

SEMANTICS IN THREE FORMAL MODELS OF LANGUAGE

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INTRODUCTION

1. Within the framework of transformational generative (TG) grammar two approaches to semantics are found: 'interpretative semantics' and 'generative semantics'. This paper examines the adequacy of both models in their treatment of various semantic facts of language and compares them in this respect with another model that has been proposed recently.

On the minimal requirements which must be satisfied by any formal model treating the semantics of language there can be assumed to be general agreement. It must be able to account for the various relationships between utterances which are determined by their 'sense' (or designation), whether these utterances be single words, phrases, sentences or sequences of sentences. Thus it must be able to deal with such properties of lexical items as synonymy, antonymy, homonymy and hyponymy and those properties of phrases and sentences such as paraphrase, contradiction, ambiguity and tautology. In order to do so it must provide utterances with semantic representations and it must supply a formal mechanism which can relate such representations to the appropriate surface forms expressing them. Being concerned with 'langue' rather than 'parole', with 'competence' rather than 'performance', it need not account for the occurrence of utterances which differ in sense but refer to the same objects;¹⁾ in other words, it must treat 'sense' rather than

¹⁾ The fact that *the building with the red roof* and *the house with the green door* may refer to the same edifice does not make the expressions synonymous since they can equally refer to two different edifices. Which is the case depends entirely on the particular context in which they are uttered, i.e. referential equivalence is exclusively a matter of 'performance' (cf. section 14 below).

'reference'. On the general distinction between these two notions we assume it will be agreed at least that: (i) 'sense' is not to be equated with 'concept', 'idea', etc. (i.e. the sense of *table* is not the concept of 'table'); (ii) since a language model is concerned essentially with linguistic properties, the exact (philosophical) status of referents, which are extra-linguistic, is largely immaterial (i.e. a referent may be (conceived as) a physical object, a fictitious object, a mental image, an individual's percept (of an object), an individual's concept of an object (or set of objects), a 'pure' concept or idea, etc.); (iii) while every lexical item has at least one sense, some have no referent (however this may be defined), e.g. those prepositions whose sense lies in their function of relating the senses of other lexical items in phrases and sentences; and (iv) the correct use of a lexical item in referring to something and the understanding of that use can be made only with knowledge of its sense, i.e. 'sense' is logically prior to 'reference'.

However, while a language model must be concerned primarily with 'sense', there are some instances when referential information must be incorporated in semantic representations, e.g. when referential identity or anaphoric reference is involved, and an adequate model must be able to deal with such cases in a straightforward manner. Regarding the representation of sense in general, most linguists would agree that only 'cognitive meaning' should be included and that 'connotations', e.g. emotive or affective meaning, should be considered part of 'performance'. Furthermore, they would agree with all three models that semantic representations should be given in terms of primary semantic elements, since this is probably the most economic formal means for dealing with the various sense relationships between utterances while at the same time supplying some link with the non-linguistic properties of referents.

After brief outlines of the two TG models and a rather longer one of my own proposal (Hutchins 1971), the discussion will concentrate on the treatment of syntactically compound utterances (phrases, sentences and sequences of sentences): their semantic representation, certain aspects of syntax, questions of paraphrase, ambiguity, anomaly, tautology and contradiction, and some aspects of reference, performance and style.

2. 'Interpretative semantics' was introduced into TG literature by

the now classic paper of Katz and Fodor (1963). It was elaborated by Chomsky (1965) and Katz and Postal (1964) – hence the common abbreviation CKP, which I shall also use – and subsequently by Katz (1967), in reply to Weinreich's criticisms (1966), and by Katz (1970), in a critique of 'generative semantics'.

The CKP model consists of three components: syntactic, semantic and phonological; of which one, the syntactic component, is divided into two subcomponents: a base component which generates the underlying phrase-markers interpreted by the semantic component, and a transformational component which produces from underlying phrase-markers the derived phrase-markers interpreted by the phonological component. Only the base is 'creative' since the semantic and the phonological components are purely 'interpretative' and the transformational component comprises only obligatory rules with no effect on the meaning of the structures to which they are applied. 'The semantic component . . . consists of a *dictionary* in which the senses of lexical items are represented and a set of *projection rules* that provide the combinatorial machinery for constructing the representations of the meanings of syntactically compound constituents from the representation of the meanings of their parts' (Katz 1967: 127). Each sense or 'reading' of a lexical item is represented as a set of 'semantic markers' (primary semantic elements present in more than one reading) and a 'distinguisher' (that part of the sense not represented by markers). Additionally a reading may have 'selection restrictions' (defined in terms of syntactic categories or semantic markers) which may block the amalgamation of readings by a projection rule if constituent readings are incompatible in sense. The formal link between the semantic representation (reading) of a sentence and its surface form is thus the transformational connection provided by the syntactic component between the semantic and the phonological components (Katz 1970: 228).

3. 'Generative semantics' (GS) has been proposed by a number of linguists, notably McCawley (1968b, 1970) and Lakoff (1970), as an alternative treatment of semantics within the TG framework. The base component of GS is no longer conceived as a mechanism to generate the syntactic (base) phrase-markers underlying sentences but as one for generating the semantic representations of sentences. The link between this semantic base and the surface form of sen-

tences is provided by 'cycles' of transformations, i.e. syntactic transformational rules, some of which are optional and others obligatory. In eliminating the deep syntax of CKP, the GS-model changes the function of the semantic component from that of 'interpretation' to one of 'generation' and at the same time modifies the role of selection restrictions so that now they can serve to 'block' the formation of anomalous base structures. The function of the dictionary is now inverted: instead of providing lexical items with various readings to be interpreted by projection rules it transforms combinations of primary semantic elements into appropriate lexical items. The basic claim of its proponents is that GS introduces considerable simplifications into TG by eliminating the base subcomponent and deep syntax and by permitting syntactic transformational rules which are far more generalised and universal in scope. Our interest, however, will concentrate on the improvements claimed for the GS treatment of semantics.

4. The approach of the SL-model (as I shall call the one described in Hutchins (1971), after its most distinctive feature 'semolexic transformation') is closer to the GS concept than that of CKP insofar as base structures are semantic representations of utterances and links with surface forms are made by series of transformations. However, the form of semantic representations and the kind of transformational rules employed differ considerably from those found in GS.

4.1. A semantic representation is conceived as an organisation of 'sememes' in the form of a graph; sememes being the senses of lexemes (lexical items) and of grammatical relations, defined in terms of sets of 'semons' (primary semantic elements). Such graphs, 'sememic formulae', may represent the sense of utterances of any length from simple sentences to complex sequences of sentences. The formation (or 'creation') of a sememic formula by an individual speaker, i.e. his semantic 'performance', may be envisaged in roughly the following terms. From the percepts, concepts, etc. of the 'cognitive experience' he wishes to communicate a speaker selects those characteristics which are sufficient to specify his intended reference and which have counterparts in the semons of his language. Simultaneously, these semons are organised as a semon network and those sememes are selected which can contain the semons and their

specified interrelationships²⁾ in an appropriate sememic formula. One semon network may provide the basis for more than one sememic formula, i.e. some formulae are synonymous.

From sememic formulae are generated (in the mathematical, non-‘performative’ sense of the term) the surface forms of utterances. The transformation of sememic formulae into the lexemic strings underlying these surface forms is achieved by the two-stage process of semolexic transformation. The first stage converts the graph form of a sememic formula into a linear sequence of sememes. One node of the graph is selected as ‘theme’ and another as ‘pivot’; a path is then traced through the whole graph which starts at the theme node and passes through all the links and nodes connected to it before proceeding to the pivot node and all the remaining links and nodes. In the second stage the symbols of the linearised sememic formula are treated as a sequence of rule-names operating on an initial symbol ‘S’. The output of these rules (the semolexic rules) is a lexemic string, a sequence of lexemes (lexical items) with associated syntactic categories.

Considered from the point of view of ‘performance’ each step in semolexic transformation offers individual speakers a wide range of alternatives. The selection of theme node may be determined by a speaker’s wish to connect the present utterance with those preceding; the theme being, in Halliday’s words (1970: 356–7), ‘the point of departure – the takeoff point of the clause’. A speaker’s choice of one path in linearisation rather than another and of one semolexic rule rather than another could be determined by a number of factors: his knowledge of vocabulary, his stylistic inclinations, what part of his communication he wants to emphasise and what part is ‘new’ as opposed to that which is ‘given’ (Halliday 1970: 354–6).

These aspects of performance are, however, ignored when we want to account for all the possible realisations of a given sememic

²⁾ The relationships between semons in a network are probably analogous to those between sememes in sememic formulae, i.e. a sememe is an ordered set of semons (much in the way Weinreich (1966: 418ff.) described for ‘readings’ of lexical items in a CKP-type model). It should be noted that relationships between semons need not be counterparts of any (actual, perceived, or conceived) relationships between characteristics in referents. In part this explains why some sememes are realised as lexical items with no referents (section 1 above).

different from 'A' or a sequence of complex symbols which may include 'A'. Semolexicemic rules are, in a sense, context-sensitive rewrite rules, the lefthand symbol (the sememe in the linearisation) providing the context in which the righthand operation may take place.³⁾ There is also additional 'context-sensitivity' provided by the sequence of sememes in the linearisation itself. A semolexicemic rule can be applied only if it contains the sememe occurring in a linearisation immediately after the sememe which appeared in the preceding semolexicemic rule.

With the following rules ⁴⁾ eight different sentences, all having the same sense, can be realised from the linearisations (2)–(5) of the sememic formula (1).

- (6)
- (i) decl: $S \rightarrow NP$
 - (ii) [: $NP \rightarrow NP(N$
 - (iii)] : $NP(\dots \rightarrow NP(\dots)$
 - (iv) (x) : $C \rightarrow C(x)$
 - (v) b(x) : $C(x) \rightarrow C(x)$
 - (vi) b(x) : $C(y) \rightarrow C(y) + C_x(\Delta)$
 - (vii) agt : $NP(\dots) \rightarrow NP(\dots) + V$
 - (viii) gl : $V(x) \rightarrow V(x) + NP$
 - (ix) gl : $V(\Delta) \rightarrow V(\Delta) + NP$
 - (x) lg : $NP(\dots) \rightarrow NP(\dots) + V(\text{be}) + V_{pp}$
 - (xi) tga : $V_{pp}(x) \rightarrow V_{pp}(x) + Pr(\text{by}) + NP$
 - (xii) tga : $V_{pp}(\Delta) \rightarrow V_{pp}(\Delta) + Pr(\text{by}) + NP$
 - (xiii) sp : $V(x) \rightarrow Z + V(x)$
 - (xiv) sp : $V(\Delta) \rightarrow V(\Delta) + Z$
 - (xv) sp : $V(\Delta) \rightarrow V(\Delta) + W$

³⁾ It is evident that semolexicemic rules are not context-sensitive rewrite rules as these are usually defined in TG literature, viz.

- (i) $xAy \rightarrow xBy$

The form of semolexicemic rules, in an analogous reformulation, would be

- (ii) $xA \rightarrow B$

Whereas in (i) 'x' and 'y' may be null, they remain unchanged by the operation of the rule, and they belong to the same vocabulary as 'A' and 'B' (i.e. that of syntactic categories), in (ii) 'x' must be nonnull, it never appears on the righthand side of the rule (i.e. as part of its product), and it belongs to a different vocabulary (sememic) from that of 'A' and 'B' (lexemic/syntactic).

⁴⁾ Clearly these rules can be only a small subset of the rules needed in a full grammar; and, in addition, they are necessarily somewhat simplified.

- (xvi) sp: $V_{pp}(x) \rightarrow Z + V_{pp}(x)$
 (xvii) sp: $V_{pp}(x) \rightarrow V_{pp}(x) + Z$
 (xviii) sp: $V_{pp}(x) \rightarrow V_{pp}(x) + W$
 (xix) sp: $V_{pp}(\Delta) \rightarrow V_{pp}(\Delta) + Z$
 (xx) sp: $V_{pp}(\Delta) \rightarrow V_{pp}(\Delta) + W$
 (xxi) ef: $Z(\text{mod}) \rightarrow \text{Adv}$
 (xxii) ef: $W(\text{mod}) \rightarrow \text{Pr}(\text{with}) + N$

In these rules 'C' indicates any syntactic category; '(x)' any node sememe; 'C_x' the category previously assigned to node '(x)'; '{...}' any sequence of symbols enclosed in parentheses; and 'Δ' the dummy sememe.

4.4. With the introduction of the initial symbol 'S' the realisation of linearisation (2) proceeds as follows (the numbers of the rule applied appearing on the right):

- (7) decl: $S \rightarrow NP$ (6i)
 [: $NP \rightarrow NP(N)$ (6ii)
 (John): $N \rightarrow N(\text{John})$ (6iv)
]: $NP(N(\text{John}) \rightarrow NP(N(\text{John}))$ (6iii)
 agt: $NP(\dots) \rightarrow NP(\dots) + V$ (6vii)
 (move): $V \rightarrow V(\text{move})$ (6iv)
 gl: $V(\text{move}) \rightarrow V(\text{move}) + NP$ (6viii)
 [: $NP \rightarrow NP(N)$ (6ii)
 (stone): $N \rightarrow N(\text{stone})$ (6iv)
]: $NP(N(\text{stone}) \rightarrow NP(N(\text{stone}))$ (6iii)
 b(move): $N(\text{stone}) \rightarrow N(\text{stone}) + V(\Delta)$ (6vi)⁵
 sp: $V(\Delta) \rightarrow V(\Delta) + Z$ (6xiv)
 (mod): $Z \rightarrow Z(\text{mod})$ (6iv)
 ef: $Z(\text{mod}) \rightarrow \text{Adv}$ (6xxi)
 (ease): $\text{Adv} \rightarrow \text{Adv}(\text{ease})$ (6iv)

The resultant lexemic string

- (8) $NP(N(\text{John})) + V(\text{move}) + NP(N(\text{stone})) + V(\Delta) + \text{Adv}(\text{ease})$

⁵ The effect of this 'branching rule' is to reintroduce the category necessary for the correct realisation of subsequent sememes without producing any unwanted lexemes. The category previously assigned to '(move)' was 'V' (in line 6) and this is therefore placed at the end of the lexemic string and followed by the dummy symbol.

contains information on syntactic structure and the information necessary for correct graphemic or phonemic realisation. E.g. the 'lexicon' would transform 'Adv(ease)' into the graphemic form *easily*, the dummy 'V(Δ)' would be erased, and so on. Thus, the sentence realised is:

(9) John moved the stone easily ⁶⁾

From the same linearisation, but using rules (6xv) and (6xxii) instead of (6xiv) and (6xxi), may be formed a sentence with a prepositional phrase in place of the adverbial:

(10) John moved the stone with ease

Linearisation (3) has one realisation, involving the use of rules (6xiii) and (6v):

(11) John easily moved the stone

The 'passive' sentences realised from linearisation (4) are

(12) The stone was moved by John easily

(13) The stone was moved by John with ease

both using rules (6x) and (6xi); and those from linearisation (5) are

(14) The stone was easily moved by John

(15) The stone was moved easily by John

(16) The stone was moved with ease by John

involving the use of (6xvi), (6xvii) and (6xxviii) respectively.

4.5. In these examples the occurrence of the definite article has not been explained. It can be argued that its use indicates anaphoric reference, i.e. that the object being referred to has been mentioned earlier in the discourse (or text).⁷⁾ If this is the case then the node '(stone)' in (1) should properly be replaced by '(pro)' (a substitute node) and an anaphoric link, 'ana', should be made to a node '(stone)' thus:

(17) (pro) ^{ana} --- (stone)

Since the pronoun *it* may serve the same anaphoric function as *the*

⁶⁾ For the derivation of the various tenses of verbs see Hutchins 1971.

⁷⁾ Obviously the definite article has many other uses than the indication of anaphora, e.g. it frequently has cataphoric and deictic functions.

in this instance it can be derived from the same sememic structure. Thus, if '(stone)' in linearisations (2)–(5) is replaced in each case by the structure (17) above, the following rules

- (18) (i) $\text{ana} : \text{N}(\text{pro}) \rightarrow \text{Det}(\text{the}) + \text{N}$
 (ii) $\text{ana} : \text{N}(\text{pro}) \rightarrow \text{Pron}$

would permit the derivation of the realisations (9)–(16), in which *the* is interpreted as anaphoric, and also of the following realisations with the pronoun *it*.

- (19) John moved it easily (cf. (9) above)
 John moved it with ease (cf. (10) above)
 It was moved by John with ease (cf. (13) above)
 It was easily moved by John (cf. (14) above) etc.

Similarly '(John)' in (1) could be replaced by

- (20) $(\text{pro}) \overset{\text{ana}}{\text{---}} \text{---} \text{---} (\text{John})$

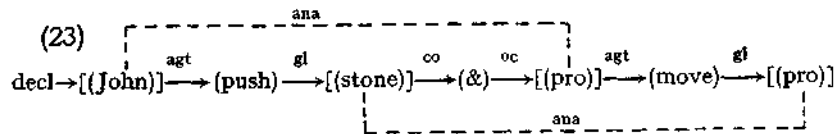
to produce *He moved it easily*, etc. One can well imagine this sentence occurring after another such as *John pushed a stone*, e.g. in the 'text':

- (21) John pushed a stone. He moved it easily

Instead of juxtaposition, however, we might find the sentences coordinated:

- (22) John pushed a stone and he moved it easily

In this case the anaphoric links from the two '(pro)' sememes would connect with the nodes '(John)' and '(stone)' occurring earlier in the same linearisation:



There are strong arguments for the view that coordination of sentences is an optional procedure taking place after linearisation, i.e. after the selection of theme and pivot nodes (Hutchins 1971: 76–82, and also Dik 1968: 31 ff.) On the other hand the coordination of individual elements must be represented in sememic formulae; it cannot be considered an optional transformation on two or more separate structures (Dik 1968: 76–92). Thus the sentence

(24) John and Bill moved the stone easily

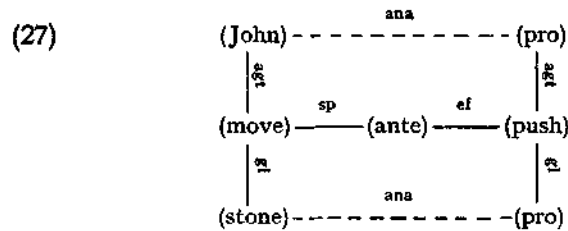
is derived not from two sememic formulae, one being (1) and the other a similar one with '(Bill)' instead of '(John)', but from a single sememic formula which is like (1) except that a node '&' replaces '(John)' and coordinating links are made as follows:

(25) (John) ^{oo}— (&) ^{oc}— (Bill)

While the coordination of sentences may be optional this is not the case with subordination. Therefore, although the linearisation of a subordinate clause as in

(26) John moved the stone after he pushed it

would be rather similar to (23), it would be derived from one sememic formula (27) in which the anaphoric links are already incorporated in the base semantic representation.

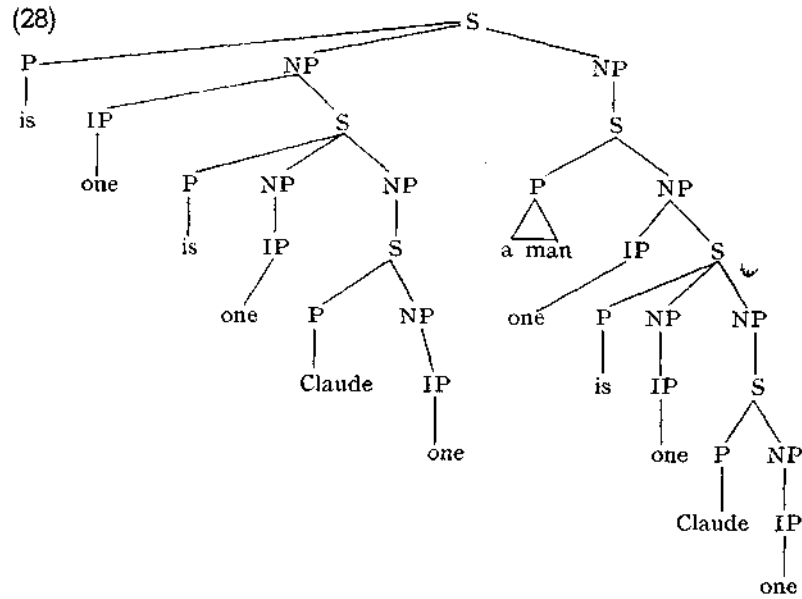


Thus we see that SL can deal with referential identity both between sentences, (21) and (22), and within sentences, (26).

SEMANTIC REPRESENTATION

5. The base component of the GS-model provides semantic representations of sentences either as formulae of predicate logic or as abstract deep structures generated by rewrite rules. The two are considered to be equivalent. McCawley (1970) argues that rules in the transformational cycle are greatly simplified if the base on which they operate places 'predicates' before 'arguments', e.g. the verb before its subject and its object. The surface form of sentences with predicate-second order (subject-verb) would then be the result of a post-cyclic transformation.

The deep structures in GS are remarkably complex. An example from Langendoen (1969: 101), who also adopts predicate-first order, illustrates:



(As Langendoen's footnote makes clear, *one* acts here as the kind of variable found in logical formulae). To derive the surface structure underlying

(29) Claude is a man

cycles of transformations are applied to (28), such as 'subjectivization', 'infinitive-clause separation', 'relative pronoun formation', etc.

5.1. Despite Langendoen's claim (1969: 101) that 'only something so abstract can possibly serve as a representation of how a sentence such as [29] is understood intuitively by fluent speakers of English' it is odd that in a model asserting the equivalence of deep structure and logical formulae the primary 'logical' relationship between *Claude* and *a man*, namely 'class-membership', seems to be completely lost. In the SL-model the sememic formula underlying (29) is quite simple, viz.

(30) (Claude) \xrightarrow{fe} (cop, mem) \xrightarrow{ps} (man)

where the node '(cop, mem)' represents the 'class-membership' relationship explicitly. (The other relationships expressed by the copula are represented equally simply in SL (Hutchins 1971: 131-5)).

From another point of view one may doubt whether the apparatus of symbolic logic is sufficiently flexible to represent the senses of all natural language utterances. While assuming that 'improved grammars result from the identification of deep structure and logical form', Harman (1970: 285) is unable to provide either a GS deep structure or a logical form for

(31) A boy who was fooling them kissed many girls who loved him

'Since *many* here must be associated with a narrower scope than that associated with the *a* of *a boy* one is tempted to try:

[32] (A boy x such that x was fooling y) ((many girls y such that y loved x) (x kissed y))'

But here 'the first occurrence of y has not been bound by the relevant quantifier'. After suggesting some other possible solutions Harman concludes that 'it is not very clear what the logical form of [31] could be. It seems at least roughly equivalent to

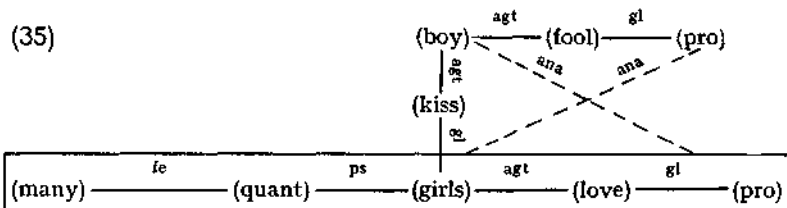
[33] A boy who was fooling many girls who loved him kissed and was fooling many girls who loved him

That suggests a deep structure roughly like this:

[34] (A boy x : (many girls y : y loved x) (x was fooling y)) ((many girls z : z loved x) (x was fooling z and x kissed z))

But it is not at all obvious what transformations would be used to get [31] from [34]' (Harman 1970: 292-3).

Leaving aside the question of whether Harman's analysis of (31) is correct, this extract shows very clearly the inherent difficulties of using bound variables with quantifiers, whether in logical formulae or in GS deep structure. The SL-model avoids much of this by using explicit anaphoric links to indicate referential identity and by not insisting on the linearity of semantic representations (note that tree structures, such as (28), are equivalent to labelled bracketed strings). Thus, the sememic formula for (31) could be:

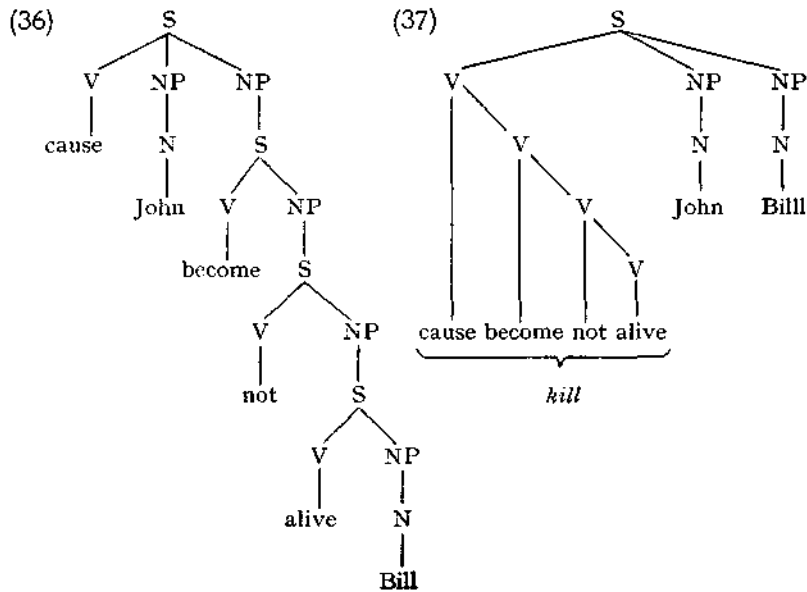


where the box indicates the scope limitation imposed by the quantifier, i.e. the range of the 'restrictive relative clause' in the sentence realised (Hutchins 1971: 67-8).

5.2. Rather more crucial than these logical aspects is the question whether GS semantic representations can be considered to be truly 'semantic'. Langendoen's base structures, e.g. (28), and those of McCawley, e.g. (36), contain nodes which are syntactic categories, 'V', 'NP', 'S', etc., and they are generated by syntactic rewrite rules. Lakoff indeed argues that his proposal on global derivational constraints⁸⁾ 'would require that semantic representations be given in the same terms as syntactic phrase-markers [and that] this is exactly what is claimed by the theory of generative semantics' (Lakoff 1970: 638). In addition, the fact that 'the ultimate elements of semantic representations need not correspond to the words of surface structures . . . but will rather be the various semantic elements involved in the meanings of words' (McCawley 1970: 291) means that the senses of lexical items are represented as organisations of semantic elements in what are essentially syntactic structures.

In GS transformational rules have two main functions. As in CKP they derive well-formed surface syntactic structures from well-formed deep structures. But they also generate the structures underlying lexical items, and one might well question this use of syntactic rules for what is primarily a semantic function. For example, *kill* in (38) is derived from a structure in (37) which has been generated from (36) by a cycle of 'predicate-raising' transformations.

⁸⁾ Briefly, global constraints are 'well-formedness conditions on configurations of corresponding nodes in non-adjacent trees in a derivation' (Lakoff 1970: 628). This is an important development in GS with probably far-reaching consequences; in particular it suggests a unifying principle behind what otherwise appear as *ad hoc* solutions to individual problems in syntactic transformations. However the proposal does not affect the basic approach of GS to semantics as presented in this paper.



(38) John kills Bill

In the SL-model the two operations are quite distinct: in the formation of sememic formulae from semon networks only semantic factors are taken into account, and in the transformation of sememic formulae into surface forms only syntactic (and stylistic) factors. Hence, sentence (38) and its synonym

(39) John causes Bill to die

are derived from two different sememic formulae, (40) and (41) respectively;

(40) (John)^{agt}—(kill)^{gl}—(Bill)

(41) (John)^{te}—(caus)^{ps}—(die)^{iga}—(Bill)

but underlying both is the same semon network (Hutchins 1971: 153 ff), one which would quite probably contain semons analogous to McCawley's primary semantic elements in (36).⁹⁾

⁹⁾ For the purposes of this paper it is immaterial whether *cause to become not alive* is a synonym of *cause to die* or *kill* or not (Katz 1970: 253); it is assumed that in many contexts it can be.

6. As in GS, the base in CKP is a syntactic structure. But it is not as abstract since its terminal objects are lexical items instead of primary semantic elements and its general form bears no parallels with the predicate-first order of symbolic logic. As the citation in section 2 showed, Katz considers that the reading of a sentence obtained by projection from the readings of its constituent items is in fact a representation of its meaning. An example of the operation of projection rules can be found in Katz and Fodor (1963). One reading of the ambiguous sentence

(42) The man hits the colourful ball

is given as follows:

(43) *The + man + hits + the + colourful + ball* → Sentence → [Some contextually definite] → (Physical Object) → (Human) → (Adult) → (Male) → (Action) → (Instancy) → (Intensity) → [Collides with an impact] → [Some contextually definite] → (Physical Object) → (Colour) → [[Abounding in contrast or variety of bright colours] [Having globular shape]]

Elements in parentheses are 'semantic markers' and those in square brackets are 'distinguishers'. The strong impression given by this reading and similar ones in CKP is that they are simply concatenations of the semantic markers and distinguishers found in the readings of lexical items with merely the redundant markers removed. The readings given by Katz and Fodor for the lexical items incorporated in (43) are (disregarding the selection restrictions which, though they play an important role in the operation of projection rules (section 10), are not part of the sense of items as such):

(44) *the* → [Some contextually definite]
man → (Physical Object) → (Human) → (Adult) → (Male)
hits → (Action) → (Instancy) → (Intensity) → [Collide with an impact]
colourful → (Colour) → [Abounding in contrast or variety of bright colours]
ball → (Physical Object) → [Having globular shape]

Only in the case of the projection rule for 'attribution', which produces the reading for *colourful ball*, is there evidence of any reorganisation of markers and distinguishers; in all other cases readings in

(44) are transferred to (43) without any change in the sequence of their elements. Furthermore, if projection rules represent the 'sense' of grammatical relations, as in a way they do (or ought), then this part of the meaning of (42) is quite absent from (43). It would seem that the only real effect of projection rules is to eliminate those readings of lexical items which are incompatible on the basis of their respective selection restrictions; thus alternative readings of *hits*, *colourful* and *ball* have been excluded in (43) – although, of course, some or all of these alternatives will be found in the other readings of (42). In other words, (43) indicates little more than that the readings in (44) are *not incompatible*, when the lexical items to which they are assigned occur as in (42). This, of course, is in keeping with the CKP concept of semantics as 'interpretative': readings of sentences are intended primarily as indicators of various relationships within and between sentences – anomaly, ambiguity, paraphrase and so forth – and only subsidiarily as representations of sense as such.

Largely it seems as a result of the criticism of Weinreich (1966: 410) that 'the meaning of a complex expression (such as a phrase or a sentence) is an unstructured heap of features', Katz later (1967: 167–173) introduced some structure into readings. He gives as an example the reading for *cats chase mice* as follows:

- (45) ((Activity of R₁) (Nature: (Physical)) ((Motion) (Rate: (Fast)) (Character: (Following R₂)), (Intention: (Trying to catch ((R₂) (Motion))))
 where R₁ is the reading for 'cats' and R₂ the reading for 'mice'

Whatever the derivation of this reading (and Katz does not indicate in what way the projection rules differ – as they surely must – from those in Katz and Fodor (1963)) the result is rather similar to the logical formulae used in GS. That is to say, it is a linear representation containing variables, and thus liable to have the problems already described for (32) and (34). In addition, (45) is in the form of a bracketed string and could therefore be held to be equivalent to a tree structure (just as (32) would be in GS), i.e. it is still essentially a 'syntactic' structure (although, of course, one which is rather more 'abstract' than the usual phrase-markers of CKP). Katz himself (1970: 247–8) rightly pointed out that the syntactic nature of GS base structures means that they are in as much need of interpreta-

tion by projection rules of some kind as are the avowedly syntactic base phrase-markers of CKP. One might well wonder in the light of this whether CKP readings such as (45), being comparable with GS deep structures, are not perhaps equally in need of further 'semantic interpretation'.

7. In the SL-model sememic formulae are claimed to be fully semantic: both nodes and links are sememes, and thus not only are the senses of lexical items represented but also the senses of grammatical relations.¹⁰ For the sake of clarity it should be stressed that there is not necessarily a one-to-one correspondence between a given grammatical relation and a given sememe, i.e. a grammatical relation may be 'ambiguous' and a sememe may be realised by more than one grammatical relation. The fact that in CKP for every grammatical relation (defined as those relations between syntactic categories that provide information to the semantic component) there is identified a particular projection rule – 'there is a different projection rule for each distinct grammatical relation' (Katz 1967: 128) – is a further reason for doubting the fully 'semantic' nature of CKP readings. Furthermore, the inherent difficulties in linear representations of meaning are claimed to be partly overcome in the SL-model by adopting graph representations – a solution which is not, of course, new: indeed the graphs employed by Mel'čuk & Žolkovskij (1970) have a close similarity to the sememic formulae of SL.

SYNTACTIC REPRESENTATION AND GRAMMATICAL FUNCTIONS

8. Since, as we have seen, both TG models are very much oriented towards the syntactic aspects of language – in CKP by making the base component wholly syntactic and in GS by assuming that syntactic relations underlie semantic representations – the adequacy of their syntactic representations would not seem to be a matter of dispute. However, without going into great detail some evidence can be adduced to throw a little doubt on such an assumption. Seuren

¹⁰ It might be argued that the organisation of sememes in sememic formulae constitutes a kind of 'syntax'; but it cannot be denied that the structures of sememic formulae differ radically from GS deep structures in two important respects: (i) as (35) shows, they cannot be reduced to (syntactic) tree diagrams; and (ii) they contain no explicitly syntactic nodes, unlike (28) and (36).

(1969: 51) has pointed out that in CKP 'although the grammar as a whole delivers only grammatical sentences, the majority of the products generated by the base are not grammatical at the level of deep structure. The base does not separate grammatical deep structures from ungrammatical ones'. This is done by the transformational component acting as a 'filter' (Chomsky 1965: 139). But, as Katz admits (1970: 226), 'transformations characteristically destroy the representation of constituent structure in phrase-markers'. So we have the rather odd consequence that the only phrase-markers which are unquestionably well-formed syntactically are just those which do not have fully adequate syntactic representations. In the literature of GS, on the other hand, the surface structures which are illustrated include as much constituent structure as the deep structures from which they derive, e.g. Langendoen (1969) and McCawley (1970). But while there is much informal description of the transformations involved there is little to indicate whether or not the formal details of GS transformational rules differ from those in CKP; Katz has remarked (1970: 244) on certain 'inherent problems' in the formalisation of such GS processes as 'predicate-raising'. In view of all this, the fact that the syntactic structures of SL, such as (8), do not have quite as much constituent structure as the *base* phrase-markers of TG grammars assumes somewhat less importance.

8.1. What is probably more significant is whether a formal grammar can represent the 'linguistic intuition of native speakers' with respect to grammatical relationships. One of these, whatever interpretation is given to 'linguistic intuition', must surely be the distinction between 'subject' and 'predicate'. In CKP grammatical functions are defined as relations between categories; thus [NP, S] and [VP, S] represent 'subject-of' and 'predicate-of' a sentence respectively. However, since constituent structure is destroyed in surface phrase-markers these definitions can apply only to base phrase-markers; only the underlying 'logical subjects' and 'logical predicates' of sentences can be defined, while their surface 'grammatical subjects' and 'grammatical predicates' cannot be handled in this way by CKP. Thus the passive constructions (12)–(16) are assigned the same 'subject', *John*, as their active equivalents (9)–(11), and the fact that they have a different 'grammatical subject', *stone*, is largely ignored. As Dik (1968: 150) remarks, this attitude to function 'is in

marked contrast to the attitude of many linguists who, while doubting the linguistic status of the 'logical' relations, have always recognized at least the 'grammatical' ones'. An odd consequent of the CKP procedure is that for a sentence such as

(46) The stone was moved easily

which has no specified agent, the 'subject' function would be assigned to a *someone* presumed to be present in the deep structure of the sentence while the grammatical subject actually present, *stone*, cannot be accounted for.

It is evident that what is really meant in CKP by such functions as 'subject-of' and 'object-of' is something like 'agent' and 'patient', i.e. semantic relationships of some kind. Indeed Katz himself acknowledges this when he discusses the difference between 'true grammatical relations' and 'pseudo-grammatical relations' (1970: 225-6). Both are relations between syntactic categories, definable in terms of '[X, Y]', but only the former have any role in the operation of projection rules during semantic interpretation and only these contribute to the sense of sentences: 'the substructures of deep syntactic structure that determine semantic representation are the domination relations and category marking that define grammatical relations' (1970: 259).

8.2. In SL 'grammatical subject' is closely connected with and in part determined by the selection of theme node in the linearisation of sememic formulae (cf. Halliday (1970) on the relationship between 'theme' and 'grammatical subject'). In sentences (9)-(11) the 'grammatical subject' is *John* and the linearisations from which they derive, (2) and (3), result from the choice of '(John)' as theme node. From the same sememic formula the selection of '(stone)' as theme gave the linearisations (4) and (5) underlying sentences (12)-(16) which have *stone* as their 'grammatical subject'. As for 'logical subject', whereas in CKP it is defined in terms of syntactic categories, in SL its semantic nature is fully recognised: it is defined as a relationship between sememes in a sememic formula. In general, the 'logical subject' will be found to be the node at the end of a 'tga' link, i.e. the 'agent' of a process. For all the sentences (9)-(16) then, their 'logical subject' is *John* and this is realised from the node

'(John)' at the end of 'tga' in (1).¹¹ As for 'predicates', they are not identifiable in SL with any particular sememic or syntactic configurations; 'logical predicates' can be defined only as those parts of sememic formulae remaining after the specification of 'logical subjects', and 'grammatical predicates' as those parts of lexemic strings occurring after the NP's which realise themes.

The SL procedure with 'logical subject' is not dissimilar to that found in those GS grammars, e.g. McCawley (1970), which subscribe to Fillmore's proposal (1968: 32-33) that 'the deep structure of . . . every simple sentence is an array consisting of a V plus a number of NP's holding special labeled relations (cases) to the sentences'. Thus the Agentive case marker, which may be realised as the preposition *by* in passive constructions, can be identified with the 'tga' link in SL sememic formulae. As in SL, in GS grammars of this kind there can be no particular configuration in the base with which a 'logical predicate' can be associated; but a 'logical object', on the other hand, may be identified with a NP following an Objective case marker (just as in SL it may be identified with the node at the end of a 'gl' link in a sememic formula). As for 'grammatical subjects' and 'grammatical predicates', the derived phrase-markers of GS are very like CKP base markers and so one may presume that the definitions adopted by CKP can be employed.

PARAPHRASE AND AMBIGUITY

9. In CKP two sentences are said to be paraphrases one of the other if they share at least one reading in common (Katz and Postal 1964: 27). This is readily achieved 'if the sentences are transformationally related to each other', and/or 'if they differ only in that one or more lexical items in the one are each replaced by a synonym in the other' (Staal 1967: 66). However, the sentences in (47), though paraphrases, are not related transformationally

- (47) (i) John sold the book to Mary
 (ii) Mary bought the book from John

nor are they related by synonymy of lexical items. The difficulty is

¹¹ The sememic formula for (46) would contain no 'agt' link and hence no 'logical subject' could be identified (cf. Hutchins 1971: 146). It is argued that this accords better with the 'linguistic intuition' of speakers than the CKP approach.

that in CKP the semantic component is applied only to base markers and that projection rules operate only on lexical items. Staal's solution (1967: 70), in the case of (47), is to incorporate appropriate indications of converse relations in the lexicon. Thus the entry for *sell* would be

(48) (*sell*, [+V, + ____ NP₂toNP₃{*buy from*}]})

Katz' solution (1967: 171-3) avoids the awkward (and inconsistent) inclusion of non-semantic features in readings – lexical items (in curly brackets) and syntactic categories – by the incorporation of variables and implicational rules within and between semantic markers. As with (45) Katz does not indicate what changes in projection rules must follow from this procedure. A more serious aspect, however, is that in order to overcome the difficulties of providing single readings for paraphrases with diverging deep structures or with lexical items not having well-defined semantic relations to each other, CKP is forced to include in readings a considerable amount of information which has more to do with the contexts in which lexical items occur than with their sense as such.

With their different approach to semantics GS and SL can avoid these particular difficulties: sentences are paraphrases of each other if they can derived be from the same semantic representation. In GS representations contain primary semantic elements and their structures are highly abstract, and so paraphrase relations can be described for sentences even if there are no direct synonymy relations between individual surface forms, whether these be lexical or syntactic: thus both (38) and (39) were generated from deep structure (36). In SL sentences realised from the same sememic formulae are obviously paraphrases; but sentences derived from different formulae can also have the same sense. This will be so if the same semon network underlies the formulae,¹² e.g. as we have seen already in the case of (38) and (39) and their sememic formulae (40) and (41). In general, identity of sememic formulae indicates that the sentences

¹² The investigation of paraphrase relations between sentences having widely diverging deep and surface structures is the primary contribution of the work of Mel'čuk and Žolkovskij (1970). Since they employ a form of semantic representation with many affinities to the sememic formulae of SL it is envisaged that their findings can contribute much in the further analysis of semon networks.

realised have more obvious lexical and structural similarities than those which differ in their sememic formulae but have the same semon network.

All three models are able, within the context of their own procedures, to provide simple explanations for the ambiguity of sentences: in CKP a sentence is ambiguous if it has two or more readings, as in the case of (42); in GS, if it can be derived from two or more deep structures; and in SL, if it can be derived from two or more sememic formulae or two or more semon networks.

However, the almost exclusive concern in CKP and GS with the syntax and semantics of sentences has led to a consequential inability to account for paraphrase and ambiguity relations between utterances longer than sentences. It is difficult to see how CKP can provide readings for sequences of sentences until some kind of 'supra-syntax' has been developed, and this is equally true for GS. On the other hand SL has made some tentative steps in this direction, particularly in regard to anaphoric relations between sentences and in coordinate constructions – earlier we gave an example of sememic formulae realised either as two juxtaposed sentences, (21), or as a coordinated sentence, (22). Thus, in SL sentences are connected not by some kind of 'syntax' but by semantic links at the level of sememic formulae.

ANOMALY AND UNGRAMMATICALITY

10. In the operation of projection rules in CKP an important role is played by 'selection restrictions'. These are attached to a reading of a lexical item in order to determine 'the combinations with the readings of other lexical items into which that reading can enter when a projection rule is applied' (Katz and Postal 1964: 15). If there are no readings for 'syntactically compound expressions . . . we shall say that the semantic component marks them as *semantically anomalous*' (ibid.: 16), and it requires only one constituent structure of a sentence to be anomalous for the whole sentence to be declared anomalous.¹³) As projection rules are part of the semantic

¹³) The unfortunate consequent of this is that in CKP no readings are assigned to sentences which are 'nonanomalous even though they have a selectional violation in an embedded sentence, for example,

It is nonsense to speak of a rock having diabetes' (McCawley 1968b: 128).

component and they operate on syntactic structures 'selection restrictions are formulated as functions of syntactic and semantic markers' (ibid.: 16). In general a feature is called 'syntactic' if it is mentioned in any syntactic rule of the base or transformational components.

Proponents of the GS-model argue that since the function of selection restrictions is to do with meaningfulness and not with syntactic well-formedness they are purely semantic in nature (McCawley 1968a: 265) and that there is hence 'no need to have the 'syntactic selection features' of Chomsky (1965) nor the complicated machinery for creating 'complex symbols'' (McCawley 1968b: 133ff.) To support this contention McCawley shows that the selection restriction imposed by a verb is one on the entire noun phrase which is its subject rather than one on a particular lexical item, e.g. the head of the noun phrase: 'there are no verbs on record which exclude *a bachelor* as subject but allow *an unmarried man*' (ibid.: 134); and that 'the various nonsemantic features attached to nouns, for example, proper versus common, grammatical gender, grammatical number, and so on, play no role in selection' (ibid.: 134). Furthermore, GS rejects the implicit assumption in CKP that all semantic anomaly is explicable in terms of selection restrictions: 'the violation of selectional restrictions is only one of many grounds on which one could reject a reading as not being what the speaker intended' (ibid.: 130). GS has adopted Fillmore's proposal that 'selectional restrictions are not restrictions imposed by a lexical item on other syntactic constituents but rather presuppositions about the intended referents of those constituents, e.g. that the selectional restriction imposed by *diagonalize* is not that its object have a semantic representation consistent with the semantic features that characterize matrixhood but rather the presupposition that the intended referent of the object be a matrix' (McCawley 1968a: 267). Thus in the natural reading of (49) *neighbour* is understood to be female because *buxom* presupposes femaleness of its subject

(49) The neighbour is *buxom*

(50) The neighbour hurt herself

Whereas CKP would have to assign two readings to *neighbour*, one containing [+ Male] and the other [- Male], in order to account for the selection of *herself* in (50), in GS the choice is made not 'on the

basis of linguistic properties of the antecedent noun phrase' but 'on the basis of one's knowledge about the intended referent of that noun phrase'. The difference between the two approaches is neatly illustrated by (51).

(51) *The waitress hurt himself

In CKP the sentence is ungrammatical, i.e. it violates syntactic selection restrictions, but in GS it is semantically anomalous: the femaleness 'presupposed' by *waitress* is contradicted by *himself* (McCawley 1968a: 257).

II. Since presupposition involves factual knowledge rather than knowledge of linguistic properties it can be argued that it falls in the realm of 'performance' rather than 'competence' and that consequently it cannot be dealt with in formal terms in a language model. Knowledge of non-linguistic facts no doubt underlies much of the semantic structure of language, but it is equally clear that a formal model must deal with the linguistic aspects of meaning (sense) rather than the non-linguistic ones (reference) (section 1 above). Therefore, while GS is quite right to suppose that presupposition relations are implicit in such formalisations of semantic incompatibilities as the selection restrictions of CKP it would be in error if it sought to explain all semantic anomaly in terms of presupposition only. *Waitress* in (51) may well presuppose the femaleness contradicted by *himself*, but it is also true to say that the two words are incompatible in sense. While the notion of presupposition is a valuable, perhaps essential, addition to the explanatory power of TG, a formal model of language should avoid extra-linguistic explanations where intra-linguistic ones are readily available.

For this reason it is not perhaps surprising that in discussing the GS treatment of anomaly Katz (1970) does not refer to presupposition - Katz and Fodor had explicitly rejected referential facts from a formal semantic theory (1963: 181). He is more concerned to demonstrate that some selection restrictions must be syntactic in nature. Against McCawley's contention (1968b: 135) that the count/mass distinction is semantic, he argues that in (52)

- (52) (i) Footwear
 (ii) Articles of wearing apparel for the feet

the expressions (i) and (ii) ... are identical in meaning [i.e.

sense]. But the expression designated (i) ... is mass while ... (ii) is count. If the syntactic features '[- Count]' and '[+ Count]' were to represent a semantic distinction, the proper syntactic assignment of these features to cases like [52] above would falsely predict that [they] are non-synonymous' (Katz 1970: 238). By this and similar arguments he seeks to prove that 'the lexical constructs in the vocabulary of semantic theory and those in the vocabulary of syntactic theory are disjoint sets' (ibid.: 239), that consequently the information required for syntactic well-formedness cannot be provided by semantic features from a GS-type base and that some deviant forms which GS claims to be semantic anomalies should in fact be interpreted as violations of syntactic selection restrictions. For Katz this is sufficient demonstration of the validity of the CKP approach, i.e. that semantics is subsidiary to syntax (ibid.: 256). But however pertinent Katz' argument may be in this instance it should be noted that he does not dispute the semantic nature of most selection restrictions and indeed it would be difficult to envisage how the arguments of GS could be countered. In other words, the majority of selection restrictions are semantic but a few are (wholly or partly) syntactic.

A more general criticism of GS put forward by Katz is that 'although generative semantics type grammars can easily account for sentences that are meaningful but not (fully) well-formed syntactically, the opposite case, sentences that are not (fully) meaningful but are syntactically well-formed, can no more be handled in such grammars than CKP type grammars can handle surface structures that have no deep structure underlying them. In both situations, there would be nothing from which to derive the representations of the admittedly existing surface form' (Katz 1970: 254). In saying that GS cannot handle semantic anomaly Katz is clearly not referring to an inability to explain why certain sentences are anomalous. From the last section it is obvious that GS's interpretative power in this regard is perhaps more adequate than that of CKP. Rather Katz is referring to the lack of a formal apparatus to generate anomalous sentences, because the GS base component cannot tolerate the violation of semantic selection restrictions.¹⁴) To allow the se-

¹⁴) Likewise, Katz is not saying that CKP cannot *explain* why an utterance is ungrammatical but only that its syntactic component does not allow the *generation* of syntactically ill-formed sentences.

speaker is free to combine semons and sememes in any way he chooses, although not all combinations may be lexemically realisable (Hutchins 1971: 21). To explain the anomalousness of the sememic formula (53) recourse is had to the notion of 'sememic incompatibility' (e.g. the sememe '(frighten)' is incompatible with a node not containing the semon '<human>', such as '(sincerity)', if the link between them is 'gl', but it is not incompatible if the link is 'tga' – hence the nonanomaly of *Sincerity frightens John*), or to the notion of 'referential implausibility' (i.e. the unlikelihood or impossibility of there being in the 'real world' anything which such a combination of sememes could refer to). The latter notion thus includes the concept of 'presupposition', while the former embraces the concept of 'selection restriction' as an interpretative device.¹⁵⁾

As for syntactic deviance, the SL-model is able to explain syntactically ill-formed sentences in exactly the same way as CKP and GS, namely as the result of rule violation; but it cannot, any more than CKP or GS, generate ungrammatical sentences since this would involve the formulation of 'deviant' rewrite rules. Thus, from (2) we could generate, instead of the grammatically correct sentence (9), the following ungrammatical one

(57) *John the stone moved easily

if we had the 'deviant semolexic rule'

(58) $gl : V(x) \rightarrow NP + V(x)$

(It is difficult to follow Katz in the quotation above when he says that GS is able to handle syntactically ill-formed sentences, since in GS, as in CPK, transformational rules are so formulated that only grammatically correct surface structures are generated, e.g. Langendoen (1969), McCawley (1970), Lakoff (1970).) To explain how syntactically ill-formed sentences such as (57) can nevertheless be understood we may say, with Katz (1964a), that hearers are able to associate with them sets of well-formed sentences, i.e. in this case

¹⁵⁾ Obviously 'sememic incompatibility' can also be incorporated in the generative mechanism of SL, namely in the form of rules which may block the formation of anomalous sememic formulae. But such rules unless they are made optional would necessarily restrict SL as a model of linguistic 'performance' (cf. sections 4, 15 and 16) to the generation of nothing but strictly nonanomalous utterances; and this is not on the whole considered to be desirable (Hutchins 1971: 170ff.).

sentences (9)–(16). The ease with which this can be done could be said to depend on how many rules are broken (or how many ‘deviant rules’ are employed) and the nature of the deformations produced – in this way we could establish ‘degrees of grammaticalness’, as Chomsky (1961) has done for CKP

In generating syntactic structures from semantic representations it may be thought that SL is open to the criticism brought by Katz against GS regarding the count/mass distinction, namely the treatment of purely syntactic features as semantic. In fact, syntactic features are introduced only during semolexic transformation, when sememes are replaced by their corresponding lexemes, and any restrictions imposed by these features are operative in the application of subsequent semolexic rules (cf. section 5.2 above). In GS, by contrast, syntactic features must be already present in some form in semantic representations since all operations on them are by ‘syntactic’ transformational rules, and in any case the structure of the base itself is essentially syntactic.

ANALYTICITY AND CONTRADICTION

13. Properties of sentences which have been studied by logicians such as analyticity, syntheticity and contradiction have been investigated within the framework of CKP by Katz (1964b). They have not apparently been treated by GS, probably because of the assumed equivalence of deep structures and the formulae of logic. On this assumption there would be no need for the proponents of GS to repeat the investigations of logicians in this area. In SL, however, as in CKP, no such assumption is made.

With the definitions of ‘subject’ and ‘predicate’ given in section 8.1, CKP defines an analytic sentence as one in which every semantic feature included in the reading of its predicate is also included in the reading of its subject; and a contradictory sentence as one in which the reading of its subject contains a marker forming an ‘antonymous pair’ with a marker in the reading of its predicate – an example of such an ‘antonymous pair’ of markers would be [+ male] and [– male], which are present in the readings of the antonymous lexical items *man* and *woman* respectively. A synthetic sentence is then defined as one which is neither analytic nor contradictory.

It is obvious that there are analogous definitions in SL for these properties, using ‘subject’ and ‘predicate’ as defined in 8.2 above and

assuming the validity of these definitions for this purpose. This will also be true for the other logical relations described by Katz (1964b: 534 ff.); but in one important respect SL appears more adequate than CKP. Katz seems to be able to account for contradiction between sentences only if 'one sentence is synonymous with (or a paraphrase of) the other's negation' (ibid.: 538). This is because CKP cannot provide readings for utterances longer than single sentences. But in SL, as we saw in section 9, sememic formulae can represent the sense of more than one sentence: the model should therefore be able to account easily for contradictions more complex than those CKP can handle.

ANAPHORA AND REFERENCE

14. In TG grammars the sentences (59) and (60) are derived from

(59) A man killed a man

(60) A man killed himself

deep structures both containing two occurrences of the NP *a man* but differing in that whereas in (59) the occurrences are assigned different 'referential indices', in (60) both occurrences receive the same 'index'. Apart from reflexivization, other transformations contingent on the identity of noun phrases and their indices are those of pronominalisation, relative clause formation, apposition, and certain kinds of coordination. Referential indices are common in CKP where they are applied to lexical items in base markers; in GS they are more frequent: they occur in conjunction with primary semantic markers in deep structures. This is because, as McCawley rightly remarks (1968b: 138), sentences (59) and (60) 'differ not only syntactically but also in meaning, [therefore] this difference in index will have to be part of not only their syntactic representation but also their semantic representation'. As alternatives (and equivalents) of indices GS often employs variables; certain difficulties in their use have thus been observed already in section 5.1 with regard to (28), (32) and (34).

However, TG uses referential indices for more than just to explain certain sense differences between individual sentences. 'We may assume that in any discourse the first noun is assigned the index 1, the next noun which refers to a different entity the index 2, and so

on. Each time reference is made to something not previously referred to, the noun is assigned a new index number' (Langendoen 1969: 48). As Dik points out (1968: 83), this means that non-linguistic (referential) facts are mixed with linguistic ones: in one particular discourse sentence (60) could be derived from the base marker:¹⁶⁾

(61) S[NP^[a man]NP₂ VP[V^[killed]V NP^[a man]NP₂]S

but in another (longer) discourse it could be from

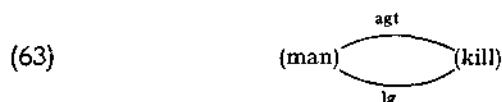
(62) S[NP^[a man]NP₃₉₄ VP[V^[killed]V NP^[a man]NP₃₉₄]S

In fact there are as many possible deep structures for (60) as there are referential indices which could conceivably be assigned to *a man* in discourse, i.e. an infinite number (Dik 1968: 84). But of course as far as its linguistic properties are concerned sentence (60) is the same no matter to whom it is made to refer. For each lexical item there is a class of potential referents (determined by its 'sense'), but the referent selected in a particular case is determined not by linguistic (i.e. semantic) factors but by non-linguistic ones: the information conveyed by (60) is simply that *a man* and *himself* refer to the same individual and his precise identity is irrelevant for correct semantic interpretation.

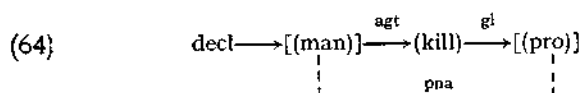
Dik observes further that 'the problem of specifying referential identity is *created* by the transformational approach. If such sentences as [60] ... are *not* described in terms of underlying structures [such as (61), in which *a man* occurs] more than once, then this point does not arise at all' (1968: 85). In SL this is precisely the approach which has been adopted: the second (third, fourth, etc., mention of a referent is not expressed by a repeat of the sememe(s) used before but by a '(pro)' sememe linked to it (them) anaphorically. In this way SL treats referential identity without recourse to the non-linguistic 'indices' of CKP and GS.

¹⁶⁾ Although referential indices are usually said to be assigned to individual lexical items, McCawley has observed (1968b: 137ff.) that they should properly be assigned to their dominating NPs: reflexivization depends not only on the identity of nouns but also on the identity of their articles - they must be either both indefinite, as in (60), or both definite. Hence indices have been assigned in (61) and (62) not to the two nouns *man* but to the NP categories that dominate them. These differences in detail, though not trivial, are yet irrelevant to the present argument.

Examples of the SL procedure have been given already for anaphoric reference from one sentence to another, (17) and (20), for anaphora within a sentence, (27) and (35), and for cases where realisations can be as one coordinated sentence, (22), or as two juxtaposed sentences, (21). As for reflexive constructions, the sememic formula underlying (60) would be (63),



which on linearisation, (64), would contain a special anaphoric link,



'anp', indicating that the realisation of the pronoun must be reflexive (Hutchins 1971: 148).

PERFORMANCE AND STYLE

15. The principal concern of this paper has been with the adequacy of the three models in their treatment of speakers' linguistic 'competence'. But it is not inappropriate to conclude with a brief consideration of their assumptions about how speakers produce sentences. A formal model of language can be said to deal with linguistic 'performance' in so far as it is able to describe the general processes of speech production which must be presumed to be the same for all speakers; but it cannot, of course, be expected to account for the many non-linguistic factors involved.

In CKP the base syntactic structures of sentences are generated before their lexical items are inserted and before they receive semantic interpretation. It is difficult to believe that speakers decide on the form of utterances before their content has been determined. Indeed Katz himself (1970: 229) appears to accept the logical priority of semantics over syntax in a 'model of speech production'. This is of course the approach adopted by GS and SL: they describe the generation of sentences as a series of transformations upon semantic representations to create the surface forms of utterances. It should be stressed that in describing the production of sentences in this way there is no denial of the observation that verbalisation (whether

internal or external) and perceptual and conceptual processes almost invariably occur simultaneously; but, while it is true that mental processes can be non-linguistic in nature (e.g. visual or musical), it would appear that no verbalisation takes place without *some* semantic content or intent. The fact that speakers do produce sentences which are meaningless for their hearers, and perhaps also in retrospect for themselves, is not an argument against the priority of meaning over the form of its expression (Fillmore 1970: 273) but simply an illustration that individual 'performance' in the conversion of thought into words can frequently be imperfect – which is ultimately just one further demonstration that TG's 'fluent speaker-hearer' is but a useful fiction.

There is an additional objection to the CKP approach. The assumption that syntax is logically prior to semantics has led to a model which is uneconomic as a 'productive' device. As we have seen, most of the products of the base are either semantically anomalous or syntactically ill-formed and need to be 'filtered out' by the semantic and transformational components. GS is not open to this particular objection: no products of the base are semantically anomalous and few of them have to be eliminated during the transformational cycle on account of syntactic ill-formedness. Similarly in the case of SL: the 'context-sensitivity' of the rules in semolexic transformation ensures minimal redundancy in the processes of sentence realisation.

16. On any particular occasion speakers can usually express the same message in a number of different ways. Which they select is often determined by many non-linguistic factors, but the mechanism which enables them to perform the selection process itself must be considered part of the general structure of language. In CKP and GS the only explanation that could be provided for a speaker's use of, say, a passive sentence instead of its active equivalent would have to be in terms of the selection of transformational rules. It is true that GS could employ the notion of 'presupposition' to describe the implications behind usage, but this does not constitute a mechanism which could be involved in the *generation* of sentences: as we saw in section 11, it can be used only as an 'interpretative' device. Only in SL is there an explicitly formulated mechanism to regulate

the kind of sentences produced, namely the process of theme selection.

There are other occasions when a speaker's choice can have considerable influence on the type of sentence produced: in SL these occur during linearisation and during the operations of semolexicemic rules, and in GS they can be in the course of lexical insertion and late in the transformational cycle. However this leads us to the general question of 'style'. Not surprisingly, none of the models has attempted to tackle this aspect of linguistic 'performance'. But it is not difficult to envisage how even this most 'personal' aspect of language use could be incorporated in the models: each transformational (or semolexicemic) rule could be assigned a particular 'stylistic value' which a speaker would take into account in producing sentences. Although many 'values' will be unique to particular speakers, it is not wholly unreasonable to suppose that some may be common to most or all speakers and could therefore, in theory at least, be included in a formal model.

CONCLUSION

17. The inadequacies in the treatment of semantics by the two TG models are attributable in most cases to their essentially syntactic approach to this aspect of language. Even though the generative base of GS is the semantic component rather than the syntactic component (as in CKP), the framework remains basically the same, and although there is evidently a great deal of flexibility in both models – the changes in CKP since its first formulation demonstrate this – it is doubtful whether fundamental deficiencies can be overcome within a syntactic orientation. The SL-model seems generally to be more adequate and it is believed that the kind of approach it exemplifies is also more likely to provide satisfactory solutions to the many other complex and difficult problems associated with the semantic aspects of formal language models.

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