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GENERALIZED QUANTIFIERS

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NATURAL LANGUAGE AND GENERALIZED QUANTIFIER THEORY

1. INTRODUCTION

The Generalized Quantifier Theory, hencefore "GQT", initiated with Barwise and Cooper (1981) has elicited promising new lines of research and theorizing in semantics, in particular by the investigation of the algebraic properties of natural language quantifiers. Not debating the general relevance of the conceptions developed in GQT, I will try a critical revision of the empirical claims of the theory.

Barwise & Cooper (1981) continues the approach of Montague (1973) aiming at a uniform treatment of all NPs as quantifiers, denoting sets of properties (or sets) of individuals. Barwise and Cooper start from one essential basic assumption (p. 177), that "the noun-phrases of a language are all and only the quantifiers over the domain of discourse". This way, both the resulting conception of natural language quantification and, the other way, the range of linguistic data to which the theory applies depend on the identification of natural language quantifiers with the syntactic category of NPs. This alliance, however, is neither as close, nor as happy or desirable as it is supposed in Barwise and Cooper (1981).

Probably nobody will object to the view that there are other than NP quantifiers, e.g. adverbials with a quantificational meaning[1]. But even in the case of quantification over parts of the universe of discourse, NPs are not the only quantificational devices. Examples of adverbial quantification in the discourse domain will be given below at several occasions. Thus, not all natural language quantifiers are NPs.

The converse, however, does not hold, either. The NPs treated in the literature can be divided into three subclasses, definite, indefinite and quantificational NPs in the narrower sense (leaving aside a fourth subclass of interrogative NPs). I shall argue that these three groups differ both syntactically and semantically and only the last subcategory of NPs should in general be considered quantifiers.

For definites, including personal pronouns and proper names, the raising from the level of individuals to that of sets of properties of

Peter Gärdenfors (ed.), Generalized Quantifiers, 181—201.

individuals — which seems such an elegant step to come to a uniform treatment of all NPs in PTQ and GQT — seems not only to be a candidate for Occam's razor but in fact logically inadequate.

As to indefinites, there are two rival theoretical approaches, the traditional quantificational one adopted by GQT and the non-quantificational discourse-semantic theories of Heim (1982), Kamp (1981), and Barwise (1985). Indeed, indefinites have (at least) two different uses, quantificational and non-quantificational, to which the two lines of theories apply respectively. As a result, indefinite NPs cannot be considered quantificational a priori.

For the remaining quantificational noun phrases in the narrower sense, it will be argued that we need a distinction between generic and non-generic quantification, which is unlikely to be definable within the present framework of GQT.

2. DEFINITE NPs

When I talk about "definite NPs" below, I use the term in a simple formal sense which does not imply any semantic or pragmatic properties. Definites are: NPs with the definite article or a demonstrative prenoun[2]; NPs with preceding possessor phrase, either a possessive pronoun or a preposed genitive NP; proper names; personal and demonstrative pronouns (proNPs, to be precise), *and*-conjunctions of definite NPs. There are, admittedly, definite NPs not covered, e.g. articleless definites in certain constructions, but the definition will do for the present purpose. I concentrate the following discussion on definite descriptions (NPs of the form *the* + N). The considerations are quite general, however, and carry over mutatis mutandis to all definite NPs.

Definite NPs behave syntactically and pragmatically completely in the same way, regardless if they are singular or plural, have a mass or count noun head. In formal semantics only, definites and definite descriptions in particular are split into radically different classes. Since Russell singular definites are logically treated as corresponding to individuals, but plural definites are understood to denote classes, i.e. second order entities. Formal semanticists uncritically adopted Russell's distinction which was not even linguistically motivated, and as a result, they were not able to formulate a uniform analysis of singular and plural, count and mass mode definites. It was not before the presentation of Link's (1983) lattice-theoretical approach that this apparent inadequacy of former approaches began to be overcome. Link treats all definites as terms, and is thus able to offer a uniform analysis of the definite article for the three possible cases.

From the point of view of discourse semantics, there are strong arguments against a quantificational treatment of definites (cf. Heim 1982). I will not enter these points here, because even under the sentence isolating perspective characteristic for model-theoretic semantics and the GQT in particular, the semantic analysis of definites yields evidence against the quantifier approach. Two arguments will be presented. The first concerns the behavior of definites under negation, which reveals that they actually behave like terms. The second deals with crucial differences in modification of quantificational and definite NPs. As a result, not only the distinction between definites and quantifiers proper will become clearer, but also the relationship between the two.

2.1 *Definites Denote Individuals*

Barwise and Cooper (1981, p. 184) characterize definite NPs as principal filters. Let me recall, for the sake of convenience, the definition of a filter as applied to NPs. I choose a definition in terms of NPs and predicates instead of sets. This way my argumentation will not be limited to a set-theoretical interpretation.

(1) A NP is a **filter** iff it has the following properties:
- (F1) (Upward monotonicity): If the predicate P is true for the NP and P implies Q then Q is true for the NP.
- (F2) (Finite intersection property): If the predicates P and Q are both true for the NP then the predicate P-and-Q is true for it.
- (F3) (Consistency): If the predicate P is true for the NP, then its negation not-P is false for the NP.

The filter property obviously holds for all definite NPs. It does not hold, e.g., for indefinites, which typically violate conditions (F2) and (F3). One kind of filters of particular interest here are ultrafilters.

(2) A filter NP is an **ultrafilter** iff it has the following property:
- (F4) (Completeness) If the predicate P is false for the NP, its negation not-P is true for the NP.

Finally, the filters occurring as natural language NP meanings usually are "principal" filters:

(3) A filter NP is a **principal filter** iff the predicates that hold for that NP are exactly those which hold for all members of a certain set.

Clearly, definite NPs corresponding to single individuals, e.g. singular proper names or singular personal pronouns, represent principal ultrafilters. The predicates true for the NPs *John* or *I* are just those attributable to a single individual. For an NP which is a principal filter but not a principal ultrafilter consider as an example *both players*. There will always be predicates which hold for only one of the referents. Such predicates will be false for that NP as will be their negations, and hence violate the completeness condition.

Now, if it is correct to treat all definites as terms, then definite NPs should not only be filters, as Barwise and Cooper assume, but in fact ultrafilters, because the completeness condition clearly holds for terms. The critical cases among definites are those where the NP refers to a complex of more than one individual: plural definites with a plural meaning (to exclude cases such as *trousers*), singular definites (*the family, the orchestra*), mass noun head definites (*the garbage*), or conjuncts such as *Paul and Paula*. Let me confine myself to the discussion of plural definites. As the critical property is completeness, the criterion will be whether both a predicate P and its negation can be false for definite NPs.

I assume that sentences can have one out of two truth-values: TRUE or FALSE. They can also lack either truth-value. In general, it is reasonable to regard natural language sentences as having truth-values only under certain semantically and pragmatically determined conditions. I take a sentence to be true iff its negation is false. Negation, thus, is always to be understood in the narrower sense, and FALSE is not just the default value for non-truth, but presupposition-preserving falsity.

Let us consider, as an example, a situation where ten children are playing more or less happily together, among them three boys and seven girls. The following will be the case:

(4)	TRUE:	*The children are playing.*	NP (P)
(5)	FALSE:	*The children are not playing.*	NP (not-P)

But how about the following sentences:

(6)	? : *The children are boys.*	NP (Q)
(7)	? : *The children are girls/not boys.*	NP (not-Q)

Obviously sentences (6) and (7) are not true. But the two sentences are not false either. (Being negations of each other, they would be true if they were false). They are, loosely speaking, partly true and partly false. In contrast to the predicate *are playing* and its negation, the predicates *are girls* and *are boys* are inapplicable to the referent of the subject NP in the situation described. Hence, sentences (6) and (7) have no truth-value. In a given situation, not all predicates among those satisfying all semantic constraints yield a truth-value when combined with a definite NP argument. The referent of a definite NP cannot be split in case the predicate holds only for some part of it, but not for the whole. Without any differentiating modification of the predication, the alternative is just that of global truth or global falsity. If it is impossible to apply the predicate or its negation globally it fails to yield a truth-value[3].

The same problem arises with simple singular definites, when they are combined with predicates which apply only to a part of the NP referent. Consider, e.g., the case of Istanbul:

(8)	TRUE:	*Istanbul is in Turkey.*
(9)	FALSE:	*Istanbul is not in Turkey/is in Germany.*

Instanbul is homogeneous with respect to the predicates used in (8) and (9), hence we get truth-values for these sentences. But neither of the following predicates yields a truth-value, nor do their respective negations:

(10) *Istanbul is in Europe.*
(11) *Istanbul is in Asia.*

Further examples are easy to find. Combine, e.g., the NP *the book* with predicates such as *is red, is visible*, or *is difficult*, in situations, where they apply only partly. Apparently, the problem whether a predicate with a definite argument yields a truth-value or not, is not only a matter of the NP, but rather a matter of the combination of the predicate and its argument in the particular situation. Predicate logic and most, if not all, formal semantic theories ignore this problem, simply assuming that every predicate yields a truth-value for any argument of the appropriate kind.

If we accept the possibility of truth-value gaps of this kind, then definite NPs in general can be treated as terms. Definites denote individuals in the literary sense of the word. In contrast, quantificational NPs yield a truth-value even in situations where the predicate combined with them applies only to a part of the domain of quantification. Consider once more the situation of a mixed group of children. If one replaces the definite subject in (6) and (7) with the quantificational NP *all children* — which is wrongly often treated as synonymous with *the children* — then the sentences become both false:

(12) FALSE: *All children are boys.*
(13) FALSE: *All children are not boys/are girls.*

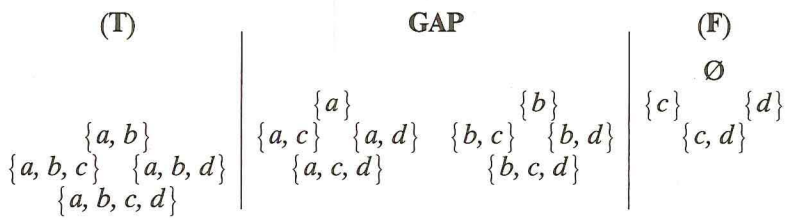
Consequently, the negations of (12) and (13) are true:

(14) *Not all children are boys/are girls.*

There is no analogue of the last sentence with a definite subject instead of the universal quantifier, and this illustrates a further difference between definites and quantifiers. In accordance with the facts, that definites are terms, they cannot be negated. Quantifiers, however, can be negated — at least in many cases. Some allow direct negation (e.g. *all, every, each, both, many, few*), others have lexicalized negative counterparts (*either/neither, some/no*).

These results can of course only be modeled in a semantic theory which provides for partial models. NPs do not combine with any predicate whatsoever to yield a truth-value in every situation. Rather in a given situation every NP has a domain of those predicates which yield a truth-value. The predicate domain of an NP can be considered closed under Boolean operations. In case of definite NPs the domain is just the principal filter of the true predicates together with the dual ideal of the false predicates. This way, all definites are principal *ultra*filters within their domain. Quantifiers with the same head noun, in contrast, have larger domains, containing also all properties which hold for only parts (in terms of the head noun) of the whole head noun denotation. To illustrate this, let the universe consist of the elements *a, b, c, d*, let the noun N denote the set consisting of *a* and *b*, and identify predicates with subsets of the universe. The domains of *all N, some N, two N* will be the whole powerset of the universe, but the domain of *the N* will only be the union of the areas (T) and (F), with a broad truth-value gap in between:

(15) domains of definite and quantificational NPs



The diagram illustrates another consequence of the ultrafilter result for definites: taken as quantifiers in the sense of GQT, definites are self-dual. Inner and outer negation are equivalent (one-to-one correspondence between the elements in the (T) area and their respective complements in the (F) area). Accordingly, there is no difference between sentence and predicate negation, in contrast with all quantificational NPs in the narrower sense.

2.2 *Definites, Quantifiers and Modification*

Being second order predicates, quantifiers proper and quantificational determiners can be modified in ways characteristic for predicates: they can be negated, for one, with the simple non-contrastive negation. And there are several more specific modifiers. Their applicability varies with the choice of the determiner due to semantic constraints.

(16) [{ *Not* / *Almost* / *Absolutely* / *Already* / *Possibly* } { **the* / *all* } *participants*]$_{NP}$ *are fast asleep.*

These modifiers can be taken syntactically and semantically as operators on the determiner *all*. They are, however, altogether impossible as prenoun modifiers if the quantificational determiner is replaced by the definite article. As a matter of fact, the definite article does not allow any modification at all. And this is exactly what is to be expected if definites are terms.

On the other hand, sentences consisting of a definite NP and a predicate can be modified, namely differentiated, in a way impossible if the sentence contains a quantificational NP instead:

(17) { *Two / *All / The } participants are { all / partly / mostly / to 70 per cent } fast asleep.

All, partly, mostly, to 70 per cent are quantifying adverbs in these sentences. Their function is to bridge the truth-value gap between global truth and global falsity of the predicate *are fast asleep* for the subject *the participants*. The same quantification can also be expressed by means of a NP quantifier with the same head noun:

(18) { All (the) / Some (of the) / Most (of the) / 70 per cent of the } participants are fast asleep.

It is impossible, however, to quantify the same variable twice. That is, why quantificational subject NPs are semantically unacceptable in (17).

Under the quasi-partitive reading implicit to the GQT approach, as a matter of fact, all real quantifying NPs can be replaced by explicitely partitive constructions. This reveals a fundamental fact about non-generic quantification: the head of a quantifying NP is, so to say, definite, i.e. it refers to the domain of quantification in the same way a definite NP with the same head noun[4] would do. This claim can easily be substantiated if one considers the various different uses of definites. It turns out that a quantificational NP in its non-generic, quasi-partitive interpretation can be used felicitously under exactly the same conditions under which the head noun could be used with a definite article[5]. The head noun taken definite, i.e. as a "global" individual term, refers to the domain of quantification as a whole. The quantificational determiner, then, specifies to what extent the predicate applies to the domain of quantification. It differentiates between global truth and global falsity.

3. INDEFINITES

Indefinite NPs can be characterized as those NPs which can occur in the grammatical subject position of existential *there*-sentences (with certain marked exceptions, cf. Woisetschlaeger 1983). They either have no prenoun at all, in which case the head is to be a plural count noun

or a singular mass noun, or they have a prenoun of a certain class, which includes the indefinite article *a(n)* as well as *some*, *(a) few, many* with eventual modifiers, *several*, or a numeral with or without additions such as *at least, exactly, at most, almost* or others. I do not attempt to give a complete list here and I do not want to decide whether *no* belongs to this group. It certainly shares a lot of properties with the other elements of the group, but on the other hand it is also different. The syntactic status of these prenouns is not clear. Some of them are in opposition to the definite article or quantificational determiners, others can cooccur with the definite article and share some characteristics with adjectives (the numerals, *few*, and *many* can be used predicatively, and the latter two have comparative and superlative forms, though irregular ones)[6]. Semantically, what I will refer to as indefinite prenouns, are distinguished in that they all contain a cardinality specification.

The indefinite prenouns treated in Barwise and Cooper (1981) can be separated from the other prenouns by the coincidence of several properties. All and only indefinite NPs

(i) have "sieve conditions" in terms of themselves:
A sentence of the form NP_{ind} with an indefinite NP is not trivially true or false for all VPs iff *there are* NP_{ind} is true. If there are not three books, e.g., then any quantificational sentence of the form *three books VP* is trivially false[7].

(ii) are "weak":
Det N is (an) N/are Ns is neither necessarily true nor necessarily false for indefinite NPs: e.g. the truth-value of the sentence *ten boys are boys* depends on whether there are ten boys at all[8].

(iii) have symmetric uses:
In these cases the two predicates involved in quantification can be exchanged salva veritate: *Seven children are girls*, is true iff *Seven girls are children*, is true[9].

In this section, I will argue that the properties common to indefinite NPs can be at least partly explained by their semantic nature, which again is not quantificational. In contrast to definite NPs, however, sentences composed of a predicate and an indefinite NP doubtlessly *can* have quantificational interpretations under certain circumstances. Only, an eventual quantificational interpretation should not be forced into the semantics of indefinite NPs or their prenouns.

3.1 *Two Uses of Indefinites*

The discourse-semantic theories mentioned above treat NPs with an indefinite article not as quantifiers but as corresponding to free variables, or discourse referents. The semantic content of the indefinite NP is taken as providing constraints on the value assignment of the discourse variable (or the anchoring of the indeterminate).

Although Heim (1982) and Kamp (1981) treat only indefinite NPs with the indefinite article, their main arguments for a non-quantificational treatment — concerning donkey-sentences, sentence-boundary crossing anaphora, and the possibility of binding the referents of indefinite NPs by adverbial quantifiers — hold equally for all indefinites. Consider donkey sentences such as the following:

(19) *Everybody who has learned* { *some* / *Ø* / *a few* / *(only) few* / *several* / *many* / *two* } *foreign languages, should use them as often as possible.*

I assume, that the proper way to treat these plural indefinites in a discourse-semantic theory would be to assign them a discourse referent or indeterminate in the same way as to singular indefinites, i.e. one variable for one indefinite. An indefinite NP such as *seven stars* would be constrained to be assigned a complex of seven stars as value. The indefinite determiner itself is also a part of the descriptive content of the indefinite NP. It is taken as an attribute, in fact a cardinality attribute. This approach, which is not so much a consequence of the proposed treatment of plural as it is a natural generalization of the discourse-semantic theories, is incompatible with any quantificational approach, as the indefinite prenoun, if it is regarded a mere cardinality attribute, is no longer a determiner in the sense of GQT. Instead of a two-place second order predicate it is just a one-place first order predicate[10].

This apparent incompatability of the discourse-semantic approach and the quantificational theories is related to a general ambiguity of sentences involving indefinite NPs, which has been stated among others

by Milsark (1977). According to Milsark, some indefinite determiners are ambiguous in that they can be taken either as cardinality predicates or as quantifiers proper. One of his examples is the sentence

(20) *Some salesmen walked in.*

He argues that *some* is ambiguous between an unstressed variant *sm* and a stressed form *some*, the further being a vague cardinality predicate and the latter a quantifier proper. Under the non-quantificational reading, the sentence means that something walked in, namely salesmen, in fact some. This interpretation would fit the discourse-semantic analysis just sketched. In the second reading, some out of a certain set of salesmen under consideration walked in. This interpretation, in turn, is clearly quantificational in the sense of GQT, and cannot yet, as far as I see, be adequately handled by the discourse-semantic approach.

The ambiguity in question is associated with several characteristic differences. The quantificational interpretation requires that a set of salesmen is already introduced in the context or else independently determined, otherwise the partitive reading would not be available. This matches with the result obtained above, that non-generic, quasi-partitive quantificational NPs have definite heads. On the other hand, in the non-quantificational reading the indefinite introduces a new referent into the discourse. This difference demands different contexts. A suitable context for the non-quantificational reading would be something as the following:

(21) *When I entered the store, nobody was there except an older lady waiting and a man cleaning the windows. Finally, after a couple of minutes, SOME SALESMEN WALKED IN.*

In contrast, a quantificational reading would be the most plausible one in the following case:

(22) *Lunchtime is from 12.30 p.m. to 1 p.m. As usual the salesmen met in the cafeteria. As there were no customers anyway at this time of the day they did not care to much too get back to the store in time. At 1 o'clock, SOME SALESMEN WALKED IN, but the rest stayed in the cafeteria.*

The crucial differences associated with the two interpretations are all interrelated:

(23)

	non-quantificational	*quantificational*
(a)	Head noun referentially new.	Head noun referentially given.
(b)	Partitive paraphrase impossible.	Partitive paraphrase possible.
	− *some of the salesmen walked in* +	
(c)	Prenoun counts the whole denotation of the head noun.	Prenoun counts part of the denotation of the head noun.
(d)	Immediate subsequent pronominal anaphora refers to the whole denotation of the head noun.	Immediate subsequent pronominal anaphora refers to part of the denotation of the head noun.
(e)	Head noun stressed, obligatory.	Head noun unstressed, omissible.
	− *some walked in* +	
(f)	Prenoun unstressed, omissible.	Prenoun stressed, obligatory.
	+ *salesmen walked in* −	
(g)	VP stressed or unstressed.	VP stressed.

The intonational characteristics, of course, only hold if the normal, or minimal intonation is not superimposed with contrastive stress or other additional intonational features.

For the quantificational interpretation, as I have argued in the previous section about definites, it is necessary to assume that that part of the head noun denotation for which the VP holds is part of the head noun denotation as it is established so far in the discourse. For the non-quantificational interpretation one has to assume the opposite.

3.2 *How to Handle the Ambiguity*

Milsark's way out consists in setting up two lists of expressions, one of "weak" (indefinite) prenouns, which are used as cardinality attributes without quantificational force, and one of "strong" ("definite") determiners or quantifiers proper[11]. The ambiguous indefinite prenouns appear in both lists. This, however, cannot be a real solution to our problem. Lexical ambiguity should be reserved to singular cases of homonymy with clearcut meaning differences. It is not the adequate explanatory device for systematic ambiguities which involve whole subcategories of NPs and even can be found in completely unrelated languages.

If we reject the non-solution of lexical ambiguity for all indefinite prenouns, the question arises, how a uniform treatment of the two uses of indefinites should look like. A common divisor, though probably not the greatest one, is that the indefinite prenoun in both cases can be considered a cardinality predicate which applies both to a part (or the whole) of the head noun denotation and to a part (or the whole) of what the VP holds for, or more generally, the matrix predicate S/NP. In a very simple formalization, this would be:

(24) $N(X)\ \&\ S/NP(X)\ \&\ Pren_N(X)$

with the index N on the prenoun Pren indicating in the count mode case that X is to be counted in the units provided by the common noun N. This is essentially the discourse-semantic analysis. While it seems appropriate for the non-quantificational uses, we still don't have an explanation how the quantificational meaning comes about. Of course, we can account for the GQT interpretation, by applying existential closure to the sentence. But we would have to explain the reason why we apply this operation in these cases and not in the others.

Another possibility is to argue that the same discourse-semantic interpretation applies in both cases. For the quantificational reading, a new discourse referent, say "X", is to be established under the characterization given in (24). If there is already a discourse referent Y with the characterization "N(Y)", we are entitled, if it makes sense, to regard X as a part of Y. (This would of course not violate the novelty condition, as X and Y would be different.) The partitive quantificational interpretation would thus be the result of the decision to locate X within Y.

This, however, is an unsatisfactory solution. For one, the question whether the referent of the indefinite is part of the head noun denotation does not enter the truth conditions. To be quantificational, would no longer be a semantic property of sentences containing indefinites. But isn't quantification a semantic conception?

In addition, all the above mentioned differences associated with the two uses of indefinites would become irrelevant for the sentence meaning. Such an analysis could not account for the distributional and

intonational features (23 *e, f, g*) which indicate the background and foreground status of the three basic parts of the construction: the prenoun, the head noun and the VP, or more generally the matrix predicate S/NP. For a more pretentious analysis which aims at modeling the cognitive processes involved in sentence interpretation, these differences are likely to be relevant.

The discourse-semantic theories, at the present state of the art, only cover the uses labeled "non-quantificational". The QGT approach, on the other hand, can only handle the uses labeled "quantificational". In case of the non-quantificational use, the referential novelty condition for the head noun contradicts the partitive interpretation implicit in the conservativity constraint on natural language quantifiers ("live-on" condition in Barwise and Cooper (1981)). The opposite interpretation which takes the VP denotation as the domain of quantification is likewise impossible, as a referent for the VP cannot be considered established in the previous discourse either. Under that interpretation, the sentence *some salesmen walked in* in (21) should be paraphrasable as

(25) *Some of what walked in were salesmen.*

But this sentence is as unacceptable a paraphrase in that context as is

(26) *Some of the salesmen walked in.*

The quantificational interpretation, if it is possible, can not be attributed to the meaning of the indefinite prenoun. Indefinites, thus, are another subcategory of NPs which should not be treated as generalized quantifiers. As far as the previous considerations suggest, indefinite NPs are most naturally regarded as first order predicates, including eventually a cardinality predicate, that serve as constraints on the anchoring of indeterminates. Any quantificational interpretation of sentences containing indefinites must be attributed to other semantic properties of the sentence[12].

3.3 *Semantic Peculiarities of Indefinites*

Let me conclude the discussion of indefinites with the attempt to explain (partly) the semantic peculiarities of indefinite prenouns mentioned above.

If indefinite NPs are not the expressions that carry existential quantificational force, nothing keeps us from regarding the *there be*-part of existential *there*-sentences as an existential quantifier proper, as already Milsark (1977) suggested. At least such an interpretation is much more natural than an analysis which does not attribute any meaning at all to this construction, and it would be much less ad hoc than the treatment of such sentences in Barwise and Cooper (1981). As an existential quantifier *there be* should take a variable with a predicate applied to it, and this is exactly the semantic format suggested for indefinites. Furthermore it can take neither ordinary terms nor a quantifier proper for its scope, as both kinds of expressions would not be of the appropriate logical type. This would provide an explanation for the distribution of NPs in the grammatical subject position of existential *there*-sentences.

The cardinality prenouns of indefinite NPs evoke mental procedures of counting or estimating. Counting always involves two predicates. A background predicate which defines the counting domain. The counting domain contains the candidates for counting. Counted, however, are only the cases where a second, foreground predicate holds for one of the candidates. Let us call this predicate the counted predicate. Under the two uses discussed above, the head noun predicate and the matrix predicate play opposite roles. In case of the non-quantificational use, the matrix predicate provides the counting domain, and the head noun predicate serves as counted predicate. Under the quantificational interpretation, the head noun defines the counting domain and the matrix predicate is counted.

The opposite roles of the head noun and the matrix predicate in the two interpretations is reflected by the differences stated in (23) above. The background counting domain predicate is to be given, the counted predicate is (relatively) foregrounded and part of the focal, new information (a). Partitive interpretation is possible iff the NP head refers to the counting domain (b/c). The count establishes the set of positive cases as a potential antecedent for subsequent anaphora (d). The background predicate will be (relatively) unstressed, and possibly omitted altogether, whereas the predicate counted receives an appropriate stress (e/g). Finally, (f) is accounted for by the fact that the cardinality predicate is the highest ranking predicate in quantificational sentences but only peripheral information in the other cases.

For quantificational uses of indefinites, this analysis explains the individual sieve-conditions for indefinite prenouns: if the counting

domain is too small, the result of a counting or estimating procedure may be predetermined. The weakness property can also be accounted for. Whatever cardinality predication we choose, we can arrange the counting domain in a way that that predicate does not hold for it.

The symmetry condition is to be handled with care. As quantificational sentences are asymmetric with respect to the two predicates involved — in terms of givenness and novelty, background and foreground — the symmetry condition can only hold if we abstract from these features. Under this perspective, the symmetry can be accounted for by the possibility to exchange the roles of the domain predicate and the counting predicate without changing the result of the count or estimate (this holds for *many* and *few* only if they are not interpreted as proportional).

The fact that cardinality predications involve two predicates, one for the domain and one as a counting criterion, does not mean that numerals and other cardinality or quantity prenouns are two-place second order operators or syntactically determiners in the sense of GQT. The number of arguments on a conceptual level can be greater than on the semantic or syntactic level. The linguistic data suggest that numerals and the other indefinite prenouns in English (and related languages) are used as one-place first order predicates. The conceptual structure of cardinality or quantity predication may, however, contribute to an explanation how the indefinite prenouns can enter a quantificational scheme.

4. QUANTIFIERS PROPER

If we exclude definite and indefinite prenouns as not genuinely quantificational, we are left with two groups of quantificational prenouns or prenoun complexes. One consists of the classical strong determiners *all, every, each, both, either*, and the other one of the proportional determiners such as *most, more/less than half* and others. The quantificational status of *all* is not unobjectionable. NPs beginning with that prenoun can have definite uses, e.g. in partitive constructions[13]:

(27) *Half of all (the) examples are boring.*

Also, *all*-NPS exhibit the collective predication possibility typical for terms (definite or indefinite).

Among the quantificational determiners, *both, either* and the proportional determiners with the exception of the vague prenoun *most* have only non-generic uses. *All, every, each*, and *most*, and also the secondary determiners *many, few, some, no* have in addition generic uses.

Generic quantification differs from that which one could call referential quantification in several aspects. Referentially quantifying sentences refer to a certain limited domain of quantification, which is either built up explicitly in the preceding discourse or else preestablished. Generically quantifying sentences, on the other hand, do not involve reference to a particular domain of quantification. They refer to kinds of objects on a conceptual level — if the term "refer" should be used here at all. Quantificational sentences of the two sorts have different paraphrases. Consider the following sentences:

(28) *All/Most/Many/Few/Some/No apples are sour.*

If they are meant referentially, a proper paraphrase would contain a definite plural term to refer to the domain of quantification and an adverbial quantifier determining the extent to which the VP holds in that domain:

(29) *The applies are* { *all* / *to the most part* / *to a great part* / *to a small part* / *to some part* / *(not)* } *sour.*

But this paraphrase has no generic reading. Under their generic interpretation, the sentences in (28) would be paraphrased with a sentence containing a bare plural, i.e. indefinite, subject and an adverbial phrase of frequency:

(30) *Apples are* { *always* / *mostly* / *often* / *seldom* / *sometimes* / *never* } *sour.*

An adverb of frequency in the referential scheme would result in a quantification over situations of reference. An adverbial of extent in

(30) yields a generic statement involving quantification over single apples as domains.

Both, (29) and (30), have simple non-quantificational[14] counterparts. The first sentence, corresponding to (29), is referential, the second generic:

(31) The apples are sour.
(32) Apples are sour.

The GQT format is apparently designed to capture the referential quantification, but it is inappropriate to cover both types at the same time. In a given text, referential and generic quantification occur often side by side. Referential quantifiers require to take the denotation set of the head noun as part of a limited universe of discourse. But generic quantication requires virtually unlimited (and characteristically fuzzy) denotation sets — that is, if a set-theoretic treatment in the GQT format can be adequate at all.

Generic quantification can well be used with respect to domains of quantification that are non-sets, i.e. real classes. Take the following example:

(31) *Every ordinal is either O or greater than O.*

We thus run into foundational problems if we try to maintain the GQT format for the generic cases.

Rather, it appears, that a notion of quantification should be preferred which involves properties instead of sets. Since properties form a Boolean algebra, the same way as any power set, the algebraic notions for the characterization of natural language quantifiers — conservativity, monotonicity, persistency etc. — would still be applicable.

A description of quantification in terms of properties instead of sets would be adequate for the referential cases, too. But we still lack a proper description of the two types of quantification and their difference.

5. CONCLUSION

Let me sum up my arguments. In view of the linguistic data, it does not appear justified to treat all NPs as genuine quantifiers in the sense of GQT. The category of noun phrases is heterogeneous, both semantically and syntactically. It seems reasonable to assume that neither

definites nor indefinites are quantifiers. Definites are terms, and the proper distinction of terms and quantifiers is helpful for the understanding of natural language quantification. Indefinites can occur in quantificational sentences, but in these cases the context must fulfil certain conditions. On the basis of lexical meaning, indefinites can not be taken a priori as quantifiers. Even among the remaining quantificational NPs in the narrower sense not all uses fit the generalized quantifier scheme. In particular, we need a distinction between referential and generic quantification. There is, after all, no direct syntactic counterpart of the semantic notion of quantifier. This should not bother semanticists. Other fundamental semantic concepts, e.g. "one-place predicate" do not have syntactic counterparts either.

Quantifiers, then, rather than being the meanings of the expressions belonging to a certain syntactic class should be regarded as operational parts of certain sentence interpretations. Quantifications can be expressed in different ways, some involving expressions typical for that purpose, and other borrowing unspecific devices (e.g. cardinality predicates) and making use of additional contextual constraints. If one procedes along the path taken by Montague (1973) in PTQ and continued in Barwise & Cooper (1981), the resulting concept of natural language quantification will be broad and unspecific, if one tries to cover all NP meanings which can under certain circumstances be interpreted as quantifiers. As a result, it would be a very complex task, to formulate any semantic language universals concerning quantification simply in terms of word meanings and syntactic categories.

An alternative approach would start from an independent semantic notion of quantification and try to describe only those means of expression which are specific for quantification. In this case, one would have to look for quantifiers in other syntactic categories, too. The field of NPs would not be any longer the only and predestinate ground to be ploughed. This opens an attractive field of research within a semantics that is conceived as autonomous with respect to syntax — at least as long as there is no evidence for a close correspondence between syntactic and semantic notions and categories.

In Loebner *a* (forthc.) a first attempt into this direction is presented. Starting from a semantic conception of quantification similar to that of GQT, quantifiers are investigated that belong to different categories such as modal verbs, verbs with gerund or infinitive complements, temporal adverbs, or scalar adjectives. The result is a conception of

natural language quantification which is much more specific than the one resulting from GQT and at the same time applies to substantially more linguistic data.

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NOTES

[1] Cf. Loebner *a* (forthc.) for a variety of quantificational expressions from other categories.

[2] As the term "determiner" is used in Barwise and Cooper (1981) in a special sense which renders all NPs quantificational, I use the neutral term "prenoun" instead, for the pre-noun-position of NPs, and reserve the notion "determiner" for quantificational prenouns.

[3] We need not be concerned here with the question how a predicate is to be applied to a complex object as a whole. This would be the task of a theory of predication and is a primarily pragmatic problem. Apparently, there are several possibilities. The argument can be taken as one thing of which the predicate holds or does not hold (collective interpretation) or it can be divided into units for each of which the predicate equally holds or equally does not hold (distributive interpretation). The way the predication is applied should however not be made part of the interpretation of the argument NP, as is shown by cases of mixed predication applied to the same NP. Cf. Lønning (this volume) for a detailed discussion.

[4] This formulation is slightly unprecise. If the head noun is used as a count noun, the corresponding definite is to be plural, if it is a mass noun, it is singular.

[5] Cf. Loebner *b* (forthc.) for an extended discussion of the uses of definites and for examples of the corresponding uses of quantificational NPs.

[6] Cf. Loebner *a* (forthc.) for a treatment of *many* and *few* as scalar adjectives, which are argued there to constitute a group of "phase-quantifiers".

[7] Cf. Barwise and Cooper (1981, pp. 179—180).

[8] Cf. Barwise and Cooper (1981, pp. 182, 219).

[9] Cf. Barwise and Cooper (1981, pp. 210, 219).

[10] To be a first order predicate does not imply first order definability.

[11] Milsark uses the terms "weak" and "strong" in a different sense than Barwise and Cooper (1981).

[12] It might be worthwhile to note that the non-quantificational readings of indefinites are by far the more frequent ones. A count of about 1000 subsequent occurrences of indefinites in five different texts rendered a portion of quantificational ones of less than 10 per cent, and most of them, in fact, were explicit partitives.

[13] This view is confirmed by the treatment of *all*-NPs in partitive constructions as it is proposed in Barwise & Cooper (1981, pp. 206—207). See also Lyons (1977, pp. 456) on the mixed status of *all*.

[14] I consider simple generic sentences as non-quantificational. If, e.g., (32) meant the same as (i) *All apples are sour.*, then the respective negations should also be equivalent. But clearly the negation of (32), namely the sentence (ii) *Apples are not sour.*, has a different meaning than the negation of (i).

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