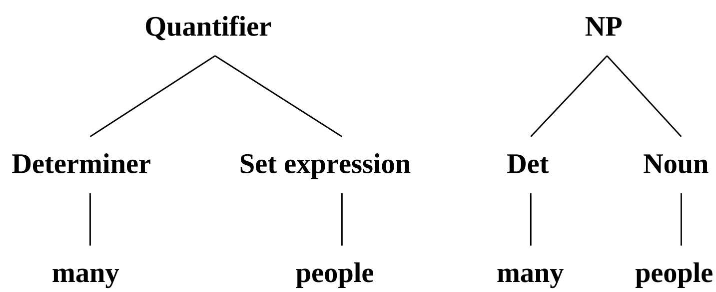

Figure 1: Similarity in the structure of quantifiers and NPs, adapted from B&C-81

In these two structures, determiners in the semantic quantifier domain correspond to determiners in the syntactic NP domain. B&C-81 interpret determiners as "functions from common noun denotations (sets of things) to noun phrase denotations (sets of sets)."

In terms of syntactic distribution, Determiners, Adjectives and Adverbs have at least the following differences:

- Determiners are necessary to form singular count NPs, Adjectives and Adverbs are not, and in fact cannot fulfill this function.

  (6) The man left.

  (7) ∗ Big man left.

(8) ∗ Quickly man left.

- Adjectives appear in predicative constructions and Determiners and Adverbs do not.

(9) John is happy.

(10) ∗ John is the.

(11) ∗ John is quickly.

- Determiners precede Adjectives when both occur in the same NP

(12) the happy man

(13) ∗ happy the man

- Adverbs can appear in many syntactic positions in which Determiners and Adjectives are not possible, such as immediately preverbal and sentence final position.

(14) the dog quickly barked.

(15) the dog barked quickly

(16) every dog barked

(17) ∗ dog every barked

(18) ∗ dog barked every

(19) the big dog barked

(20) ∗ the dog big barked

(21) ∗ the dog barked big

Consider how these distributional differences lead us to categorize some of the less obvious cases. The ability of *one* to complete singular count NPs (e.g. *one llama*) leads us to either take *one* to be completely different from other cardinal numbers (e.g. *two*, *three*, etc.) or to take all cardinal numbers to be determiners rather than adjectives as argued by (McCawley, 1988). McCawley gives as an argument "that numerals can be preceded by definite determiners whereas a determiner cannot in general be preceded by another determiner." However many determiners can be preceded by other determiners as in (22)-(24) so this does not seem like very strong evidence for classifying cardinal numbers as adjectives.

(22) the many problems

(23) their few friends

(24) our every whim

Also, notice that cardinal numbers are not especially good in the predicative sentences in (25b) and (26b). The only way to interpret *one* or *four* in (25) and (26) is as an elliptical expression of age. Compare this marginality/change of meaning for *one* or *four* to the acceptability and consistency of interpretation of a clear adjective such as *yellow* in the same sentence positions in (27a) and (27b).

(25) a. the one dog.

b. The dog is one.

(26) a. the four dogs.

b. The dogs are four.

(27) a. the yellow dog.

b. The dog is yellow.

As another example, consider *several*, which we take to be a determiner and *little*, which although "quantitative" we take to be an adjective. Completion of a singular count NP is not a useful diagnostic for *several* since it is plural. *Little* on the other hand, can occur with singular count nouns as can be seen in (28) but it clearly cannot complete a singular count NP, as shown in (29) and therefore behaves like an adjective rather than a determiner in this respect.

(28) A little dog

(29) ∗little dog

Little also performs as one would expect from an adjective in predicative sentences such as (30) while *several* is peculiar in (31) as is usual for determiners.

(30) This dog is little.

(31) ∗This dog is several.

Finally, notice that neither *little* nor *several* is acceptable in typical adverb positions in (32)-(35)

(32) ∗The alpaca little spit.

(33) ∗The alpaca spit little.

(34) ∗The alpaca several spit.

(35) ∗The alpaca spit several.

And as a final example consider *only*, which has often been taken to be a determiner. *Only* can occur in various positions typical of adverbs rather than determiners, e.g. preverbal position, as in *The dogs only barked.* This adverb 'float' is also taken by Partee et al. as evidence that *only* is an adverb rather than a determiner. In addition, *only* cannot complete a singular count NP even though is it is compatible with singular count nouns as in (36) and (37).

(36) The only aardvark

(37) ∗only aardvark

Only also fails as the predicate in predicative sentences such as (38), further supporting the conclusion that *only* is not a determiner.

(38) ∗The aarvark is only

Thus, we have seen that there seems to be considerable evidence for differentiating between the syntactic classes of adverb, adjective, and determiner.

3 Determiner Ordering Using Features

In our English FB-LTAG grammar, all nouns select the noun phrase (NP) tree structure shown in figure 2. Common nouns do not require determiners in order to form grammatical NPs. Rather than being ungrammatical, singular countable nouns without determiners are restricted in interpretation and can only be interpreted as mass nouns. Allowing all nouns to head determinerless NPs correctly treats the individuation in countable NPs as a property of determiners. Under our analysis, common nouns are listed in the lexicon as having negative values for all of the determiner features. A common noun can only acquire a positive value for a given determiner feature if a determiner that has a positive value for that feature adjoins onto the noun. Other types of NPs such as pronouns and proper nouns have been argued by Abney (Abney, 1987) to either be determiners or to move to the determiner position because they exhibit determiner-like behavior. We can capture this insight in our system by giving pronouns and proper nouns values for determiner features. For example, pronouns and proper nouns would be marked as definite, a value that common nouns can only obtain by having a definite determiner adjoin.

A single tree structure is selected by simple determiners, an auxiliary tree which adjoins to NP. An example of this determiner tree anchored by the determiner *these* is shown in figure 3. Complex determiners such as partitives

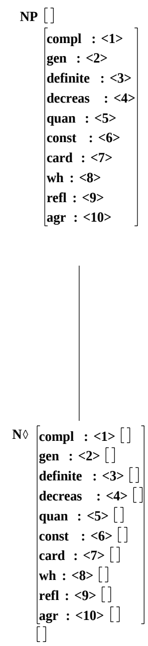

Figure 2: NP Tree

and genitives also anchor tree structures that adjoin to NP. They differ from the simple determiners in their internal complexity. Details of our treatment of these more complex constructions appear in Sections 3 and 4. Sequences of determiners, as in the NPs *all her dogs* or *those five dogs* are derived by multiple adjunctions of the determiner tree, with each tree anchored by one of the determiners in the sequence. The order in which the determiner trees can adjoin is controlled by features.

This treatment of determiners as adjoining onto NPs is similar to that of (Abeillé, 1990), and allows us to capture one of the insights of the DP hypothesis, namely that Determiners select NPs as complements. In figure 3 the Determiner and its NP complement appear in the configuration that is typically used in LTAG to represent selection by functional heads. That is, the head serves as the anchor of the tree and its complement is a sister node in the same elementary tree. One alternative to the adjunction analysis in which the NP anchored by N contains a Determiner or Determiner Phrase substitution node, has the disadvantage of having the determiner and the noun in a configuration in which the Determiner should be expected to be a complement of the noun.

The feature analysis that we use in determiner ordering is relatively independent of any particular analysis of NP structure. In fact, we believe that this

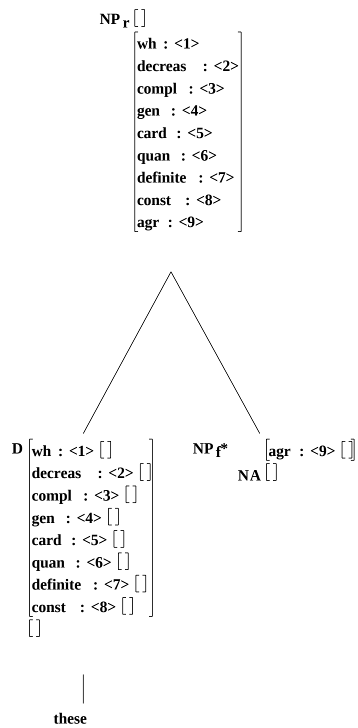

Figure 3: Determiner Trees with Features

sequencing analysis is a general one, not specifically related to TAGs, and would work for any other feature-based formalism, assuming appropriate, formalism-specific modifications.

3.1 The Features

In our analysis, features are crucial to ordering determiners correctly. We have identified nine features which are sufficient to order the determiners. These features are: **definiteness** (definite), **quantity** (quan), **cardinality** (card), **genitive** (gen), **decreasing** (decreas), **constancy** (const), **wh**, **agreement** (agr), and **complement** (compl). The first eight of these features have been previously proposed as semantic properties of determiners, while the last feature is a feature we feel should be considered as a plausible semantic property of determiners. The semantic definitions underlying the features are given below.

3.1.1 Definiteness

Possible Values: [+/–].

Definition: This definition of definiteness is a compact paraphrase of the definition given by Keenan and Stavi, 1986. They adapt their definition from B&C-81.

A function f is definite iff f is non-trivial and whenever $f(s) \neq \emptyset$ then it is always the intersection of one or more individuals.

The crux of this definition is that an NP with a definite determiner denotes a unique set of individuals. For definiteness under this definition, the size of the set s has no effect on the denotation.

To gain an understanding of how to apply this definition of definiteness, we will consider the determiners *the*, *both*, *all*, and *several*. The determiner *the* is decidedly definite since its denotation is associated with a specific, discourse familiar individual, regardless of the size of the overall set to which the individual belongs. In the sentence *the man walks*, *the man* refers to some unique individual mentioned previously in the discourse, regardless of the size of the set of men. The determiner *both*, being very similar to *the* in that it picks out unique individuals from the discourse (in this case two, rather than one), is also classified as definite. The denotation of *both* depends only upon the discourse, and not upon the size of the set to which the two individuals belong.

On the other hand, the determiners *all* and *several* are not definite according to this definition. In the case of *all*, the interpretation of the truth value of *all* applied to an NP depends crucially on the size of the set to which it is being applied. To determine whether or not *all men walk* is a true statement for a given model, we must know the size of the set of men to check whether or not that many men in fact walk. For *several*, we do not necessarily need to know the size of the set to which *several* is being applied to check its truth value. The notion of the quantity implied with the use of the determiner *several* is shared among English speakers, and does not depend on the total size of the set. However, *several* is not definite because it does not denote a unique set of individuals. In the sentences *several women climb ladders* and *several women eat cheese*, the women who climb ladders and the women who eat cheese may or may not be equivalent sets. Contrast this example with a definite determiner such as *the*. In the sentences *the women climb ladders* and *the women eat cheese*, the NP *the women* refers to the same set of women in both sentences, namely the value that *the women* has been given previously in the discourse.

3.1.2 Quantity

Possible Values: [+/–].

Definition: If A and B are sets denoting an NP and associated predicate, respectively; E is a domain in a model M, and F is a bijection from M_1

to M_2, then we say that a determiner satisfies the constraint of quantity if $\text{Det}_{E_1}\text{AB} \leftrightarrow \text{Det}_{E_2}\text{F(A)F(B)}$. (Partee *et al.*, 1990)

The intuition behind the quantity condition is described in Partee *et al.*, 1990 as follows:

> The third universal condition on quantifiers requires that only the number of elements in the relevant sets determine the interpretation of a quantifier. To evaluate in a model M, for instance, whether several men walk we only need to know how many men there are and how many of them walk. It is not relevant who they actually are, since the interpretation of that sentence should not be affected if we were to substitute other men for the given ones. No quantifier hence may depend on a specific or particular choice of individuals in the domain, i.e. the quantifiers under considerations are 'topic neutral'.

As examples of how we apply Partee *et al.*, 1990's definition with our **quan** feature, consider *all* and *the*. The determiner *all* is **quan+**; for the sentence *all men run*, the truth value of the statement requires only that the number of men and the number of men who run are equal. The identity of the men in the set of men is not crucial; only the number of men compared to the number of male runners is important. *The*, on the other hand, is **quan-** since the truth value of a statement such as *the man jumps* depends crucially on the identity of the man indicated by the speaker, and is not at all associated with the sizes of the sets of men or jumpers.

A less obvious case is *both*. *Both* is classified as **quan-**. Although *both* is quantitative in that it must pick out exactly two individuals, the identities of those individuals are important. *Both* does not indicate just any two individuals, but two discourse salient individuals. So, like *the*, the interpretation of *both* is not at all associated with the overall sizes of sets involved in the statement. The sentence *both men walk* may be true for two men mentioned in the discourse, but if two other men from the set of all men were substituted for the two indicated by the discourse, this statement may no longer be true. A case similar to *both* is *neither*. Although *no* is **quan+** (its interpretation requires one to know that the intersection of the two sets involved is of size zero), the determiner *neither* is classified as **quan-**. *Neither*, like *no*, does in fact require that the intersection of the subject NP and predicate is of size zero, however the interpretation of the subject NP is not associated with the overall set. In fact, like *both*, it is dependent upon two unique individuals specified previously in the discourse. Thus, *neither* is also **quan-**.

3.1.3 Cardinality

Possible Values: [+/–].

Definition: A determiner D is cardinal iff D $\in$ cardinal numbers ≥ 1.

The cardinal numbers include the natural numbers: *one*, *two*, *three*,..., *ten*, etc. It is interesting to note that rational numbers expressed in decimal notation (i.e., representing *three-fourths* as *0.75*) behave grammatically like cardinal numbers while the fractional representations of rational numbers (e.g., *three-fourths* or *3/4*) have a different distribution.

3.1.4 Genitive

Possible Values [+/–].

Definition:

Possessive pronouns and the possessive morpheme (*'s*) are marked **gen+**; all other nouns and determiners are **gen−**. Examples of genitive NPs are *her dogs*, *their mice*, and *John's mother's roommate's car*.

3.1.5 Decreasing

Possible Values: [+/–].

Definition: A set of Q properties is decreasing iff whenever s$\leq$t and t$\in$Q then s$\in$Q. A function f is decreasing iff for all properties f(s) is a decreasing set.

A non-trivial NP (one with a Det) is decreasing iff its denotation in any model is decreasing. (Keenan and Stavi, 1986)

A convenient diagnostic for testing whether or not a determiner is decreasing is given by B&C-81. Basically, the test involves testing a given determined set, a predicate, and a restricted form of the predicate, in an if-then statement. If the if-then statement is true when the unrestricted predicate is in the if-clause, then the determiner is decreasing. If the if-then statement is true when the restricted predicate is in the if-clause, then the determiner is increasing. Consider the following examples adapted from B&C-81.

(39) If DET men entered the race, then DET men entered the race early.

(40) If DET men entered the race early, then DET men entered the race.

For a given determiner DET, if the first of these sentences is true, then the determiner DET is decreasing. If the second is true, then the determiner is increasing. In the following examples, substituting *few* for DET in the first sentence causes the if-then statement to be true, while substituting *some* in the second sentence causes that sentence to be true. Thus, *few* is decreasing and *some* is increasing.

(41) If **few** men entered the race, then **few** men entered the race early.

(42) If **some** men entered the race early, then **some** men entered the race.

3.1.6 Constancy

Possible Values: [+/–].

Definition: Our definition of constancy resembles Keenan's notion of "transparent" or "extensional" (Keenan, 1987) and is also similar to Partee's definition of "Extension (Constancy)" (Partee *et al.*, 1990).

If A and B are sets denoting an NP and associated predicate, respectively, and E is a domain, then we say that a determiner displays constancy if A,B $\subseteq$ E $\subseteq$ E$'$, then $\text{Det}_E\text{AB} \leftrightarrow \text{Det}_{E'}\text{AB}$.

The definition given above can be restated equivalently as: a determiner displays constancy if A,B $\subseteq$ E,E$'$, then $\text{Det}_E\text{AB} \rightarrow \text{Det}_{E'}\text{AB}$ for both E $\subseteq$ E$'$ and E$'$ $\subseteq$ E. This recasting of the definition makes it easy to grasp the intuition that for a determiner that displays constancy, if you move to either a sub-domain (E$'$ $\subseteq$ E) or super-domain (E $\subseteq$ E$'$) of the start domain, E, then the truth value of $\text{Det}_{Dom}\text{AB}$ should remain constant. The constancy feature essentially separates the proportional determiners from the non-proportional determiners; the proportional determiners are **const-**, while the non-proportional determiners are **const+**.

Consider the following sample model. Let A be the set of lawyers, B be the set of individuals that attended a given conference, let C be the set of doctors, let A,B $\subseteq$ E, and E $\subseteq$ E$'$. In addition, let C $\subseteq$ E$'$ and |C|>>|A|. For the domain E, let's assume that Many_EAB is true. Thus, the statement *many lawyers attended the conference* is true in the domain E. However, when we move to the domain E$'$, there are doctors, in addition to lawyers, that attended the conference (i.e., we have *extended* the domain to include doctors). In fact, the number of doctors at the conference greatly exceeds the number of lawyers at the conference, so it would no longer be true to say that there are many lawyers at the conference in relation to the total number of individuals attending the conference. Thus, the truth value of $\text{Many}_{Dom}\text{AB}$ is not constant across domains, and so *many* is **const-**. A similar explanation can be given for assigning *few* the value **const-**, the only difference in this case being that we will need to contract the domain (E$'$ $\subseteq$ E) to show that the value of $\text{Few}_{Dom}\text{AB}$ is not constant across domains.

The determiner *every* is **const+** since in moving from one domain, E, to either a sub- or super-domain, one cannot detract from the size or the nature of the original set, A, representing the noun phrase. Thus, if *every duck swims* is true in one domain, it is true in any sub- or super-domain that also contains A and B (A= ducks, B = swims). Thus, *every* is constant across domains.

3.1.7 Wh

Possible Values: [+/–].

Definition: Interrogative determiners are **wh**+; all other determiners are **wh**−.

The interrogative determiners *what* and *which* are shown in the example sentences, *what man was asked to perform?* and *which duck swims the fastest?*.

3.1.8 Agreement

Possible Values: [3sg, 3pl, 3 [1]].

Definition: For Determiners in English this means number agreement. Number (in English) is plural for Determiners that can be part of an NP which denotes a set of entities of cardinality greater than one. Number is singular for Determiners that can be part of an NP which denotes a single entity.

Although English does not have the morphological marking of determiners for case, gender or number, we hold that most determiners in English are semantically marked for number. This is also the position held by Pollard and Sag, 1994, and by earlier work in GPSG.

3.1.9 Complement

Possible Values: [+/–].

Definition: The following definition is adapted from (Mateyak, 1997).

> A determiner Q is positive complement if and only if for every set X, there exists a continuous set of possible values for the size of the negated determined set, NOT(QX), and the cardinality of QX is the only aspect of QX that can be negated.

A good example of a determiner that is positive complement is *every*. Consider the sentence *not every dog walked down the street.* The cardinality of the determined set *every dog* is equal to the total number of dogs. Let the total number of dogs be D. The negative determined set, *not every dog*, has a cardinality somewhere in the range of zero through D-1. Thus, the complement of Every X, NOT(Every X), always has a continuous set of possible values representing its cardinality, namely [0, |X|-1].

The determiner *some* is clearly negative complement. Consider again the set of dogs, whose total size is represented by D. The cardinality of *some dogs* is somewhere between 0 and D[2]. The range of values for the complement of *some dogs*, *not some dogs*, is either 0 or greater than the cardinality of *some dogs*. Thus, the cardinality of the complement of Some X cannot be represented by a continuous range of values, and so *some* is deemed negative complement.

[1] 3 represents the case of third person with either singular or plural number agreement possible.

[2] In this example, we are discussing the second interpretation of *some* (see Table 1), although both of the interpretations of *some* are negative complement.

The determiners *each* and *both* present more interesting cases. *Each* is negative complement, while *both* is positive complement. In the case of *each*, the second clause of the above definition applies. Although *each* satisfies the first clause in that it exactly mirrors *every* in terms of cardinality, there is an aspect of the meaning of *each* that distinguishes it from *every*. *Each* strongly individuates the NP it modifies. For example, the sentence *each company is expected to pay the tax* implies that all of the companies were expected to pay the tax individually. The complement of this NP, *not each company*, might indicate either that less than the total number of companies paid the tax, or that the companies were expected to pay the tax as a group, not individually. Thus, *each* is negative complement since in addition to its cardinality, the individuating aspect of *each* can also be negated.

The determiner *both* is positive complement. The cardinality of Both X is 2, and the cardinality of the complement of Both X is 1. Witness the following example.

(43) Not both David and Amy came to my party.

Although the identity of the person who came to the party is ambiguous, we can accurately infer that one and only one person from this set came to the party. Thus, the range of values for the cardinality of the complement of Both X is continuous since it contains only one value, and so *both* is positive complement.

The determiner tree in figure 3 shows the appropriate feature values for the determiner *these*, while Table 1 shows the corresponding feature values of several other common determiners.These feature values are part of determiner anchors for the tree shown in figure 3 and are passed to the NP root node through the coindexing in the tree.

There are two interesting aspects of this table that warrant further discussion. First, we have chosen to explicitly represent the fact that *some* has two distinct meanings. The first meaning, represented by the feature sequence [**definite-**, **quan+**, **card-**, **gen-**, **wh-**, **decreas-**, **const+**, **agr=3**], is the meaning of *some* that closely resembles the meaning of *a*, with the only difference being that this meaning of *some* does not specify a preference for agreement. The second meaning of *some* differs from the first meaning in that it is **const-** and **agr=3pl**[7]. When this *some* is used, it means an indefinite amount that is

[3]We use the symbol UN to represent the fact that the selectional restrictions for a given feature are unspecified, meaning the noun phrase that the determiner selects can be either positive or negative for this feature.

[4]Except *one* which is 3sg.

[5]Except *one* which is **complem+**.

[6]A partitive can be either **quan+** or **quan-**, depending upon the nature of the noun that anchors the partitive. If the anchor noun is modified, then the quantity feature is determined by the modifier's quantity value.

[7]This *some* is often distinguished orthographically from the first meaning by the use of the symbol sequence *sm* Milsark, 1977,Postal, 1969

Det	definite	quan	card	gen	wh	decreas	const	agr	compl
all	−	+	−	−	−	−	+	3pl	+
both	+	−	−	−	−	−	+	3pl	+
this	+	−	−	−	−	−	+	3sg	−
these	+	−	−	−	−	−	+	3pl	−
that	+	−	−	−	−	−	+	3sg	−
those	+	−	−	−	−	−	+	3pl	−
what	−	−	−	−	+	−	+	3	−
whatever	−	−	−	−	−	−	+	3	−
which	−	−	−	−	+	−	+	3	−
whichever	−	−	−	−	−	−	+	3	−
the	+	−	−	−	−	−	+	3	−
each	−	+	−	−	−	−	+	3sg	−
every	−	+	−	−	−	−	+	3sg	+
a/an	−	+	−	−	−	−	+	3sg	+
$some_1$	−	+	−	−	−	−	+	3	−
$some_2$	−	+	−	−	−	−	−	3pl	−
any	−	+	−	−	−	−	+	3sg	+
another	−	+	−	−	−	−	+	3sg	+
few	−	+	−	−	−	+	−	3pl	−
a few	−	+	−	−	−	−	+	3pl	−
many	−	+	−	−	−	−	−	3pl	+
many a/an	−	+	−	−	−	−	−	3sg	+
several	−	+	−	−	−	−	+	3pl	−
various	−	−	−	−	−	−	+	3pl	−
sundry	−	−	−	−	−	−	+	3pl	−
no	−	+	−	−	−	+	+	3	−
neither	−	−	−	−	−	+	+	3	−
either	−	−	−	−	−	−	+	3	−
GENITIVE	+	−	−	+	−	−	+	UN[3]	−
CARDINAL	−	+	+	−	−	−	+	3pl[4]	−[5]
PARTITIVE	−	+/-[6]	−	−	−	−	+	UN	+/-

Table 1: Determiner Features associated with D anchors

definitely more than one, but unspecified in terms of its relation to the amount in the total set of objects to which the determined NP belongs. Essentially, the first interpretation of *some* focuses on the uncertainty in the identity of the object(s) of reference, while the second interpretation focuses on the uncertainty in the number of the objects of reference. Sentences (44) and (45) demonstrate the difference in meanings.

(44) Some man came into the store yesterday looking for John.

(45) Some men walked into the building bearing fire arms.

In (44), *some man* is clearly related to the interpretation of *a man*, meaning that one man, of unknown identity, came into the store yesterday. Example (45) is ambiguous between the two interpretations of *some*. On the first interpretation, the sentence means that a group of men, whom the speaker does not know, walked into the building. The second interpretation would mean that a group of men, at least two, walked into the building.

Another interesting aspect of Table 1 is that we have chosen to represent the determiner sequences *a few* and *many a* as multi-word determiners. This means that the two items in the sequences simultaneously anchor the determiner auxiliary tree and are assigned features as a single unit. The reason why we chose to represent these determiners as multi-word constituents is that neither of these multi-determiner sequences seems to directly mirror the feature structures of their members. For example, *a* is singular and *few* is decreasing, while *a few* is plural and increasing. *Many* is plural and *a* displays constancy, but *many a* is singular and does not display constancy. Thus, it seems reasonable to represent *a few* and *many a* as multi-word determiners.

In addition to the features that represent their own properties, determiners also have features to represent the selectional restrictions they impose on the NPs they take as complements. The selectional restriction features of a determiner appear on the NP footnode of the auxiliary tree that the determiner anchors. The NP_f node in figure 3 shows the selectional feature restriction imposed by *these*[8], while Tables 2 and 3 show the corresponding selectional feature restrictions imposed on the NP foot node by several other determiners. In Tables 2 and 3, many determiners have more than one listing. The separate listings for a given determiner represent the fact that a determiner can select for several different types of noun phrases, each with different determiner feature values. While each selectional restriction listing would need to be a separate entry in the Xtag grammar's lexicon for that determiner, these entries do not represent separate senses of the determiner.

[8] In addition to this tree, *these* would also anchor another auxiliary tree that adjoins onto **card+** determiners and one that adjoins onto **definite-**, **quan+**, **decreas-**, **const-** determiners (e.g., *few*).

[9] *one* differs from the rest of CARD in selecting singular nouns

Det	defin	quan	card	gen	wh	decreas	const	agr	compl	*e.g.*
	−	−	−	−	−	−	−	3pl	−	*dogs*
all	+	−	−	UN	−	UN	UN	3pl	−	*these dogs*
	UN	UN	+	UN	UN	UN	UN	3pl	UN	*five dogs*
both	−	−	−	−	−	−	−	3pl	−	*dogs*
	+	−	−	UN	−	UN	UN	3pl	−	*these dogs*
	−	−	−	−	−	−	−	3sg	−	*dog*
this/that	−	+	UN	UN	−	+	−	3	UN	*few dogs*
	−	+	UN	UN	−	−	−	3pl	+	*many dogs*
	UN	UN	+	UN	UN	UN	UN	3sg	UN	*five dogs*
	−	−	−	−	−	−	−	3pl	−	*dogs*
these/those	−	+	UN	UN	−	+	−	3pl	UN	*few dogs*
	UN	UN	+	UN	UN	UN	UN	3pl	UN	*five dogs*
what/which	−	−	−	−	−	−	−	3	−	*dog(s)*
whatever	−	+	UN	UN	−	+	−	3	UN	*few dogs*
whichever	UN	UN	+	UN	UN	UN	UN	3	UN	*many dogs*
	−	−	−	−	−	−	−	3	−	*dog(s)*
the	−	+	UN	UN	−	+	−	3	UN	*few dogs*
	−	+	UN	UN	−	−	−	3pl	+	*many dogs*
	UN	UN	+	UN	UN	UN	UN	3	UN	*five dogs*
	−	−	−	−	−	−	−	3sg	−	*dog*
every/each	−	+	UN	UN	−	+	−	3	UN	*few dogs*
	UN	UN	+	UN	UN	UN	UN	3	UN	*five dogs*
a/an	−	−	−	−	−	−	−	3sg	−	*dog*
$\text{some}_{1,2}$	−	−	−	−	−	−	−	3	−	*dog(s)*
some_1	UN	UN	+	UN	UN	UN	UN	3pl	UN	*dogs*
	−	−	−	−	−	−	−	3sg	−	*dog*
any	−	+	UN	UN	−	+	−	3	UN	*few dogs*
	UN	UN	+	UN	UN	UN	UN	3	UN	*five dogs*
	−	−	−	−	−	−	−	3sg	−	*dog*
another	−	+	UN	UN	−	+	−	3	UN	*few dogs*
	UN	UN	+	UN	UN	UN	UN	3	UN	*five dogs*
few	−	−	−	−	−	−	−	3pl	−	*dogs*
a few	−	−	−	−	−	−	−	3pl	−	*dogs*
many	−	−	−	−	−	−	−	3pl	−	*dogs*
many a/an	−	−	−	−	−	−	−	3sg	−	*dog*
several	−	−	−	−	−	−	−	3pl	−	*dogs*
various	−	−	−	−	−	−	−	3pl	−	*dogs*
sundry	−	−	−	−	−	−	−	3pl	−	*dogs*
no	−	−	−	−	−	−	−	3	−	*dog(s)*
neither	−	−	−	−	−	−	−	3sg	−	*dog*
either	−	−	−	−	−	−	−	3sg	−	*dog*

Table 2: Selectional Restrictions Imposed by Determiners on the NP foot node

Det	definite	quan	card	gen	wh	decreas	const	agr	compl
GENITIVE	–	–	–	–	–	–	–	3	–
	–	+	UN	UN	–	+	–	3	UN
	–	+	UN	UN	–	–	–	3pl	+
	UN	UN	+	UN	UN	UN	UN	3	UN
	–	+	–	–	–	–	+	3pl	–
	–	–	–	–	–	–	+	3pl	–
CARDINAL	–	–	–	–	–	–	–	3pl[9]	–
PARTITIVE	UN	UN	UN	UN	–	UN	UN	UN	UN

Table 3: Selectional Restrictions Imposed by
Groups of Determiners/Determiner Constructions

3.2 Wh and Agr Features

A determiner with a **wh+** feature is always the left-most determiner in linear order since no determiners have selectional restrictions that allow them to adjoin onto an NP with a +wh feature value. The presence of a wh+ determiner makes the entire NP wh+, and this is correctly represented by the coindexation of the determiner and root NP nodes' values for the wh-feature. Wh+ determiners' selectional restrictions on the NP foot node of their tree only allows them adjoin onto NPs that are **wh-** or unspecified for the wh-feature. Therefore ungrammatical sequences such as *which what dog* are impossible. The adjunction of **wh +** determiners onto **wh+** pronouns is also prevented by the same mechanism.

The **agr** feature is inherently a noun feature. While determiners are not morphologically marked for agreement in English many of them are sensitive to number. Some determiners are semantically either singular or plural and must adjoin to nouns which are the same. For example, *a* can only adjoin to singular nouns (*a dog* vs ∗*a dogs*) while *many* must have plurals (*many dogs* vs *many dog*). Other determiner such as *some* are unspecified for agreement in our analysis because they are compatible with either singulars or plurals (*some dog*, *some dogs*).

3.3 Justifying the Features

In addition to the necessity of the features **wh+**, **agr**, and **gen** (see Section4), we would also like to argue that the other six features are crucial to accurately capturing the ordering of determiners. To show that each of these six features are necessary, we will demonstrate that if any one of these six are eliminated, some degree of coverage of the phenomenon will be lost.

To begin, consider that several of the determiners select for NPs that are **card+** (see Table 2). Without the cardinality feature, it would be impossible to distinguish cardinal numbers from many other of the determiners. For example, cardinal numbers would thus be indistinguishable from the determiners *several*, *a few*, and $some_1$, so that a determiner that would correctly select for **card+** NPs, such as *every*, would also select NPs containing these determiners. This would result in the acceptance of many ungrammatical sequences (i.e., ∗*every some men* would be acceptable). Another interesting thing about the cardinality feature is that it allows all of the cardinals to be selected as a whole, regardless of agreement. Without the cardinality feature, NPs containing *one* and cardinals greater than one would have to be selected separately by a determiner's selection requirements.

The choice of the features **decreasing** and **constancy** can be supported by noting that several determiners select for NPs containing the determiner *few*, i.e., those that are [**quan+**, **decreas+**, **const-**]. To take a specific example, we see in Table 2 that the determiner *every* specifically selects for NPs containing the determiner *few* (along with selecting cardinal NPs and bare nouns). Without the feature **decreasing**, *any* would select the other [**quan+**, **const-**] determiners, along with *few*. The acceptable sequences would then include *every many X*, *every* $some_2$ *X*, and *every many a X*. Without the feature **constancy**, the acceptable sequences would consist of NPs containing [**quan+**, **decreas+**] determiners, namely *every no X* and *every neither man*.

The feature **complement** plays many important roles in achieving accurate determiner ordering. One tricky construction is that with *both* or *all* followed by a definite NP. Although just using the **definite** feature seems to be sufficient on the surface, on a closer look we see that in this situation, we would also accept the ungrammatical sequences ∗*all both X* and ∗*both both X*. To avoid this situation, we can require that *both* and *all* select NPs that are **compl-**, as well as **definite+**. The ungrammatical sequences will then be unacceptable in the system. The **complement** feature is also crucial in singling out the determiner *many*. While it is true that there are only four determiners that are **const-**, *many* appears in several places where at least two of the other three do not appear. Thus, it is important that we can single out *many* from the other three, which the feature **complement** allows us to do (*many* is the only **const-** determiner that is **compl+**).

The remaining two features to be discussed are **definite** and **quantity**. In almost every case, a determiner is positive for one of these features, and negative for the other. Thus, it seems that including both of these features in the system is unnecessary. However, there are a few determiners, namely *neither*, *either*, *sundry*, and *various*, that are both **definite-** and **quan-**. If we eliminated the **definiteness** feature, then we would not be able to distinguish between *either*, *sundry*, and *various*, and the definite determiners *this*, *these*, *that*, *those*, and *the*. Without the definite feature, the system would then accept several ungrammatical sequences, including ∗*both various men*. If we eliminated the **quantity** feature, a similar situation would arise.

Therefore, we have shown thus far that eight of our nine features are crucial to an accurate characterization of the English determiner system. The final feature we will discuss is the **genitive** feature, which plays a critical role in the treatment of genitive constructions.

4 Genitive Constructions

There are two kinds of genitive constructions: genitive pronouns, and genitive NP's (which have an explicit genitive marker, *'s*, associated with them). It is clear from examples such as *her dog was located* vs ∗*dog was located* that genitive pronouns function as determiners and as such, they sequence with the rest of the determiners. The features we use for the genitives are the same as for other determiners. Genitives are not required to agree with either the determiners or the nouns in the NPs that they modify. The value of the **agr** feature for an NP with a genitive determiner depends on the NP to which the genitive determiner adjoins. While it might seem to make sense to take *their* as 3pl, *my* as 1sg, and *Alfonso's* as 3sg, this number and person information only effects the genitive NP itself and bears no relationship to the number and person of the NPs with these items as determiners. Consequently, we have represented **agr** as unspecified for genitives in Table 1.

Genitive NP's are particularly interesting because they are potentially recursive structures. Complex NP's can easily be embedded within a genitive determiner.

(46) [[[John]'s friend from high school]'s uncle]'s mother came to town.

There are two things to note in example (46). One is that in embedded NP's, the genitive morpheme comes at the end of the NP phrase, even if the head of the NP is at the beginning of the phrase. The other is that the determiner of an embedded NP can also be a genitive NP, hence the possibility of recursive structures.

In the FB-LTAG grammar, the genitive marker *'s* is separated from the lexical item that it is attached to and given its own category (G). In this way, we can allow the full complexity of NP's to come from the existing NP system, including any recursive structures. As with the simple determiners, there is one auxiliary tree structure for genitives which adjoins onto NPs. As can be seen in figure 4, this tree is anchored by the genitive marker *'s* and has a branching D node which accommodates the additional internal structure of genitive determiners.

Since the NP node which is sister to the G node can itself have a genitive determiner in it, the type of genitive recursion shown in (46) is quite naturally accounted for by the genitive tree structure used in our analysis.

5 Partitive Constructions

The deciding factor for including partitive constructions (e.g. *some kind of*, *all of*) in the category of determiner constructions was the behavior of the

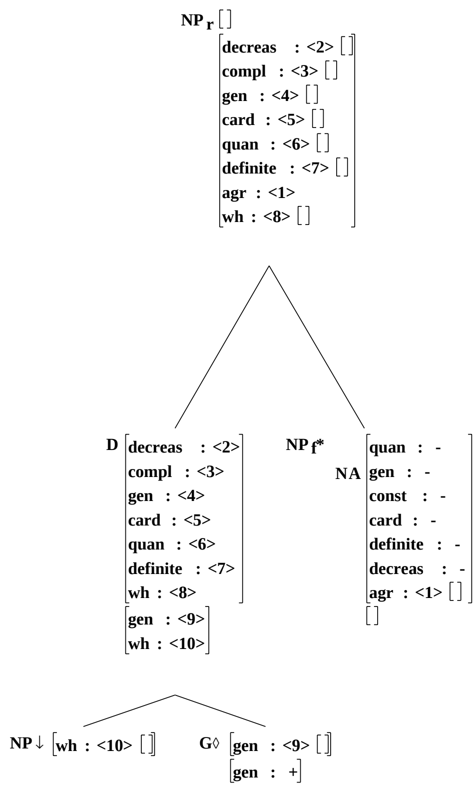

Figure 4: Genitive Determiner Tree

agreement features. If partitive constructions are analyzed as an NP with an adjoined PP, then we would expect to get agreement with the head of the NP (as in Example (47)). If, on the other hand, we analyze them as a determiner construction, then we would expect to get agreement with the noun that the determiner phrase modifies (as we do in Example (48)).

(47) a *kind* [of these machines] *is* prone to failure.

(48) [a kind of] these *machines are* prone to failure.

Note that both the partitive and PP readings are possible for the same NP. The distinguishing characteristic is with which noun agreement occurs.

In our analysis the partitive tree in figure 5 is anchored by one of a limited group of nouns that can appear in the determiner portion of a partitive construction. A rough semantic characterization of these nouns is that they either represent quantity (e.g. part, half, most, pot, cup, pound etc.) or classification (e.g. type, variety, kind, version etc.). In the absence of a more implementable characterization we use a list of such nouns compiled from a descriptive grammar (Quirk *et al.*, 1985), a thesaurus, and from online corpora. In our grammar, the nouns on this list are the only ones that select the partitive determiner tree.

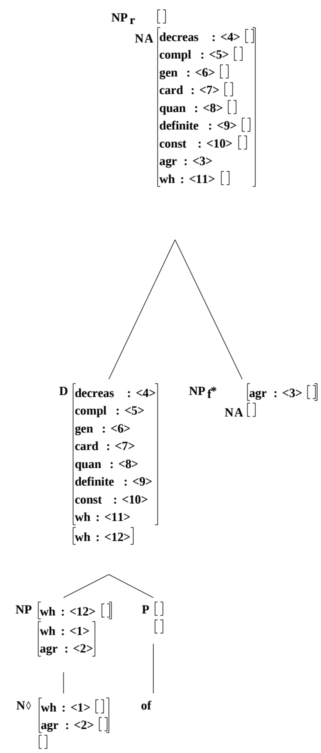

Figure 5: Partitive Determiner Tree

Like other determiners, partitives can modify the noun itself (*'[a certain kind of] machine'*), or adjoin to NPs that already have determiners (*'[some parts of] these machines'*. Notice that just as for the genitives, the complexity and the recursion are contained below the D node and rest of the structure is the same as for simple determiners.

6 Adverbs, Noun Phrases, and Determiners

Many adverbs interact with the noun phrase and determiner system in English. For example, consider sentences (49)-(56) below.

(49) **Approximately** thirty people came to the lecture.

(50) **Practically** every person in the theater was laughing hysterically during that scene.

(51) **Only** John's crazy mother can make stuffing that tastes so good.

(52) **Relatively** few programmers remember how to program in COBOL.

(53) **Not** every martian would postulate that all humans speak a universal language.

(54) **Enough** money was gathered to pay off the group gift.

(55) **Quite** a few burglaries occurred in that neighborhood last year.

(56) I wanted to be paid **double** the amount they offered.

Although there is some debate in the literature as to whether these should be classified as determiners or adverbs, we believe that these items that interact with the NP and determiner system are in fact adverbs. These items exhibit a broader distribution than either determiners or adjectives in that they can modify many other phrasal categories, including adjectives, verb phrases, prepositional phrases, and other adverbs (see section 2).

Using the determiner feature system, we can obtain a close approximation to an accurate characterization of the behavior of the adverbs that interact with noun phrases and determiners. Adverbs can adjoin to either a determiner or a noun phrase (see figure 6), with the adverbs restricting what types of NPs or determiners they can modify by imposing feature requirements on the foot D or NP node. For example, the adverb *approximately*, seen in (49) above, selects for determiners that are **card+**. The adverb *enough* in (54) is an example of an adverb that selects for a noun phrase, specifically a noun phrase that is not modified by a determiner.

Most of the adverbs that modify determiners and NPs divide into six classes, with some minor variation within classes, based on the pattern of these restrictions. Three of the classes are adverbs that modify determiners, while the other three modify NPs.

The largest of the five classes is the class of adverbs that modify cardinal determiners. This class includes, among others, the adverbs *about*, *at most*, *exactly*, *nearly*, and *only*. These adverbs have the single restriction that they must adjoin to determiners that are **card+**. Another class of adverbs consists of those that can modify the determiners *every*, *all*, *any*, and *no*. The adverbs in this class are *almost*, *nearly*, and *practically*. Closely related to this class are the adverbs *mostly* and *roughly*, which are restricted to modifying *every* and *all*, and *hardly*, which can only modify *any*. To select for *every*, *all*, and *any*, these adverbs select for determiners that are [**quan+**, **card-**, **const+**, **compl+**], and to select for *no*, the adverbs choose a determiner that is [**quan+**, **decreas+**,

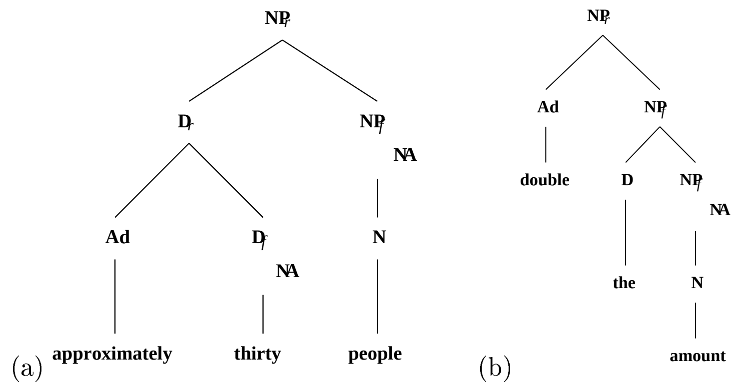

Figure 6: (a) Adverb modifying a determiner; (b) Adverb modifying a noun phrase

const+]. The third class of adverbs that modify determiners are those that modify the determiners *few* and *many*, representable by the feature sequences [**quan+**, **decreas+**, **const-**] and [**quan+**, **decreas-**, **const-**, **3pl**, **compl+**], respectively. Examples of these adverbs are *awfully*, *fairly*, *relatively*, and *very*.

Of the three classes of adverbs that modify noun phrases, one actually consists of a single adverb *not*, that only modifies determiners that are **compl+**. Another class consists of the focus adverbs, *at least*, *even*, *only*, and *just*. These adverbs select NPs that are **wh-** and **card-**. For the NPs that are **card+**, the focus adverbs actually modify the cardinal determiner, and so these adverbs are also included in the first class of adverbs mentioned in the previous paragraph. The last major class that modify NPs consist of the adverbs *double* and *twice*, which select NPs that are [**definite+**] (i.e., *the*, *this/that/those/these*, and the genitives).

Although these restrictions succeed in recognizing the correct determiner/adverb sequences, a few unacceptable sequences slip through. For example, in handling the second class of adverbs mentioned above, *every*, *all*, and *any* share the features [**quan+**, **card-**, **const+**, **compl+**] with *a* and *another*, and so ∗*nearly a man* is acceptable in this system. In addition to this over-generation within a major class, the adverb *quite* selects for determiners and NPs in what seems to be a purely idiosyncratic fashion. Consider the following examples.

(57) a. **Quite** a few members of the audience had to leave.

b. There were **quite** many new participants at this year's conference.

c. **Quite** few triple jumpers have jumped that far.

d. Taking the day off was **quite** the right thing to do.

e. The recent negotiation fiasco is **quite** another issue.

f. Pandora is **quite** a cat!

In examples (57a)-(57c), *quite* modifies the determiner, while in (57d)-(57f), *quite* modifies the entire noun phrase. Clearly, it functions in a different manner in the two sets of sentences; in (57a)-(57c), *quite* intensifies the amount implied by the determiner, whereas in (57d)-(57f), it singles out an individual from the larger set to which it belongs. To capture the selectional restrictions needed for (57a)-(57c), we utilize the two sets of features mentioned previously for selecting *few* and *many*. However, *a few* cannot be singled out so easily; using the sequence [**quan+**, **card-**, **decreas-**, **const+**, **3pl**, **compl-**], we also accept the ungrammatical NPs ∗*quite several members* and ∗*quite some members* (where *quite* modifies *some*). In selecting *the* as in (d) with the features [**definite+**, **gen-**, **3sg**], *quite* also selects *this* and *that*, which are ungrammatical in this position. Examples (57e) and (57f) present yet another obstacle in that in selecting *another* and *a*, *quite* erroneously selects *every* and *any*.

It may be that there is an undiscovered semantic feature that would alleviate these difficulties. However, on the whole, the determiner feature system we have proposed can be used as a surprisingly efficient method of characterizing the interaction of adverbs with determiners and noun phrases.

7 Exploring Alternative Approaches

Although their discussion of determiners is directed at topics other than determiner ordering, it is clear that our analysis is similar in a number of ways to that of Pollard and Sag, 1994. Both analyses take the noun as head of the NP. For Pollard and Sag this means that nouns subcategorize for their determiners while for us it means that nouns anchor NPs and determiners become part of NPs through adjunction. The selectional restrictions that determiners exercise over nouns are handled in our system by stating selectional restrictions on the footnode of the auxiliary tree anchored by the determiner, while in HPSG the SPEC feature is used to allow selection of head sisters by non-heads. These two approaches are more similar to each other than to the DP hypothesis which addresses the problem of determiner selectional restrictions on nouns by making the determiner the head of the phrase. Since both FB-LTAG and HPSG are lexicalized and use feature unification, the features we use to account for determiner order could be easily incorporated into an HPSG approach.

A more interesting question is whether there is an alternative suggested by the nature of other formalisms that would be more elegant or linguistically satisfying while still accounting for the same data. For example, could determiner ordering be specified as a set of linear precedence rules or could clusters of features be turned into finer syntactic categories along the lines of Pollock, 1989's analysis for INFL.

First let us consider to what extent the determiners can be divided into useful subcategories, and in particular, whether determiner ordering can be accounted for by such a division. Our analysis essentially does treat cardinals as a subcategory. They adjoin directly onto nouns only, therefore do not precede any other determiners. Other determiners that adjoin only onto nouns and might be candidates for forming a subcategory of determiners with the cardinals are: *few*, *a few*, *many a*, *several*, *various*, *sundry*, *no*, *neither*, and *either*. Notice first that even within cardinals, agreement would have to be retained as a feature in order to differentiate between *one* and the other cardinals. In addition, the determiners in this potential subcategory behave quite differently from each other with respect to what determiners can precede them. For example, *every* can precede *few* but not *many*. Accounting for this difference between *few* and *many* requires making different categories for the two or retaining either **decreasing** or **complement** as a feature.

In fact, a review of Table 1 shows that there are only a few groups of items that share all their feature values and could therefore unproblematically form subcategories. These potential subcategories are: {*this/that*}, {*these/those*}, {*what/which*}, {*whatever/whichever*}, {*every/a/any/another*}, {*various/sundry*}, genitives, and cardinals greater than one. All other lexical items in the table would each need to be their own category, and partitives would have to be divided up based on the **quantity** and **complement** features of the NP headed by their anchoring noun. This means that it would require greater than 22 subcategories of determiners to achieve the same coverage as our feature based account.

What about a linear precedence account based on features? We can say that anything that precedes a **+card** item is **-card**, but we cannot say that **-card** items precede **+card** items generally because not all **-card** items do so. Based on *these/those few alpacas*, it might seem that **+definite** precedes **-definite** but *all the alpacas* provides a counterexample. One can examine Tables 1 and 2 and see that combinations of features do not provide a clean precedence pattern either. We suspect that a linear precedence account will not offer a dramatic improvement in elegance or coverage over the feature based account we propose.

8 Conclusion

With this work, we present a syntactic account of determiner sequencing. Nine independently identified semantic features prove sufficient to account for the sequencing of a substantial portion of the English determiner system. The system handles single-word determiners and recursive constructions such as genitives and partitives, as well as adverbs that modify NPs and determiners. Longer determiner sequences are constructed by multiple adjunctions of the various types of determiners. Combining a relatively formalism independent feature analysis with an analysis of determiners as adjoining onto NPs in an FB-LTAG framework allows us to capture several of the insights of the DP hypothesis. This work has been implemented in an existing Lexicalized Tree Adjoining Grammar for English as part of the XTAG project described in C. Doran et al. this volume.

9 Acknowledgments

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