Chapter 3

Determiners and Context Sets

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1. UNIVERSES

There are several roles for universes in modeltheoretic semantics. To begin with, we have *universes of models* – the set M in a model $\mathcal{M} = \langle M, [\![\cdot]\!] \rangle$ – or *discourse universes*[1]. But suppose that, during a piece of discourse about the participants at some political meeting (which are thus elements of M) I point to the supporters of Jones and say

(1) All cheered.

(1) is then equipped with a *contextually selected sub-universe* of M: the set of supporters of Jones at that meeting. Such sets will be called *context sets* in what follows. This use of sub-universes is very common; pointing is of course just one of the many ways in which, at various points in a discourse, context sets can be selected. For example, if I say (describing the meeting afterwards to someone)

(2) The mayor entered the podium and gave a short speech. All cheered,

a different context set has been selected (this time the set of all participants at the meeting, except the mayor, presumably), by a different mechanism.

Getting the universe right is important primarily for quantification; a universe is often described as the universe *of* quantification. If we agree with Montague's PTQ or Barwise & Cooper (1981) that quantification occurs in *noun phrases* in natural language, a third sort of universe can be

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identified: *the NP universe*. When the NP consists of a determiner and a noun, this universe is simply the denotation of the noun in the model. For example, if I had said, instead of (1),

(3) All supporters of Jones cheered,

the NP universe is the previously mentioned context set, this time selected explicitly, not contextually. Clearly, the universe of quantification is *restricted* in (3) to the NP universe.

These distinctions are usually taken lightly.[2] One assumes that suitable universes are somehow selected, so that one's examples get 'normally intended' meanings, but that the mechanisms belong to pragmatics rather than semantics. In practice this means identifying context sets with (temporarily chosen) model universes. Let us call this the *flexible universe* (FU) strategy. Although seldom discussed, it could perhaps be motivated by the fact that even though the choice of universe may affect truth values of quantified sentences, semantics proper deals not with actual truth values but *truth conditions*, and these are uniform over all universes. Then, it would not really matter whether or not one grasps the intended meaning of a given example, as long as one understands what a possible model for it looks like.

Nevertheless, in this paper I wish to argue that the three kinds of universe must be distinguished also by semantics proper if we want to get the linguistic facts right. The FU strategy can be made to work in some cases (such as the examples above), but even then it is methodologically unsound; in other cases it is simply wrong (section 3). Moreover, the occurrence of context sets is often indicated in the sentences themselves in ways which are worth noticing. One way is when a determiner occurs without a noun, as in (1). Another concerns a particular group of determiners, among them the definite article, which will be called the *definites*. I will suggest a semantic treatment of definites different from the usual treatment of determiners, based on their role as context set indicators (sections 8 and 10). The definites also have a particular relation to *partitive* NPs (section 9).

As formal semantic background I will use the treatment of quantifiers in natural language given in Barwise & Cooper (1981); B&C for short (section 4). This framework can easily be accommodated to the use of context sets (sections 5-6); the effects for the logical theory of such quantifiers (van Benthem, 1984), can also be assessed (section 7). Although the chosen framework is of the extensional, 'static', type, context sets are obviously relevant also for a more 'dynamic' semantic perspective, such as the one in Barwise & Perry (1983).

Before showing why the FU strategy fails, I need to get some facts about determiners straight; this is the subject of the next section.

2. CLASSIFYING DETERMINERS

Expressions of the categories NP, DET, N, are standardly divided into *simple* and *complex* ones. It is convenient to regard DETs (also) as syntactic *functions* which give NPs when applied to Ns. (This may be taken as the basic criterion (necessary condition) for DET-hood). A DET is n-*place*, if, as a function, it takes n arguments (of category N).

In B&C only 1-place DETs are discussed. Typical examples of simple 1-place DETs are

(a) *all, each, some, both, most, many, few, a few, several, this, these, one, two, three,* . . .
(b) *every, a, no, the*

A typical example of a 2-place DET occurs in

(4) More men than women voted for Henry.

The most natural analysis here is to consider the NP *more men than women* as formed by applying the 2-place DET *more . . . than* to the arguments *men* and *women*. This is not the only analysis, however: one could see the NP as the result of applying the 1-place DET *more . . . than women* to the argument *men*. The example reveals that the analysis of DET-N structure, according to the basic criterion above, is not unique. To make a choice we need further considerations. In the present case, there are good reasons to prefer the first analysis (cf. Keenan & Stavi, (1981) and Keenan & Moss, (this volume)); the strongest, perhaps, being that *more . . . than women* is not a *quantitative* DET (cf. section 7 below), in contrast with *more . . . than*.

Other similar 2-place DETs are *less . . . than* and *as many . . . as*. For further examples of 2-place DETs, and of n-place DETs for n > 2, cf. Keenan & Moss (this volume).

Many 1-place DETs have the property that they *can* occur pronominally, i.e. without argument. Such DETs will be called *pronominal* here; all those in (a) are pronominal, whereas those in (b) *must* be followed by an N. Pronominal use of DETs, which is not discussed in B&C, is a frequent phenomenon: cf. examples like (1) or

(5) Some like it hot

(6) Few were there to meet him.

The distinction applies to simple as well as complex DETs; a brief glance at the extensive list of English DETs in Keenan & Stavi (1981) reveals that most of these are pronominal; For n-place DETs with n > 1, however, pronominal use does not seem to occur.

The syntactic classification of DETs given here has an immediate counterpart for their semantic interpretations – from now on I will use 'DET' for the syntactic expressions and 'determiner' for their interpretations (but it is hard to avoid all confusion, since DETs are both used and mentioned). An n-place DET is thus interpreted as an n-ary determiner, i.e. as an n-ary function from N denotations (subsets of M) to NP denotations (sets of subsets of M; cf. section 4).

3. DISCOURSE UNIVERSES AND CONTEXT SETS

It is clear that NP universes cannot in general be identified with 'sentence universes', whether the latter are discourse universes or context sets; to see this we need only consider sentences with at least two NPs containing different Ns. I want to show that neither can discourse universes and context sets be identified. The first argument is methodological. One point of a discourse universe, it seems, is that it can be kept constant during a piece of discourse containing several sentences. This indicates that discourse universes should be *large* in the sense that they contain all objects 'relevant' to the sentences in question. We can thus formulate two *methodological postulates*:

(MP1) Discourse universes are constant over pieces of discourse.

(MP2) Discourse universes are large.

(MP2) has the effect that the exact choice of discourse universe is not important, as long as it is large (this may be one sound insight at bottom of the putative argument, given in section 1, for the FU strategy). The reason is that (most) natural language DETs are 'universe-independent', in a sense which will be made precise in the next section (cf. the condition EXT). This is in contrast with, for example, the universal quantifier of standard predicate logic, for which the choice of universe is always important.

Furthermore, *each* of (MP1) and (MP2) implies that context sets should not be identified with discourse universes. For, different context sets can occur within one piece of discourse, and context sets are in general *not* large (this is one point of using them).

Sentences with pronominal use of DETs afford clear examples of the occurrence of context sets. In sentences (1), (5) and (6), the lack of an argument is a visible *context set indicator*, which signals the implicit occurrence of a context set (as argument for the corresponding determiner), although the sentence itself does not tell us which.

However, it should be noted that restriction to context sets can occur with all kinds of DETs, whether pronominal or not, and without any explicit indication at all. This brings us to the second argument against the FU strategy. Consider the following pieces of discourse.

(7) Swedes are funny. All tennis players look like Björn Borg, and more men than women watch tennis on TV. But most non-Swedish tennis players are disliked by many.

(8) The English love to write letters. Most children have several pen pals in many countries.

In the natural interpretation of (7), *all* in the second sentence is restricted to the set of Swedes, in spite of the fact that it occurs in an ordinary NP with no indication of this restriction, and similarly for the 2-place DET *more . . . than*. But *most* is not thus restricted in the last sentence, although the pronominal *many* is. The discourse universe must contain both Swedes and non-Swedes.

Likewise, in (8) the universe of discourse must contain English as well as other children (and also countries!), but *most* in the second sentence is restricted to Englishmen whereas *several* is not.

Examples such as these are conclusive against the FU strategy. For, looking only at the last sentences of (7) and (8), we see that there is *no way* to make sense of these sentences if the discourse universe is identified with the context set. (Note that this argument is independent of the postulates MP1 and MP2.)

I conclude that although the choice of discourse universe can be ignored in semantics (given MP1 and MP2), the occurrence of context sets must somehow be accounted for. In what follows we shall only consider the formal framework for context sets, leaving the (more difficult) question of *how* context sets are chosen to more ambitious semantic theories.

4. BACKGROUND ON DETERMINER SEMANTICS

To fix ideas we use the formal apparatus developed in B&C: the fragment of English, the syntax and semantics of the logic L(GQ), and the translation rules from the fragment into L(GQ). All of this is admirably presented in the first three sections of B&C; below, only some extensions of the B&C framework, and some minor notational differences, will be explained.

In the fragment, Ns and VPs are translated as *set terms* in L(GQ), which in turn are interpreted, in a model $\mathcal{M} = \langle M, [\![\cdot]\!] \rangle$, as subsets of M. Similarly, NPs get interpreted as *quantifiers on* M, i.e. set of subsets of M, and DETs are interpreted as functions from subsets of M to quantifiers on M; such a function is a *determiner on* M (only unary determiners are considered in B&C, but there is no problem in extending the framework to arbitrary n-ary determiners).

The distinction in B&C between *logical* and *non-logical* determiners will not be important here (for a discussion of this distinction cf. Westerståhl, (1982)), but I will assume that all determiner symbols are *constants* in the sense that they denote, on each universe M, a fixed determiner on M. Thus, an n-ary *determiner* is a functor D which with each non-empty set M associates an n-ary determiner D_M on M.

With a familiar abuse of language I will often use the same letter ('D', 'D_1', etc.) for determiner symbols and determiners. Similarly for 'A', 'B', 'A_1', . . . , 'X', 'Y', which in general stand for sets, but sometimes for expressions (Ns and VPs) denoting sets. A sentence in the fragment of the form

$$[[[D]_{DET}[A]_N]_{NP}[B]_{VP}]_S$$

will be written simply

$$(DA)B,$$

and the corresponding truth condition in a model $\mathcal{M}$, i.e. the condition that $B \in D_M(A)$, will often be written $(D_M A)B$, or even

$$D_M AB,$$

emphasizing the fact that a determiner on M can be thought of as a relation between subsets of M. (This is for unary determiners; in the n-ary case a quantified sentence can be written $(DA_1 \ldots A_n)B$).

A crucial condition on determiners in B&C is *conservativity* (this term, though, is from Keenan & Stavi (1981)):

(CONSERV) For all M and all $A,B \subseteq M$, $D_M AB \Leftrightarrow D_M A\, A \cap B$.

Thus, the universe is restricted to A in the sense that only that part of B which is common to A is important for the truth value of $D_M AB$. But note that M is still essential since it determines the interpretation of D. A formal condition expressing the idea from the previous section that the universe is unimportant if large enough is the following:

(EXT) If $A,B \subseteq M \subseteq M'$ then $D_M AB \Leftrightarrow D_{M'} AB$.

It is easy to see that the conjunction of CONSERV and EXT is equivalent to

(UNIV) For all M and all $A,B \subseteq M$, $D_M AB \Leftrightarrow D_A A\ A \cap B$.

This condition, finally, expresses the idea, mentioned in section 1, that a DET *restricts* (within the NP where it occurs) the universe of quantification to the NP universe.

The three conditions above also have natural versions when $n > 1$, but these will not be needed here.

Although most natural language DETS satisfy UNIV, it can be argued that EXT fails in some cases. This is hinted at in B&C, and further discussed in Westerståhl (1982), for DETs such as *many* and *few*. For example, EXT fails if *many* is given the following interpretation:

$$many_M AB \Leftrightarrow |A \cap B| > 1/3 \cdot |M|$$

(where $|X|$ is the number of elements in the set X).

5. ADDING CONTEXT SETS

In order to represent context sets in the semantic framework we first add a list of *set variables* $X_0, X_1, X_2, \ldots$ to the symbols of L(GQ). In the formation rules these are treated just as unary predicate symbols. So sentences of L(GQ) may now contain free set variables, and such a sentence has a truth value in a model $\mathcal{M}$ only relative to a *value assignment* (of subsets of M to the set variables) in M. The idea is simply that the context provides this assignment; indeed, for present purposes the context can be identified with the value assignment.

We also make the following (terminological) change in L(GQ). Add the formation rule

(R) If D is a determiner symbol and η a set term then D^{η} is a determiner symbol.

In particular, D^X is a determiner symbol if X is a set variable. Semantically, we introduce an operation on determiners which could be called *restriction*: if D is a unary determiner and X a fixed set, define a new unary determiner D^X by

(RES) $\quad D^{X}{}_{M}AB \;\Leftrightarrow\; D_{M}X{\cap}A\,B,$

for all M and all A,B $\subseteq$ M. Thus, the semantic rule of L(GQ) corresponding to (R) is

(S) $\quad [\![D^{\eta}]\!] = [\![D]\!]^{[\![\eta]\!]}.$

Since $(D^{\eta}\alpha)\beta$ is equivalent to $(D\hat{x}[\eta(x) \wedge \alpha(x)])\beta$, no logical strength has been added to L(GQ).

As to the fragment, the only change we need is to allow for pronominal use of DETs. In order to preserve the B&C phrase structure we do this by including the set variables among the lexical items under N. Then the rule NP $\rightarrow$ DET N must be modified a little, to avoid generating a set variable with a non-pronominal DET. In the fragment, relative clauses can be generated under N by the two rules N $\rightarrow$ N R and R $\rightarrow$ *that* VP. But in every N there is a uniquely determined *principal lexical noun*, namely, the leftmost lexical noun in it. Thus, the revised rule is this: NP $\rightarrow$ DET N, *provided* that, if the principal lexical noun in the N is a set variable, the DET is pronominal.

In the B&C fragment, the phrase structure trees generated by the syntactic rules give sentences by means of (unstated) morphological rules. To preserve this feature in the revised fragment, simply add a rule which deletes all set variables. Now sentences such as the following can be generated:

(9) Many love Susan

(10) Every girl that loves many wants all

Finally, we review the translation rules, which define the relation "α' is a translation of α", where α is a phrase structure tree or a lexical item, and α' is an expression in L(GQ). Clearly a set variable serves as its own translation. But we must also account for the introduction of set variables which do not appear in the phrase structure trees, as in the examples (7) and (8). Only the translation of NPs is affected. Here we may stipulate that, optionally, an NP

$$[[\alpha]_{DET}[\beta]_{N}]_{NP},$$

where β is *not* a set variable, is translated as

$$\alpha'^{X}(\beta'),$$

where X is a new set variable. This extension of the translation rules is designed to give maximal freedom in the assignment of context sets. Several variants are possible. For example, we could make the above rule obligatory, and leave to the context to assign the whole universe M to X when no restriction is intended. Further, we could require that, for each sentence of the fragment, at most one context-set variable occurs in its translation (though possibly in several places). This latter condition, which may be called the *uniqueness condition* on translation, appears to be satisfied in most cases. For instance, it holds for the sentences in (7) and (8).

As an example we give a translation of (10):

(10') $(\mathit{every}^{X}(\hat{x}[\mathit{girl}(x) \wedge (\mathit{many}(Y))\hat{y}[\mathit{love}(x,y)]]))\hat{x}[(\mathit{all}(Z))\hat{y}[\mathit{want}(x,y)]]$

Here we have introduced as many set variables as possible, but X is optional and can be dropped.

6. JUSTIFICATION

Restricting the universe to a smaller set is common practice in logic, where it is usually called *relativization*. In logic with generalized quantifiers there is a standard procedure for relativizing sentences (and formulas) to a fixed formula with one free variable. This procedure can be transferred to L(GQ), where sentences can be relativized to a fixed set term. The important step is passing from each unary determiner D to the *binary relativized determiner* D^r, defined as follows: For all M and all A,B,C, $\subseteq$ M,

(REL) $\quad D^r{}_M ABC \Leftrightarrow D_C A\cap C\ B\cap C$

(in general, if D is n-ary, an (n+1)-ary D^r is defined similarly). Thus, relativizing in L(GQ) means adding a new binary determiner symbol – also denoted D^r – for each unary D, to be interpreted according to (REL). Let us assume, for simplicity, that the set term we relativize to is a set variable X, and that no individual constants occur in the formulas we consider. Then, for each set term η and each formula ψ in L(GQ) where X does not occur, $\eta^{(X)}$ and $\psi^{(X)}$, the *relativizations* of these expressions to X, are defined inductively as follows:

(11) $P^{(X)} = P$ (P a unary predicate symbol)

$\hat{x}[\eta]^{(X)} = \hat{x}[\eta^{(X)}]$

$R(x_1, \ldots, x_n)^{(X)} = R(x_1, \ldots, x_n)$ (R an n-ary relation symbol)

$\eta(x)^{(X)} = \eta^{(X)}(x)$

$((D\eta)\delta)^{(X)} = (D^r X\eta^{(X)})\delta^{(X)}$

$(\sim\psi)^{(X)} = \sim\psi^{(X)}$

$(\phi \wedge \psi)^{(X)} = \phi^{(X)} \wedge \psi^{(X)}$

The point of all this is that the sentence $\psi^{(X)}$ expresses just what ψ says in a universe restricted to X. More precisely, if $\mathcal{M} = \langle M, [\![\cdot]\!]\rangle$ is a model and X is assigned the subset C of M, let $\mathcal{M}\restriction X$ be the model $\langle C, [\![\cdot]\!]'\rangle$, where $[\![R]\!]' = [\![R]\!] \cap C^n$ for each n-ary relation symbol R. Then it is a fact of logic that

(12) $\psi^{(X)}$ is true in $\mathcal{M}$ iff ψ is true in $\mathcal{M}\restriction X$.

This logical technique thus provably accomplishes restriction to a subuniverse of M. On the other hand, it is not adapted to a natural language context. Indeed, the determiner D^r defined by (REL) does not in general correspond to a 2-place natural language DET (such as those mentioned in section 2), even when D corresponds to a 1-place natural language DET.

For this reason, we did *not* use the above technique when defining restriction to context sets in the previous section, as the reader will have noticed. We did *not* increase the number of arguments of the determiners, but used the given determiners with the restriction operation instead. To justify this simpler procedure we must show that it achieves the same results as ordinary relativization. This, in fact, is guaranteed by the conditions CONSERV and EXT. The following shows why:

(13)
$$\begin{aligned}
D^r{}_M ABC &\Leftrightarrow D_C A\cap C\ B\cap C && \text{(def. of } D^r\text{)}\\
&\Leftrightarrow D_M A\cap C\ B\cap C && \text{(EXT)}\\
&\Leftrightarrow D_M A\cap C\ A\cap B\cap C && \text{(CONSERV)}\\
&\Leftrightarrow D_M A\cap C\ B && \text{(CONSERV)}\\
&\Leftrightarrow D^C{}_M AB && \text{(def. of } D^C\text{).}
\end{aligned}$$

Thus, the restriction operation actually performs relativization, under EXT and CONSERV, i.e. under UNIV. We also have a converse: if $D^r{}_M ABC$ is equivalent to $D^C{}_M AB$ for all A,B,C, $\subseteq$ M, then D satisfies UNIV (as is seen by letting C = A in this equivalence).

If the uniqueness conditions holds, a bit more can be said, for then each sentence ψ obtained by translation is logically equivalent to a relativized sentence. In fact, this relativized sentence is simply obtained as follows: Delete, in ψ, all superscript set variables, and replace the remaining ones with a predicate denoting the univese (e.g. the logical predicate *thing* in B&C). Call the result ψ^*. Then, using (12) and (13) it is easy to verify that ψ is logically equivalent to $\psi^{*(X)}$.

The justification of our procedure may be summarized in the following

PROPOSITION 1: Assume the uniqueness condition for translation. Let ψ be a sentence of L(GQ) obtained by translation from the fragment, containing the set variable X. Then, if UNIV holds, ψ is logically equivalent to $\psi^{*(X)}$. Conversely, if this equivalence holds for all translated sentences, UNIV will be satisfied.

It follows that the procedure will not work when EXT fails. Consider, for example, the interpretation of *many* from section 4: $many_M AB \Leftrightarrow |A \cap B| > 1/3 \cdot |M|$. Translating

Many boys run

we get

$(many^X(boy))run$

with the truth condition

$|X \cap [\![boy]\!] \cap [\![run]\!]| > 1/3 \cdot |M|$,

instead of the more natural reading.

$|X \cap [\![boy]\!] \cap [\![run]\!]| > 1/3 \cdot |X|$.

To get this we must use, instead of $many^X$, the binary relativized determiner $many^r$.

7. RESTRICTED DETERMINERS

There is a fairly well developed logical theory of unary determiners; the main source here is van Benthem (1984). Can the results of this theory be transferred to restricted determiners of the form D^X? In general this is not the case. The present section will give some illustrations of what is lost, and what can be preserved, when attention is confined to determiners restricted to a fixed context set.

Recall the definition of D^X: for all M and all A,B $\subseteq$ M,

(RES) $D^X{}_M AB \Leftrightarrow D_M X\cap A\ B$

(we do not have to assume that $X \subseteq M$ here, but we will assume that $X \neq \emptyset$). A property of determiners is *preserved under restriction*, if, whenever D has the property, so does every D^X.

PROPOSITION 2: CONSERV and EXT are preserved under restriction.

PROOF For EXT this is immediate; for CONSERV we have $D^X{}_M AB \Leftrightarrow D_M X\cap A\ B \Leftrightarrow D_M X\cap A\ X\cap A\cap B$ (since D is conservative) $\Leftrightarrow D_M X\cap A\ A\cap B$ (similarly) $\Leftrightarrow D^X{}_M A\ A\cap B$. □

We assume CONSERV and EXT for all ordinary determiners, and can thus do the same for the restricted ones. In particular, by EXT, the subscript 'M' in '$D_M AB$' or '$D^X{}_M AB$' can then be dropped: DAB $\Leftrightarrow$ for *some* M with A,B $\subseteq$ M, $D_M AB$.

However, the theory in van Benthem (1984) deals with *logical* determiners, namely, those which, in addition to CONSERV and EXT, satisfy the following condition of *quantity*:

(QUANT) If A,B $\subseteq$ M and f is a permutation of M, then
$DAB \Rightarrow Df[A]f[B]$.

QUANT is obviously *not* preserved under restriction to a fixed set X – what we get is $D^X AB \Rightarrow D^{f[X]}f[A]f[B]$ (this means, though, that a 'local' form of QUANT holds, namely, w.r.t. permutations of the set X). So results involving QUANT essentially cannot be expected to hold for restricted determiners (an example is given below).

The theory of determiners studies, among other things, relational properties of determiners like transitivity, symmetry, asymmetry, reflexivity, quasi-reflexivity (i.e. DAB $\Rightarrow$ DAA for all A,B), as well as monotonicity properties (upward or downward monotonicity in the right or left argument). Many of these are preserved under restrictions; in fact, all of the above-mentioned ones are *absolute* in the sense that D has the property *if and only if* every D^X has the property. Johan van Benthem pointed out to me that (part of) this observation is an instance of a general phenomenon: Call a property of determiners *simply universal*, if it can be expressed in form

(*) $\forall A_1 \ldots \forall A_n \psi(A_1, \ldots, A_n;D)$,

where $\psi(A_1, \ldots, A_n;D)$ is a truth functional combination of expressions of the form DA_iA_j. Then we have

PROPOSITION 3: All simply universal properties of determiners are absolute.

PROOF This is a consequence of CONSERV. Suppose first that D satisfies (*); we must show that so does D^X. Take any $A_1, \ldots, A_n$. As in the proof of Proposition 3, $D^XA_iA_j$ is equivalent to $DX\cap A_i\, X\cap A_j$, by CONSERV. It follows that $\psi(A_1, \ldots, A_n;D^X)$ is equivalent to $\psi(X\cap A_1, \ldots, X\cap A_n; D)$. But the last statement is a consequence of (*) for D.

Conversely, suppose that every D^X satisfies (*), and take any $A_1, \ldots, A_n$. Let $X = A_1 \cup \ldots \cup A_n$. We have $\psi(A_1, \ldots, A_n;D^X)$, and thus, as before, $\psi(X\cap A_1, \ldots, X\cap A_n;D)$. Hence, since $X\cap A_i = A_i$, $\psi(A_1, \ldots, A_n;D)$. □

Of the properties mentioned above, all *except* those involving monotonicity are simply universal (e.g. the following version of monotonicity is not simply universal: DAB & B $\subseteq$ C $\Rightarrow$ DAC). Actually, Proposition 3 can be generalized, if one wishes, to wider notions of universality, which include monotonicity.

An example of a property *not* preserved under restriction is anti-symmetry: DAB & DBA $\Rightarrow$ A = B (from D^XAB & D^XBA we only get $X\cap A = X\cap B$, not A = B; i.e. the identity relation must be restricted too). Other examples are various non-triviality properties (which involve *existential* quantification over sets): Call D *trivial on* M, if either DAB for all A,B $\subseteq$ M, or DAB for no A,B $\subseteq$ M. A weak non-triviality requirement is that, on *some* M, D is not trivial. This is not preserved when passing from D to D^X, and the same holds for the stronger requirement that D is non-trivial on *all* M. In fact, D^X *never* has this latter property, since it is trivial on all M such that $M\cap X = \emptyset$. For restricted determiners, the corresponding requirement is instead that D^X is non-trivial on all M which have non-empty intersection with X.

A result from B&C is that symmetry is equivalent to the property

(SYMM) $DAB \Leftrightarrow DA\cap B\ A\cap B$.

From this it follows that if D is (ir)reflexive and symmetric, then D is trivial on all M. Since QUANT is not used, this holds for restricted determiners too. Other results, which do not use QUANT but involve the stronger non-triviality requirement, may be reformulated for the restricted case. Here is an example from van Benthem (1984): If D is symmetric, quasi-reflexive, and non-trivial on all M, then D = *some*. A restricted version goes as follows:

THEOREM 4: If D^X is symmetric, quasi-reflexive, and non-trivial on all M such that $M \cap X \neq \emptyset$, then $D^X = some^X$ on all such M.

The proof is just a variation of van Benthem's proof, so we omit it.

But when QUANT is needed, there may be no 'restricted versions'. For example, van Benthem shows that if D is asymmetric, then D is trivial on all M. Here QUANT is used, and there are in fact non-trivial asymmetric D^X, e.g. the following. Let DAB $\Leftrightarrow$ $|A-B| > \frac{n}{2}$, and take X such that $|X| = n$. Then

$$D^X AB \Leftrightarrow |(A \cap X)-B| > \frac{|X|}{2}$$

Clearly D^X is non-trivial (on some M). But $|(A \cap X)-B| > \frac{|X|}{2}$ and $|(B \cap X)-A| > \frac{|X|}{2}$ cannot both be true, so D^X is asymmetric.

I conclude that the logical theory of restricted determiners is of somewhat doubtful interest, in view of the importance of QUANT. But then, restricted determiners arise from unrestricted ones, and it can be argued that all unrestricted determiners that are interpretations of natural language DETs actually satisfy QUANT. Such an argument will be produced in section 10. It proceeds, however, via a detour involving a linguistic application of the idea of context sets, and that is the subject of the next section.

8. THE DEFINITE ARTICLE

In B&C, as in other places, the definite article is treated as a DET with the following interpretation:

$$\text{(14)} \qquad the\text{AB} \begin{cases} \Leftrightarrow \; all\text{AB, if } |A| = 1 \\ \text{undefined, otherwise} \end{cases}$$

A slight (Russellian) variant is to make *the*AB false when $|A| \neq 1$.

There are several reasons to be suspicious of this analysis. The first, and most obvious, is that it ignores the contextual reference of the definite article. In general, it is certainly *not* a condition for the truth of

(15) The dog bit John

that there is exactly one dog in the whole universe. The fact that (14) is still proposed reveals, I think, an instance of tacit use of the FU strategy. But this strategy has already been discredited. Thus, introduction of a context set is essential here. Indeed, the method of section 6 lets us do just that, translating (15) as the^{X}AB. I am going to suggest, however, another, slightly more radical, solution.

A second unhappy feature of (14) is that it treats only the singular use of *the*. Thus it will not take care of

(16) The dogs bit John.

It is then sometimes suggested that we define another definite article, say the_{pl}, by

(17)
$$the_{pl}AB \begin{cases} \Leftrightarrow all\mathrm{AB}, \text{ if } |A| > 1 \\ \text{undefined, otherwise.} \end{cases}$$

But this may be another case of poor methodology. Prima facie, at least, there seems to be no good reason why *the* should be *ambiguous* between the singular and the plural case.

More principled arguments can be given. The singular-plural distinction is essential to the definite article. This property distinguishes *the* from most other DETs. In fact, I am going to suggest (section 10) that the singural-plural distinction is *never* essential for determiners, in the present framework. Then *the* is not DET; an alternative analysis will be given below.

The idea that *the* should not be interpreted as a determiner is not new. For example, Heim (1982) gives a special treatment of definites (and indefinites), although with a rather different motivation.[3] Likewise, Barwise & Perry (1983) do not interpret *the* as an ordinary determiner (ch. 7).

A third and final drawback of (14) and (17) is that they do not tell us how to analyze more *complex* NPs containing *the*. Consider the sentences:

(18) The boys saw the film

(19) Susan ate the cake

(20) Most of the men love Linda

(21) John kissed each of the girls

(22) The captain knew most of the few survivors

(23) Several of the seven men felt sick

(24) The three boys saw Harry

A uniform treatment of the use of *the* in all these cases is clearly desirable.
The idea behind the analysis of *the* that I shall propose can be formulated as follows:

(THE) *the* is not a DET but a context indicator which signals the presence of a context set X, in such a way that *the* A denotes $X \cap A$, a subset of A.

It would be possible to let *the* actually denote X, but I shall not do this. The question of the syntactic category of *the* will be resumed in section 10.

It is immediately clear that an analysis according to (THE) avoids the first two problems with the standard analysis. It accounts for the presence of contextual reference, and it does not distinguish a singular from a plural *the*. Instead, the singular-plural distinction comes in a natural way from the syntactic form of the N, as an extra condition on $X \cap A$.

But what about real definite descriptions, where the N succeeds in uniquely determining an object (or at least is intended to do that) independently of the context? Since nothing is said here about how context sets are chosen, we can assume for the time being that this is a special case of (THE), for example, one in which the context set is the whole universe M.

It remains to analyze (18) - (24). The NPs in these sentences have the following forms:

(i) *the* A

(ii) D *of the* A

(iii) D_1 *of the* D_2 A

(iv) *the* D_2 A

(iii) can be seen as the most general form, of which the others are special cases. The interpretations that follow conform to this intuition. Consider first (ii). Here the idea of (THE) fits directly: we can let *the* A give the argument for the determiner. Formally, this can be expressed with a restricted determiner:

(ii') $(D \text{ } \mathit{of\ the} \text{ } A)B \Leftrightarrow D^X AB$,

where X is the context set indicated by *the*. Now (iii) is interpreted by the following extension of this idea:

(iii') $(D_1 \text{ of the } D_2 \text{ } A) \text{ } B \begin{cases} \Leftrightarrow \text{ } D_1{}^X AB \text{ , if } D_2{}^X AM \\ \text{undefined, otherwise.} \end{cases}$

We see that (ii') is the special case of (iii') when D_2 = *all*. Finally, (i') is obtained by letting D = *all* in (ii'), and (iv') by letting D_1 = *all* in (iii').

These uniform interpretations are easily seen to give the 'right' meaning to (i) - (iv) (in the case of (i) and (iv) this depends on the fact that only distributive quantification is allowed in the B&C framework; cf. section 10). The only thing one might wish to add is a 'plural condition', corresponding to the fact that the N denoting A in (ii) - (iv) is always plural (except for mass nouns, which are not treated here). This syntactic property appears to have semantic effect, which in our case can be taken care of by adding, on the right hand side of (ii') - (iv'), the condition that $|X \cap A| > 1$ (undefined otherwise). Similarly, we can make (i') sensitive to the syntactic number of the N by requiring that $|X \cap A| = 1$ in the singular case and $|X \cap A| > 1$ in the plural case.

The condition $D_2{}^X AM$ for the sentence to have a truth value in (iii') is adapted from the B&C analysis of "there are"-sentences. B&C interpret sentences of the form

(25) There are D A

as

DAM.

Similarly, our use of the condition $D_2{}^X AM$ becomes clear if it is read as

(26) There are D_2 As in X.

To incorporate the above treatment of the definite article into the B&C framework, we do the following. In L(GQ), delete the determiners *the1, the 2, the 3, . . .* (these are all *primitive* in B&C, which hardly seems natural). In particular, *the* (= *the 1*) is deleted. Further, add a new determiner-forming operation: from two determiner symbols D_1 and D_2, and a set variable X (or a set term), form the determiner symbol

$$D_1 \; of D_2{}^X,$$

which is interpreted according to (iii'). Now *the n* can be expressed:

$$(\textit{the } n \text{ A})\text{B} \Leftrightarrow (\textit{all of } n^{\text{M}} \text{ A})\text{ B};$$

so nothing is lost by its omission. As for the fragment and the translation rules, there are various ways to extend these to the present analysis. Perhaps the simplest is the following. Delete *the* from the list of DETs, and add the syntactic rules:

$$\text{(DF)} \qquad \text{NP} \rightarrow \begin{cases} \textit{the } \text{N} \\ \text{DET } \textit{of the } \text{N} \\ \text{DET } \textit{of the } \text{DET N} \\ \textit{the } \text{DET N} \end{cases}$$

Then, the corresponding translation rules, according to (i') - (iv') above, are immediate. An obvious adjustment (of (DF) and the translation rules) will take care of the 'plural conditions' just mentioned on the NPs involved.

(DF) and (i') - (iv') have been formulated for arbitrary DETs. In natural language, however, there are certain clear restrictions on which DETs may occur here. We return to these restrictions in the next section.

Note that we have not introduced any DET-forming rules corresponding to the two determiner-forming operations added to L(GQ). The reason is that the partitive constructions of (ii) and (iii) are difficult to iterate in natural language. For example, a rule like

DET → DET *of the* DET

would yield ungrammatical NPs like

some of the two of the five boys

(on the other hand, iteration within a relative clause is allowed by (DF), so e.g. *two of the boys that love all of the girls* can be generated). Under certain circumstances, however, it appears that the partitive construction can be iterated; this is not included here.[4]

Partitive NPs are also discussed in B&C (Appendix A). They add, essentially, a rule

$$\mathrm{N} \rightarrow \textit{of}\,\mathrm{NP},$$

where the NP must be formed with *the* or *the n* or *both*, and a syntactic partitive marking prevents iteration of the construction. Disregarding *both* (which is equivalent to *the 2*), the phrase structures generated in this way can, essentially, be obtained also by (DF) (actually (DF) is a little more general). So on the syntactic side, their treatment and the one given here are rather similar. The semantic treatment, on the other hand, is different in the two cases, mainly because the stress laid here on the occurrence of context sets (cf. also section 10).

9. RESTRICTIONS ON PARTITIVE NOUN PHRASES

The rules (DF) are subject to certain rather interesting restrictions. To state these, we consider the most general form of NPs in (DF); this form can be written, even more generally, as

(27) DET_1 *of* DET_2 DET_3 N.

The restrictions, stated below, on the expressions from the standard list of DETs that can take the position DET_i here apply, mutatis mutandis, to the other NPs in (DF) as well.

As to the position DET_1, we find that *only pronominal* DETs are allowed. An explanation of this is provided in Hoeksema (ms.): he analyzes all partitives on the form

$$\mathrm{NP}\ \textit{of}\ \mathrm{NP}\ ,$$

which in the case of (27) means that a 'dummy' N is present as an argument to DET_1, and only pronominal DETs can occur without the N. Can *all* pronominal DETs occur here? No, consider

(a) *possessive* DETs: *John's, Susan's, his, their, . . .*
(b) *demonstrative* DETs: *this, that, these, those.*

These are all pronominal, but cannot take the position DET_1 in (27).

Concerning the position DET_2, we find that

(a) the possessives

(b) the demonstratives (but only the plural ones, as should be expected from the 'plural condition' on partitives mentioned in section 8)

(c) the definite article

will do. In fact, with the possible addition of *both* (but cf. section 10), it would seem that *precisely* these DETs fit here. This is a significant restriction, which may be taken as characteristic of the partitive construction; it will be exploited further in the next section.

As for DET_3, finally, we may take our lead from the B&C analysis of "there are"-sentences mentioned before. A determiner is called *weak*, if, as a binary relation, it is neither reflexive nor irreflexive (otherwise it is *strong*). It is noted in B&C that weak determiners are characteristic of "there are"-sentences, and this is explained by the fact that such sentences, when analyzed as in B&C, become trivially true or trivially false if constructed with strong determiners. If our interpretation of NPs of the form (iii) in section 8 is correct, we should expect that *only weak* DETs can occur in position DET_3, and this is indeed the case. However, not all weak DETs fit here; notable exceptions are *some, one, a few, no.* But, *given the 'plural condition'* on partitives, these can be excluded for exactly the same kind of reason as the strong ones: they make (26) trivially true or trivially false (assuming that *a few* means something like *at least two*). The B&C explanation of the restrictions on "there are"-sentences can thus be successfully extended to the restrictions on the position DET_3 in (27).

10. DEFINITES

Let us go back to the question, touched upon in section 8, of how DETs relate to the singular-plural distinction. Here are some simple facts. For most DETs, the syntactic number of the succeeding N is fixed. For example, *all, many, few, most, both* must take a plural N, whereas *every, each, neither* take only singular Ns. In a few cases, such as *some* and *no*, both singular and plural Ns can follow. But, in the examples mentioned, these syntactic features of DETs have no obvious semantic counterparts for determiners. Indeed, *all* and *every* are interpreted as the *same* determiner. Likewise, although both *neither* and *both* presuppose that the succeeding N denotes a set with exactly two elements, one takes a singular and the other a plural N. Also, the semantic difference (if any) between *some man* and *some men*, or between *no man* and *no men*, has nothing to do with the number of men in the model.

These DETs are semantically indifferent to the singular-plural distinction in a sense which can be made precise as follows. We want to call a

DET *number-sensitive*, if, in all well-formed NPs constructed with it, the syntactic number of the N determines a corresponding semantic condition on the interpretation of the N (in each model). The condition is that the set denoted by the N has exactly one element if the N is singular, and at least two elements if the N is plural. This condition, however, should be a *presupposition* rather than a truth condition – we do *not* want e.g. the DET *two* to be number-sensitive, even though *two*AB $\Rightarrow |A| \geq 2$ and the N is always plural here.[6] This can be expressed, as in B&C, by using *partial* determiners as interpretations of DETs. Thus, the requirement for number-sensitivity is that the determiner (which interprets the DET) is *defined* for the argument (set) which interprets the N, just in case this argument satisfies the condition corresponding to the syntactic number of the N.[7]

It is easy to check that the usual total DETs (i.e. those interpreted as total determiners) are not number-sensitive, as expected.[8] In section 8 we noted, on the other hand, that syntactic number does make a difference to the definite article. Similarly, it matters for the possessives and the demonstratives. However, in these three cases we must also take account of the occurrence of context sets. Consider the NPs

the toy
Susan's toy
this toy.

In each case it is presupposed that a certain set has exactly one element. But this set is *not* the set of toys in the universe, i.e. the denotation A of the N. Instead, it is that denotation *intersected* with a context set X. This is clear for *the* and the demonstratives; for *Susan's* , X is (usually) the set of things in the universe that belong to Susan (we agree to call this a context set; actually, X is sometimes a (context-given) subset of this set).

Thus, these DETs are *contextually number-sensitive* in the sense that the condition in the above definition of number-sensitivity holds for $X \cap A$ and not for A (the denotation of the N). They are not number-sensitive in the 'pure' sense. In fact, it seems that *there are no number-sensitive DETs in English*. This fact is by no means conceptually obvious or necessary; it is easy to imagine a language with number-sensitive DETs. Their absence from natural languages is something which needs to be explained. Here we shall only note that the property of being sensitive to syntactic number and the property of being a context set indicator seem to be linked together in natural language.

Before going on, we shall make the following methodological move, in order to avoid certain complications: *both* and *neither* are excluded from the list of DETs. More about the reasons, and the justification, for this will be said presently.

We have found, in this and the two preceding sections, that the group of DETs consisting of the definite article, the possessives, and the demonstratives is distinguished from other DETs in several ways:

They are context set indicators
They are (contextually) number-sensitive
They have a special role in partitives (specified in section 9)[9].

Further, it is easy to see that the special syntactic and semantic treatment of the definite article that was suggested in section 8 can be extended to demonstratives and possessives. For example, if X is the set of things belonging to Susan, then

Most of Susan's ten cars are new

is true just in case the intersection of X with the set of cars has more new elements than old ones, given that it has ten elements (otherwise the sentence lacks truth value), just as the interpretation (iii') of section 8 predicts when adapted for possessives.

The following *methodological proposal* thus seems to be rather well motivated: Remove the above-mentioned expressions from the list of DETs and put them in a special group, the *definites* (DEF), say. The DEFs can then be treated in the present framework by syntactic and semantic rules modelled on the ones given for the definite article in section 8 (with certain obvious modifications). The arguments given there for the advantages of this analysis over the usual one apply, in fact, to all the DEFs: it accounts for their contextual reference, it avoids treating the definite article and the possessives as ambiguous between a singular and a plural setting (which is in line with the usual assumption that DETs (and DEFs) are *constants*), and it covers uniformly certain complex NPs with DEFs, in particular certain partitive constructions.

Further motivation for the present proposal can be obtained by stating a few consequences of it. We formulate two of these as *semantic universals*. The first one is

(U1) All natural language determiners are *total*.

Since the only reason for introducing partial determiners was number-sensitivity, and since we have lifted out the (contextually) number-sensitive DETs, (U1) is reasonable. It results in a notable simplification of the logical theory of determiners (indeed, in existing work on determiner theory such as van Benthem (1984) and Keenan & Stavi (1981), only total determiners are considered).

Another consequence of the proposal is that *no DETs are context set indicators*. This is not a semantic universal, though, since it does not say anything directly about determiners. In particular, it does *not* say that no restricted determiners will ever be needed. For we have seen in sections 2 and 5 that restricted determiners may be called for without any explicit indication at all.

The following universal, however, is purely semantic. It depends on the proposed separation of the DEFs from the DETs.

(U2) All natural language determiners are *quantitative*.[10]

(U2) is based on the assumption that the only serious candidates for non-quantitative DETs are the possessives: permutations of the universe will not in general preserve the ownership relations that pertain. Other possible counterexamples that have been proposed are 1) DETs of the type *all blue*, as in

All blue grapes are tasty,

and 2) DETs of type *every . . . but John*, as in

Every professor but John attended the meeting.

But it is not necessary to treat any of these as non-quantitative DETs. In 1), we can either let the N be complex (*blue grapes*) and use the ordinary DET *all*, or introduce a binary DET (quantitative), which is the same as using the ordinary *all restricted* to the set of blue things. In 2), the second option is open, i.e. we can consider *every A but a* as an operation with a set *and* an individual as arguments; this operation is quantitative. Or, we can use the ordinary DET *every*, and just stipulate in translation that special conditions (that John is a professor and that he didn't attend the meeting) must be added.

Since many results in determiner theory depend on the assumption of quantity (section 7), (U2) has the effect of making this theory directly relevant for DETs in natural language.

We shall end the discussion of the DEFs by commenting on the alternative semantic treatment of these proposed in B&C. There the DEFs are interpreted as determiners, but they are characterized by a special semantic property, called *definiteness*: a determiner D is definite, if, for all universes M and all $A \subseteq M$ for which D is defined, there is a non-empty set, say B_A, such that for all $B \subseteq M$, $D_M AB \Leftrightarrow B_A \subseteq B$.

The first thing to note is that this characterization works *only* if partial determiners are allowed:

PROPOSITION 5: There are no total definite determiners.

PROOF Suppose D is total and definite. Take a universe M and let $A = \emptyset$. D is defined for this argument, so, by definiteness, $D_M\emptyset B_\emptyset$. Thus, by CONSERV, $D_M\emptyset\emptyset$, and so, again by definiteness, $B_\emptyset \subseteq \emptyset$, contradicting the requirement that $B_\emptyset$ is non-empty □

Let us, however, forget (U1) for the time being, and assume that we have to use partial determiners. One drawback of the B&C analysis is that it neglects the function of DEFs to indicate context sets. About this more than enough has been said already. The semantic property of definiteness, though, is interesting. On closer scrutiny, it seems to tell us two things about these determiners, which, for clarity, could perhaps be kept apart. The first is that definite determiners are all special cases, as it were, of the determiner *every*. The second is that they make an existence assumption.

It is the first property which explains their usefulness in partitives: they create quantifiers that can be reduced to a single set (the generator, B_A above), which can serve as argument for the main determiner in the partitive. We can express this property by weakening the assumptions in the definition of definiteness slightly. Call a determiner D *universal*, if, for all A for which D is defined, there is a set B_A such that B_A is non-empty *if* A *is*, and, for all B, $DAB \Leftrightarrow B_A \subseteq B$. We assume that determiners are *logical* (section 7), so there is no need to mention the universe M here. Then, clearly, all definite determiners are universal. Now we shall see that universal determiners really are special cases of *every*:

THEOREM 6: If D is universal then D = *every* on all arguments for which it is defined.

PROOF Suppose that D is universal and defined for the set A. We must show that $DAB \Leftrightarrow A \subseteq B$, for all B. By universality, we have, for all B, $DAB \Leftrightarrow B_A \subseteq B$. We distinguish two cases.

Case 1: $A = \emptyset$. Then, by the proof of Proposition 5 above, $B_A = \emptyset$, which means that the desired conclusion holds.

Case 2: $A \neq \emptyset$. By universality, it then follows that $B_A \neq \emptyset$. Furthermore, we have $B_A \subseteq A$. To see this, note that, by CONSERV and universality, $DAB \Leftrightarrow B_A \subseteq A \cap B$. for all B. Let $B = B_A$. Since DAB_A holds, by universality, we get $B_A \subseteq A \cap B_A$, i.e. $B_A \subseteq A$. Now we claim that, in fact, $B_A = A$. From this, the theorem follows immediately. To prove the claim, suppose that it is false. Then, by the above, there is an element a in B_A, and an element a' in $A - B_A$. Now let f be a function which permutes a and a' but leaves everything else as it is. Since DAB_A holds and D is quantitative, $Df[A]f[B_A]$. Here $f[A] = A$ and $f[B_A] = (B_A - \{a\}) \cup \{a'\} = B_0$. Thus, DAB_0, and so, by universality, $B_A \subseteq B_0$. But this is a contradiction, since $a \in B_A - B_0$ □

Thus *every* itself is the only total and universal determiner. But *every* cannot be allowed to be definite, since it cannot occur in the desired positions in partitives. This is where the existence assumption comes in. Requiring that the generator B_A is always non-empty is, as we have seen, the same as requiring that D is *undefined* for $A = \emptyset$, i.e. that it *presupposes* that the argument is non-empty.

In conclusion, it seems to me that the B&C analysis uncovers an interesting property of partitives (i.e. universality), in addition to the ones that have already been mentioned. But Theorem 6 shows that the generator B_A, i.e. the set which 'replaces' the quantifier DA, is actually *identical* to A. Thus it is quite feasible to use A directly in the interpretation of partitives, instead of recovering it from a quantifier, and this is precisely what our alternative proposal does (modulo context sets).

It remains to say something about *both* and *neither*. Actually, they fit rather badly in the patterns we have discerned. To begin with, they seem number-sensitive in *some* way, but the condition of (contextual) number-sensitivity formulated earlier fails, as is easily seen, for them. They also seem to be context set indicators (e.g. *both boys* is synonymous with *both (of) the boys*). But in partitives, they can appear before *of*, in contrast with the DEFs. Furthermore, *neither* can occur in none of the DEF positions in partitives, and *both* only in very few of them (some instances of the NP form (ii) in section 8 are possible with *both*, but none of the forms (iii) and (iv)). So we don't want them as DEFs. On the other hand, if they are DETs, universal (U1) fails.

Thus, one would prefer to give them a separate treatment, and not assimilate them to either DETs or DEFs. There are in fact independent reasons for doing this. One is that in many languages it is *impossible* to treat them as DETs: they do not form NPs out of Ns. Here I am not thinking only about languages like French, which seems to lack these constructions altogether. But in Swedish, for example, the words *båda* and *ingendera* are quite accurate translations of *both* and *neither*, respectively, and occur in similar positions. Yet they cannot combine with Ns: *båda män* (both men) is impossible; one has to say *båda männen* (both the men). Whatever the right analysis of these words, I conclude that one shouldn't be too concerned if *both* and *neither* form exceptions to linguistic patterns that are valid for DETs (or DEFs).

One final word, to avoid a possible misunderstanding. The semantic framework used in all of this paper is the modeltheory of B&C. It is in *this* framework that we can say, for example, that DETs are not number-sensitive, i.e. that syntactic number is irrelevant for determiners. With a more sophisticated modeltheory, such statements have to be revised. For example, if *collective quantification* is allowed, the above statement is no longer true; indeed we can *explain* the difference between *all* and *every* regarding syntactic number by their different behaviour in this respect: *every* can never be used collectively, whereas *all* can. Also, the treatment of partitives would have to be modified (though I think the basic ideas can be preserved).

The advantage of the simpler framework is, of course, that it is more familiar: it is easier to *prove* things in it. It seems to me that 'classical' determiner theory, and its use in the semantics of natural language, is yet far from exhausted.

NOTES

1. The reason for using the term "discourse universe" here will become clear in what follows.
2. There are exceptions; for example, Hausser (1974) uses variables for what I have called context sets (for certain quantifiers), and Smaby (1979) discusses 'variable domains' for the universal and existential quantifiers.
3. She treats only the singular *the*. Also, her framework is not the simple model theory of B&C but something more like the discourse representation semantics of Kamp (1981). The contextual reference of *the* is basic in her treatment, however, and she accounts for it by means of free individual variables, rather similarly to our set variables. Finally, she not only gives a formal framework, but also attempts to explain *how* values are given to the variables.
4. Alice ter Meulen suggested several examples, e.g.

    Two of the five who flunked of the boys will take the test again.
5. A further exception could be NPs like

    (a) two of all the boys.

I prefer to regard *all the boys* as a partitive in itself (*all of the boys*); (a) is then an iterated partitive.

6. In other words, *two lions roar* is simply *false* if there are less than two lions in the model – there is no presupposition about the number of lions.
7. For a related, but different, type of 'semantic number' condition, cf. van Eijck (1983), who studies how syntactic and semantic number of Ns is related to mechanisms of anaphora.
8. Under reasonable assumptions about the language it should *follow* that no total DETs are number-sensitive.
9. This special role is clearly tied to the fact that the partitive construction itself acts as a kind of context set indicator: in an NP of the form DET *of* . . . N (or NP *of* . . . N) we are in general not talking about the whole denotation of N but only a contextually given subset of it.
10. This is a strengthening of a semantic universal proposed in Keenan & Stavi (1981), which says (roughly) that all *simple* DETs are quantitative.

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