

Numerals as determiners

0. Introduction*

This paper will deal with an explanation of the distributional facts in (1) and (2), concerning the Dutch NP:

- | | | | |
|--------|--|--------|---|
| (1) a. | mijn vier grote broers
(my four big brothers) | (2) a. | *mooie die schoenen
(beautiful those shoes) |
| b. | alle honderd deelnemers
(all hundred participants) | b. | *zes de bomen
(six the trees) |
| c. | die lange acht narcissen
(those long eight daffodils) | c. | *deze alle vragen
(these all questions) |
| d. | sommige goede plannen
(some good plans) | d. | *ieder mijn antwoord
(every my answer) |
| e. | drie kleine kleuters
(three little tots) | e. | *grappige zeven dwergen
(funny seven dwarfs) |

My discussion will be based on the categorial status of the types of numeral that occur in these examples.

In English as well as in Dutch, the internal structure of NP's is quite rigid. The position occupied by the head of the phrase, and the relative positions of the other elements within the NP are severely restricted. Their linear order is strict, and there are very few possibilities of movement in or out of the NP. Besides, there is hardly any indication that it makes sense to distinguish between a deep and a surface structure for NP. As a consequence a structural explanation for the differences in (1) and (2) will have to be based on a very careful line of argument. This is reflected in the existing literature, which on the one hand shows a high degree of diversity, and on the other reminds one of the work by structural linguists on the subject.

Of course one cannot deny that there have been attempts at a description of NP structure that fits a more comprehensive framework. But quite often such a theoretical restriction in advance is not truly restrictive. The choice for a certain theoretical framework does not necessarily impose essential restraints on an analysis. An example of this is Jackendoff's (1977) chapter on NP specifiers. In his description of prenominal structure Jackendoff commits himself to the limitations of the \bar{X} -theory and those of the Uniform Three-Level Hypothesis in particular. But even within this doubly restricted framework it is not hard to present an alternative account of specifier structure that is at least as satisfactory as Jackendoff's proposal, or, one might say, not less unsatisfactory.

In the absence of sensible syntactic or semantic restrictions, my strategy will be to present a proposal for the categorial status of numerals that is unrelated to any common syntactic principle. Rather, I intend to derive support from an analysis of the role of the determiner. This proceeds as follows.

1. The determiner

There is little unanimity in the literature on the concept of the notion of

determiner. It is even unclear whether the information under a DET node is purely syntactic or semantic as well. Anyway, it is certain that the determiner can play a role in the appropriateness of a syntactic context for NP's, as the following sentences show:

- (3) a. Er zit een muis in de kelder (There is a mouse in the cellar)
 b. Er zitten muizen in de kelder (There are mice in the cellar)
 c. *Er zitten alle muizen in de kelder (There are all mice in the cellar)

Since sentences beginning with existential *Er* are accessible for indefinite subjects only, the ill-formedness of (3c) can be ascribed, as is commonly done, to the fact that *alle muizen* is definite, while *een muis* and *muizen* are indefinite. Part of this explanation is the assumption that the bare plural *muizen* is accompanied by an indefinite article, just as *een muis*: this is the so-called null determiner.¹

This indicates that some concept of the category of determiner is available, apart from the question of which element constitutes the category. The determiner functions as an element that links the NP and the rest of the sentence. It bears the information that is essential for the well-formedness judgements on the sentences under (3). This central role of the determiner is also part of the theory of generalized quantifiers elaborated in Barwise & Cooper (1981), and in Zwarts (1981).

In my proposal for the shape of prenominal structures I will make use of this linking function of the determiner. In themselves such external aspects might seem questionable when one is concerned with the internal structure of a phrase. However, given the fact noted above that there are no other guiding principles, there is no evidence in advance that pleads against this 'strategy'. It even supplies support for one of the main assumptions that I will make: NP's are characterized by the occurrence of a determiner.

2. The NUM-Hypothesis

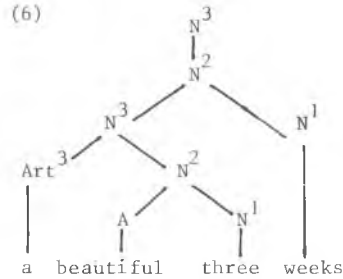
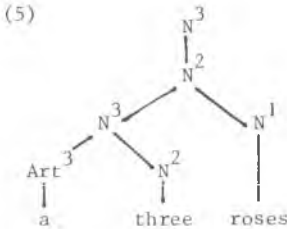
In this section I will discuss four recent analyses of NP structure. Beside many differences, they exhibit a common view: when a NP contains a numeral as its prenominal element, this numeral is accompanied by a second prenominal element, with or without phonological matrix. Rephrasing this slightly, these four analyses share the following hypothesis:

- (4) NUM-Hypothesis: a. NP's are characterized by the occurrence of a determiner
 b. Numerals do not function as determiner

Note that I use 'NUM' to indicate a syntactic position that can be filled by a numeral, whereas 'numeral' is the name for a wordclass containing words like *one, two, four, twenty, hundred*, etc. I will illustrate the effects of the NUM-Hypothesis by presenting the different ways it is incorporated in the analyses of the literature.

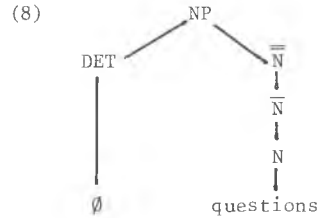
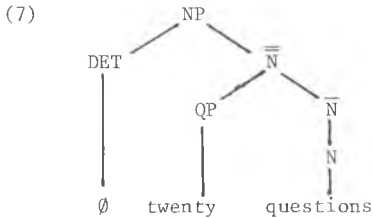
Jackendoff (1977) is restricted by the Uniform Three-Level Hypothesis. This predicts that for every projection of X there are three leftbranching nodes. Only two of them are relevant for N projections: N² can have one sisternode, N¹ can have two of them: a node for quantity denoting elements like numerals, and a recursive node for adjectives. Within these boundaries Jackendoff proposes a deep structure for NP's like *three roses* as given in (5). The N-status of numerals is motivated by their resemblance to numerical elements like

a dozen. The presence of the article *a* in DS (5) is motivated by NP's such as (6).

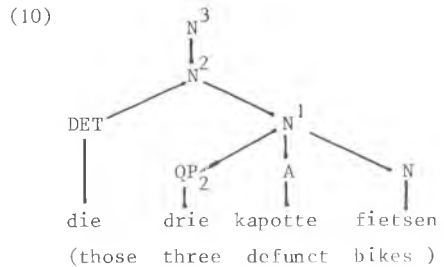
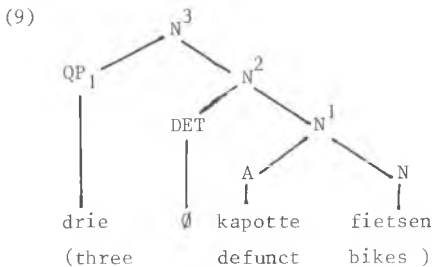


If N^2 contains a numeral without an adjective to its left (cf. (5)), a local *a*-deletion transformation operates. But in deep structure a numeral such as *three* is always accompanied by the article *a*, an element of the category [+Det].

A second analysis in accordance with the NUM-Hypothesis can be found in Selkirk (1977), in the context of the question whether NP's such as *many questions* should or should not be ascribed a partitive deep structure. Selkirk shows that there are restrictions on the possible specifiers of the 'lower NP' in partitive NP's. One of the impossible lower NP's is *twenty questions*. She assigns it a structure in which the QP numeral is preceded by a null determiner: (7). The null determiner also occurs in the structure assigned to bare plurals: (8). Cf. Selkirk (1977:295).

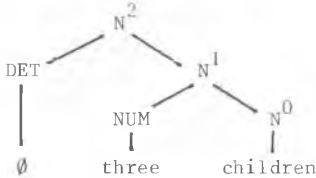


Third, Coppen (1982) appears to assume something like (4a) in advance. His structures are identical to those proposed in Blom (1977), although Blom's aims are quite different. Note the two positions generated for quantity denoting elements in the NP. Their function is illustrated in (9) and (10). Coppen's conditions accounting for ill-formed sequences will not be discussed here.

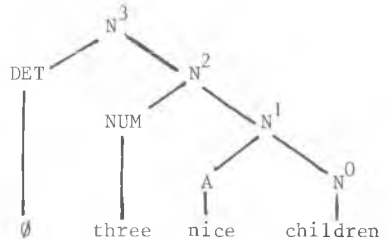


Finally Verkuyl (1981) distinguishes between three kinds of prenominal elements. Their distribution is guided by the type logical part of the categorial grammar that functions as a structure building component. Tokens of two of them are always present: due to their type properties every NP contains a determiner and a numerical element. Because numerals are considered numerical elements, a NP like *three children* or *three nice children* contains a null determiner.

(11)



(12)



Given these brief descriptions, the question rises in what way these analyses supply support for the assumptions of the NUM-Hypothesis, assumed either implicitly or explicitly in their descriptions of NP structures. First, the presence of *a* in deep structure (5) is motivated by an unusual NP like *a beautiful three weeks*. However, it seems that the unusual character of this NP might as well be accounted for by a structure in which *three weeks* is a complex head with *a* and *beautiful* as specifiers: [*a beautiful* [*three weeks*]_{N⁰}]_{N³}. But if (6) is no longer the motivation for (5), the only alternative is to do without a deep structure article *a*. This has the advantage that the completely ad hoc *a*-deletion transformation becomes superfluous.

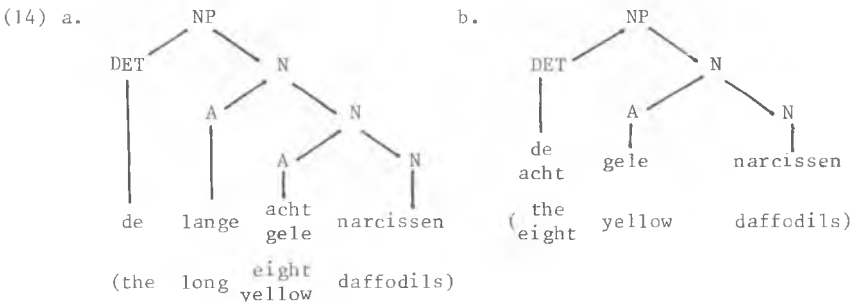
In the other proposals the presence of a determiner without a phonological matrix reflects the incorporation of (4a). But the necessity of a null determiner is not evident as long as there is no independent motivation for the QP or NUM status of the numerals in (7), (9), (11) and (12). When the categorial status of numerals is not motivated on independent grounds, it is unclear why a null determiner should function as the element that reflects assumption (4a). This leaves the evidence that supports (4b) rather dangling, and in fact in the proposal under discussion an answer to this question is neither formulated nor implicated. I will take an alternative route here, and I will sketch an analysis in which (4b) is simply left out.

3. The DET-A-Hypothesis

The observations under (1) confirm that, next to a position for the determiner (DET), it makes sense to distinguish a (recursive) A-position for adjectival elements in NP. I will argue here that these two prenominal categories provide a sufficient rich structure for a description of the relevant distributional facts. There is no need to generate a QP or NUM position if one stipulates that numerals can occur in the two positions now available. This assumption is formulated in (13b), that should be combined with (13a) (=4a), motivated on independent grounds in section 1. In addition to (13), I assume a structure-building rule which generates one DET-position as the leftmost element in the N projection.

- (13) *DET-A-Hypothesis*: a. NP's are characterized by the occurrence of a determiner
 b. Numerals can occur in DET-position and in A-position

Some of the relevant configurations predicted by the DET-A-Hypothesis are represented under (14). The hierarchical ordering of the prenominal elements might seem arbitrary, but although there are many arguments that support this structural analysis, I will not discuss them here: the assumptions we are concerned with are neutral with respect to hierarchical orderings, and we are concerned with linear orderings.



The following observations confirm the assumptions under (13), and especially (13b). The phrases under (15a) and (15b) illustrate the permutability of elements in A-position in linear order. (15c) and (15d) illustrate this, too.

- (15) a. de lange gele narcissen c. lange gele narcissen
 b. de gele lange narcissen d. gele lange narcissen

The prediction of (13) is that *acht* in (15e) is interchangeable with *gele*, because *acht* occupies an A-position. In (15g) however, *acht* occurs in DET-position, so it should not be interchangeable with *gele* in that case. (15f) and (15h) show that this prediction is correct.

- (15) e. de acht gele narcissen g. acht gele narcissen
 f. de gele acht narcissen h. *gele acht narcissen

Another prediction of (13) is that the numerals in DET-position share properties with determiners like *de* and not with adjectives. In (16a) *de* is not interchangeable with *gele* as is shown in (16d), so *acht* in (16b) should not be interchangeable with *gele*, whereas *lange* in (16c) should. In (16e) and (16f) the correctness of these predictions is confirmed.

- (16) a. de gele narcissen d. *gele de narcissen
 b. acht gele narcissen e. *gele acht narcissen
 c. lange gele narcissen f. gele lange narcissen

These facts strongly suggest that there is no need to distinguish a NUM node or a QP node among the specifiers of N. When quantity denoting elements such as *alle* (all), *sommige* (some) and *iedere* (every) are considered to be determiners, just as the demonstrative and possessive pronouns and *de* (the), the strings under (1) will be correctly marked as well-formed. The cases in (2a-2d) are ruled out since a NP contains only one DET-position, whereas (2e) is out for the same reason as (15h). (2e) and (15h) both lack a determiner: the leftmost element is an adjective. In this respect the NP's in (2e) and (15h) resemble the bare plurals in (1e), (15c) and (15d). Following the convincing analysis

in Carlson (1978), according to which all bare plurals are treated as the proper names of kinds, it is possible to regard those constituents as NP's without a DET-position, just as the proper names *Mary* and *Rome*.² The unwell-formedness of (2e) and (15h) can be seen as a consequence of the fact that cardinality, expressed by numerals, is not a possible property of a kind, whereas color or length, expressed by adjectives, is. This explains why a numeral cannot occur in a NP that should be analysed as a bare plural due to its internal structure.

With respect to the observations under (1) and (2) the proposed analysis seems to give an adequate description. But since we consider numerals as determiners when they occur as the leftmost element in the NP, the proposal bears on other issues as well: first we have a direct explanation for the fact that numerals and adjectives are interchangeable in (15e), but not in (15g); and second, the ill-formedness of sentence (18)³ can be related to the fact that NP's with a quantifying determiner cannot be combined with a predicate such as *zeldzaam* (rare). In this respect *drie* has the same restrictions as *de* in (19), whereas a combination of an adjective and a plural noun behaves like a bare plural.

- (17) Zwarte vlinders zijn zeldzaam (Black butterflies are rare)
 (18) *Drie vlinders zijn zeldzaam (Three butterflies are rare)
 (19) *De vlinders zijn zeldzaam (The butterflies are rare)

4. Toward a 1:1-correspondence between syntactic and semantic properties

So far I have given a description of the observations under (1) and (2). However, it is now time to note that the group of examples presented there is incomplete. Relative quantifying elements like *vele* (many), *weinige* (few), and *sommige* (some (unstressed)) have been left out. I will consider them elements of the category of numerals, without a discussion of the favouring arguments. This implies that the observations under (20) are as yet unexplained.⁴

- (20) a. *drie vele boeken (three many books)
 b. *vele drie boeken (many three books)

A second issue that has gone ignored so far is the categorial status of *sommige*. I have distinguished two classes of prenominal elements that can occur in leftmost position: numerals, and determiners. This suggests that determiners like *sommige* and *de* have the same distributional properties. But (21) and (22) illustrate that this is only partly true.

- (21) a. *mijn sommige boeken (my some books)
 b. *mijn de boeken (my the books)
 (22) a. *sommige drie boeken (some three books)
 b. de drie boeken (the three books)

As far as I know there is no analysis that accounts for the behaviour of *sommige* in (22a) on purely syntactic grounds. Coppens (1982) and Verkuyl (1981) do not even mention these cases. Summarizing the relevant observations, we see that a) *de* can be followed by a numeral, whereas *sommige*, *drie* and *vele* cannot. b) numerals can occur in A-position, whereas *sommige* and *de* cannot.

I will provide here an account that incorporates the idea that the distributional properties of the elements that can occur in the leftmost position of NP are related to their semantic properties. It happens to be the case that we must distinguish three, rather than two classes of DET-elements.

The kind of classification I will propose is based on some inherent properties of the NP definitions that are common in the theory of generalized quantifiers. Within this framework the idea of some logicians that all NP's are to be analysed as quantifiers, is elaborated in a way that allows for linguistic generalizations. A crucial aspect of the analyses is the linking role that is assigned to the elements that are referred to as determiners: the elements that occur in leftmost position, including the numerals.⁵

In the following I will argue that some of the features of the definitions of NP denotations that are formulated in Zwarts (1981) a.o. can function as the foundation for a classification that is reflected in the syntactic properties of determiners. The relevance of this classification for other phenomena than the distributional properties we are concerned with here is discussed in De Jong (1983). The following remarks might function as a preliminary illustration of what is meant by the 'linking role' of determiners. For a detailed explanation, see Barwise & Cooper (1981), or Zwarts (1981).

In a model-theoretical interpretation of NP's, the denotation of a NP can be seen as a set of subsets. The actual definitions of the sets depend on the determiner that occurs in the NP. For example:

- (23) a. $\llbracket \text{drie } N \rrbracket = \{ X \subset E \mid \text{card}(X \cap \llbracket N \rrbracket) = 3 \}$
 b. $\llbracket \text{de } N \text{ [pl]} \rrbracket = \{ X \subset E \mid X \cap \llbracket N \rrbracket = \llbracket N \rrbracket \}; \text{card}(\llbracket N \rrbracket) \geq 2$
 c. $\llbracket \text{sommige } N \rrbracket = \{ X \subset E \mid \text{card}(X \cap \llbracket N \rrbracket) \geq 2 \}; \text{card}(\llbracket N \rrbracket) = 2$
 (E is the set that constitutes the domain of discussion)

These definitions function as a scheme for the truth conditions for sentences of the form *DET N VP*. In (23) ' $\llbracket N \rrbracket$ ' refers to the set that is the denotation of the noun and ' X ' is a variable for the set denoted by the VP. The truth conditions consist of restrictions on the intersection of $\llbracket N \rrbracket$ and the VP denotation: $\llbracket N \rrbracket \cap X$. As is illustrated by (23), those restrictions vary with the choice of the determiner.

Some NP interpretations are restricted by a condition on the size of the set $\llbracket N \rrbracket$, expressed by a cardinality operator on $\llbracket N \rrbracket$, as can be seen in (23b, c). If this condition is not met, the NP interpretation is undefined.

This implicates that in a given sentence, the element analysed as DET has two semantic roles. First it defines the relation between N and VP, either by a condition on the size of the intersection $\llbracket N \rrbracket \cap \llbracket VP \rrbracket$ (23a,c), or by what one might call 'identification' of the intersection (23b). Second, the DET definition may contain a condition on the size of $\llbracket N \rrbracket$ (23b,c). Compare the interpretation of the following sentences.

- (24) Er zijn drie muizen in de kelder (There are three mice in the cellar)
 (25) De muizen zijn blind (The mice are blind)
 (26) Sommige muizen zijn blind (Some mice are blind)

Sentence (24) is true if the cardinality of the set of mice that is in the cellar is three, but untrue if there are less than three mice in the model of interpretation. Sentence (25) states that the whole set of mice, irrespective of its size, is contained in the set of blind entities. But (25) is nonsensical if there are no mice. Sentence (26) is true if there are more than two blind mice, but nonsensical if there are no mice in the model of interpretation.

As will be clear I distinguish between four semantic effects that can be triggered by the determiner. They are summarized in (27).⁶

- (27) a. conditions on the size of the intersection $[[N] \cap [[VP]$
 b. conditions on the identity of the intersection $[[N] \cap [[VP]$
 c. conditions on the size of $[[N]$
 d. no conditions on $[[N]$

My claim is that these semantic properties of determiners are in a 1:1-correspondence to the following syntactic properties.

- (28) a. never followed by a numeral
 b. possibly followed by a numeral
 c. never in A-position
 d. possibly in A-position

On the basis of the properties (27 a-d) and (28 a-d), three classes of determiners can be distinguished as is shown in diagram (29).

(29)

	examples	syntactic properties	semantic conditions
A	<i>sommiige</i>	a. never followed by a numeral (22a) c. never in A-position (21a)	a. $\text{card}([N] \cap [VP]) \geq 2$ c. $\text{card}([N]) \geq 2$
B	<i>enkele, vele, weinige</i> and numerals	a. never followed by a numeral (22a) d. possibly in A-position (22b)	a. $\text{card}([N] \cap [VP]) \approx n$ d. no condition on $[N]$
C	<i>alle</i> ⁷ , <i>de</i>	b. possibly followed by a numeral (22b) c. never in A-position (21a)	b. $[N] \cap [VP] = [N]$ c. $\text{card}([N]) \geq 2$

Diagram (29) makes it clear that the syntactic properties (28 a-d) correspond closely to the semantic properties (27 a-d). The different classes of determiners A, B and C are built up on the basis of different choices from the sets of properties. The largest class B is characterized semantically by the property that the intersection condition associated with the class specifies the required number of elements that must be contained in the intersection. (' \approx ' and 'n' are variables whose value is determined by the actual numerals.)

Class C is characterized semantically by two conditions. It shares one of them (c) with class A. This explains the partial syntactic similarity of *sommiige* and *de* in (21). The difference in the syntactic properties of *sommiige* and *de* that shows up in (22) corresponds to a difference in the intersection condition: (a) vs. (b).

If we accept the semantic classification in (29) as an explanatory device for the corresponding distributional properties, the observations under (20-22) cease to be problematic. Upon this, the proposal as a whole becomes slightly redundant. For example, the ungrammaticality of **de sommiige boeken* is accounted for by the categorial status of *sommiige* since it is a determiner, but also by property (28c). The proper balance between structure building rules, lexical information, and the semantic properties of determiners is an issue that still needs clarification.

Notes

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1. Cf. Kraak & Klooster (1968), and Paardekooper (1971).
2. Alternating one might stipulate the presence of a (definite!) null determiner for proper names. This would prevent proper names from violating (13a). Since proper names are exceptional anyway, it seems to me that to allow such a violation is less problematic than to introduce a null determiner for systematic reasons.
3. The intended reading of (18) is not: 'You rarely see three butterflies at the same time'. I noticed that some people tend to consider (18) and (19) grammatical in a context in which *vlinders* is interpreted as *vlindersoorten* (kinds of butterflies). To get the intended interpretation of (17) this 'correction' is unnecessary.
4. The impossibility of interchanging relative numerals such as *vele*, with adjectives (**de gele vele narcissen*) does not affect the proposal as a whole. The relative order of adjectives is submitted to restrictions even in the class of fine adjectives: **de houten leuke stoel* (the wooden nice chair), vs. *de leuke houten stoel*. Cf. Roose (1956).
5. The proposal in section 3 can be seen as syntactic support for this semantic generalization.
6. In De Jong (1983) I argued that the difference between determiners that trigger (27c) and the determiners that trigger (27d), is responsible for the restrictions on the kinds of NP that can occur as subject in the so-called existential sentences.
7. By assigning *alle* the properties of class C, my analysis of *alle* is different from that of Zwarts, for example. In my opinion an analysis that does not involve a condition on the size of $\llbracket N \rrbracket$, cannot do justice to the fact that sentences like *alle muizen zijn ziek* (alle muizen zijn ziek) is nonsensical when there are no mice in the context of interpretation. All contingent properties that can be expressed by a VP require subjects with a class C determiner not to denote the empty set. As a consequence I distinguish between this 'presuppositional' use (cf. De Jong (1983)) of *alle* and its generic use. The latter is often referred to in the well-known conditional scheme for universal quantification: $\forall x [P(x) \rightarrow Q(x)]$.

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