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THE SYNTAX AND SEMANTICS OF NOMINAL COMPARATIVES

0. Introduction

This paper is primarily concerned with the analysis of nominal expressions involving _many_ and _few_:

(1) (a) the many/few students

(b) many/few students

(c) as many/few students as professors

(d) more/fewer students than we had invited

I shall make some fairly detailed proposals for deriving and interpreting such constructions; my basic claim will be that the 'quantifiers' _many_ and _few_ are properly to be regarded as adjectives, albeit of a special kind. Most of what I shall say can be carried over to _much_ and _little_ as well. However, I shall ignore these expressions since I want to avoid the added complication of mass terms.

Justification for this approach can be given on both syntactic and semantic grounds. More importantly though, the analysis I shall present is one in which syntactic and semantic considerations interlock in a coherent and illuminating manner. In practice, it is seductively easy to formulate syntactic rules without worrying whether they can be made sense of semantically, and it is equally easy to construct rather abstract logical forms without providing any systematic method for relating them to surface structures. It is my conviction, however, that grammatical analysis will not advance significantly unless syntactic and semantic rules are developed side by side.

This does not mean that we cannot give purely syntactic arguments for a particular analysis. Nor does it mean that syntactic operations should be conditioned by semantic factors. On both these counts, I would decidedly support a modular approach to grammar. Rather, I am claiming that sensitivity to both syntactic and semantic requirements can be a useful, indeed crucial, heuristic in guiding the linguist to a well-founded analysis. For it hardly needs pointing out that most current proposals are grossly underdetermined by the available syntactic evidence, even given a framework of metatheoretical constraints of the kind currently favoured by Chomsky. Of course, it is rarely possible to prove that a given syntactic analysis cannot be matched with an appropriate logical form, or more generally, that a fragment of grammar cannot be provided with a model-theoretic interpretation. But the burden of proof that a syntactic analysis is semantically coherent lies with the linguist who proposes it; and without such a demonstration, the analysis can be regarded as little more than an optimistic guess.

1. Phrase Structure Grammar

Before advancing to any substantive proposals, it will be useful to indicate my background assumptions about the form of a grammar. As will be obvious, I am deeply indebted to recent work by Gazdar (forthcoming a, b).

Following McCawley (1968), phrase structure (PS) rules will be interpreted as node admissibility conditions rather than string rewriting rules. In order to indicate this, the familiar arrow notation

(2) $S \rightarrow NP\ VP$

is replaced by

(3) $[_S\ NP\ VP]$

and analogously for other rules. (3) will admit a tree rooted by S just in case this node immediately and exhaustively dominates two nodes NP and VP, in that left-to-right order.

Each syntactic rule of the grammar is associated with a semantic rule which specifies how the tree admitted by the syntactic rule is to be translated into an interpreted formal language *L*[1]. That is, given a syntactic rule of the form $[_{\underline{C}}\ \underline{D}_1 \ldots \underline{D}_{\underline{n}}]$, the semantic rule will determine a translation of *C* as a function of the translation of $\underline{D}_1 \ldots \underline{D}_{\underline{n}}$. This corresponds to the Compositionality Principle that the meaning of a complex expression is a function of the meaning of its parts. I adopt the convention that if *C* is any constituent, then *C'* represents the translation of *C*. For example, given an NP, NP' stands for the (possibly complex) expression of *L* which translates NP. Individual lexical items of English will be mapped into constants of *L*, represented as boldface versions of the English word forms. Thus, *many* will be translated as **many**. Finally, we take a complete rule of the grammar to be a triple consisting of an integer -- the rule number --, a PS rule, and a translation rule. So, for example, our first rule of English might take the form

(4) $\langle 1, [_S \text{ NP VP}], \text{VP}'(\text{NP}')\rangle^2$.

2. many and few as Predicates

2.1 Quantifiers vs. Adjectives

Certain prenominal modifiers have standardly been classified as quantifiers; for example, a, every, some, all, and each. I shall call these classical quantifiers, and I shall assume that the usual representations in first-order logic give an adequate guide to their semantic interpretations.

It is usually thought that many and few should be classed as quantifiers too. Yet the respects in which these expressions resemble adjectives more than quantifiers have often been noted in the literature. For example, unlike classical quantifiers they can occur in post-determiner position:

(5) A cargo boat rescued the starving/few/*some survivors.

Unlike classical quantifiers, they can occur in predicate position:

(6) The questions to which the inquiry team are now seeking answers are difficult/many/*all.

And unlike classical quantifiers, they cooccur with degree modifiers:

(7) (a) The chairs were too hard/few/*some to seat all the guests comfortably.
(b) These are as difficult/many/*all problems as you'll ever encounter.

Let us suppose then, that <u>many</u> and <u>few</u> are not of category Q, as Bresnan (1973) has suggested, but are instead plural adjectives: i.e. of category A. I shall now develop a fragment of grammar in order to show how data like (5)-(7) can be dealt with.

For the present, I will only consider very simple AP structures, involving neither prehead recursion, nor posthead complementation. Degree modifiers will be treated as determiners within the adjectival system, and labelled DetA. They are to be distinguished, therefore, from determiners within the nominal system -- for example, the classical quantifiers -- which will be labelled DetN.

(8) $\langle 2, [_{VP}\ V\ AP], V'(AP')\rangle$

$\langle 3, [_{AP}\ \bar{A}], \bar{A}'\rangle$

$\langle 4, [_{\bar{A}}(DetA)A], DetA'(A')\rangle$

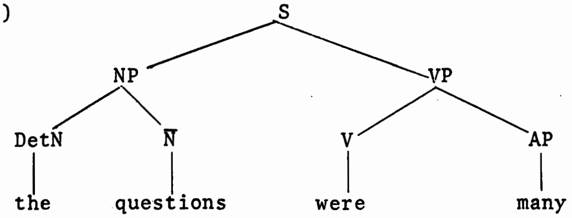
$\langle 5, [_{NP}\ DetN\ \bar{N}], DetN'(\bar{N}')\rangle$

$\langle 6, [_{\bar{N}}\ A\ \bar{N}], \lambda \underline{x}_1 [A'(\lambda \underline{X}_1 \underline{X}_1(\underline{x}_1)) \quad \bar{N}'(\underline{x}_1)]\rangle$[3]

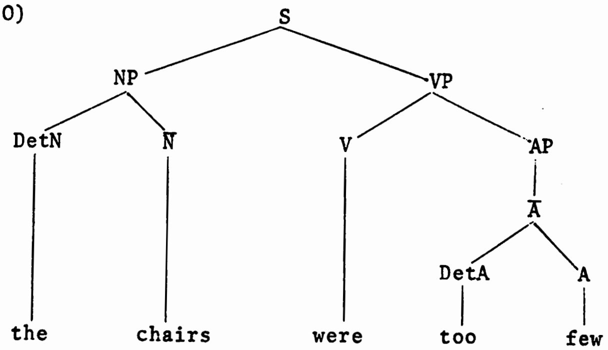
$\langle 7, [_{\bar{N}}\ N], N'\rangle$

As predicate adjectives, <u>many</u> and <u>few</u> will occur in trees of the the following sort[4]:

(9)

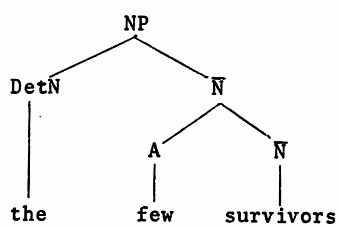


(10)



Next, consider the post-determiner cases. We might try, first of all, to derive these by means of rule 6:

(11)



On this approach, *few* is simply a prenominal adjective, on a par with, say, *unlucky* in the *unlucky students*. However, there are three problems with this analysis. (a) It is difficult to state the restriction that if *many* and *few* are preceded by a determiner, it must be definite: **some many problems*, **all few girls*[5]. (b) It is difficult to state the restriction that *many* and *few* typically cannot follow other prenominal adjectives: **the difficult many problems*, **Leo's expensive few books*[6]. (c) Most importantly, it fails to capture the fact that postdeterminer *many* and *few* can only be interpreted nonrestrictively, as Carden (1970) has emphasized. While *unlucky* can be restrictive or nonrestrictive in (12), it only has a restrictive reading in (13), which is equivalent to (14) (examples from Carden (1970:424)):

(12) The unlucky students flunked.

(13) The unlucky students flunked, but it could never have happened to all of them.

(14) The students who were unlucky flunked, but it could never have happened to all of them.

Notice now that (15) is anomalous:

(15) *The many students flunked, but it could never have happened to all of them.

2.2 Nonrestrictive Adjectives

In view of the above facts, I am going to propose that nonrestrictive adjectives, including *many* and *few*, are not introduced by rule 6, but by a different rule which I will formulate shortly.

First, we need to introduce the notion of a "metarule" (Gazdar, forthcoming a). A metarule is a higher-level statement about the rules of the grammar. It takes the following form: if $\langle \underline{n}, X, \phi \rangle$ is a rule of the grammar, then $\langle \underline{n}, \underline{f}(X), \underline{g}(\phi) \rangle$ is also a rule of the grammar; or more succinctly $\langle \underline{n}, X, \phi \rangle \Rightarrow \langle \underline{n}, \underline{f}(X), \underline{g}(\phi) \rangle$. X and ϕ are the PS component and translation component, respectively, of the input rule, and $\underline{f}$ and $\underline{g}$ are functions such that $\underline{f}(X)$ is also a PS rule and $\underline{g}(\phi)$ is also a translation rule. Despite appearances, metarules should not be identified with transformations. While transformations map trees into trees, metarules map PS rules into PS rules; they provide a systematic way of enlarging the rules of a PS grammar. Next, let many and few be distinguished from nonquantifying adjectives like unlucky by the feature specification [+quant] (cf. Milner (1978)).

Then the metarule we require for nonrestrictive adjectives takes the following form:

(16) $\langle 5,\ [_{NP}\ \mathrm{DetN}\ X\ \bar{N}],\ \underline{f}_X(\mathrm{NP}')\rangle \Rightarrow \langle 5,\ [_{NP}\ \mathrm{DetN}\ A\ X\ \bar{N}],$

$\lambda\underline{Q}_1[\lambda\underline{X}_1\underline{Q}_1(\lambda\underline{x}_1[A'(\lambda\underline{X}_1\underline{X}_1(\underline{x}_1)) \wedge \underline{X}_1(\underline{x}_1)])](\underline{f}_X(\mathrm{NP}'))\rangle$

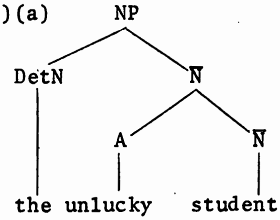
(a) provided that $X \neq \underset{[+\mathrm{quant}]}{A}Y$,

(b) and if $X = \underline{e}$, then $\underline{f}_X(\mathrm{NP}') = \mathrm{DetN}'(\mathrm{N}')$,

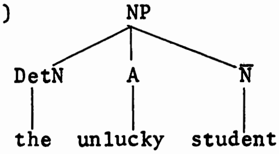
and if $X = \alpha Y$, then $\underline{f}_X = \alpha'(\underline{f}_Y(\mathrm{NP}'))$.

In order to show how this approach works, I shall first take a simple case. The NP the unlucky student now has two possible analyses:

(17)(a)



(b)



(17a) will induce the restrictive reading, while (17b) will induce the nonrestrictive reading. Let us suppose that singular the has the translation given in (18).

(18) $\langle 9,\ [_{\substack{\mathrm{DetN} \\ \begin{bmatrix}+\mathrm{def}\\ -\mathrm{pl}\end{bmatrix}}}\ \underline{\mathrm{the}}],\ \lambda\underline{X}_1\lambda\underline{X}_2\exists\underline{x}_1[\forall\underline{x}_2[X_1(x_2)\leftrightarrow \underline{x}_1 = \underline{x}_2] \wedge \underline{x}_2(\underline{x}_1)]\rangle$

Then the two NPs in (17) will be translated as (19a, b) respectively:

(19) (a) $\lambda \underline{X}_2 \exists \underline{x}_1 [\forall \underline{x}_2 [\text{unlucky}(\underline{x}_2) \wedge \text{student}(\underline{x}_2) \leftrightarrow \underline{x}_1 = \underline{x}_2]$

$\wedge\ \underline{X}_2(\underline{x}_1)]$

(b) $\lambda \underline{X}_2 \exists \underline{x}_1 [\forall \underline{x}_2 [\text{student}(\underline{x}_2) \leftrightarrow \underline{x}_1 = \underline{x}_2] \wedge \text{unlucky}(\underline{x}_1)$

$\wedge\ \underline{X}_2(\underline{x}_1)]$

Notice that in the second of these, unlucky is not in the scope of $\forall$, i.e. it is not a part of the uniqueness condition associated with the. This is because nonrestrictive adjectives are not within $\overline{N}$, and hence do not fall inside the scope of DetN'. An individual *u* will belong to the extension of (19a) (in a context *c*) iff *u* is the unique student who is unlucky (in *c*); by contrast, *u* will belong to the extension of (19b) (in *c*) iff *u* is the unique student (in *c*), and *u* is unlucky.

2.3 Plural

Let us return now to the quantifying adjectives many and few. These only occur in plural phrases. I shall assume that agreement features such as Pl(ural) are specified initially at the level of phrasal categories, and then distributed down the tree according to various conventions. In presenting the latter, I shall adopt the convention that Δ, Γ, Γ_0, Γ_1,... are variables ranging over sets of minor syntactic features. I shall also use "$[\alpha \underline{F}] \subseteq \Delta$" to mean that the singleton set $[\alpha \underline{F}]$ is included in the set Δ.

The most important means of distributing features is the Head Feature Convention (HFC)[7]:

(20) Head Feature Convention

In the rule $[_{\underset{\Delta}{\underline{C}}}\ \underset{\Gamma_0}{\underline{D}_0} \ldots \underset{\Gamma_{\underline{n}}}{\underline{D}_{\underline{n}}}]$, if $\underset{\Gamma_{\underline{i}}}{\underline{D}_{\underline{i}}}$ is the head of $\underline{C}$, then

$\Delta \subseteq \Gamma_{\underline{i}}$.

The other relevant conventions are the following:

(21) <u>NP Agreement</u>

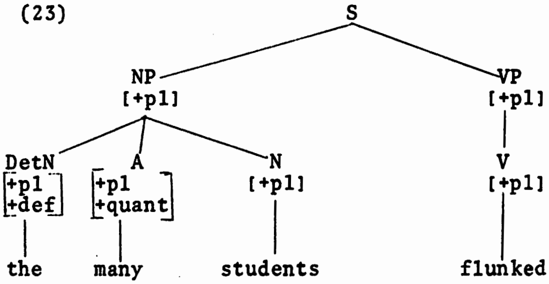
In the rule $[_{\underset{\Delta}{\underline{C}}}\ \underset{\Gamma_0}{D_0} \ldots \underset{\Gamma_{\underline{n}}}{D_{\underline{n}}}]$, if $\underline{C}$ has the class features

(22) <u>Subject-Verb Agreement</u>

In the rule $[_S \underset{\Delta}{NP}\ \underset{\Gamma}{VP}]$, if $[+pl] \subseteq \Delta$, then $[+pl]$ $\subseteq \Gamma$; otherwise, $[-pl] \subseteq \Gamma$.[8]

As a result, the quantifying adjectives will appear in structures of the following sort:

(23)



When a lexical item α is immediately dominated by a category $\underline{C}_{[+pl]}$, and (unlike <u>many</u> and <u>few</u>) is not marked in the lexicon with the inherent feature [+pl], then it will be translated as $\underline{Pl}(\alpha)$, where <u>Pl</u> is to be interpreted as a plurality operator of the language <u>L</u>. In the first instance, we define <u>Pl</u> only for expressions of type $<\tau,\underline{t}>$ (where τ is any type). If α is such an expression, then $\underline{Pl}(\alpha)$ is an expression of type $<<\tau,\underline{t}>,\underline{t}>$. Thus, for example, if α is of type $<\underline{e},\underline{t}>$, denoting a set of individuals, then $\underline{Pl}(\alpha)$ will be of type $<<e,t>,\underline{t}>$, and will denote a set of sets of individuals. Let κ denote a function which yields the cardinality of any set in its domain. Then <u>Pl</u> is defined as follows:

(24) If α is an expression of type $<\tau,\underline{t}>$ and β is a variable of the same type, then

$\forall\beta[\mathrm{Pl}(\alpha)(\beta) \leftrightarrow [\beta \subseteq \alpha \wedge \kappa(\beta) \geq 2]]$

For instance, if S is the extension of student, then Pl(student) denotes the set of subsets of S (i.e. the set of sets of students) which contain at least two members. Consequently, if Pl(student) ($\underline{X}_1$) is true under an assignment a, then the set assigned to $\underline{X}_1$ by a will be a subset of S, i.e. it will be a set of students.

At this point, I have to say something briefly about plural definite descriptions. On an intuitive level, the students refers to the set of all students (in a given context). However, it is not very satisfactory to just translate the students as student (which will indeed have the desired denotation). On the one hand, this lacks the kind of quantificational structure which we need if we are to capture well-known scopal ambiguities (as well as the restrictive/nonrestrictive distinction). On the other hand, it makes singular and plural the seem totally unrelated in their semantics. Although I do not have space to justify the proposal here, I am going to assume that plural the $\bar{N}$ parallels singular the $\bar{N}$ in the following way: loosely speaking, it refers to the (unique) maximal set which satisfies the descriptive predicate Pl($\bar{N}$'). A more precise analysis is given in (25), where $\underline{Q}_i$, as before, is a variable of type $<<\underline{e},\underline{t}>,\underline{t}>$.

(25) $<10,\ [_{\mathrm{DetN}\ \left[\begin{smallmatrix}+\mathrm{def}\\+\mathrm{pl}\end{smallmatrix}\right]}\ \underline{\mathrm{the}}],\ \lambda\underline{Q}_1\lambda\underline{Q}_2\exists\underline{X}_1[\forall\underline{X}_2[\underline{Q}_1(\underline{X}_2) \leftrightarrow \underline{X}_2 \subseteq \underline{X}_1] \wedge \underline{Q}_1(\underline{X}_1)]]>$

(23) will consequently induce the following translation:

(26) $\exists \underline{X}_1 [\forall \underline{X}_2 [\underline{P1}(student)(X_2) \leftrightarrow \underline{X}_2 \subseteq \underline{X}_1] \wedge many(\underline{X}_1)$

$\wedge\ \underline{P1}(flunk)(\lambda \underline{Q}_1 \underline{Q}_1(\underline{X}_1))]]$

This says that there is a maximal set $\underline{X}_1$ of students, and $\underline{X}_1$ is many-membered, and every element of $\underline{X}_1$ flunks.

2.4 Some Remarks on Interpretation

It may help the reader if I now make some further remarks on the interpretation of many and few. I do not wish to go into details here, but I beleive that most of the characteristic semantic properties of the quantifying adjectives can be accounted for if they are analysed as (vague, context-dependent) predicates of sets.

In other words, they are just like ordinary predicate adjectives, but instead of mapping individuals into truth values, they map sets of individuals into truth values[9]. Intuitively, many will be true of a set X just in case X has many members. (Of course, what counts as 'many' will depend on the context of use; but in this respect, many is just like any other predicate adjective). Moreover, if many is true of a set X (in a given context of use) and X has the same cardinality as Y, then many will also be true of Y (in that context). Note that this characteristic also holds of quantifier phrases, at least when they are treated -- as is common in higher order logic -- as second order predicates of predicates. Suppose, for example, that we interpret something as equivalent to the unrestricted existential quantifier. If something is true of a set X, and Y has the same cardinality as X, then something will be true of Y. We might, to be concrete, take X to be the extension of the predicate is a natural number between 2 and 4 and Y to be the extension of is the present Prime Minister of Great Britain. Thus, while the predicate many is not a quantifier phrase[10], it can nevertheless play a quantifying role by virtue of the fact that it is sensitive to the cardinality of sets in its domain.

Last, the interpretation of few can be defined straightforwardly in terms of the interpretation of many: few is true of a set X just in case many is false of X.

(27) $\forall \underline{X}_1 [\underset{\sim}{few}(\underline{X}_1) \leftrightarrow \underset{\sim}{many}(\underline{X}_1)]$

3. many and few as Quantifiers

Suppose the conclusions of the previous section are correct. How then should we deal with sentences like (28)?

(28) Few difficult problems can be solved in a day.

One possibility would be to say that few is again a (nonrestrictive) prenominal adjective, preceded by a phonologically null indefinite determiner. However, there are compelling arguments against the analysis. First, there is distributional evidence showing that NP-initial many and few pattern like classical quantifiers, rather than prenominal adjectives. Thus, unlike ordinary adjectives, they can precedepartitives:

(29) I saw *green/many/some of the frogs.

Unlike ordinary adjectives, they can fall within the scope of not:

(30) Not *green/many/all frogs can jump that far.

And unlike ordinary adjectives, they can be coordinated with classical quantifiers:

(31) (a) [Many or all] frogs are insectivorous.

(b) *There are [trivial or no] solutions to this problem.

Second, there is also a semantic argument. The lack of an overt determiner in (28) could be accounted for in two ways. Either as I just suggested, we could hypothesize a null plural indefinite determiner; alternatively, following Carlson (1977), we could treat the NP as a 'bare plural'. Whichever option we took, however, the classification of *few* as a prenominal adjective in (28) would lead us to expect the latter to have the same range of interpretations as (32):

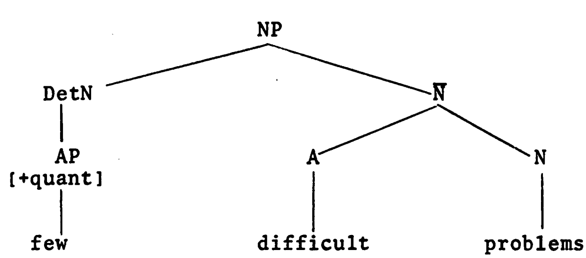
(32) Difficult problems can be solved in a day.

But this prediction is not borne out, since (28), but not (32), is entailed by (33):

(33) No difficult problems can be solved in a day.

Let me propose an alternative therefore. In the rules for NP presented earlier, DetN was intended to dominate formatives like *every*, *all*, *the*, and *a*. I want to suggest that, in addition, it can dominate the phrasal category AP. That is, the subject NP of (28) should receive the following analysis:

(34)



Although the syntactic rule for deriving (34) is straightforward, the corresponding semantic rule involves two cases, according to whether the lexical head of the AP is *many* or the inherently negative few. I shall deal with this by introducing a function $f_{[\alpha neg]}$, where the value of α is determined by the feature specif- on DetN:

(35) $<11, [_{\substack{DetN\\ [\alpha neg]}} \underset{[+quant]}{AP}], \underline{f}_{[\alpha neg]}(AP')>$

where (a) $\underline{f}_{[-neg]} = \lambda\underline{Q}_1\lambda\underline{Q}_2\lambda\underline{Q}_3\exists\underline{X}_1[\underline{Q}_1(\underline{X}_1) \wedge \underline{Q}_2(\underline{X}_1) \wedge \underline{Q}_3(\underline{X}_1)]$

(b) $\underline{f}_{[+neg]} = \lambda\underline{Q}_1\lambda\underline{Q}_2\lambda\underline{Q}_3\forall\underline{X}_1[\underline{Q}_2(\underline{X}_1) \wedge \underline{Q}_3(\underline{X}_1) \rightarrow \underline{Q}_1(\underline{X}_1)]$

On the version of X-bar theory that I am assuming, rule 11 would not violate the usual constraint on PS rules. For DetN is not the head of any category, and does not enter into the X-bar hierarchy. On the other hand, for the purposes of HFC, AP will count as the head of DetN, and will thus inherit the feature specification [αneg]. This in turn will determine whether the lexical head of AP is <u>many</u> -- [+quant, -neg], or <u>few</u> -- [+quant, +neg].

By virtue of rule 11, the sentences in (a) below will be paired with the logical structures in (b):

(36) (a) Many students work.

(b) $\exists\underline{X}_1[\text{many}(X_1) \wedge \underline{Pl}(\text{student})(\underline{X}_1) \wedge \underline{Pl}(\text{work})(\lambda\underline{Q}_1\underline{Q}_1(\underline{X}_1))]$

(37) (a) Few students work.

(b) $\forall\underline{X}_1[\underline{Pl}(\text{student})(\underline{X}_1) \wedge \underline{Pl}(\text{work})(\lambda\underline{Q}_1\underline{Q}_1(\underline{X}_1)) \rightarrow \text{few}(\underline{X}_1)]$

Notice that (37) makes no existential claims. That is, it is entailed by (38):

(38) (a) No students work.

(b) $\neg\exists\underline{X}_1[\underline{Pl}(\text{student})(\underline{X}_1) \wedge \underline{Pl}(\text{work})(\lambda\underline{Q}_1\underline{Q}_1(\underline{X}_1))]$

4. Comparative Constructions

4.1 Unbounded Dependencies

It might be thought that phrase structure grammars are totally inadequate to handle unbounded dependencies of the sort typically found in comparative constructions. This assumption, however, is without foundation, as Gazdar (forthcoming a, b, c) has shown. The important new steps are (a) to exploit the possibility of treating category labels as complex symbols, and (b) to introduce various higher-level conditions on the set of rules available to the grammar.

Let V_N be the set of basic nonterminal (NT) symbols, i.e. the set of all NT symbols standardly used. Then we define a set $\underline{Der}(V_N)$ of derived NT symbols as follows:

(39) $\underline{Der}(V_N) = \{\underline{C}/\underline{D}: \underline{C}, \underline{D} \in V_N\}$

To make clear how this works, let us suppose that S and NP are the only basic NT symbols. Then $\underline{Der}(V_N)$ would be {S/S,S/NP,NP/NP,NP/S}. These derived symbols are to be interpreted as follows: a node labelled C/D will dominate just the trees that can be dominated by a node C, except that they will all contain a node D/D, which immediately dominates a phonologically null dummy element. Moreover, every node on the path between C/D and D/D will be labelled by a derived symbol E/D, for some E in V_N. Intuitively, a tree rooted by C/D will contain somewhere within it an empty node of category D, i.e. what would be an extraction site on a movement analysis. So, for example, S/NP will be a sentence with an NP gap somewhere.

In addition to defining derived categories, we also need a set of rules which utilize them. Let G be the set of basic rules, i.e.

the set of rules that would be required by a grammar not handling unbounded dependencies. Moreover, let $V_{\underline{D}} \subseteq V_N$, for $\underline{D} \in V_N$, be the set of categories which can dominate $\underline{D}$ according to the rules in G. Then, for any $\underline{D} \in V_N$, we define a set of derived rules Der($\underline{D}$,G) as follows:

(40) $\underline{\text{Der}}(\underline{D},G)$ is the set of rules $[_{\underline{C}/\underline{D}}\ \underline{E}_1 \ldots \underline{E}_i/\underline{D} \ldots \underline{E}_n]$ such that $[_{\underline{C}}\ \underline{E}_1 \ldots \underline{E}_{\underline{i}} \ldots \underline{E}_{\underline{n}}]$ is in G and $\underline{C}$, $\underline{E}_{\underline{i}}$ are in $V_{\underline{D}}$, for $\underline{i} = 1,\ldots \underline{n}$

Recall that $\underline{C}/\underline{D}$ is the category of an expression which contains a category $\underline{D}$ gap at some point. So we expand constituents of category $\underline{C}/\underline{D}$ in the same way as constituents of category $\underline{C}$, except that exactly one of the dominated categories also indicates a category $\underline{D}$ gap. In this way, the information that there is an empty node is first coded onto some dominating node, and then carried progressively down the tree. An example may help to make this clearer. Suppose (41) comprises the set G of basic rules:

(41) (a) $[_S$ NP VP$]$

(b) $[_{VP}$ V AP$]$

(c) $[_{AP}$ $\bar{A}]$

(d) $[_{\bar{A}}$ DetA A$]$

(e) $[_{NP}$ DetN $\bar{N}]$

(f) $[_{\bar{N}}$ A $\bar{N}]$

(g) $[_{DetN}$ AP$]$

Then the set $\underline{\text{Der}}$(AP,G) will contain the following rules:

(42) (a) $[_{S/AP}$ NP/AP VP$]$, $[_{S/AP}$ NP VP/AP$]$

(b) $[_{VP/AP}$ V AP/AP$]$

(e) $[_{NP/AP}$ DetN/AP $\bar{N}]$

(g) $[_{DetN/AP}$ AP/AP$]$

Derived rules have no special lexical or semantic properties. That is, all derived rules will have the same rule-numbers, the same subcategorization properties, and the same semantic rules as the basic rules from which they are constructed.

In addition to derived rules, it will also be necessary to have some linking rules which introduce and eliminate derived categories. Only the following rule schema is required for eliminating derived categories.

(43) $\langle 12,\ [_{C/C}\ \underline{t}],\ \underline{v}_0^{\tau}\rangle$, where $\underline{C} \in V_N$, τ is the translation type associated with $\underline{C}$, and $\underline{v}_0^{\tau}$ is the first variable of that type.

Note that $\underline{t}$ is a dummy element postulated solely for phonological purposes -- it serves to block contraction -- and has no semantic function.

4.2 Adjectival Comparatives

I shall use the morphemes more, less, and as as features on AP which will eventually determine the realisation of DetA within $\bar{A}$ (cf. Gazdar (forthcoming, c)). To begin with, it is necessary to replace the earlier rule 4 for $\bar{A}$ by (44):

(44) $\langle 4a,\ [_{\underset{[\alpha]}{\bar{A}}}\ \underset{[\alpha]}{\text{DetA}}\ \text{A}],\ \text{DetA}'(\text{A}')\rangle$, where α is more, less, or as.

$\langle 4b,\ [_{\underset{[more]}{\bar{A}}}\ \underset{[more]}{\text{A}}\ ],\ \underset{[more]}{\text{DetA}'}(\text{A}')\rangle$

I assume that adjectives will be marked [+more] in the lexicon if they have a morphological comparative, either inflected in er, or suppletive (better, worse, more). Such comparative adjectives will be inserted directly under A[more].

In the rules which expand DetA, $\underline{S}_i$ is a variable of type τ_{AP} (the type associated with $AP_{[-pl]}$), i.e. $\langle\langle\langle \underline{e},\underline{t}\rangle,\underline{t}\rangle,\underline{t}\rangle$, $\underline{p}_i$ is a variable of type $\underline{t}$[11], and $\underline{d}_i$ is a variable of type τ_{DetA} (the type associated with DetA), i.e. $\langle\tau_{AP},\ \tau_{AP}\rangle$.

(45) 13, $[_{\substack{\text{DetA}\\ [\text{more}]}}\ \underline{\text{more}}]$, $\lambda\underline{S}_1\lambda\underline{p}_1\lambda\underline{Q}_1\ \underline{d}_0[\underline{d}_0(\underline{S}_1)(\underline{Q}_1) \qquad \lambda\underline{S}_0[\underline{p}_1](\underline{S}_1)]$

14, $[_{\substack{\text{DetA}\\ [\text{less}]}}\ \underline{\text{less}}]$, $\lambda\underline{S}_1\lambda\underline{p}_1\lambda\underline{Q}_1\ \underline{d}_0[\ \underline{d}_0(\underline{S}_1)(\underline{Q}_1) \quad \lambda\underline{S}_0[\underline{p}_1](\underline{S}_1)]$

15, $[_{\substack{\text{DetA}\\ [\text{as}]}}\ \underline{\text{as}}]$, $\lambda\underline{S}_1\lambda\underline{p}_1\lambda\underline{Q}_1\ \underline{d}_0[\lambda\underline{S}_0[\underline{p}_1](\underline{S}_1) \rightarrow \underline{d}_0(\underline{S}_1)(\underline{Q}_1)]$

When $\underline{d}_i$ occurs in logical structures for comparatives, it functions something like the pro-DetA that. This is illustrated in (47) which is the translation of (46):

(46) Alex is taller than Chris is.

(47) $\exists\underline{d}_0[\underline{d}_0(\text{tall})(\text{Alex}) \wedge \neg\underline{d}_0(\text{tall})(\text{Chris})]$

The truth conditions of (47) can be conveyed roughly by the paraphrase (48):

(48) There is some value of that which makes Alex is that tall come out true and which makes Chris is that tall come false.

For further discussion, see Klein (forthcoming a).

Clearly, when an AP takes a comparative complement, the choice of the complement-introducing morpheme, _than_ or _as_, depends on the degree modifier in the head. Moreover, prehead modifiers can also take comparative complements:

(49) (a) Jude is less obviously as nice as Kim than Chris is.

(b) You are as much taller than me as I expected.

It would be possible to derive such strings by centre embedding, but this yields highly unnatural constituent structures. Nevertheless, there is an alternative way of treating such constructions in phrase structure grammar.

Let CPAR be the set {MORE,LESS,AS}; each element of this set is a two-place sequence:

(50) MORE = <_more_, _than_>

LESS = <_less_, _than_>

AS = <_as_, _as_>

Formally, a finite sequence is a function on an initial segment of the natural numbers. If σ is an ($\underline{n}$+1)-place sequence, and $\underline{j} \leq \underline{n}$, then $\sigma(\underline{j})$, the value of σ for the argument $\underline{j}$, is usually written as $\sigma_{\underline{j}}$. For example, MORE_0 = _more_ and MORE_1 = _than_.

It is also customary to represent σ as $<\sigma_0,\sigma_1,\ldots\sigma_{\underline{n}}>$. Thus, $<\text{MORE}_0,\text{MORE}_1>$ = MORE. Last, suppose that $\sigma_{\underline{j}}$ is itself a sequence τ. Then $\sigma_{\underline{j},\underline{k}}$ is to be understood as $\tau_{\underline{k}}$.

Now let Σ be the set of all finite sequences of elements of CPAR. Members of Σ will be used as minor features which govern the cooccurrence of comparative heads and their complements[12].

(51) $<16, [_{AP}\ \underset{[\sigma]}{AP}\ \underset{[\sigma_{\underline{0},\underline{1}}]}{\underline{C}_{\underline{0}}} \ldots \underset{[\sigma_{\underline{n},\underline{1}}]}{\underline{C}_{\underline{n}}}\ ],\ AP'(\underline{C}'_{\underline{0}})\ldots(C_{\underline{n}})>,$

where

(a) σ is an (n+1)-place sequence in Σ,

(b) $\underline{C}_{\underline{i}} \in$ {NP, S/AP, S/DetA}, for $\underline{i}$ = 0,...$\underline{n}$.

If $\underline{n}$ is greater than 0 in rule 16, then AP will contain adverbial prehead modifiers which themselves coocur with comparative determiners. Bresnan (1973) and Emonds (1976) have suggested that adverbs formed by suffixing ly -- for example, obviously in (46a) -- are to be categorized as A(djectives). I shall let them be dominated by A[+adv]. I shall assume that much also belongs to this category; for arguments, see Klein (forthcoming b).

(57) $<17, [\underset{[<\alpha>^\frown\sigma]}{AP}\ \underset{\begin{bmatrix}\sigma\\ +adv\end{bmatrix}}{AP}\ \underset{[\alpha_0]}{\bar{A}}\ ],\ \lambda\underline{p}_1[AP'(\bar{A}')(\underline{p}_1)]>,$

where $\alpha \in$ CPAR

The next rule is a subcase of rule 3, but I am listing it separately for convenience:

(53) $<18, [\underset{\begin{bmatrix}<\alpha>\\ +adv\end{bmatrix}}{AP}\ \underset{[\alpha_0]}{\bar{A}}\ ],\ \lambda\underline{p}_1\lambda\underline{S}_1\lambda\underline{Q}_1\exists\underline{S}_2[\underline{S}_2 \subseteq \underline{S}_1 \wedge \underline{S}_2(\underline{Q}_1)$
$\wedge\ \bar{A}'(\lambda\underline{S}_0[\underline{p}_1](\underline{S}_2))(\underline{S}_2)]>$, where $\alpha \in$ CPAR.

Following Chomsky and Lasnik (1977:495), as and than in the comparative clause are not assigned to any category, but are introduced by the schema in (54):

(54) $<19, [\underset{[\alpha]}{\underline{C}}\ \alpha\ \underline{C}],\ \underline{g}(\underline{C}')>$, where

(a) α is than or as,

(b) $\underline{C}$ is NP, S/AP or S/DetA,

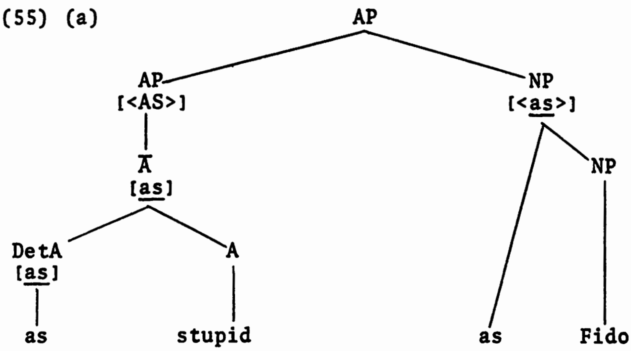
(c) if $\underline{C}$ = NP, then $g(\underline{C}') = (\underline{d}_0(\underline{S}_0))(NP')$

if $\underline{C}$ = S/AP, then $\underline{g}(\underline{C}') = \lambda\underline{S}_0[S/AP'](\underline{d}_0(\underline{S}_0))$

if $\underline{C}$ = S/DetA, then $g(C') = S/DetA'$.

I shall now give some examples of trees admitted by these rules, together with translations they induce. First, a "phrasal comparative" (Hankamer 1973):

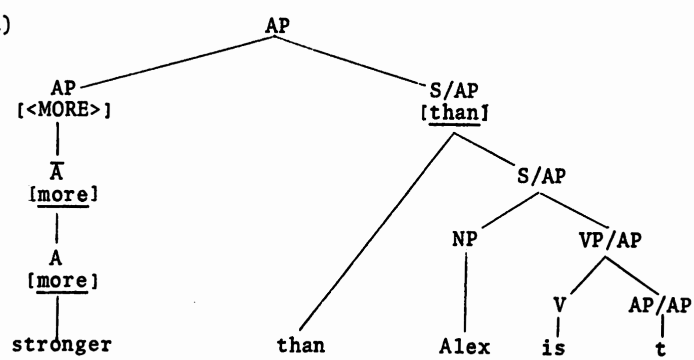
(55) (a)



(b) $\lambda\underline{Q}_1\forall\underline{d}_0[(\underline{d}_0(\utilde{stupid}))(\utilde{Fido}) \rightarrow (\underline{d}_0(\utilde{stupid}))(\underline{Q}_1)]$

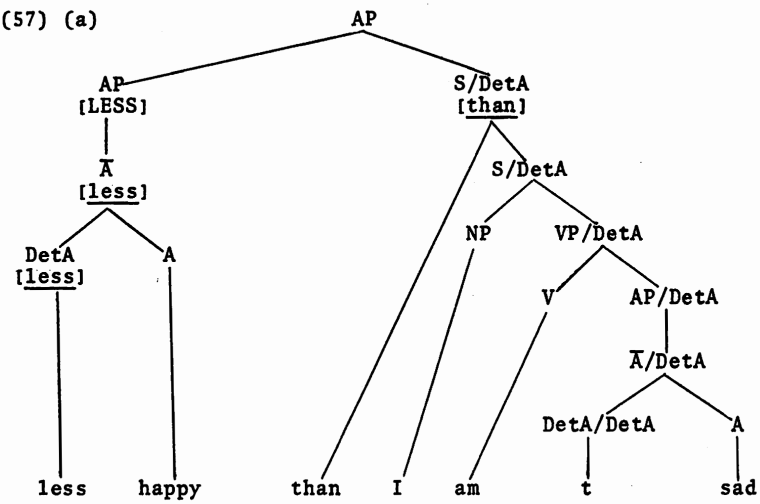
The next two examples involve Comparative Deletion and Subdeletion respectively (Bresnan, 1975).

(56) (a)



(b) $\lambda\underline{Q}_1\exists\underline{d}_0[(\underline{d}_0(\utilde{strong}))(\underline{Q}_1) \wedge \neg(\underline{d}_0(\utilde{strong}))(\utilde{Alex}))]$

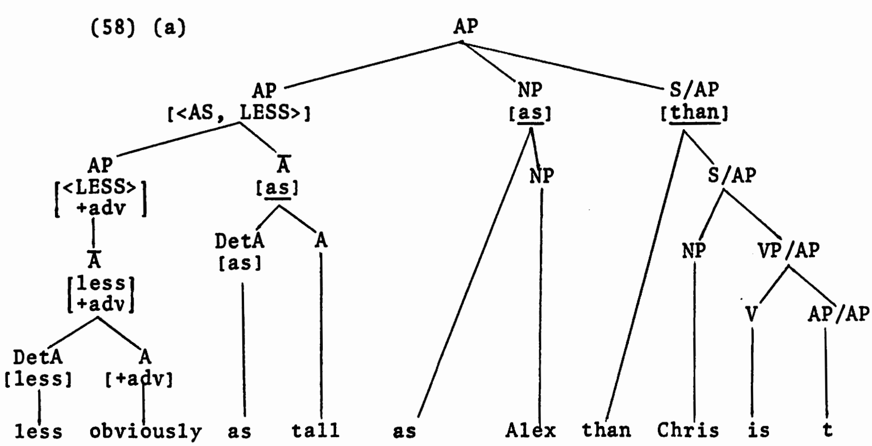
(57) (a)



(b) $\lambda \underline{Q}_1 \exists \underline{d}_0 [\neg(\underline{d}_0(\underset{\sim}{\text{happy}}))(\underline{Q}_1) \wedge (\underline{d}_0(\underset{\sim}{\text{sad}}))(\underset{\sim}{\text{I}})]$

Finally, we have an example which illustrates the treatment of nested constructions:

(58) (a)



$$\text{(b)}\quad \lambda Q_1 S_2 [S_2 \subseteq \lambda Q_2 \forall d_0 [(d_0(\mathbf{tall}))(\mathbf{Alex}) \rightarrow (d_0(\mathbf{tall}))(Q_2)]$$

$$\wedge\ S_2(Q_1) \wedge \exists d_0 [\neg (d_0(\mathbf{obvious}))({}^\wedge S_2(Q_1))$$

$$\wedge\ (d_0(\mathbf{obvious}))({}^\wedge S_2(\mathbf{Chris}))]]$$

It should be fairly clear that this appartus can be extended in a straightforward manner to deal with nested structures involving other degree modifiers, such as the following sentence from Bowers (1976:535).

(59) This fence is so much too much higher than that one for me to even consider climbing it that its simply incomprehensible to me that Mary would try to get me to do it.

4.3 Nominal Comparatives

Let us now turn to nominal comparatives involving quantifying adjectives. We add to the grammar the following rule:

$$\text{(60)}\quad \langle 20,\ [_{NP}\ \underset{[\sigma]}{\text{DetN}}\ \bar{N}\ \underset{[\sigma_{0,1}]}{C_0} \ \ldots\ \underset{[\sigma_{n,1}]}{C_n}\ ],\ \text{DetN}'(C_0)\ldots(C_n)(\bar{N}')\rangle$$

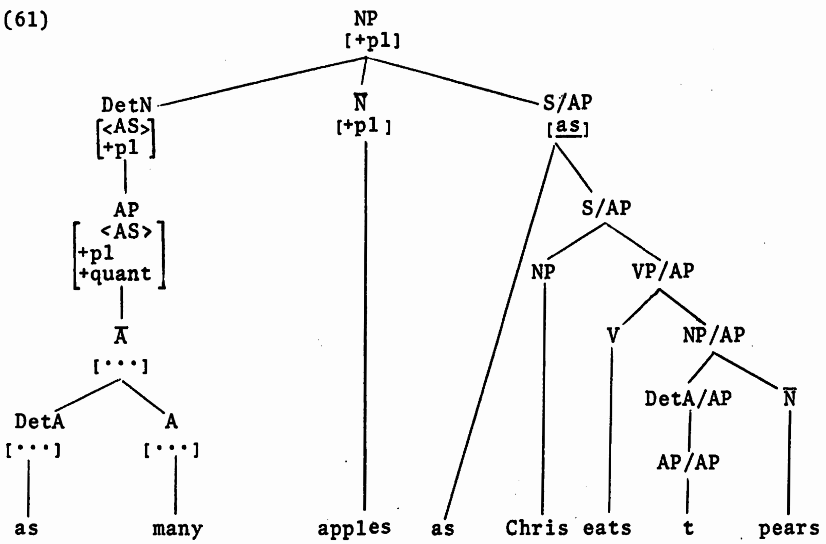
where

(a) σ is an $(n+1)$-place sequence in Σ,

(b) C_i is $NP/\underset{[+quant]}{AP}$ or $S/\underset{[+quant]}{AP}$, for $i = 0, \ldots n$.

It will be possible, as a result, to construct trees like the following:

(61)



In order to deal with the translation of this, we need to say something about the interpretation of DetA within plural adjective phrases. The role of such expressions is to map plural predicates into plural predicates. I shall adopt the convention that $\underline{D}_i$ is a 'plural' variable parallel to $\underline{d}_i$; i.e. it is a variable of type $<\tau_{AP[+pl]}, \tau_{AP[+pl]}>$.

If we then make appropriate adjustments to the type of variables in the DetA translation rules of (45), the NP in (62) will translate as (63), and the whole complement clause (64) will translate as (65):

(62) $[_{NP}\ [_{DetN/AP}\ \underline{t}]\ [_{\bar{N}}\ \text{pears}]\ ]$

(63) $\lambda \underline{Q}_3 \exists \underline{X}_1 [\underline{Q}_0(\underline{X}_1) \wedge \underline{Pl}(\text{pear})(\underline{X}_1) \wedge \underline{Q}_3(\underline{X}_1)]$

(64) $[_{S/AP}$ as Chris eats $\underline{t}$ pears$]$
$\quad [\underline{as}]$

(65) $\exists \underline{X}_1[\underline{D}_0(\underline{Q}_0)(\underline{X}_1) \wedge \underline{Pl}(\mathrm{pear})(\underline{X}_1) \wedge \mathrm{eat}(\lambda \underline{Q}_1 \underline{Q}_1(\underline{X}_1))(\mathrm{Chris})]$

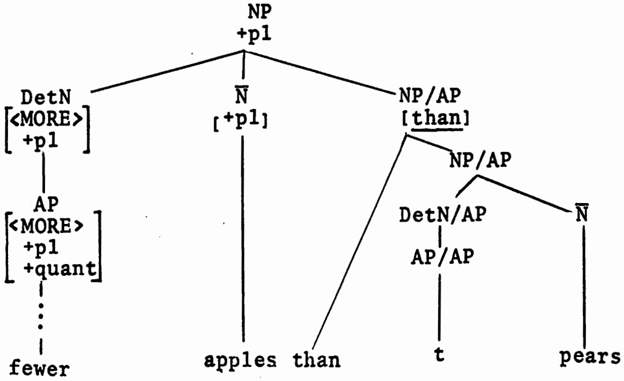
The whole tree (61) induces the translation (66):

(66) $\lambda \underline{Q}_3 \exists \underline{X}_2[\forall \underline{D}_0[\exists \underline{X}_1[\underline{D}_0(\mathrm{many})(\underline{X}_1) \wedge \underline{Pl}(\mathrm{pear})(X_1) \wedge \mathrm{eat}(\lambda \underline{Q}_1 \underline{Q}_1(\underline{X}_1))$

$(\mathrm{Chris})] \rightarrow \underline{D}_0(\mathrm{many})(\underline{X}_2)] \wedge \underline{Pl}(\mathrm{apple})(\underline{X}_2) \wedge \underline{Q}_3(\underline{X}_2)]$

Next, (67) illustrates the analysis of a phrasal nominal comparative, together with its translation.

(67) (a)



(b) $\lambda \underline{Q}_3 \forall \underline{X}_2[\underline{Pl}(\mathrm{apple})(\underline{X}_2) \wedge \underline{Q}_3(\underline{X}_2) \rightarrow \exists \underline{D}_0[\underline{D}_0(\mathrm{few})(\underline{X}_2) \wedge$

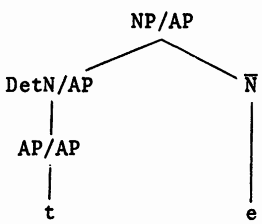
$\neg \exists \underline{X}_1[\underline{D}_0(\mathrm{few})(\underline{X}_1) \wedge \underline{Pl}(\mathrm{pear})(\underline{X}_1) \wedge \underline{Q}_3(\underline{X}_1)]]]$

Last, let us briefly consider an example in which a whole NP is missing from the comparative clause:

(68) $[_{NP}$ as many apples as Chris eats ___$]$

At first sight, this appears to be evidence that the complement of a nominal comparative can be of the form S/NP. I do not think this is right, however. First, if $[_{NP/NP}\ \underline{t}]$ is translated according to the schema (43) for slash categories, ie. as a designated variable of type τ_{NP}, it will be impossible to employ the crucial device of binding a DetA variable when I have relied on so far. Second, Bennis (1978) has argued convincingly that such apparent cases of controlled NP 'deletion' are in fact the result of DetN 'deletion' plus the independently motivated rule of $\bar{N}$-anaphora. In other words, the correct analysis of the missing NP in (68) is something like this:

(69)



$[_{\bar{N}}\ \underline{e}]$ will be translated as a variable-like term which receives a semantic value on the basis of contextual information (in the widest sense). In this way, the general translation strategy exhibited in (61) can also be applied to (68).

EWAN KLEIN

NOTES

1. L can be identified, more or less, with Montague's language of intensional logic, IL. However, I shall ignore intensionality in this paper.

2. The subject NP is treated as argument of VP, as in Montague's Universal Grammar. This approach is discussed and motivated in Keenan and Faltz (1978) and Bach (1979).

3. $\underline{x}_i$ and $\underline{X}_i$ are variables of type $\underline{e}$ and $\underline{e},\underline{t}$ respectively. This translation rule only covers degree adjectives (i.e. not modifiers like alleged), and does not deal with the fact that the comparison class relative to which A' is evaluated is determined by the head of the construction, $\bar{N}$. I assume that this context-dependence is best introduced as a parameter of the class of admissible interpretations, but I cannot go into details here.

4. When drawing tree diagrams, I shall adopt the following abbreviatory convention: any nonbranching node $X^{\underline{n}}$ will be omitted if there is a note $X^{\underline{m}}$, $\underline{m} > \underline{n}$, which immediately and exhaustively dominates it.

5. It might be objected that few and many are preceded by a null indefinite determiner in phrases like many girls. I shall deal with this issue in section 3.

6. Phrase like the remaining few survivors are acceptable. It is not clear to me what constraints are operating here.

7. Cf. Gazdar, Pullum and Sag (1979).

8. VP is always specified [+pl] or [-pl], but NP will be unspecified for Pl if it is specified [-count].

9. It is not crucial that the domains of such predicates are sets of individuals; but they should be sets of whatever objects are in the domain of ordinary predicate adjectives. For further discussion of vague predicates, see Klein (forthcoming a).

10. Though, as I shall argue in section 3, it can occupy the position of a quantifier.

11. Strictly speaking, we should use a variable of higher type than $\underline{t}$, i.e. of the same type as $\lambda \underline{S}_0 \lambda \underline{d}_0 \phi$, where ϕ is of type $\underline{t}$. However, I will ignore this extra refinement here.

12. It seems likely that grammars containing this device will generate <u>indexed</u> languages (Hopcraft and Ullman, 1979). The indexed languages are a proper superset of the context free languages, but a proper subset of the strictly context sensitive languages.

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The other relevant conventions are the following:

(21) <u>NP Agreement</u>

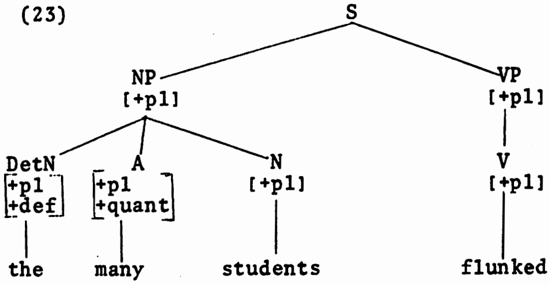
In the rule $[_{\frac{\underline{C}}{\Delta}}\ \frac{\underline{D}_0}{\Gamma_0} \ldots \frac{\underline{D}_n}{\Gamma_{\underline{n}}}]$, if $\underline{C}$ has the class features

(22) <u>Subject-Verb Agreement</u>

In the rule $[_S\ \underset{\Delta}{NP}\ \underset{\Gamma}{VP}]$, if $[+pl] \subseteq \Delta$, then $[+pl] \subseteq \Gamma$; otherwise, $[-pl] \subseteq \Gamma$[8].

As a result, the quantifying adjectives will appear in structures of the following sort:

(23)



When a lexical item α is immediately dominated by a category $\underline{C}_{[+pl]}$, and (unlike <u>many</u> and <u>few</u>) is not marked in the lexicon with the inherent feature [+pl], then it will be translated as <u>Pl</u>(α), where <u>Pl</u> is to be interpreted as a plurality operator of the language <u>L</u>. In the first instance, we define <u>Pl</u> only for expressions of type $<\tau,\underline{t}>$ (where τ is any type). If α is such an expression, then <u>Pl</u>(α) is an expression of type $<<\tau,\underline{t}>,\underline{t}>$. Thus, for example, if α is of type $<\underline{e},\underline{t}>$, denoting a set of individuals, then <u>Pl</u>(α) will be of type $<<e,t>,\underline{t}>$, and will denote a set of sets of individuals. Let κ denote a function which yields the cardinality of any set in its domain. Then <u>Pl</u> is defined as follows:

(24) If α is an expression of type $<\tau,\underline{t}>$ and β is a variable of the same type, then
$\forall\beta[\mathrm{Pl}(\alpha)(\beta) \leftrightarrow [\beta \subseteq \alpha \wedge \kappa(\beta) \geq 2]]$

For instance, if S is the extension of student, then Pl(student) denotes the set of subsets of S (i.e. the set of sets of students) which contain at least two members. Consequently, if Pl(student) $(\underline{X}_1)$ is true under an assignment $\underline{a}$, then the set assigned to $\underline{X}_1$ by $\underline{a}$ will be a subset of S, i.e. it will be a set of students.

At this point, I have to say something briefly about plural definite descriptions. On an intuitive level, the students refers to the set of all students (in a given context). However, it is not very satisfactory to just translate the students as student (which will indeed have the desired denotation). On the one hand, this lacks the kind of quantificational structure which we need if we are to capture well-known scopal ambiguities (as well as the restrictive/nonrestrictive distinction). On the other hand, it makes singular and plural the seem totally unrelated in their semantics. Although I do not have space to justify the proposal here, I am going to assume that plural the $\bar{N}$ parallels singular the $\bar{N}$ in the following way: loosely speaking, it refers to the (unique) maximal set which satisfies the descriptive predicate Pl($\bar{N}$'). A more precise analysis is given in (25), where $\underline{Q}_i$, as before, is a variable of type $<<\underline{e},\underline{t}>,\underline{t}>$.

(25) $<10,\ [_{\mathrm{DetN}\begin{bmatrix}+\mathrm{def}\\ +\mathrm{pl}\end{bmatrix}}\ \underline{\mathrm{the}}],\ \lambda\underline{Q}_1\lambda\underline{Q}_2\exists\underline{X}_1[\forall\underline{X}_2[\underline{Q}_1(\underline{X}_2) \leftrightarrow \underline{X}_2 \subseteq \underline{X}_1]$
$\wedge\ \underline{Q}_1(\underline{X}_1)]]>$

(23) will consequently induce the following translation:

$$(26)\quad \exists \underline{X}_1 [\forall \underline{X}_2 [\underline{\text{Pl}}(\text{student})(X_2) \leftrightarrow \underline{X}_2 \subseteq \underline{X}_1] \wedge \text{many}(\underline{X}_1) \wedge \underline{\text{Pl}}(\text{flunk})(\lambda \underline{Q}_1 \underline{Q}_1(\underline{X}_1))]]$$

This says that there is a maximal set $\underline{X}_1$ of students, and $\underline{X}_1$ is many-membered, and every element of $\underline{X}_1$ flunks.

2.4 Some Remarks on Interpretation

It may help the reader if I now make some further remarks on the interpretation of _many_ and _few_. I do not wish to go into details here, but I beleive that most of the characteristic semantic properties of the quantifying adjectives can be accounted for if they are analysed as (vague, context-dependent) predicates of sets.

In other words, they are just like ordinary predicate adjectives, but instead of mapping individuals into truth values, they map sets of individuals into truth values[9]. Intuitively, _many_ will be true of a set X just in case X has many members. (Of course, what counts as 'many' will depend on the context of use; but in this respect, _many_ is just like any other predicate adjective). Moreover, if _many_ is true of a set X (in a given context of use) and X has the same cardinality as Y, then _many_ will also be true of Y (in that context). Note that this characteristic also holds of quantifier phrases, at least when they are treated -- as is common in higher order logic -- as second order predicates of predicates. Suppose, for example, that we interpret _something_ as equivalent to the unrestricted existential quantifier. If _something_ is true of a set X, and Y has the same cardinality as X, then _something_ will be true of Y. We might, to be concrete, take _X_ to be the extension of the predicate _is a natural number between 2 and 4_ and Y to be the extension of _is the present Prime Minister of Great Britain_. Thus, while the predicate _many_ is not a quantifier phrase[10], it

THE SYNTAX AND SEMANTICS OF NOMINAL COMPARATIVES

0. Introduction

This paper is primarily concerned with the analysis of nominal expressions involving _many_ and _few_:

(1) (a) the many/few students
    (b) many/few students
    (c) as many/few students as professors
    (d) more/fewer students than we had invited

I shall make some fairly detailed proposals for deriving and interpreting such constructions; my basic claim will be that the 'quantifiers' _many_ and _few_ are properly to be regarded as adjectives, albeit of a special kind. Most of what I shall say can be carried over to _much_ and _little_ as well. However, I shall ignore these expressions since I want to avoid the added complication of mass terms.

Justification for this approach can be given on both syntactic and semantic grounds. More importantly though, the analysis I shall present is one in which syntactic and semantic considerations interlock in a coherent and illuminating manner. In practice, it is seductively easy to formulate syntactic rules without worrying whether they can be made sense of semantically, and it is equally easy to construct rather abstract logical forms without providing any systematic method for relating them to surface structures. It is my conviction, however, that grammatical analysis will not advance significantly unless syntactic and semantic rules are developed side by side.

This does not mean that we cannot give purely syntactic arguments for a particular analysis. Nor does it mean that syntactic operations should be conditioned by semantic factors. On both these counts, I would decidedly support a modular approach to grammar. Rather, I am claiming that sensitivity to both syntactic and semantic requirements can be a useful, indeed crucial, heuristic in guiding the linguist to a well-founded analysis. For it hardly needs pointing out that most current proposals are grossly underdetermined by the available syntactic evidence, even given a framework of metatheoretical constraints of the kind currently favoured by Chomsky. Of course, it is rarely possible to prove that a given syntactic analysis cannot be matched with an appropriate logical form, or more generally, that a fragment of grammar cannot be provided with a model-theoretic interpretation. But the burden of proof that a syntactic analysis is semantically coherent lies with the linguist who proposes it; and without such a demonstration, the analysis can be regarded as little more than an optimistic guess.

1. Phrase Structure Grammar

Before advancing to any substantive proposals, it will be useful to indicate my background assumptions about the form of a grammar. As will be obvious, I am deeply indebted to recent work by Gazdar (forthcoming a, b).

Following McCawley (1968), phrase structure (PS) rules will be interpreted as node admissibility conditions rather than string rewriting rules. In order to indicate this, the familiar arrow notation

(2) $S \rightarrow NP\ VP$

is replaced by

(3) $[_S\ NP\ VP]$

and analogously for other rules. (3) will admit a tree rooted by S just in case this node immediately and exhaustively dominates two nodes NP and VP, in that left-to-right order.

Each syntactic rule of the grammar is associated with a semantic rule which specifies how the tree admitted by the syntactic rule is to be translated into an interpreted formal language *L*[1]. That is, given a syntactic rule of the form $[_C\ D_1 \ldots D_n]$, the semantic rule will determine a translation of *C* as a function of the translation of $D_1 \ldots D_n$. This corresponds to the Compositionality Principle that the meaning of a complex expression is a function of the meaning of its parts. I adopt the convention that if *C* is any constituent, then *C'* represents the translation of *C*. For example, given an NP, NP' stands for the (possibly complex) expression of *L* which translates NP. Individual lexical items of English will be mapped into constants of *L*, represented as boldface versions of the English word forms. Thus, *many* will be translated as **many**. Finally, we take a complete rule of the grammar to be a triple consisting of an integer -- the rule number --, a PS rule, and a translation rule. So, for example, our first rule of English might take the form

(4) $\langle 1, [_S \text{ NP VP}], \text{VP}'(\text{NP}')\rangle$[2].

2. many and few as Predicates

2.1 Quantifiers vs. Adjectives

Certain prenominal modifiers have standardly been classified as quantifiers; for example, *a*, *every*, *some*, *all*, and *each*. I shall call these *classical* quantifiers, and I shall assume that the usual representations in first-order logic give an adequate guide to their semantic interpretations.

It is usually thought that *many* and *few* should be classed as quantifiers too. Yet the respects in which these expressions resemble adjectives more than quantifiers have often been noted in the literature. For example, unlike classical quantifiers they can occur in post-determiner position:

(5) A cargo boat rescued the starving/few/*some survivors.

Unlike classical quantifiers, they can occur in predicate position:

(6) The questions to which the inquiry team are now seeking answers are difficult/many/*all.

And unlike classical quantifiers, they cooccur with degree modifiers:

(7) (a) The chairs were too hard/few/*some to seat all the guests comfortably.

(b) These are as difficult/many/*all problems as you'll ever encounter.

Let us suppose then, that <u>many</u> and <u>few</u> are not of category Q, as Bresnan (1973) has suggested, but are instead plural adjectives; i.e. of category A. I shall now develop a fragment of grammar in order to show how data like (5)-(7) can be dealt with.

For the present, I will only consider very simple AP structures, involving neither prehead recursion, nor posthead complementation. Degree modifiers will be treated as determiners within the adjectival system, and labelled DetA. They are to be distinguished, therefore, from determiners within the nominal system -- for example, the classical quantifiers -- which will be labelled DetN.

(8) $\langle 2, [_{VP}\ V\ AP],\ V'(AP')\rangle$

$\langle 3, [_{AP}\ \bar{A}],\ \bar{A}'\rangle$

$\langle 4, [_{\bar{A}}(DetA)A],\ DetA'(A')\rangle$

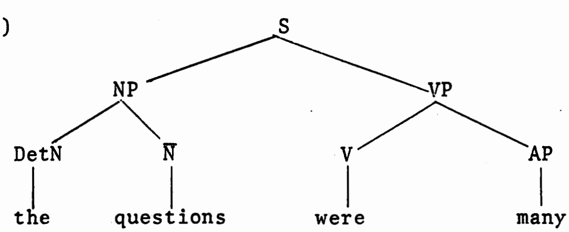
$\langle 5, [_{NP}\ DetN\ \bar{N}],\ DetN'(\bar{N}')\rangle$

$\langle 6, [_{\bar{N}}\ A\ \bar{N}],\ \lambda \underline{x}_1 [A'(\lambda \underline{X}_1 \underline{X}_1(\underline{x}_1)) \quad \bar{N}'(\underline{x}_1)]\rangle$[3]

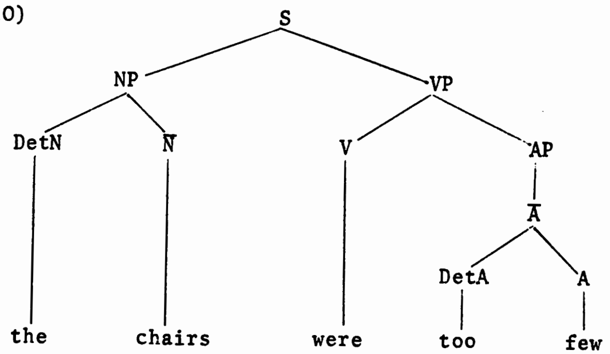
$\langle 7, [_{\bar{N}}\ N],\ N'\rangle$

As predicate adjectives, <u>many</u> and <u>few</u> will occur in trees of the the following sort[4]:

(9)

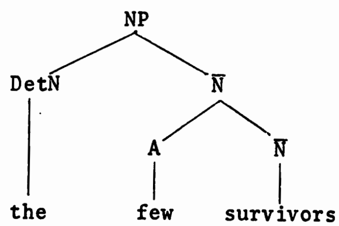


(10)



Next, consider the post-determiner cases. We might try, first of all, to derive these by means of rule 6:

(11)



On this approach, *few* is simply a prenominal adjective, on a par with, say, *unlucky* in the *unlucky students*. However, there are three problems with this analysis. (a) It is difficult to state the restriction that if *many* and *few* are preceded by a determiner, it must be definite: **some many problems*, **all few girls*[5]. (b) It is difficult to state the restriction that *many* and *few* typically cannot follow other prenominal adjectives: **the difficult many problems*, **Leo's expensive few books*[6]. (c) Most importantly, it fails to capture the fact that postdeterminer *many* and *few* can only be interpreted nonrestrictively, as Carden (1970)