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Functional Grammar

The term *functional grammar* has been used before, notably by Dik (1978). I risk adding to the number of its meanings here, and thus debasing its value, only because it is peculiarly apt for this new employment. I propose to outline a new grammatical formalism which, if it can be successfully developed, will be worthy of the name *functional* on three counts. First, it is required to *function* as part of a model of language production and comprehension. The formalism is interpretable by an abstract machine whose operation is intended to model the syntactic processing of sentences by speakers and hearers indifferently. This is not to say that it is not also intended to represent a speaker's grammatical competence. Secondly, the formalism ascribes to every sentence, word, and phrase, a *functional description* which differs from the structural description of better known formalisms mainly by stressing the function that a part plays in a whole rather than the position a part occupies in a sequence of others. The names of grammatical categories, like *S, NP,* and *VP* will therefore play a secondary role to terms like *subject, object,* and *modifier* . Thirdly, properties that distinguish among logically equivalent sentences will have equal importance with properties that they share. In other words, this will be a functionalist view of grammar in which notions like *topic* and *focus, given* and *new* will have equal status with *subject* and *predicate, positive* and *negative.*

For the most part, theoretical linguists see a grammar as an abstract device that characterizes the presumably infinite set of sentences of a language, that is, which differentiates the sentences from other strings which are not sentences. Computational linguists, on the other hand, have usually taken a grammar to be a transducer showing how a meaning comes to be represented as a string of words or, more frequently, how a string of words is analyzed to reveal its meaning. Functional grammar has both aspects. It can also be said to be a transducer whose input is a more or less incomplete account of the syntactic relations among the parts of a sentence and whose output is one or more accounts which are complete according to the theory. Given a more or less incomplete description, it verifies that it describes a legal grammatical object – a word, phrase, or sentence – and adds such additional detail as the grammar allows. If it is not a legal grammatical object, no output is produced. If it is, one or more descriptions are produced, each an enrichment of the original, but reflecting different grammatical interpretations.

The ideal speaker comes to the syntactic processor wanting a sentence with a certain meaning; the processor's job is to complete his picture of the sentence by supplying appropriate words and phrases. The ideal hearer has a complete description of the words in the sentence but needs descriptions of the phrases and the meaning of the whole to complete the picture. A more realistic hearer starts with a picture including imperfectly heard words and some notions about what is being said and needs details filled in in a variety of places. In any case, the process consists in applying the grammar to a functional description to yield a more complete functional description or, if the description does not correspond to a grammatical object, the null functional description.

Functional Descriptions

Intuitively, a description is a set of properties. The objects it describes are those that share just those properties. Generally speaking, to add new properties to a description is to reduce the number of objects in the set described. In fact, there is a duality in the set-theoretic properties of descriptions and those of their extensions, that is, the sets of objects described. Thus, the empty description applies to all objects; the union of two descriptions applies to the intersections of the sets they individually describe; and the intersection of a pair of descriptions applies to the union of the two original sets of objects. Functional descriptions are defined in such a way as to preserve these intuitive properties. So, suppose that $F(s_1)$ ... $F(s_4)$ describe sentences (1) – (4) respectively.

(1) Brutus killed Caesar

(2) Cassius killed Caesar

(3) John hit Caesar

(4) John wrote a book

(5) ... killed Caesar

(6) John ...

(7) John killed Caesar

$F(s_5) = F(s_1) \cap F(s_2)$ is a description of all the sentences that have the predicate *killed Caesar* and $F(s_6) = F(s_3) \cap F(s_4)$ is a description of all sentences of which *John* is the subject. $F(s_7) = F(s_5) \cup F(s_6)$ describes sentence (7).

A simple functional description consists of a possibly empty set of *patterns* and a list of attributes with associated values. I shall come to the form and function of patterns shortly. For the moment, we shall consider the attribute-value pairs.

The attributes in a functional description must be distinct from one another so that if a functional description F contains the attribute a, the phrase "the a of F" uniquely identifies a value. An attribute is a *symbol*, that is, a string of letters. A value is a symbol or another functional description. In the notation I shall use, symbols are to be interpreted as representing attributes when they are immediately followed by an "=" sign or when they are written inside angle brackets. Otherwise, they are values. So, in (8), ALPHA and BETA are attributes and GAMMA is a value.

(8) [ALPHA = BETA = GAMMA]

The list of attribute-value pairs in a functional description is written in square brackets, the members of each pair separated by the equal-sign. No significance attaches to the order in which the attribute-value pairs are written. Thus, for example, (9) might be a description, albeit a very simple one, of the sentence *He saw her*. In what follows, I shall use uppercase letters for true atomic values and lowercase letters as an informal surrogate for complex values whose details are either irrelevant or readily inferrable from the context.

(9)
$$\begin{bmatrix} \text{CAT} & = \text{S} \\ \text{SUBJ} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{MASC} \\ \text{CASE} & = \text{NOM} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{DOBJ} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{FEM} \\ \text{CASE} & = \text{ACC} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{VERB} & = \text{SEE} \\ \text{TENSE} & = \text{PAST} \\ \text{VOICE} & = \text{ACTIVE} \end{bmatrix}$$

(10)
$$\begin{bmatrix} \text{CAT} & = \text{S} \\ \text{PROT} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{MASC} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{GOAL} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{FEM} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{VERB} & = \text{SEE} \\ \text{TENSE} & = \text{PAST} \end{bmatrix}$$

(11)
$$\begin{bmatrix} \text{CAT} & & = \text{S} \\ \text{SUBJ} & = \text{PROT} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{MASC} \\ \text{CASE} & = \text{NOM} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{DOBJ} & = \text{GOAL} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{FEM} \\ \text{CASE} & = \text{ACC} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{VERB} & & = \text{SEE} \\ \text{TENSE} & & = \text{PAST} \\ \text{VOICE} & & = \text{ACTIVE} \end{bmatrix}$$

If the values of SUBJ and DOBJ are reversed in (9), and the value of VOICE changed to PASSIVE, it becomes a description of the sentence *She was seen by him*. However, in both this and the original sentence, he is the protagonist (PROT), or logical subject, and she the goal (GOAL) of the action, or logical direct object. In other words, both sentences are equally well described by (10). In the sense of transformational grammar (10) shows a *deeper* structure than (9). However, in functional grammar, if a given linguistic entity has two different descriptions, a description containing the information in both can be constructed by the process of *unification* which we shall examine in detail shortly. The description (11) results from unifying (9) and (10).

A pair of descriptions is said to be *incompatible* if they have a common attribute with different symbols, or incompatible descriptions, as values. Grammatically ambiguous sentences have two or more incompatible descriptions. Thus, for example, the sentence *He likes writing books* might be described by (12) or (13). Incompatible simple descriptions $F_1 ... F_k$ can be combined into a single *complex* description $\{F_1 ... F_k\}$ which describes the union of the sets of objects that its components describe. The notation allows common parts of components to be factored in the obvious way, so that (14) describes all those objects that are described by *either* (12) or (13).

The use of braces to indicate alternation between incompatible descriptions or sub-descriptions provides a compact way of describing large classes of disparate objects. In fact, as we shall see, given a few extra conventions, it makes it possible to claim that the grammar of a language is nothing more than a complex functional description.

(12)
$$\left[\begin{array}{ll} \text{CAT} & = \text{S} \\ \text{SUBJ} & = \text{he} \\ \text{DOBJ} & = \left[\begin{array}{ll} \text{CAT} & = \text{NP} \\ \text{HEAD} & = \text{books} \\ \text{MOD} & = \left[\begin{array}{ll} \text{CAT} & = \text{PRESP} \\ \text{LEX} & = \text{WRITE} \end{array}\right] \end{array}\right] \\ \text{VERB} & = \text{LIKE} \\ \text{TENSE} & = \text{PRES} \\ \text{VOICE} & = \text{ACTIVE} \end{array}\right]$$

(13)
$$\left[\begin{array}{ll} \text{CAT} & = \text{S} \\ \text{SUBJ} & = \text{he} \\ \text{DOBJ} & = \left[\begin{array}{ll} \text{CAT} & = \text{NP} \\ \text{HEAD} & = \left[\begin{array}{ll} \text{CAT} & = \text{S} \\ \text{VERB} & = \left[\begin{array}{ll} \text{CAT} & = \text{PRESP} \\ \text{LEX} & = \text{WRITE} \end{array}\right] \\ \text{DOBJ} & = \left[\begin{array}{ll} \text{CAT} & = \text{NP} \\ \text{HEAD} & = \text{books} \end{array}\right] \end{array}\right] \end{array}\right] \\ \text{VERB} & = \text{LIKE} \\ \text{TENSE} & = \text{PRES} \\ \text{VOICE} & = \text{ACTIVE} \end{array}\right]$$

$$(14)\ \begin{bmatrix}
\text{CAT} & = \text{S} \\
\text{SUBJ} & = \text{he} \\
\text{DOBJ} & = \begin{bmatrix} \text{CAT} = \text{NP} \\ \left\{ \begin{matrix} \begin{bmatrix} \text{HEAD} & = \text{books} \\ \text{MOD} & = \begin{bmatrix} \text{CAT} & = \text{PRESP} \\ \text{LEX} & = \text{WRITE} \end{bmatrix} \end{bmatrix} \\ \begin{bmatrix} \text{HEAD} = \begin{bmatrix} \text{CAT} & = \text{S} \\ \text{VERB} & = \begin{bmatrix} \text{CAT} & = \text{PRESP} \\ \text{LEX} & = \text{WRITE} \end{bmatrix} \\ \text{DOBJ} & = \begin{bmatrix} \text{CAT} & = \text{NP} \\ \text{HEAD} & = \text{books} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{matrix} \right\} \end{bmatrix} \\
\text{VERB} & = \text{LIKE} \\
\text{TENSE} & = \text{PRES} \\
\text{VOICE} & = \text{ACTIVE}
\end{bmatrix}$$

Unification

A string of atoms enclosed in angle brackets constitutes a *path* and there is at least one that identifies every value in a functional description. The path $\langle a_1\ a_2 ... a_k \rangle$ identifies the value of the attribute a_k in the functional description that is the value of $\langle a_1\ a_2 ... a_{k-1} \rangle$. It can be read as *The* a_k *of the* a_{k-1} *... of the* a_1. Paths are always interpreted as beginning in the largest functional description that encloses them. Attributes are otherwise taken as belonging to the small enclosing functional description. Accordingly,

$$\begin{bmatrix} \text{A} & = \begin{bmatrix} \text{B} & = \langle \text{C} \rangle = \text{X} \end{bmatrix} \end{bmatrix} \equiv \begin{bmatrix} \text{A} & = \begin{bmatrix} \text{B} & = \text{X} \end{bmatrix} \\ \text{C} & = \langle \text{A B} \rangle \end{bmatrix}$$

A pair consisting of a path in a functional description and the value that the path leads to is a *feature* of that functional description. If the value is a symbol, the pair is a *basic feature* of the description. Any functional description can be represented as a list of basic features. For example, (15) can be represented by the list (16).

$$(15)\ \begin{bmatrix}
\text{CAT} & & = \text{S} \\
\text{SUBJ} & = \text{PROT} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{MASC} \\ \text{CASE} & = \text{NOM} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\
\text{DOBJ} & = \text{GOAL} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{FEM} \\ \text{CASE} & = \text{ACC} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\
\text{VERB} & & = \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{WORD} & = \text{SEE} \end{bmatrix} \\
\text{TENSE} & & = \text{PAST} \\
\text{VOICE} & & = \text{ACTIVE} \\
\text{ASPECT} & & = \begin{bmatrix} \text{PERFECT} & = + \\ \text{PROGRESSIVE} & = - \end{bmatrix}
\end{bmatrix}$$

(16)

$$
\begin{array}{rcl}
\langle\text{CAT}\rangle & = & \text{S} \\
\langle\text{SUBJ CAT}\rangle & = & \text{PRON} \\
\langle\text{SUBJ GENDER}\rangle & = & \text{MASC} \\
\langle\text{SUBJ CASE}\rangle & = & \text{NOM} \\
\langle\text{SUBJ NUMBER}\rangle & = & \text{SING} \\
\langle\text{SUBJ PERSON}\rangle & = & 3 \\
\langle\text{PROT CAT}\rangle & = & \text{PRON} \\
\langle\text{PROT GENDER}\rangle & = & \text{MASC} \\
\langle\text{PROT CASE}\rangle & = & \text{NOM} \\
\langle\text{PROT NUMBER}\rangle & = & \text{SING} \\
\langle\text{PROT PERSON}\rangle & = & 3 \\
\langle\text{DOBJ CAT}\rangle & = & \text{PRON} \\
\langle\text{DOBJ GENDER}\rangle & = & \text{FEM} \\
\langle\text{DOBJ CASE}\rangle & = & \text{ACC} \\
\langle\text{DOBJ NUMBER}\rangle & = & \text{SING} \\
\langle\text{DOBJ PERSON}\rangle & = & 3 \\
\langle\text{GOAL CAT}\rangle & = & \text{PRON} \\
\langle\text{GOAL GENDER}\rangle & = & \text{FEM} \\
\langle\text{GOAL CASE}\rangle & = & \text{ACC} \\
\langle\text{GOAL NUMBER}\rangle & = & \text{SING} \\
\langle\text{GOAL PERSON}\rangle & = & 3 \\
\langle\text{VERB CAT}\rangle & = & \text{VERB} \\
\langle\text{VERB WORD}\rangle & = & \text{SEE} \\
\langle\text{TENSE}\rangle & = & \text{PAST} \\
\langle\text{VOICE}\rangle & = & \text{ACTIVE} \\
\langle\text{ASPECT PERFECT}\rangle & = & + \\
\langle\text{ASPECT PROGRESSIVE}\rangle & = & -
\end{array}
$$

It is in the nature of functional descriptions that they blur the usual distinction between features and structures. (15) shows descriptions embedded in other descriptions, thus stressing their structural properties. Rewriting (15) as (16) stresses the componential nature of descriptions.

The possibility of viewing descriptions as unstructured sets of features makes them subject to the standard operations of set theory, thereby bestowing on them that most salient property of descriptions in general discussed in reference to (1) – (7). However, it is also a crucial property of functional descriptions that they are not closed under set-theoretic operations. Specifically, the union of a pair of functional descriptions is not, in general, a well-formed functional description. The reason is as follows: The requirement that a given attribute appear only once in a functional description implies a similar constraint on the set of features corresponding to a description. A path must uniquely identify a value. But if the description F_1 has the basic feature $\langle a \rangle = x$ and the description F_2 has the basic feature $\langle a \rangle = y$ then either $x = y$ or F_1 and F_2 are incompatible and their union is not a well-formed description. So, for example, if F_1 describes a sentence with a singular subject and F_2 describes a sentence with a plural subject, then $S_1 \cup S_2$, where S_1 and S_2 are the corresponding sets of basic features, is not well formed because it would contain both ⟨SUBJ NUMBER⟩ = SINGULAR and ⟨SUBJ NUMBER⟩ = PLURAL.

When two or more simple functional descriptions are compatible, they can be combined into one simple description describing those things that they both describe, by the process of unification: Unification is the same as set union except that it yields the null set when applied to incompatible arguments. The "=" sign is used for unification, so that $\alpha = \beta$ denotes the result of unifying α and β. (17) – (19) show the results of unification in some simple cases.

(17)
$$\begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{RUN} \\ \text{TENSE} & = \text{PRES} \end{bmatrix} = \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{NUM} & = \text{SING} \\ \text{PERS} & = 3 \end{bmatrix} \Rightarrow \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{RUN} \\ \text{TENSE} & = \text{PRES} \\ \text{NUM} & = \text{SING} \\ \text{PERS} & = 3 \end{bmatrix}$$

(18)
$$\begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{RUN} \\ \text{TENSE} & = \text{PRES} \end{bmatrix} = \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{TENSE} & = \text{PAST} \\ \text{PERS} & = 3 \end{bmatrix} \Rightarrow \text{NIL}$$

(19)
$$\begin{bmatrix} \text{PREP} & = \text{MIT} \\ \text{CASE} & = \text{DAT} \end{bmatrix} = \begin{bmatrix} \text{CAT} & = \text{PP} \\ \text{HEAD} & = \begin{bmatrix} \text{CAT} & = \text{NP} \\ \text{CASE} & = \langle\text{CASE}\rangle \end{bmatrix} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{CAT} & = \text{PP} \\ \text{PREP} & = \text{MIT} \\ \text{CASE} & = \text{DAT} \\ \text{HEAD} & = \begin{bmatrix} \text{CAT} & = \text{NP} \\ \text{CASE} & = \langle\text{CASE}\rangle \end{bmatrix} \end{bmatrix}$$

The result of unifying a pair of complex descriptions is, in general, a complex description with one term for each compatible pair of terms in the original descriptions. Thus $\{a_1 \ldots a_n\} = \{b_1 \ldots b_m\}$ becomes a description of the form $\{c_1 \ldots c_k\}$ in which each c_h $(1 \leq h \leq k)$ is the result of unifying a compatible pair $a_i = b_j$ $(1 \leq i \leq m, 1 \leq j \leq n)$. This is exemplified in (20).

(20)
$$\left\{ \begin{matrix} \begin{bmatrix} \text{TENSE} & = \text{PRES} \\ \text{FORM} & = \text{is} \end{bmatrix} \\ \begin{bmatrix} \text{TENSE} & = \text{PAST} \\ \text{FORM} & = \text{was} \end{bmatrix} \end{matrix} \right\} = \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{TENSE} & = \text{PAST} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{TENSE} & = \text{PAST} \\ \text{FORM} & = \text{was} \end{bmatrix}$$

Unification is the fundamental operation underlying the analysis and synthesis of sentences using functional grammar and there will be abundant examples of its use in the sequel.

Patterns and Constituents

We come now to the question of recursion in the grammar and how constituency is represented. I have already remarked that functional grammar deliberately blurs the distinction between structures and sets of features. It is clear from the examples we have considered so far that some parts of a description of a phrase typically belong to the phrase as a whole whereas others belong to its constituents. For example, in (15) the value of SUBJ is the description of a constituent of the sentence whereas the value of ASPECT is not. The purpose of patterns is to identify constituents and to state constraints on the order of their occurrence. (21) is a version of (15) that specifies the order. (SUBJ VERB DOBJ) is a pattern stating that the values of the attributes SUBJ, VERB and DOBJ are descriptions of constituents and that they occur in that order.

(21)
$$\begin{bmatrix} \text{(SUBJ VERB DOBJ)} & & \\ \text{CAT} & & = \text{S} \\ \text{SUBJ} & = \text{PROT} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{MASC} \\ \text{CASE} & = \text{NOM} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{DOBJ} & = \text{GOAL} & = \begin{bmatrix} \text{CAT} & = \text{PRON} \\ \text{GENDER} & = \text{FEM} \\ \text{CASE} & = \text{ACC} \\ \text{NUMBER} & = \text{SING} \\ \text{PERSON} & = 3 \end{bmatrix} \\ \text{VERB} & & = \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{WORD} & = \text{SEE} \end{bmatrix} \\ \text{TENSE} & & = \text{PAST} \\ \text{VOICE} & & = \text{ACTIVE} \\ \text{ASPECT} & & = \begin{bmatrix} \text{PERFECT} & = + \\ \text{PROGRESSIVE} & = - \end{bmatrix} \end{bmatrix}$$

Equivalently, the description could have contained many other sets of patterns, for example, those in (22) – (26).

(22) (SUBJ VERB ...) (... VERB DOBJ)

(23) (SUBJ ... DOBJ) (... VERB ...)

(24) (... SUBJ ... DOBJ) (# VERB ...)

(25) (... SUBJ ... VERB ... DOBJ)

(26) (... SUBJ ... VERB ...) (... DOBJ)

If an attribute or, more generally, a path, appears in one or more patterns, then its value is the description of a constituent. If more than one constituent is named in the same pattern, then they must appear in the phrase or sentence in the order given. If a pair of attributes or paths is separated by dots, other constituents, specified in other patterns, may optionally intervene. Adjacent attributes or paths specify adjacent constituents and an attribute or path that begins (or ends) a pattern names a constituent that occurs first (or last). The symbol # signifies exactly one constituent specified in another pattern. Consider now examples (27) – (29) in which the order of the constituents is not uniquely specified.

(27) (... SUBJ ... VERB DOBJ ...) (... MOD ...)

(28) (... SUBJ ...) (... VERB ...) (... DOBJ ...)

(29) (... NOM ...) (... ACC ...) (... DAT ...) (# VERB ...)

(27) says that SUBJ precedes VERB and VERB precedes DOBJ but allows MOD, presumably an adverbial modifier, to occur before or after SUBJ or at the end of the sentence. (28) allows SUBJ, VERB and DOBJ to occur in any order relative to one another. (29) specifies NOM, ACC, DAT, and VERB as constituents. The only constraints it places on the order is that the verb must be in second position.

Clearly, patterns, like attribute-value pairs, can be incompatible thus preventing the unification of descriptions. This is the case in examples (30) – (32).

(30) (... SUBJ ... VERB ...) (... VERB ... SUBJ ...)

(31) (# SUBJ ...) (SUBJ ...)

(32) (... SUBJ VERB ...) (... SUBJ DOBJ ...)

If the name of a path or an attribute is preceded by an asterisk in a pattern, the corresponding value must be unified with a value specified in another pattern in order to establish compatibility between them. Thus, for example, while the patterns in (33) are incompatible, those in (34) are not. Unifying a pair of descriptions each containing one of the patterns in (33) will result in the unification of SUBJ and PROT.

(33) (SUBJ VERB ...) (PROT VERB ...)

(34) (*SUBJ VERB ...) (PROT VERB ...)

As we have seen, the functional descriptions of sentences and phrases may have other descriptions embedded in them that describe their constituents. However, the outer description is also taken as applying to each of these constituents. Thus, if G is a functional description that fills the role of a grammar which, when unified with a sentence description F, reveals it to have constituents with descriptions $F_1 ... F_n$, then these are also unified with G, and so on recursively. As we shall see, it follows from this that patterns can only be usefully employed in complex descriptions. Consider, for example, the description (35), which is roughly equivalent to the phrase-structure rule (36).[1]

(35)

$$\left\{\begin{array}{l}\left[\begin{array}{l}\text{(SUBJ VERB ...)}\\ \text{CAT} = \text{S}\\ \text{SUBJ} = [\text{CAT} = \text{NP}]\\ \text{PRED} = [\text{CAT} = \text{VERB}]\\ \left\{\begin{array}{l}[\text{SCOMP} = \text{NONE}]\\ \left[\begin{array}{l}\text{(... SCOMP)}\\ \text{SCOMP} = [\text{CAT} = \text{S}]\end{array}\right]\end{array}\right\}\end{array}\right]\\ [\text{CAT} = \text{NP}]\\ [\text{CAT} = \text{VERB}]\end{array}\right\}$$

(36) *S → SUBJ:NP VERB:VERB (SCOMP:S)*

(35) describes *either* sentences *or* verbs *or* noun phrases. Nothing is said about the constituency of the verbs or noun phrases described – they are terminal constituents. The sentences have either two or three constituents depending on the choice made in the embedded alternation. All constituents must match the description (35). Since the first constituent has the feature [CAT = NP], it can only match the second term in the main

[1]This is, in fact, more like a tagmemic rule including, as it does, the relation that each constituent bears to the phrase, as well as its category.

alternation. Likewise, the second constituent can only match the third term. If there is a third constituent, it must match the first term in the alternation, because it has the feature [CAT = S]. It must therefore also have two or three constituents which (35) also describes. It is for this reason that patterns make sense only in complex descriptions. For the same reason, context-free grammars make sense only if some of the symbols are terminal and there is some nonrecursive expansion for every symbol. If (35) consisted only of the first term in the outer alternation, it would have a null extension because the first term, for example, would be required to have the incompatible features [CAT = NP] and [CAT = S]. On other hand, if the inner alternation were replaced by its second term, so that [SCOMP = NONE] were no longer an option, then the description would correspond to the rule (37), whose derivations do not terminate.

(37) *S → SUBJ:NP VERB:VERB SCOMP:S*

(35) is a recursive definition and a trivial example of the way a functional description can be used to characterize an infinite class of sentences and thus serve as the grammar of a language. Generally speaking, grammars will take the form of alternations each clause of which describes a major category; that is, they will have the form exhibited in (38).

(38)
$$\left\{\begin{array}{l}\begin{bmatrix}\text{CAT} & = C_1 \\ & \vdots\end{bmatrix} \\ \begin{bmatrix}\text{CAT} & = C_2 \\ & \vdots\end{bmatrix} \\ \begin{bmatrix}\text{CAT} & = C_3 \\ & \vdots\end{bmatrix} \\ \vdots\end{array}\right\}$$

A Grammar of Simple Sentences

In this section, I examine (51), the sentence part of a simple grammar covering such sentences as (39) – (50).

(39) *Jesus wept*

(40) *Brutus killed Caesar*

(41) *Caesar was killed by Brutus*

(42) *They gave Socrates hemlock*

(43) *They gave hemlock to Socrates*

(44) *?They gave to Socrates hemlock*

(45) *Socrates was given hemlock by them*

(46) *?Socrates was given by them hemlock*

(47) *Hemlock was given to Socrates by them*

(48) *Hemlock was given by them to Socrates*

(49) *Socrates was given hemlock*

(50) *Hemlock was given to Socrates*

Specifically, the sequence of word descriptions corresponding to (39) results from unifying (52) with (51); (40) and (41) from unifying (53) with (51); (42) through (48) from unifying (54) with (51); and (49) and (50) from unifying (55) with (51).

(51)

$$
\begin{bmatrix}
\text{CAT} = \text{S} \\
(\text{SUBJ V ...}) \\
\text{FV} = \begin{bmatrix} \text{INFLEXION} = \langle \text{SUBJ INFLEXION} \rangle \end{bmatrix} \\
\text{VERB} = \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{ANY} \end{bmatrix} \\
\left\{ \begin{array}{l}
\begin{bmatrix} \text{PROT} & = \text{NONE} \\ \text{VERB} & = \begin{bmatrix} \text{VOICE} = \text{PASSIVE} \end{bmatrix} \end{bmatrix} \\
\begin{bmatrix}
\text{PROT} = \begin{bmatrix} \text{CAT} & = \text{NP} \\ \text{LEX} & = \text{ANY} \end{bmatrix} \\
\left\{ \begin{array}{l}
\begin{bmatrix} (\text{PROT V ... }) \\ \text{VERB} = \begin{bmatrix} \text{VOICE} = \text{ACTIVE} \end{bmatrix} \end{bmatrix} \\
\begin{bmatrix} (\text{... V ... BY-OBJ ... }) \\ \text{BY-OBJ} = \begin{bmatrix} \text{CAT} & = \text{PP} \\ \text{PREP} & = \text{by} \\ \text{OBJ} & = \langle \text{PROT} \rangle = \text{ANY} \end{bmatrix} \\ \text{VERB} = \begin{bmatrix} \text{VOICE} = \text{PASSIVE} \end{bmatrix} \end{bmatrix}
\end{array} \right\}
\end{bmatrix}
\end{array} \right\} \\
\left\{ \begin{array}{l}
\begin{bmatrix} \text{GOAL} = \text{NONE} \end{bmatrix} \\
\begin{bmatrix}
(\text{... GOAL ...}) \\
\text{GOAL} = \begin{bmatrix} \text{CAT} & = \text{NP} \\ \text{LEX} & = \text{ANY} \end{bmatrix} \\
\left\{ \begin{array}{l}
\begin{bmatrix} \text{BENEF} = \text{NONE} \end{bmatrix} \\
\begin{bmatrix}
\text{BENEF} = \begin{bmatrix} \text{CAT} & = \text{NP} \\ \text{LEX} & = \text{ANY} \end{bmatrix} \\
\left\{ \begin{array}{l}
(\text{... BENEF ... GOAL ...}) \\
\begin{bmatrix} (\text{... V ... TO-OBJ ... }) \\ \text{TO-OBJ} = \begin{bmatrix} \text{CAT} & = \text{PP} \\ \text{PREP} & = \text{to} \\ \text{OBJ} & = \langle \text{BENEF} \rangle = \text{ANY} \end{bmatrix} \end{bmatrix}
\end{array} \right\}
\end{bmatrix}
\end{array} \right\}
\end{bmatrix}
\end{array} \right\} \\
\left\{ \begin{array}{l}
\begin{bmatrix} \text{V} = \text{FV} = \text{VERB} = \begin{bmatrix} \text{TENSE} & = \langle \text{TENSE} \rangle = \text{ANY} \\ \text{VOICE} & = \text{ACTIVE} \end{bmatrix} \end{bmatrix} \\
\begin{bmatrix}
\text{VERB} = \begin{bmatrix} \text{VOICE} = \text{PASSIVE} \end{bmatrix} \\
\text{V} = \begin{bmatrix}
\text{CAT} & = \text{VG} \\
\text{V1} & = \langle \text{FV} \rangle = \begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{be} \\ \text{TENSE} & = \langle \text{TENSE} \rangle = \text{ANY} \end{bmatrix} \\
\text{V2} & = \langle \text{VERB} \rangle = \begin{bmatrix} \text{TENSE} = \text{PASTP} \end{bmatrix}
\end{bmatrix}
\end{bmatrix}
\end{array} \right\}
\end{bmatrix}
$$

(52)
$$\begin{bmatrix} \text{CAT} & = \text{S} \\ \text{PROT} & = \begin{bmatrix}\text{LEX} = \text{Jesus}\end{bmatrix} \\ \text{GOAL} & = \text{NONE} \\ \text{BENEF} & = \text{NONE} \\ \text{VERB} & = \begin{bmatrix}\text{LEX} = \text{weep}\end{bmatrix} \\ \text{TENSE} & = \text{PRES} \end{bmatrix}$$

(53)
$$\begin{bmatrix} \text{CAT} & = \text{S} \\ \text{PROT} & = \begin{bmatrix}\text{LEX} = \text{Brutus}\end{bmatrix} \\ \text{GOAL} & = \begin{bmatrix}\text{LEX} = \text{Caesar}\end{bmatrix} \\ \text{BENEF} & = \text{NONE} \\ \text{VERB} & = \begin{bmatrix}\text{LEX} = \text{kill}\end{bmatrix} \\ \text{TENSE} & = \text{PRES} \end{bmatrix}$$

(54)
$$\begin{bmatrix} \text{CAT} & = \text{S} \\ \text{PROT} & = \begin{bmatrix}\text{LEX} = \text{They}\end{bmatrix} \\ \text{GOAL} & = \begin{bmatrix}\text{LEX} = \text{hemlock}\end{bmatrix} \\ \text{BENEF} & = \begin{bmatrix}\text{LEX} = \text{Socrates}\end{bmatrix} \\ \text{VERB} & = \begin{bmatrix}\text{LEX} = \text{give}\end{bmatrix} \\ \text{TENSE} & = \text{PRES} \end{bmatrix}$$

(55)
$$\begin{bmatrix} \text{CAT} & = \text{S} \\ \text{PROT} & = \text{NONE} \\ \text{GOAL} & = \begin{bmatrix}\text{LEX} = \text{hemlock}\end{bmatrix} \\ \text{BENEF} & = \begin{bmatrix}\text{LEX} = \text{Socrates}\end{bmatrix} \\ \text{VERB} & = \begin{bmatrix}\text{LEX} = \text{give}\end{bmatrix} \\ \text{TENSE} & = \text{PRES} \end{bmatrix}$$

No claims are made for the theoretical soundness of the analysis represented in (51), which was designed only to elucidate the formalism. In particular, it should not be taken as implying an argument in favor of eliminating *VP*.

(51) contains six alternations, five of which represent choices that the speaker must make in the course of framing a sentence. Indeed, there is a strong family resemblance between grammatical descriptions in this formalism and *systems* that Halliday (1961, 1967-8) uses to represent such sets of choices. (51), for example, corresponds closely to the system (56).

(56)
$$\left\{ \begin{array}{l} \begin{bmatrix} \text{–without protagonist} \\ \text{–with protagonist} \begin{bmatrix}\text{–active} \\ \text{–passive}\end{bmatrix} \end{bmatrix} \\ \begin{bmatrix} \text{–without goal} \\ \text{– with goal} \begin{bmatrix} \text{–without beneficiary} \\ \text{–with beneficiary} \begin{bmatrix}\text{–indirect object} \\ \text{–prepositional object}\end{bmatrix} \end{bmatrix} \end{bmatrix} \end{array} \right\}$$

The sixth alternation is different only in that, as we shall see, the choice to be made here is determined entirely by the choices made at the other five.

The first four terms in (51) state that any object meeting this description will be a sentence whose first two constituents are a subject and a verb, that the values of the paths ⟨FV INFLEXION⟩ and ⟨SUBJ INFLEXION⟩ will be equal and that VERB – to be distinguished from V – will have the feature [CAT = VERB] and a non-null value for the attribute LEX. ANY is not a true *symbol* in the sense defined above. In the first place, any description containing ANY is deemed to be incomplete. I will give an example to illustrate the point of this shortly. Secondly, if a pair of descriptions are unified, one with the feature $\langle\alpha\rangle$ = ANY and the other with the feature $\langle\alpha\rangle = v$, where v is not NONE, the result will have the feature $\langle\alpha\rangle = v$. In other words, ANY is a "wild card" that will match any substantive, non-null, value.

The remainder of (51) consists of three alternations. The first of these says that any sentence meeting the description will either have no protagonist, in which case it will have the feature ⟨VERB VOICE⟩ = PASSIVE, or its protagonist will be a noun phrase with a substantive value for the attribute LEX. The embedded alternation says that a sentence with a protagonist can be either active or passive. In the first case, the protagonist is a constituent which immediately precedes the verb and in the second, there will be a constituent called BY-OBJ somewhere after the verb. This BY-OBJ will be a prepositional phrase with preposition *by* and the protagonist of the sentence as object. If the sentence is active, it is implicit that the values of PROT and SUBJ will be unified because the patters (SUBJ V ...) and (PROT V ...) must be unified.

The second major alternation in (51) states that, if the sentence has a value for the GOAL attribute, then that value describes a constituent which is a noun phrase with a substantive value for the LEX attribute. Furthermore, only if there is a goal can there be a beneficiary. If there is a beneficiary, it must be a substantive noun phrase which can either precede the goal in the sentence or be the object of the preposition *to* following the goal. If the beneficiary precedes the goal, it will follow the verb as indirect object in active sentences and be the subject of passive sentences, for otherwise there would not be a substantive subject. If there is no beneficiary, the goal is the subject in passive sentences.

The last alternation provides the correct value for the V-attribute according as the sentence is active or passive. In an active sentence, V, the surface verb, FV, the finite verb, and VERB, the "deep" verb are all the same and the values are unified and given the tense attribute of the sentence. In a passive sentence, V is a verbal group consisting of two verbs. The first is an appropriately tensed form of *be* and the second is the past participle of the value of VERB. The first of these is the finite verb and the one whose INFLEXION must be unified with that of the subject.

Consider now the sentences that could be generated from the description (57) which makes no mention of the attribute BENEF.

$$(57)\quad \begin{bmatrix} \text{CAT} & = \text{S} \\ \text{PROT} & = \begin{bmatrix}\text{LEX} = \text{They}\end{bmatrix} \\ \text{GOAL} & = \begin{bmatrix}\text{LEX} = \text{hemlock}\end{bmatrix} \\ \text{VERB} & = \begin{bmatrix}\text{LEX} = \text{give}\end{bmatrix} \\ \text{TENSE} & = \text{PRES} \end{bmatrix}$$

They seem to include (60) – (63), in which “???” represents a beneficiary with the feature [LEX = ANY] supplied by the grammar, as well as (58) and (59).

(58) *They gave hemlock*

(59) *Hemlock was given by them*

(60) *They gave ??? hemlock*

(61) *They gave hemlock to ???*

(62) *??? was given hemlock by them*

(63) *Hemlock was given to ??? by them*

More accurately, (57) describes all the sentences that can be obtained from (60) – (63) by replacing “???” with a noun phrase. It is precisely to exclude such cases as these that the special symbol ANY is provided in the formalism. In (51), either an explicit value for BENEF must be provided in the initial description of a sentence, or the description that results from unifying it with the grammar will be deemed incomplete.

While it is indeed the case that (51) correctly describes (39) – (50), it also describes such sentences as (64) – (67).

(64) *Jesus gave*

(65) *Brutus wept Caesar*

(66) *Caesar was given by Brutus*

(67) *Hemlock was wept to Socrates*

I shall describe a simple way of excluding these here and another, which may be preferable, in the following section. The simplest solution is to employ essentially the same device as is used in (51) for subject-verb agreement and include in the grammar something like (68). This requires appropriate values in the lexical entry for each verb. The entries for the verbs in the examples would be somewhat as in (69) – (71).

(68) $$\left[\text{VERB} = \begin{bmatrix} \text{PROT} & = \langle\text{PROT}\rangle \\ \text{GOAL} & = \langle\text{GOAL}\rangle \\ \text{BENEF} & = \langle\text{BENEF}\rangle \end{bmatrix}\right]$$

(69) $$\begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{weep} \\ \text{GOAL} & = \text{NONE} \end{bmatrix}$$

(70) $$\begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{kill} \\ \text{BENEF} & = \text{NONE} \end{bmatrix}$$

(71) $$\begin{bmatrix} \text{CAT} & = \text{VERB} \\ \text{LEX} & = \text{give} \end{bmatrix}$$

This guarantees that *weep*, for example, can only be the verb of a sentence that has the feature [GOAL = NONE] which, according to the grammar, implies that it must also have the feature [BENEF = NONE]. The principal disadvantage of this solution is that it replicates large amounts of the sentence structure within the description of the verb.

Some More Complex Phenomena

In this section, I give a brief sketch of how functional grammar accounts for the phenomena that require unbounded-movement rules of transformational grammar. Specifically, I shall consider (1) topicalization and relativization; (2) subject raising.

Suppose that the grammar describes noun phrases somewhat as in (72) and phrases of category $\overline{S}$ as in (73). The "↑" symbol provides a way of referring to levels in the constituent structure above the one to which the current description is being applied. Suppose that a given noun phrase is the direct object of the comment of the relative of the direct object of the comment of the matrix sentence; that is, it is the value of the path ⟨COMMENT DOBJ REL COMMENT DOBJ⟩ and that the grammar is now being unified with that noun phrase. ⟨↑REL⟩ refers to the higher-level constituent – presumably a noun phrase – in whose REL it is embedded. In other words, it refers to the value of ⟨COMMENT DOBJ⟩ in the matrix sentence. ⟨↑REL HEAD⟩ refers to the HEAD of that noun phrase. DOBJ refers to the lower sentence, in which the current noun phrase fills the role of direct object, that is, to the value of ⟨COMMENT DOBJ REL COMMENT⟩. In general, if $\langle\alpha_1 ... \alpha_i \alpha_{i+1} ... \alpha_n\rangle$ is the path that identifies the current constituent, and α_{i+1} does not occur in $\langle\alpha_{i+2} ... \alpha_n\rangle$, then $\uparrow \alpha_{i+1}$ refers to the value of $\langle\alpha_1 ... \alpha_i\rangle$.

(72)
$$\begin{bmatrix} \text{CAT} = \text{NP} \\ \left\{ \begin{array}{l} \begin{bmatrix} \text{(TOPIC COMMENT)} \\ \text{TOPIC} = \begin{bmatrix}\text{CAT} = \text{NP}\\ \text{GAP} = \text{ANY}\end{bmatrix} \\ \text{COMMENT} = \begin{bmatrix}\text{CAT} = \overline{S}\end{bmatrix} \end{bmatrix} \\ \begin{bmatrix} \text{(ART HEAD ...)} \\ \text{ART} = \begin{bmatrix}\text{CAT} = \text{DEF}\end{bmatrix} \\ \text{HEAD} = \begin{bmatrix}\text{CAT} = \text{NOUN}\end{bmatrix} \\ \left\{\begin{array}{l} \begin{bmatrix}\text{REL} = \text{NONE}\end{bmatrix} \\ \begin{bmatrix}\text{(... REL)}\\ \text{REL} = \begin{bmatrix}\text{CAT} = \text{S}\end{bmatrix}\end{bmatrix}\end{array}\right\} \end{bmatrix} \\ \langle\rangle = \langle\uparrow \text{COMMENT TOPIC}\rangle = \begin{bmatrix}\text{GAP} = ?\end{bmatrix} \end{array} \right\} \end{bmatrix}$$

(73)
$$\begin{bmatrix} \text{CAT} = \overline{S} \\ \text{(... COMMENT)} \\ \text{COMMENT} = \begin{bmatrix}\text{CAT} = \text{S}\end{bmatrix} \\ \left\{\begin{array}{l} \begin{bmatrix}\text{TOPIC} = \text{NONE}\end{bmatrix} \\ \text{TOPIC} = \langle\uparrow \text{COMMENT TOPIC}\rangle = \text{ANY} \\ \text{(TOPIC ...)} \end{array}\right\} \end{bmatrix}$$

(74)
$$\left[\begin{array}{l} \text{CAT} = \overline{S} \\ \text{TOPIC} = \left[\begin{array}{l} \text{CAT} = \text{NP} \\ \text{GAP} = \text{x} \\ \text{... The soup} \end{array}\right] \\ \text{COMMENT} = \left[\begin{array}{l} \text{CAT} = \text{S} \\ \text{PROT} = \text{The boys} \\ \text{VERB} = \text{like} \\ \text{GOAL} = \langle\text{TOPIC}\rangle \end{array}\right] \end{array}\right]$$

(75)
$$\left[\begin{array}{l} \text{CAT} = \text{NP} \\ \text{TOPIC} = \langle\text{COMMENT TOPIC}\rangle \\ \text{COMMENT} = \left[\begin{array}{l} \text{CAT} = \overline{S} \\ \text{TOPIC} = \left[\begin{array}{l} \text{CAT} = \text{NP} \\ \text{GAP} = \text{x} \\ \text{... The soup} \end{array}\right] \\ \text{COMMENT} = \left[\begin{array}{l} \text{CAT} = \text{S} \\ \text{PROT} = \text{The boys} \\ \text{VERB} = \text{like} \\ \text{GOAL} = \langle\text{TOPIC}\rangle \end{array}\right] \end{array}\right] \end{array}\right]$$

For present purposes, I take it that main and relative clauses, among others, belong to the category $\overline{S}$ whose constituents are an optional TOPIC and an obligatory COMMENT. A noun phrase is either a determiner followed by a noun or, to provide for relative clauses, a noun phrase as the value of TOPIC followed by an $\overline{S}$ as the value of COMMENT. Alternatively, a noun phrase can simply be unified with the TOPIC of the lowest constituent in whose COMMENT it is embedded and with the feature [GAP = ?]. The sign "?", occurring as the value of an attribute, is a meta-symbol each instance of which represents a different symbol not otherwise occurring in the description. By requiring that the value of GAP be unique in this way, we ensure that a given TOPIC be unified with at most one *NP* in the way just described; that is, that there should be only one trace, or *gap* corresponding to it. The grammar would therefore describe the sentence *The soup the boys liked* somewhat as in (74). The same sequence of words is described in (75) as a noun phrase. Notice that the COMMENT of (75) is just (74).

Suppose, now, that the lexical entry for a relative pronoun is (76). According to (72), it is a noun phrase with neither TOPIC nor HEAD constituents; its description must therefore be unified with that of a TOPIC higher in the constituent structure. Since relative pronouns themselves function as TOPICS of $\overline{S}$'s. there must be some noun phrase in the corresponding COMMENT with which they are also unified. The description of *the soup that the boys liked* will therefore also be (75).

This analysis covers – it is tempting to say *predicts* – Pied Piping. Thus (77) describes the sentence *In the house the boys live* and (78) describes the noun phrase *The house in which the boys live.* The relative pronoun in the prepositional phrase is unified with the TOPIC of the outer noun phrase *the house* to give, as TOPIC of the $\overline{S}$, a description for *in the house.* This is then unified with the value of the LOC attribute in the *S* on the understanding that prepositional phrases, like noun phrases, may be unified with higher TOPICS just in case they have no local constituents.

(76) $$\begin{bmatrix} \text{CAT} = \text{NP} \\ \text{LEX} = \text{Rel} \\ \text{TOPIC} = \text{HEAD} = \text{ANY} \end{bmatrix}$$

(77) $$\begin{bmatrix} \text{CAT} = \overline{S} \\ \text{TOPIC} = \begin{bmatrix} \text{CAT} = \text{PP} \\ \text{GAP} = \text{x} \\ \text{PREP} = \text{in} \\ \text{OBJ} = \text{the house} \end{bmatrix} \\ \text{COMMENT} = \begin{bmatrix} \text{CAT} = \text{S} \\ \text{PROT} = \text{The boys} \\ \text{VERB} = \text{live} \\ \text{LOC} = \langle \text{TOPIC} \rangle \end{bmatrix} \end{bmatrix}$$

(78) $$\begin{bmatrix} \text{CAT} = \text{NP} \\ \text{TOPIC} = \langle \text{COMMENT TOPIC} \rangle \\ \text{COMMENT} = \begin{bmatrix} \text{CAT} = \overline{S} \\ \text{TOPIC} = \begin{bmatrix} \text{CAT} = \text{PP} \\ \text{GAP} = \text{x} \\ \text{PREP} = \text{in} \\ \text{OBJ} = \text{the house} \end{bmatrix} \\ \text{COMMENT} = \begin{bmatrix} \text{CAT} = \text{S} \\ \text{PROT} = \text{The boys} \\ \text{VERB} = \text{live} \\ \text{LOC} = \langle \text{TOPIC} \rangle \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

The "↑" device also suggests a solution to a large class of problems for which *Raising* rules are invoked in transformational grammar. If the grammar in (51) were expanded to provide for sentential complements as values of the attribute SCOMP, it is easy to see how it would interact appropriately with lexical entries such as (79) and (80).

(79) $$\begin{bmatrix} \text{CAT} = \text{VERB} \\ \text{LEX} = \text{expect} \\ \uparrow\text{VERB} = \begin{bmatrix} \text{BENEF} = \text{NONE} \end{bmatrix} \\ \left\{ \begin{array}{l} \begin{bmatrix} \langle \uparrow\text{VERB GOAL} \rangle = \text{NONE} \\ \langle \uparrow\text{VERB SCOMP SUBJ} \rangle = \langle \uparrow\text{VERB PROT} \rangle = \text{ANY} \end{bmatrix} \\ \begin{bmatrix} \langle \uparrow\text{VERB SCOMP SUBJ} \rangle = \langle \uparrow\text{VERB GOAL} \rangle = \text{ANY} \end{bmatrix} \end{array} \right\} \end{bmatrix}$$

(80) $$\begin{bmatrix} \text{CAT} = \text{VERB} \\ \text{LEX} = \text{persuade} \\ \uparrow\text{VERB} = \begin{bmatrix} \text{BENEF} = \text{NONE} \end{bmatrix} \\ \langle \uparrow\text{VERB SCOMP SUBJ} \rangle = \langle \uparrow\text{VERB GOAL} \rangle = \text{ANY} \end{bmatrix}$$

(79) requires that the phrase in which *expect* functions as VERB have the feature [BENEF = NONE] and that the SUBJ of the SCOMP of that phrase be unified with the value of PROT if the value of GOAL is NONE; otherwise with the value of GOAL. In other words, the subject of the complement will be the description of *John* in the description of *John expected to go*, and *Mary* in *John expected Mary to go*. (80), on the other hand, requires the phrase in which *persuade* functions as VERB to have a substantive value for the GOAL attribute, which is unified with the subject of the complement.

The lexical entries of *weep* and *kill* can be restated as (81) and (82) on the analogy of (79) and (80), thus avoiding the disadvantage of my previous proposal, namely that much of the sentential structure is restated as part of the description of the verb.

(81) $$\begin{bmatrix} \text{CAT} = \text{VERB} \\ \text{LEX} = \text{weep} \\ \uparrow\text{VERB} = \begin{bmatrix} \text{GOAL} = \text{NONE} \end{bmatrix} \end{bmatrix}$$

(82) $$\begin{bmatrix} \text{CAT} = \text{VERB} \\ \text{LEX} = \text{kill} \\ \uparrow\text{VERB} = \begin{bmatrix} \text{BENEF} = \text{NONE} \end{bmatrix} \end{bmatrix}$$

So, for example, (81) causes any constituent in which *weep* is the VERB to be unified with [GOAL = NONE].

Conclusion

It is the business of syntax to state constraints on the relations that words and phrases contract by virtue of their position in sentences. One of the principal attractions of functional grammar is that it states these constraints simply and explicitly. In other words, the constraints are not manifested only in objects that can be produced by following a set of rules that constitute the grammar. A good *prima facie* case can therefore be made for functional grammar as the form in which a child stores the grammatical knowledge he acquires. The null grammar describes all possible languages and to reduce the range of languages described is, generally speaking, to add new features to the current set. Delicate interactions such as those that occur between the members of ordered sets of rules are largely absent.

One of the advantages that I claimed for functional grammar at the outset was that it places the logical relations that words and phrases contract on an equal footing with relations that expound communicative functions. It is noteworthy that those linguists that have given equal weight to these two aspects of language have not, for the most part, constructed formal theories. This is accounted for partly by current fashion. But it is also due to a fundamental conflict between the demands of formalization and the clarity that comes from keeping statements about grammatical relations separate when they are exponents of separate kinds of meaning relations. This is the kind of clarity that presumably motivates Halliday's systems in which grammatical phenomena are collected together more because of similarities in what they expound than because of the way they interact in a carefully articulated generative scheme.

A frontal attack on the design of a formalism to meet both sets of requirements all too easily compounds previous errors and results in a device of wondrous complexity (see, for example, Hudson 1971). I hope that the formalism proposed here may be simple enough in its basic design to avoid this danger. It treats of one kind of entity only, namely functional descriptions. Grammatical constructions, lexical entries, and the grammar itself are known to the formalism only through this one type of representation. Unification is the only operation that is used, and it is also simple and intuitive, for it is nothing more than a slight embellishment of the notion of set union.

Publications referenced

Bresnan 1978; Dik 1978; Halliday 1961; Halliday 1967-68; Hudson 1971.