THE INCLUSION OF SEMANTICS INTO GENERATIVE GRAMMAR

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O.   In the present stage of algebraic linguistics (to which generative and
transformational grammars belong) it is no longer questioned whether or not the semantic
part pertains to the characteristics of a sentence and, consequently, whether or not the
semantic description should be a component of the linguistic description.

1.   The old version of transformational syntax presented by Chomsky in
Syntactic Structures (1957) as a theory completely formal and non-semantic, i.e. a theory
where semantics was put clearly outside grammar (cf. "grammar is best formulated as a
self-contained study independent of semantics") has long been abandoned by the author
himself.

1.1.   Yet it would be unjust - in spite of the quoted statement - to blame Chomsky
that he had fully disregarded the interconnection between syntax and semantics.   What he
refused then was to build grammar on the foundations of meaning (esp. meaning in a broad
interpretation).   He excluded semantic phenomena (like synonymy, etc.) from the grammar
and transferred them to another branch of linguistics, to a parallel semantic theory, and
suggested that the correlation between formal and semantic features should be studied by
some higher discipline of linguistic science, a more general theory of language which would
include the theory of linguistic form alongside with the theory of the use of language (as he
understood meaning).

At that time Chomsky already admitted: "the fact that correspondences
between formal and semantic features exist, cannot be ignored."   Nevertheless, believing
that these relations are too inexact and unexplored to enable us to take semantics as a basis
for grammatical description, he kept to the principle that "only a purely formal basis can
provide a firm and productive foundation for the construction of grammatical theory."
Therefore he deliberately left semantics aside in his earlier conception of a generative
grammar (with phrase-structure, morphophonemic and transformational rules).

But this avoidance of semantics was soon felt as a serious deficiency.   It was
realized more and more in American and European linguistics that this is a substantial

shortcoming which has to be remedied, if linguists are to achieve an adequate model of language as a mechanism generating well-formed sentences.

1.2.   Accordingly, Chomsky extended and deepened in certain ways his formulations, and proposed in his Aspects of the Theory of Syntax (1965) an essential reformulation of transformational generative grammar, taking into account accumulated criticism and recent developments in semantic theory, esp. as presented by Katz, Fodor and Postal.

Here, in Aspects, Chomsky conceives a generative grammar as a system of rules that can iterate to generate an indefinitely large number of structures.   This generative grammar (further GG)   consists now of three major parts: the syntactic, phonological and semantic components.

In this newer, but apparently again not definite version, the semantic component is regarded as a direct part of GG, but the syntactic component remains central and, as a matter of fact, the only really generative component, whereas the other two are regarded as purely interpretive.   They utilize information provided by the syntactic component concerning formatives (words), their inherent properties and their interrelations in a given sentence.   The phonological component relates a structure generated by the syntactic component to a phonetically represented signal, and the semantic component relates the generated structure to a certain semantic interpretation.   In a footnote Chomsky states that in his discussion of the semantic component he follows the exposition in Katz and Postal, An Integrated Theory of Linguistic Descriptions (1964) and assumes throughout that the semantic   component is essentially as they described it.

Yet, he is evidently aware of its weakness; in Topics in the Theory of Generative Grammar (1966) Chomsky says that the theory of semantic interpretation is in a much less developed state (than the phonological component, where he was guided by the studies of Jakobson, Fant, Halle, Lukoff).   He regards the work by Katz, Fodor and Postal as quite encouraging, though he says a bit further that the notion of "semantic interpretation of a sentence" remains in a rather primitive state, for the moment.   Therefore, when we shall comment critically on some points of the semantic component theory it mainly concerns the authors of this semantic theory.

Chomsky deals primarily with the syntactic component which must generate deep and surface structures (in the notes he puts these terms almost equal to Humboldtian 'inner form' and 'outer form' or Postal's underlying structure' and 'superficial structure')

and must interrelate them. The syntactic component must specify for each sentence a deep structure that determines (through its grammatical relations and grammatical functions) the semantic interpretation, and a surface structure that determines its phonetic interpretation. These two structures (deep and surface) are viewed as distinct, in general, which constitutes the fundamental difference from traditional syntax. The surface structure is understood as determined by the repeated application of certain formal operations called "grammatical transformations" to objects of a more elementary sort, "deep structures," constituted as base phrase-markers (i.e. basic strings with associated structural description P-markers). Thus, by applying the T-markers, a final derived P-marker is obtained, i.e. the actual string of words of which sentences consist.

1.3. The semantic interpretation should be produced (according to this theory) afterwards, by a projective device assigning a meaning for each lexical item in the string, then for the constituents in the string and finally for the string as a whole. In other words, the so-called projection rules operate to combine "readings" for lexical items and readings for higher-level constituents to produce readings for a whole sentence. This is a sort of amalgamation of partial meanings of the nodes in the P-marker to a total meaning.

Originally the authors intended to distinguish two types of projection rules: Type 1 Projection rules (P1) for the semantic interpretation of underlying P-markers and obligatory singulary transformations which do not affect the meaning of the underlying sentence, and Type 2 Projection rules (P2) for optional and generalized transformations that do change meaning, to explicate the manner in which such transformations alter or build up meanings. But later, in the course of the work, maybe to facilitate their task or to make the system more simple and better applicable, the authors come to the conclusion that actually there are no transformations that affect meaning, or rather, that no correctly formulated singulary transformations have a semantic effect. For the apparent counter examples they simply generated (inserted) special morphemes (such as negative, imperative, interrogative etc.) directly in the P-structure. By this skillful procedure (which may indeed correspond to the 'programming' of a sentence by the speaker) the authors succeeded in restricting substantially the number of transformations.

The only function of the generalized transformation is seen in embedding a sentence transform in a position that is already specified in the underlying structure (by a presence of a dummy symbol). Thus the notion of generalized transformations practically disappears, as these are replaced by singulary transformations applied cyclically, reintro-

ducing the initial symbol S in designated positions as many times as necessary. Of course, the notion of the T-markers disappears as well. This simplification represents a certain advantage. I am not sure, however, whether it can solve satisfactorily the crucial problem of the interrelation (or close interaction) between the semantic and formal components in a linguistic description, or only shifts the problem down, into the base structure. In the earlier version the recursive property was a feature of the transformational component, now this recursive power is assigned to the base component only.

The sole creative part of the grammar conceived in this way is the syntactic component. Its base generates deep structures, then the deep structure enters the semantic component and receives a semantic interpretation. Then it is mapped by transformational rules (including substitutions, deletions and adjunctions) into a surface structure, which is not interpreted semantically any more, but given a phonetic interpretation by the rules of the phonological component. Thus the grammar assigns semantic interpretation to signals through the mediation of the recursive rules of the syntactic component.

1.4. The whole theory is far from being elaborated and applicable to particular languages in full size description. Chomsky himself remains sober and realizes the difficulties. In chapter 4 of Aspects he points out some unanswered questions, first of all on the boundaries of syntax and semantics. I would say, however, that this is not at all a residual, but a fundamental problem. Chomsky finds that the current theories of syntax and semantics are highly fragmentary and tentative; since they involve open questions of a fundamental nature, the problem can be at best a source of speculation. Further Chomsky admits that his fragmentary and inconclusive discussion of the interrelation of semantic and syntactic rules is by no means a settled issue. There is quite a range of possibilities that deserve serious exploration. In general, Chomsky says, one should not expect to be able to delimit a large and complex domain before it has been thoroughly explored. A decision as to the boundary separating syntax and semantics (if there is one) is not a prerequisite for the theoretical and descriptive study of syntactic and semantic rules. On the contrary, the problem of delimitation will clearly remain open until these fields are much better under-stood than they are today. Chomsky is aware that – apart from the universal, language-independent constraints on semantic features – it is obvious that in any linguistic system lexical items enter into intrinsic semantic relations of a much more systematic sort than has been suggested so far. There are very likely certain "field properties," etc. In concluding this subchapter, Chomsky simply points out that the syntactic and semantic structure of

natural languages evidently offers many mysteries, both of fact and of principle, and that any attempt to delimit the boundaries of these domains must certainly be quite tentative. So Chomsky is, as we see, sensible in his reasoning and he views the problem in the proper light.   Sentences, as other language units, are bilateral language units and the side of content is inseperable from the side of formal expression.

     2.   I have no better solution to offer in this paper to this knotty question, but would merely like to add several critical remarks on the concept of the semantic component and on its place in the so-called integrated theory of linguistic descriptions, and I would like to suggest another possible approach.

     When we seek to clarify the interrelation of formal structure and semantics in the system of language we have to realize first what kind of linguistic description we aim at.

     2.1.   Chomsky reminds the reader of Aspects (pp. 139 - 140) that the system of generative rules must not be regarded as a point-by-point model for the actual construction of a sentence by a speaker, since a generative grammar is not a model of performance (= speech) , but rather a model of competence (= language).   A generative grammar as it stands is no more a model of the speaker than it is a model of the hearer, he stresses.   But this statement is unlikely to be understood, I think, in the sense that the aim would be to formulate a mechanism appropriate neither for the speaker nor for the hearer.   After all, Chomsky says that GG can be regarded as a characterization of the intrinsic tacit knowledge or competence that underlies actual performance.

     Katz and Postal pose the problem in a slightly different way; they say (in the introduction of their book) that a linguistic description of a natural language is an attempt to reveal the nature of a fluent speaker's mastery of that language.   This mastery is manifested in the speaker's ability to communicate with other speakers of the language, that means to produce appropriate sentences that convey information, ask questions, give commands etc., and to understand the sentences of other speakers.   This would mean that the language system in its functioning should be approached from two opposite directions; or - it could be described from one angle and then a simple operation indicated how to reverse it if there is full symmetry and reversibility.

     A communication presupposes, of course, two participants.   This is borne in mind by Katz and Postal in the introduction when they set up their tasks: "A linguistic

description must reconstruct the principles underlying the ability of speakers to communicate with one another.   Such a reconstruction is a scientific theory whose statements represent the linguistic structure characteristics of the language and whose deductive consequences enable the linguist to explain sentence use and comprehension in terms of the features of this structure."   In this sense the study by Katz & Postal tries to develop an integrated conception of the nature of a linguistic description of a natural language (in their case English).   But if we do want to reconstruct the principles underlying the ability of speakers to produce and understand sentences in their language (at that moment, naturally, the speaker converts into a hearer), then – it seems to me – the whole model of the actual procedure is far from adequate.   It does not reflect the nature of linguistic reality, even if we do not try to give a model of the actual speech performance, but only the rules of underlying competence.

2.2.   I have objections to the way the problem is stated.   In a non-sequitur to the principle stated in the introduction, the process of generating sentences is described from the point of view of the speaker, generator.   This is evident from the diagram of the integrated linguistic description (p. 161) too:
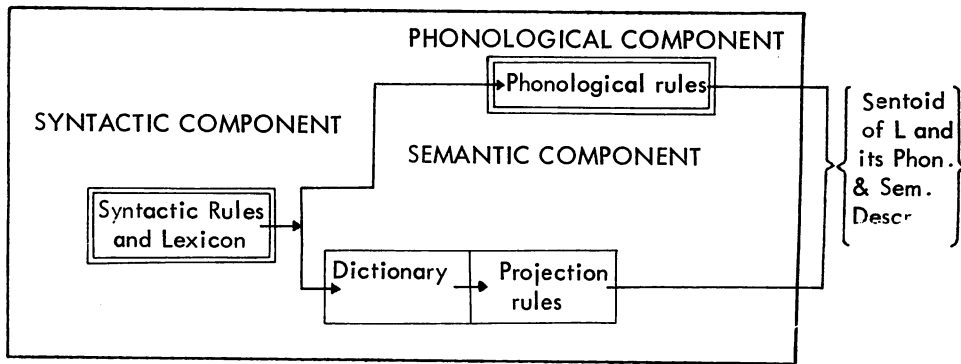
The authors also assume that the syntactic component is fundamental as the only generative source, and this component generates abstract formal structures (strings of formatives) underlying actual sentences.   The other two components both operate on its output, so they appear to be some kind of appendage to the syntactic formal component!.   This seems to find its explanation in the fact that the new theory has been constructed as an amendment to the earlier version of transformational syntax and merely combines the syntactic structures with the semantics.

From many formulations throughout the exposition it follows that first a

string of formatives is generated by the syntactic component; this component, according to Chomsky, also contains lexicon - of course; and it is assumed that each lexical item is specified in the lexicon in terms of its intrinsic semantic features, whatever these may be (they have not been described yet, merely sketched roughly). So we have to accept as an axiom that this syntactic structure (string of words with a certain structural description in the way of labelled bracketing or a tree diagram) has arisen, or has been generated still without semantics. Only then is it interpreted semantically as it enters the semantic component, i.e. as meaning is assigned to it in parts and then in toto. At the same time (evidently) the phonological component provides each of the generated formal structures with a phonological representation which includes a phonetic representation.

In my opinion the whole description is rather dubious. First, because it strictly separates the formal syntactic structure from the semantic relations necessarily present in the string which cannot get a structural description without them; secondly, because it takes the generation of abstract formal structures as a starting point. I am convinced that the speaker's process of producing well-formed and meaningful sentences takes quite a different path and its reconstruction must be different accordingly.

2.3. When a speaker is about to convey a message he first has the idea to be communicated in his mind. How the idea arises is an extra-linguistic problem. So at the beginning there is a semantic content, still unexpressed by language means, but having its own structure built of notions and relations between them such as the performer of the action - the action - its result or circumstances, or the bearer of a property and the property attributed to him, etc. So we are fully entitled to assume the existence of a semantic structure (or let us say, logical-semantic structure) which we call "proposition." The semantic categories in it have a universal character. Now to arrive from this proposition to a pronounced (or written) sentence or utterance, several successive operations have to be accomplished.

The speaker looks for a proper expression of the semantic structure of the proposition by means of the most suitable words arranged in the most suitable formal syntactic structure - he determines which parts of sentence to use with which lexical items filled. Then he puts the words into correct morphological forms conditioned by the syntactic position (function) of the words and by the syntactic relations in the sentence. All this is manifested morphophonemically, and then phonetically.

This is saying that the syntactic structure is partly predetermined by the

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semantic structure, but not reversely. The speaker has, naturally, a certain option how to express the semantic content, the parts of which may be compared with "deep structures", but are already complemented with semantics. He selects the optimal (in his view) syntactic construction and adjusts it in accordance with the morphology and phonology of the language.

All this, is - of course - a commonplace truth in traditional linguistics, but I believe this is the real sequence and it cannot be disregarded or distorted in the new trends of linguistic description if the new system is to operate well. A way of formalization must, and can, be found for it.

Therefore we can hardly accept such formulations as: "the speaker obtains a meaning for a sentence by assigning meaning to the string of formatives, or, more precisely, to the sentoid, i.e. a sentence with an unambiguous structural description." (How could we remove the ambiguity before the semantic interpretation?) Or: "The syntactic structure of a sentence, by providing the formal relations between the lexical items determines what possible combinations of meaning there are in the sentence. This could apply perhaps to the underlying ability of the hearer, decoder, but not of the speaker. From the standpoint of the speaker it is not true that "the meaning of the sentence is in part determined by the grammatical relations in it." On the contrary: the grammatical relations are affiliated to the semantic relations. There is, of course, not a relation of direct correspondence or identity (in this sense we recognize the distinction between deep and surface structures), but a one-to-many relation (asymmetric dualism). Between the potential ways of expression of a particular proposition by various syntactic constructions and sentence patterns is a relation of syntactic synonymy which involves the stylistic aspect that cannot be overlooked in an integrated linguistic description.

2.4. Thus, if we want to give a model of the mechanism used by the speaker's language competence, we have to proceed not as in the adduced diagram, but from the symbolic representation of the proposition on the semantic level through several steps down to the representation on the phonic (or graphic) level.
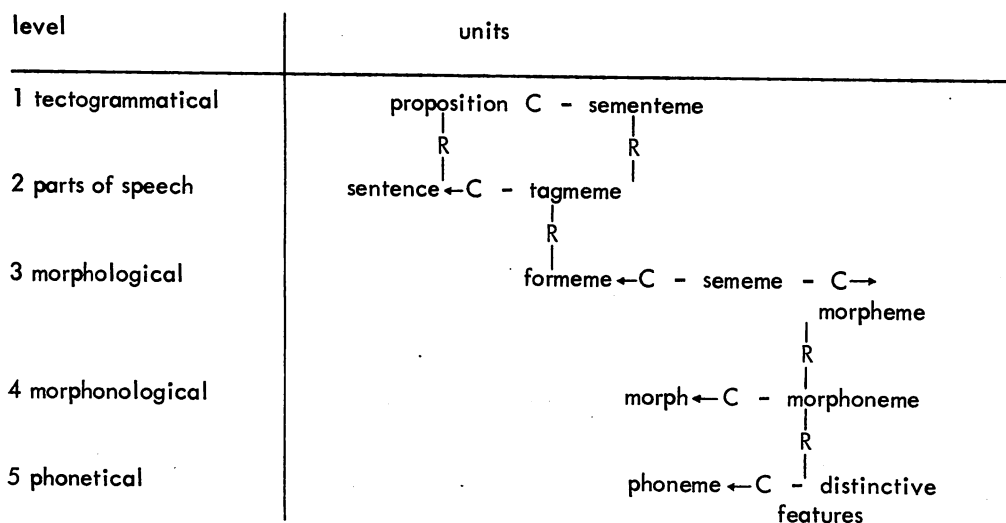
For this approach we have to conceive the model as an apparatus operating on several levels successively (it is a mechanism with several sieves one below the other).

The principle of linguistic levels is developed in some papers by Chomsky, e.g. in his Logical Basis of Linguistic Theory, or in Topics in the Theory of Generative Grammar. He explicitly speaks of several levels. On each level (which is a system of

representation in terms of certain primes, i.e. elementary atomic symbols of the level) markers are constructed that represent a sentence. Chomsky thinks of the markers of each level as being mapped into the markers of the next lowest level and as representing the lowest level marker (phonetic level) which is associated directly with an actual signal. Unfortunately this idea is not applied in a clear-cut form in Aspects.

In the Czech linguistic theory a new modification of the multi-level description of language has been elaborated and partially applied by P. Sgall, who takes for the theoretical foundation of his conception the Prague School theory of function and-form relation.

Sgall distinguishes 5 levels minimally, with complex and elementary units in each of them:

level	units
1 tectogrammatical	proposition C - sementeme
	R R
2 parts of speech	sentence ←C - tagmeme
	R
3 morphological	formeme ←C - sememe - C→
	morpheme
	R
4 morphonological	morph ←C - morphoneme
	R
5 phonetical	phoneme ←C - distinctive features

The arrow at C relation goes from the
elementary unit to the complex one;
distinction of C and R relation is from Hockett.

Sgall admits that there might be a higher level above 1 and possibly a transitional level between 4 and 5. Levels 2 to 5 are interpretive, or better transductive; they translate the generated string from one level to the following one. Between the two adjacent levels is a relation of representation (R in the diagram), i.e. relation of function and form. The ordering of the levels is motivated by ordering of the components of the description.

Only the first level, the semantic one has the recursive character. This first

level consists of a set of rules generating representations on the level of sentence semantics. Here there are rules such as:

1 Sentence $\begin{cases} \text{Enunt} \\ \text{Inter} \\ \text{Voc} \end{cases}$

2 Enunt $\qquad$ Pred – Modal

3 Pred $\begin{cases} NP_1 \quad R_a \quad VP \\ VP \quad R'_a \quad NP_1 \end{cases}$

4 X $\begin{cases} NP_o \quad R_d \quad X \\ X \quad R'_d \quad NP_o \end{cases}$

5 VP $\begin{cases} NP_1 \quad R_p \quad V_{tr} \\ V_{tr} \quad R'_p \quad NP_1 \end{cases}$

6 NP_1 $\begin{cases} N \\ A \\ \text{Pred-Rel} \end{cases}$

7 N $\qquad$ Subst-Num-Def

8 VP $\qquad$ $Verb_{int}$
$\qquad\qquad$ Asp-Mod-Temp

9 V_{tr} $\qquad$ $Verb_{tr}$
$\qquad\qquad$ Asp-Mod-Temp

10 Subst $\qquad$ man, table

11 Num $\qquad$ Sing, Plur
$\qquad\qquad$ etc..

These rules belong to a context-free phrase structure grammar; dependency relations are also considered here.

The symbol Pred (predication) plays a similar role here as S in the new variant of transformational grammar.

On this level there are 3 types of symbols:

semoglyphes (=word-meanings), suffixes (only the independent

ones) and functors (R_a for actor, R_p for patiens, R_d for determination) .

The second component consists of rules(a) giving to the string the order 'regens post rectum',(b) changing the string into a string with parts-of-sentence structure.

Then comes a component, changing the string into a morpheme string, then to phoneme string and at last to a string of sounds.

2.5. In this new modification of generative grammar the semantics is not treated as a special component added to the grammar, but as an integral part of the "grammatical" description. The relation between the set of "semantic representations" as the input and the phonetic representation as the output is described as a hierarchic structure (divided into several levels) by a sequence of operations of translating the string from one level to the adjacent level below.

This pushdown generative grammar has some advantages as compared with the transformational grammar. The new system has been tested on a description of the Czech

declension. Naturally, the conception is undergoing developments and is open to criticism. However, it seems to me, the integration of semantics is more acceptable than the attempt by Katz and others.

Bibliography:

Chomsky, N.:	Syntactic Structures (1957)
Chomsky, N.:	Aspects of the Theory of Syntax (1965)
Chomsky, N.:	Topics in the Theory of Generative Grammar
Katz, J.J. – Postal P.M.:	An Integrated Theory of Linguistic Descriptions (1964)
Sgall, P.:	"Generative Beschreibung und die Ebenen des Sprachsystems", in Zeichen u. System der Sprache III (1966)
Sgall, P.:	Generativni popis jazyka a ceska deklinace (1967)