

# Models in linguistics: some epistemological considerations through three models from the past

Chiara Mazza  
University of Pisa  
`chiara.mazza@for.unipi.it`

April 28, 2011

## Abstract

Starting from Shaumjan [1965]'s definition of *model*, I will present three different examples of linguistic model in order to try to answer the question *Models in linguistics? Why should we use them?* The models presented have been conceived between 1954 and 1965, an important period of change in linguistic science. Moreover, their authors come from different linguistic traditions: Lucien Tesnière is a french linguist coming from the structuralist tradition, Noam Chomsky is a descendent of the american structuralism, and Sebastian Kostantinovich Shaumjan is a sovietic linguist. For these reasons, it may be interesting to compare them and to figure out, through the differences and analogies in the models, an answer to our question. Additionally, some epistemological considerations are presented throughout the paper.

## Introduction

*Peu à peu cependant, on se convainc que la langue n'existe que dans les cerveaux de ceux qui la parlent et que ce sont les lois de l'esprit humain et de la société qui expliquent les faits linguistiques.*  
**Charles Bally, Le langage et la vie, 1926**

Although the tradition of using models in linguistics started more than fifty years ago, the discussion about the opportunity of using them and, above all, about which kinds of models linguistics should use, is still open. The question is a delicate one because it gives space to more general epistemological considerations about which kind of science linguistics is, what is its object of study, what a linguist is supposed to do, and so on. That's why I think it may be useful to look back at some models of the past to try to understand which aims moved the authors to construct them for their theories. The aim of the present paper is also to present Tesnière's and Shaumjan's works which are not less important, at least for epistemological reflexions, than the more well-known one proposed by Chomsky.

## 1 Model: a question of terminology

The use of the word *model* is quite confusing because of the many different definitions of it given by linguists. Before starting my analysis is therefore necessary to clearly define what is my meaning for that word. For this reason, I propose to take Shaumjan's definition of model:

a model is a theory with visual content in the form of images which serve as analogues of unobservable objects<sup>1</sup>.

Hence with *model* I mean a representation of a particular aspect of reality, elsewhere not easily observable, by means of abstract objects created for the model or concrete objects taken from reality, which have an analogue function as the objects the scientist is studying. This representation is conceived from the intuitions the investigator has while observing the visible aspects of the reality he's trying to find an explanation for.

To give a very simple but significative example of model, let us consider a plastic model representing the planet Earth. It perfectly works as functional analogue of our planet. It is inclined as the Earth, it rotates on its axis, there are meridians and parallels on it, there are blue zones which represent the seas and coloured zones which represent the lands... We can't say that it is identical to the Earth and, looking at some aspects, it is far from similar to the real planet, but it certainly gives some rough information about its composition and functioning.

## 2 Analysis of three linguistic models

I will now present the three models trying to be as much synthetic and exhaustive as possible. I will give only a rough description of the most representative features as they appear in the three major works of their authors: Tesnière [1959], Chomsky [1957], and Shaumjan [1965]. In spite of publication's years, the chosen order is chronological as the book by Tesnière has been published after his death in 1954.

### Lucien Tesnière

The french linguist never uses expressly the word *model*. However, his point of view on syntax, underlying its non-visible aspect and the necessity of investigating it on the base of the observable data, using an introspective approach, makes his theory of syntax a good example for our definition of *model*.

First of all, he distinguishes between the *ordre linéaire*, the outer form of the *chaîne parlée*, i.e., the linear order of the surface string of words in the text, and the *ordre structurale*, i.e., the inner form which includes a network of relations on an abstract independent level. Then he establishes that the object of study of syntax is to investigate the structural order and its relations.

The core concept in Tesnière's model is the idea of *connection*<sup>2</sup>, the syntactic link existing between the elements within the sentence. In Tesnière's words:

---

<sup>1</sup>[Shaumjan, 1971, 62]

<sup>2</sup>Cfr. Schneider [1998] for english translation of french terms introduced by Tesnière.

la connexion est **indispensable** à l'expression de la pensée. Sans la connexion, nous ne saurions exprimer aucune pensée continue et nous ne pourrions qu'énoncer une succession d'images et d'idées isolées les unes des autres et sans lien entre elles<sup>3</sup>.

Every connection builds a dependency link between two elements in the sentence, one of them taking the role of governor and the other of dependent (*régissant* and *subordonné* in tesnièrean terminology). If we take a very simple sentence such as *Peter sleeps*, we have then three elements: *Peter*, *sleeps*, and the connection between them.



Tesnière chooses to represent syntactic relations, i.e., connections, using a so-called *stemma* as in 1<sup>4</sup>.

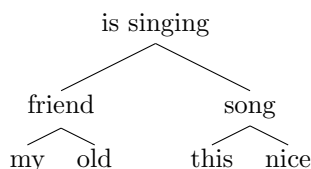


Figure 1: *Stemma* of the sentence *My old friend is singing this nice song*.

Such a kind of representation makes clear the dependency between governors and dependents, putting the formers above the latters. Every element, except the root one, can be a governor and a dependent at the same time. If we take e.g. *friend* in the stemma 1 above, it depends on *is singing* but at the same time it governs *my* and *old*. The root element in a clause, except for verbless clauses, is the verb.

For Tesnière, all words should be divided into two classes: *mots pleins*, i.e., full content words, and *mots vides*, i.e., empty functional words<sup>5</sup>; the formers being words with semantical content, and the latters functional words without semantical content, e.g. articles or prepositions. This distinction is not the same for every language and it is not strict or fixed, but rather a continuum from semantically full words to completely empty ones. Each full word forms a *nucléus* which may include one or more empty words, and it is between nuclei that connections are established. For this reason, we should consider *nuclei* as the basic element of the model.

The syntactic function (or *fonction nodale*, in tesnièrean words) within the nucleus is performed by the so-called *nœud*, i.e., the node, corresponding with the full word within the nucleus, and it's the *nœud verbal* which plays the principal syntactic role within the simple clause.

Le nœud verbal [...] exprime tout un **petit drame**. Comme un drame en effet, il comporte obligatoirement un **procès**, et le plus

<sup>3</sup>[Tesnière, 1959, 12]

<sup>4</sup>The sentence represented is my translation from french original one *Mon vieil ami chante cette jolie chanson* [Tesnière, 1959, 14].

<sup>5</sup>The english traslantion of these terms is mine.

souvent des **acteurs** et des **circonstances**. Transposés du plan de la réalité dramatique sur celui de la syntaxe structurale, le procès, les acteurs et les circonstances deviennent respectivement le **verbe**, les **actants** et les **circonstants**<sup>6</sup>.

The verb represents the process expressed by the clause, *actants*, i.e., verb's arguments, represent the participants (objects or persons) in the process, and are always nouns or noun's equivalents, while *circonstants*, i.e., clause's adjuncts, represent the circumstances under which the process is taking place, i.e. time, space, manner, etc., and are always adverbs or adverb's equivalents.

*Actants* are usually compulsory within the clause, and the number of compulsory arguments of the verb is determined by the verb's *valence*. So the verb *to give* is *trivalent* as it requires at least the presence of a giver, a destinatory, and a thing to be given, while *to sing* is *bivalent*, requiring a singer and something to be sung, and *to sleep* is *monovalent*, requiring only a subject. However, Tesnière underlines the fact that it is not always necessary for verbs' valences to be *saturated*, e.g. we can say *Alfred is singing* instead of *Alfred is singing a song*. Although arguments might be syntactically absent within the clause (e.g. actors in passive constructions), they are always semantically present because of the verb's semantic structure, which conceptually requires them.

Having explained the scheme of the simple clause, Tesnière introduces two operations, by means of which is possible to pass from simple clauses to more complex ones.

One of them is the *jonction*, i.e., junction, which is employed to bond nodes lying at the same level, i.e., horizontally in the stemma, and corresponds to coordination or non-subordinating conjunction. Junction creates a conjunction by means of an empty word called *jonctif* between two or more elements, belonging to the same node category, without establishing a dependency connection. There are cases in which the junctive might be absent or replaced by a punctuation mark, such as a coma.

Here are some examples of junction with their corresponding stemmas in figure 2. In clause 1, the bond is established between noun nodes through the conjunction *and*, in 2 there's a bond between adjectival nodes through *but*, and in 3 between verbal nodes through *and*.

- [1] Alfred and Bernard fall
- [2] a good, but expensive lunch
- [3] children laugh and sing

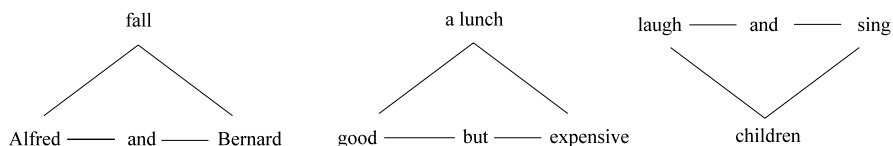


Figure 2: Some examples of *junction*.

<sup>6</sup>[Tesnière, 1959, 102]

The other operation presented by Tesnière is called *translation*, which can be best translated in English as *transference*, as Tesnière [1959, 367] himself suggests, to avoid all kind of misunderstandings with the other meaning of the word *translation* in English<sup>7</sup>. There are two types of transference, a first degree transference, which applies to single words and corresponds to derivation and composition, and a second degree transference, which applies to verbal nodes, i.e., whole clauses composed by the verb and all its dependents, and corresponds to subordination.

The first degree transference is a shifting process which makes a word change from a grammatical category, i.e., a part of speech or word class, to another. Tesnière distinguishes four word classes, i.e., O for noun, A for adjective, I for verb, and E for adverb, and uses transference to allow words to take functions which normally are accomplished by words of a different word class. The process occurs by means of an empty word called *translatif*. Similarly to junctive, also this *transferrer* element might be absent in some cases.

To take some examples of first degree transference we may compare the following sentences meaning exactly the same in english, french and latin. In all the examples a word from the word class O (noun) is transferred to the word class A (adjective): O>A. Figure 3 shows the corresponding stemmas.

- [4] Peter's book
- [5] le livre de Pierre
- [6] liber Petri

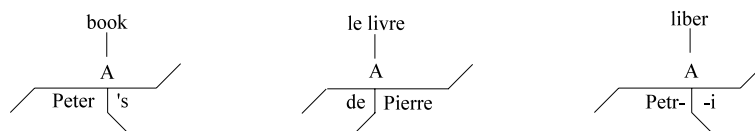


Figure 3: Some examples of *first degree transference*.

In 4, the noun *Peter* takes the function of an adjective by means of the transferrer *'s*, in 5 *Pierre* is transferred by means of the preposition *de*, and in 6 *Petrus* becomes an adjective through the genitive ending *-i*.

Tesnière's point of view [1959, 361] is that, even if we have three different linguistic expressions in three different languages, the concept expressed, i.e., possession, is the same for all of them, as well as its syntactic deep structure. It is only the surface form of it which differs. He underlines the idea that connection is a phenomenon concerning all languages. According to him, linguists should study languages starting from their syntactic similarities, and only at a later stage study how they differ at the morphological level.

The second degree transference implies a change of syntactic level: a verbal node takes a dependent position within another verbal node, maintaining all its previous lower connections. In this case, we always have a verb (I) changing to another word class.

<sup>7</sup>Cfr. Schneider [1998], who translates it as *translation*.

The sentences below represent some examples of second degree transference<sup>8</sup>. In 7 and 8, we have two transferences I>>O by means of the transferrer *that*. The embedded clause in italics takes the function of a noun: it is the object in 7 and the subject in 8. The embedded clause in 9 has the function of an adjective. It is a transference I>>A without any transferrer. The sentences in 10 and 11 are two examples of the transference I>>E. In 10, the clause in italics has the function of a temporal adverb; the transferrer is *when*. In 11, the clause in italics is a causal clause; the transferrer is *because*. In figure 4 you find the corresponding stemma for 7.

- [7] I believe *that he speaks*
- [8] It's sure *that he speaks*
- [9] The man *I saw yesterday* is here today
- [10] You will see him *when he comes*
- [11] He could not come, *because he was ill*

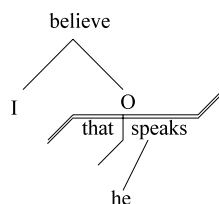


Figure 4: An example of *second degree transference*.

In Tesnière classification of the empty words by means of which it is possible to obtain a junction or a transference, the junctives correspond to coordinating conjunctions, while the first degree transferrers correspond to prepositions or postpositions, and the second degree transferrers correspond to subordinating conjunctions. When a junction or a transference occurs without any empty word he speaks of *marquant zéro*, which corresponds to juxtaposition or parataxis.

## Noam Chomsky

*Syntactic structures* by Chomsky represents *part of an attempt to construct a formalized general theory of linguistic structures and to explore the foundations of such a theory*<sup>9</sup>. The idea of a *formalized general theory* does not match our concept of model<sup>10</sup>, but it clashes with another important chomskyan concept, a *grammar of L*, which is not far from our meaning for model.

A *grammar of the language L* is presented as *a device that generates all of the grammatical sequences of L and none of the ungrammatical ones*<sup>11</sup>. In this

<sup>8</sup>These sentences are some english examples proposed by Tesnière [1959, livre D].

<sup>9</sup>[Chomsky, 1957, 5]

<sup>10</sup>However, Chomsky uses this word elsewhere with another meaning, see e.g. the *finite state model* and the *phrase structure model* presented in §3 and §4 [Chomsky, 1957].

<sup>11</sup>[Chomsky, 1957, 13]

sense it is a model which should produce exactly the observable real objects of a language L, i.e., grammatical sequences of L. Chomsky himself, later in the text<sup>12</sup>, gives a definition of it which is very similar to the one we gave above for model:

a grammar of the language L is essentially a theory of L. Any scientific theory is based on a finite number of observations, and it seeks to relate the observed phenomena and to predict new phenomena by constructing general laws in terms of hypothetical constructs such as (in physics, for example) “mass” or “electron”. Similarly, a grammar of English is based on a finite corpus of utterances (observations), and it will contain certain grammatical rules (laws) stated in terms of the particular phonemes, phrases, etc., of English (hypothetical constructs). These rules express structural relations among the sentences of the corpus and the indefinite number of sentences generated by the grammar beyond the corpus (predictions).

Since *language*, in Chomsky’s words, is *a set (finite or infinite) of sentences, each finite in length and constructed out of a finite set of elements*, the aim of linguistic analysis, in chomskyan view, is

to separate the *grammatical* sequences which are sentences of L from the *ungrammatical* sequences which are not sentences of L and to study the structure of the grammatical sequences<sup>13</sup>.

This should be done by *producing a device of some sort (called grammar) for generating all and only the sentences of a language*<sup>14</sup> and by establishing if the grammars created are adequate or not for this aim, according to some conditions of adequacy. Within the external conditions, we have already noticed the *grammaticality* of the generated sequences. Within the internal conditions, we find *generality* and *simplicity* of the proposed grammar.

Whether a sequence is grammatical or not should be established on an intuitive base, following the native speaker’s judgment on it. This judgement on grammaticality should not be confused with a judgment on the meaning of sequences or on the probability of finding them in context. Chomsky affirms the total independence of grammar from meaning and use, i.e., the complete independence of syntax from semantics and pragmatics<sup>15</sup>.

The generality condition requires the existence of a *general theory of linguistic structure*, written in a *metalanguage*, and *in which the descriptive devices utilized in particular grammars are presented and studied abstractly, with no specific reference to particular languages*<sup>16</sup>. This general theory defines the elements concerning each language (e.g. “phoneme” or “phrase”) independently from any language, i.e., as general abstract elements corresponding to particular concrete elements in each language, and helps us to evaluate different grammars and choose the best one for our aims<sup>17</sup>.

---

<sup>12</sup>[Chomsky, 1957, 49]

<sup>13</sup>[Chomsky, 1957, 13]

<sup>14</sup>[Chomsky, 1957, 85]

<sup>15</sup>See [Chomsky, 1957], §6 on the conditions of adequacy and §2 on the independence of grammar.

<sup>16</sup>[Chomsky, 1957, 11]

<sup>17</sup>[Chomsky, 1957, §6]

On the other hand, the simplicity condition requires an evaluation within the system of a concrete language:

it is when we find that simplification of one part of the grammar leads to corresponding simplification of other parts that we feel that we are really on the right track<sup>18</sup>.

For Chomsky, the core concept of the linguistic theory is the notion of *linguistic level*, i.e., *a set of descriptive devices that are made available for the construction of grammars, [...], a certain method for representing utterances*. The linguist should study different aspects of linguistic structure by *considering a succession of linguistic levels of increasing complexity which correspond to more and more powerful modes of grammatical description*<sup>19</sup>.

Between the levels there's an interdependence relation, but Chomsky thinks we should abandon the idea that higher levels are constructed out of lower level elements. He introduces an abstract level of representation, a representation as transformational structure, *where each utterance is represented by the sequence of transformations by which it is derived from a terminal string of the phrase structure*<sup>20</sup>. Consequently, the grammars conceived within a linguistic theory which takes account of the linguistic levels will possess a natural tripartite arrangement:

corresponding to the level of phrase structure, a grammar has a sequence of rules of the form  $X \rightarrow Y$ , and corresponding to lower levels it has a sequence of morphophonemic rules of the same basic form. Linking these two sequences, it has a sequence of transformational rules<sup>21</sup>.

In Chomsky's opinion, the phrase structure model, which he presents in §4, serves to give descriptions for many phenomena of English, but it does not suffice to explain the complexity of language. So, he proposes to maintain the concepts of the phrase structure model based on constituent analysis as one of the linguistic levels concerning language, and to integrate it with a set of *grammatical transformations* which could describe in a simple way all the sentences of L.

If we were to attempt to extend phrase structure grammar to cover the entire language directly, we would lose the simplicity of the limited phrase structure grammar and of the transformational development<sup>22</sup>.

To resume, we have a grammar G, composed by a phrase structure part,

defined by a finite set  $\Sigma$  of initial strings and a finite set F of 'instruction formulas' of the form  $X \rightarrow Y$  interpreted: "rewrite X as Y"<sup>23</sup>

---

<sup>18</sup>[Chomsky, 1957, 56]

<sup>19</sup>[Chomsky, 1957, 11]

<sup>20</sup>[Chomsky, 1957, 59]

<sup>21</sup>[Chomsky, 1957, 45-46]

<sup>22</sup>[Chomsky, 1957, 42]

<sup>23</sup>[Chomsky, 1957, 29]

and a transformational part, where a transformation is defined as follow:

a grammatical transformation  $T$  operates on a given string (or on a set of strings) with a given constituent structure and converts it into a new string with a new derived constituent structure<sup>24</sup>.

Then the morphophonemic rules have to be applied to pass from the deep structure to the linear form of speech.

The example of simple *instruction formulas*, which you find in 12, is given in §4, too. As well as the tree representational diagram of the simple sentence *The man hit the ball*, which is in figure 5.

- [12] (a)  $Sentence \rightarrow NP + VP$   
 (b)  $NP \rightarrow T + N$   
 (c)  $VP \rightarrow Verb + NP$   
 (d)  $T \rightarrow the$   
 (e)  $N \rightarrow man, ball, ecc.$   
 (f)  $Verb \rightarrow hit, took, ecc.$

- [13] The man hit the ball

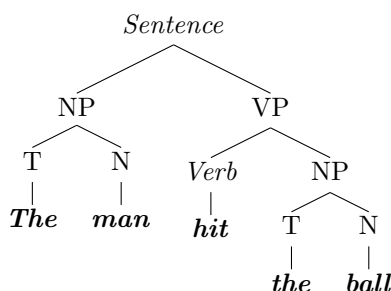


Figure 5: An example of representation following the constituent analysis.

The set of grammatical transformations includes obligatory transformations, as well as optional ones. Chomsky defines the *kernel* of the language, the set of sentences that are produced when only obligatory transformations are applied to the terminal strings of the  $[\Sigma, F]$  grammar. The transformational part of  $G$  should be conceived in such a way that transformations can be applied to kernel sentences and to prior transforms, as well. Consequently, we would have two kinds of sentences in  $L$ : kernel sentences and derived sentences by means of one or more transformations<sup>25</sup>.

This approach has the aim to simplify as much as possible the grammar and to proceed in a recursive way from the simplest sequences to more complex ones. For the same reason, Chomsky proposes to choose as kernel of  $L$  the set

<sup>24</sup>[Chomsky, 1957, 44]

<sup>25</sup>[Chomsky, 1957, 45]

of sentences which appears to be the simplest to describe by the constituent analysis and the most natural base for the application of transformations, i.e., *simple, declarative, active sentences*<sup>26</sup>.

To specify a transformation it is necessary to describe explicitly the analysis of the type of sentences it applies to and the structural change it operates on them. Let us consider, e.g., the *passive transformation*<sup>27</sup>. It applies to strings (corresponding to kernel sentences) of the form in 14a and gives, as a result, strings (corresponding to transforms) structurally modified as in 14b.

- [14] (a)  $NP_1 - C - V - NP_2$   
 (b)  $NP_2 - C + be + en - V - by + NP_1$

Let's then apply it to a concrete sentence, as in 15 below:

- [15] (a)  $John - C - admire - sincerity \rightarrow$  John admires sincerity  
 (b)  $sincerity - C + be + en - admire - by + John \rightarrow$  sincerity is admired by John

To conclude, let us come back for a moment to the *natural tripartite arrangement* of grammar mentioned above. There are three linguistic levels: the phrase structure level, in which the simplest strings are generated, the morphophonemic level, in which strings of morphemes are converted into strings of phonemes, and the transformational level, in which the strings generated by the phrase structure level are converted into strings to which morphophonemic rules can be applied. However, there is a substantial difference between the levels, which makes the transformational level more abstract than the others:

the phrase structure and morphophonemic rules are elementary in a sense in which the transformational rules are not. To apply a transformation to a string, we must know some of the history of derivation of this string; but to apply non-transformational rules, it is sufficient to know the shape of the string to which the rule applies<sup>28</sup>.

## Sebastian Kostantinovich Shaumjan

With his *Strukturnaja Lingvistika*, Sebastian Kostantinovich Shaumjan describes a new *dynamic theory* of structural linguistics, arguing that the object of study of structural linguistics should be the dynamic aspect of synchrony<sup>29</sup>.

Based on the same *Generative Grammars* framework, the model proposed in Shaumjan [1965] is actually an attempt to extend and modify the transformational model presented in Chomsky [1957]. However, the *applicational generative model*, how its author calls it, is much more complex and formal than the chomskyan one. We will therefore limit our presentation to its fundamental principles, avoiding a deep description of its more formal aspects.

First of all, Shaumjan builds up his model using the *hypothetico-deductive method*, which he describes as follow:

---

<sup>26</sup>[Chomsky, 1957, 80]

<sup>27</sup>[Chomsky, 1957, 42-43]

<sup>28</sup>[Chomsky, 1957, 107]

<sup>29</sup>[Shaumjan, 1971, 5]

the hypothetico-deductive method consists of constructing and using for cognitive purposes a deductive system of hypotheses, from which assertions about empirical facts may be deduced<sup>30</sup>.

To better explain his methodology, Shaumjan quotes I. A. Melchuk on *verifying the adequacy of generative grammars*. I will use this quotation and the following ones to better clarify the functioning of the hypothetico-deductive method and to define more precisely the shaumjan concept of *model*.

Let us assume that we are considering a group of arbitrary objects generated by a mechanism unknown to us. This mechanism is not available for immediate observation, and we can draw conclusions about it only from the results of its activity, i.e., from the properties of the set of objects it has generated. Here we are interested in the particular mechanism only in a strictly defined sense: It is important for us just to know those aspects of its functioning that cause it to generate the particular set. None of the concrete properties of the mechanism or of its functioning are relevant to us.

By analysing the totality of objects available to us from the mechanism, we can create a hypothetical description of it. To verify this description, we can construct a model of the mechanism based on it. This would be only a model and not a copy of the mechanism, since very many concrete properties of the mechanism will not have been studied, and in some respects the model will not resemble the mechanism itself at all. But if this model in function can generate exactly the same objects as the mechanism studied, then we can conclude that our model is adequate in the relevant respects and consequently that our description is accurate. (Of course, this description does not have to be unique; other equally correct descriptions are possible.)<sup>31</sup>

The hypothetico-deductive method consists therefore of an *hypothetical description* of a non-directly observable mechanism on the base of the observable data generated by the activity of the mechanism itself. In Shaumjan's opinion, however, a further condition should be added for the description to be considered verifiable: the model should not be limited to the generation of the exact elements which exist in the language for which it has been created, but also, *on a deductive base*, to generate some observable consequences on the hierarchy existing between them. In fact,

a hypothetico-deductive system can serve the purpose of cognition only if it is capable of predicting facts lying outside the boundaries of the circle of facts for the explanation of which it was constructed<sup>32</sup>.

However,

to consider that a generative device from which it is impossible to deduce any other observable consequences except about the correct

---

<sup>30</sup>[Shaumjan, 1971, 40]

<sup>31</sup>[Ahmanova, O. A., Melchuk, I. A., Frumkina, R. M. and E. V. Paducheva, 1963, 45], quoted in [Shaumjan, 1971, 50-51].

<sup>32</sup>[Shaumjan, 1971, 47]

objects present in the given language — to consider that such a generative device is a theoretically unverifiable hypothesis, does not mean denying the value of this generative device. It all depends on the angle from which one looks at a generative device. [...] To state that the work done by a sewing machine does not model the work done by a seamstress does not mean denying the usefulness of sewing machines. Sewing machines do nothing for us to model the mechanism of the work done by the seamstress, but sewing machines are necessary for sewing clothes. A generative device, from the description of which it is impossible to deduce any other consequences except about the correct objects present in the given language, cannot be used for finding out about the inner generative mechanism of the language, but it is none the less very useful for machine translation or other practical purposes<sup>33</sup>.

Paying attention to this important methodological premise, let us try to explain the two fundamental principles that Shaumjan takes as a base for the development of his model: the *semiotic two-stratum structure* of natural languages and the *two-level principle*.

The concept of *semiotic two-stratum structure* refers to the necessity of a secondary semiotic stratum in natural languages, which makes it differ from other semiotic systems. Shaumjan argues that, due to the limited capacity of the human memory, in natural languages the primitive semiotic system of signs is overlaid by a secondary semiotic system of diacritic linguistic elements<sup>34</sup>.

According to the *two-level principle*, and taking in account the semiotic two-stratum structure, Shaumjan then distinguishes two fundamental levels of abstraction:

on the semiotic level are idealized semiotic elements free of any physical substance, and on the physical level are the acoustic substrata of these idealized semiotic elements<sup>35</sup>.

A generalization of this principle to the whole linguistic analysis leads to a *two-level theory of generative grammars*, in which to the *level of observation* is added the *level of constructs*, i.e., the level of the model. The former being the level of concrete and observable linguistic objects, and the latter the one of the abstract objects within the model, i.e., *constructs*, that help us to understand the functioning of the internal mechanism of language.

In connection with the necessity of applying the two-level principle in generative grammar, I introduced the terms ‘phenotype’ and ‘genotype’ into structural linguistics. I borrowed these terms from biology where ‘phenotype’ is the outward appearance of an organism, but ‘genotype’ is the genetic constitution of the organism. Organisms can have similar phenotypes but different genotypes, and, vice versa, similar genotypes but different phenotypes<sup>36</sup>.

---

<sup>33</sup>[Shaumjan, 1971, 51-52]

<sup>34</sup>[Shaumjan, 1971, 69]

<sup>35</sup>[Shaumjan, 1971, 73]

<sup>36</sup>[Shaumjan, 1971, 77]

The Russian linguist distinguishes therefore a *phenotype level* and a *genotype level*. According to this distinction, he overtly criticizes Chomsky arguing for the necessity of a new model, which should work differently from the American linguist's transformational one.

Corresponding to the two-level principle the task of each generative grammar must be, not directly to generate the linguistic objects of an actual language, as provided for in Chomsky's one-level theory of generative grammars discussed above, but to generate objects in two phases. In the first phase idealized linguistic objects are generated — genotype words and sentences together forming an idealized language which I call a genotype language. In the second phase the idealized objects of the genotype language must be transformed by correspondence rules into phenotype words and sentences of actual languages, which I call phenotype languages to distinguish them from the genotype language<sup>37</sup>.

Shaumjan finds out an important difficulty in the transformational model, i.e., its attempt to be an *explanatory model* of deep structures of language, on one hand, together with the fact that it operates with strings that should be considered as a *linguistic phenotype*, on the other hand. Therefore, in Shaumjan's opinion the transformational model works intertwining genotype level and phenotype level facts. Consequently,

in connection with the necessity for strictly differentiating the genotype and phenotype levels of abstraction I have proposed a new model, called the applicational generative model. This model deals not with strings but with complexes<sup>38</sup>.

A complex, as he explains, is a set of ordered elements whose notational order is irrelevant. The relationship existing between the structure of complexes and of strings is the same as the relationship between genotypes and phenotypes. There are two types of rules for the generation of complexes, i.e., *rules for generating complexes* and *rules for transforming complexes*. *Application* is the basic operation for the generative rules and, in principle, using this operation it is possible to generate complexes of any degree of complexity. For this reason, in theory, this operation should be sufficient for the model. However, as Shaumjan explains, transformational rules are added to the applicational generative model because they enable us to derive the transformations automatically, while in the transformational model the transformations are given arbitrarily in a list.

Moreover,

it is transformations which allow us to set up invariance relations between sentences. [...] By revealing the invariance relations we can investigate the inner dependencies of linguistic structure and thus increase the explanatory power of the applicational model<sup>39</sup>.

---

<sup>37</sup>[Shaumjan, 1971, 80]

<sup>38</sup>[Shaumjan, 1971, 143]

<sup>39</sup>[Shaumjan, 1971, 201]

According to these considerations, the applicational generative model consists of four special models, related one to another, that Shaumjan calls *generators*. They generate *abstract objects* that must be *empirically interpreted*, i.e., a correspondence is to be established, in a second phase, between the symbols in the model and the grammatical objects of a concrete language<sup>40</sup>.

The *abstract generator* is based on elementary units called *semions* which are abstract analogues of the distinctive elements of phonology, i.e., the simplest semiotic objects which serve as a base for any linguistic unit. A *word generator* is used for generating analogues of natural language words, while a *phrase generator* is in charge of the generation of *complexes of words*, i.e. abstract analogues of natural language phrase. Finally, a *transformational-field generator*, or *T-generator*, generates abstract objects called *transformational fields*, i.e. sets of possible transforms based on the same primitive phrase.

There are four *types of generation*, used by the generators in their activity, the *iterative process*, the *reductive process*, the *conversion process*, and the *connectorial process*<sup>41</sup>.

Shaumjan then introduces the notion of *relator*, which can be interpreted as an *abstract affix* used for generating derived words into the word generator, adding to their *root* some grammatical information.

Elementary words, generated by the word generator, after the application of relators to roots, look then like this:

$$R_10, R_20, R_30, R_40, R_50$$

where 0 represent words' *lexemes*, to which *verb affixes* ( $R_1$ ), *noun affixes* ( $R_2$ ), *adjective affixes* ( $R_3$ ), *adverb modifying verb affixes* ( $R_4$ ), and *adverb modifying adjective affixes* ( $R_5$ ) are applied to form words<sup>42</sup>.

To conclude, let us show some examples of *abstract words*, generated by the word generator, some examples of *complexes of words*, generated by the phrase generator, one example of *transform string*, and one example of *transformation*, generated by the T-generator, and consider some possible interpretations for russian and their english equivalents<sup>43</sup>.

Between words of the *first degree of derivation* we can find:

- $R_10$  finite forms of verbs (e.g., *učit* 'teaches', *bežit* 'runs', *vidit* 'sees');
- $R_20$  nouns in nominative case (e.g., *dom*, 'house', *karta* 'map', *koška* 'cat', *lico* 'face');
- $R_30$  adjectives (e.g., *belyj* 'white', *veselyj* 'merry', *krasivyj* 'beatiful', *gor'kij* 'bitter');

<sup>40</sup>Due to the complexity of Shaumjan's theory, to explain the basic features of the applicational generative model I refer to Shaumjan [1970, §III], the italian translation of Shaumjan [1965], while for russian and english examples I refer to Shaumjan [1971]. Moreover, in the english version of the book chapter §5 has been completely rewritten, adding some further developments of the theory which I prefer to ignore, as they have been conceived six years later, when many developments had been introduced in Chomsky's theory as well (cfr. Chomsky [1965]).

<sup>41</sup>[Shaumjan, 1971, 339]

<sup>42</sup>[Shaumjan, 1971, 172]

<sup>43</sup>Actually, the applicational model should be an useful explanatory model for any natural language. The description of each language, however, should be done by adapting the correspondence rules between the abstract objects generated by the model and the concrete objects in each language, i.e. different languages have different interpretations for the same abstract objects [Shaumjan, 1971, 310-311].

$R_40$  adverbs modifying verbs (e.g., *zdes* ‘here’, *tam* ‘there’, *včera* ‘yesterday’, *zaftra* ‘tomorrow’);  
 $R_50$  adverbs modifying adjectives (e.g., *očen*, *ves’ma* ‘very’).

While, between words of the *second and third degree of derivation* we have:

$R_2R_10$  (e.g., *učenie* ‘teaching’, *učit* ‘to teach’, *učitel* ‘teacher’; *beg* ‘running’, *bežat* ‘to run’, *beglec* ‘fugitive’);  
 $R_1R_2R_10$  (e.g., *est’ učenie* ‘is teaching’, *est’ učitel* ‘is a teacher’, *učitel’stvuet* ‘works as a teacher’);  
 $R_3R_20$  nouns in the genitive case (e.g., *dóma* ‘of the house’, *karty* ‘of the map’) or an adjective derived from a noun (e.g., *domašnij* ‘domestic’, *košačij* ‘feline’, *licevoj* ‘facial’);  
 $R_4R_20$  nouns in an oblique case modifying a verb or an adverb derived from a noun (e.g., *noč’ju* ‘at night’, *sverxu* ‘on top’);  
 $R_2R_30$  noun derived from an adjective (e.g., *belizna* ‘whiteness’, *veselost’* ‘meriment’, *krasota* ‘beauty’);  
 $R_4R_30$  adverb, derived from an adjective, modifying a verb (e.g., *veselo* ‘merrily’, *bystro* ‘quickly’);  
 $R_3R_40$  adjective derived from an adverb modifying a verb (e.g., *včerašnyj* ‘yesterday’s’, *zavtrašnyj* ‘tomorrow’s’)<sup>44</sup>.

Let us consider, as instances of complexes of words, some sentences with the structure subject-verb-object in 16. These sentences, in the model, are all of the type  $R_20R_10R_4R_20$ , where  $R_20$  is a noun with the function of *subject*,  $R_10$  is a verb in its finite form, and  $R_4R_20$  can be a noun with or without a preposition or an adverb with the function of *direct* or *indirect object*.

- [16] (a) He won 10 pounds  
 (b) He came home  
 (c) He works at the office

Let us now show in 17 an instance of the so-called, in Shaumjan terminology, *transform string*, i.e.,

a sequence of transforms  $T_0, T_1, T_2, \dots, T_n$  in which the initial unit is the T-base (the null transform) and the final unit is the transform which we want to generate during one or another cycle of the T-generator<sup>45</sup>.

- [17] (a)  $T_0$  *belyj sneg* ‘white snow’  $R_30R_20$   
 (b)  $T_1$  *sneg bel* ‘snow is white’  $R_1R_30R_2R_20$   
 (c)  $T_2$  *belizna snega* ‘the whiteness of the snow’  $R_2R_1R_30R_3R_2R_20$

Finally, in 18 we have an instance of the *transformation*  $R_20R_10R_4R_20 \rightarrow R_1(R_3R_20R_2R_10)R_2R_4R_20$ , where the verb in the T-base becomes a noun derived from a verb<sup>46</sup>.

- [18] *Fleming otkryl penicillin* ‘Fleming discovered penicillin’  $\rightarrow$  *Otkrytie Fleminga — penicillin* ‘Fleming’s discovery was penicillin’

<sup>44</sup>[Shaumjan, 1971, 173-174]

<sup>45</sup>[Shaumjan, 1971, 211]

<sup>46</sup>[Shaumjan, 1971, 283]

### 3 Different traditions

From the analysis of the three models evident analogies emerge, both for their epistemological and philosophical fundamental ideas and for their practical organization.

Four basic concepts in particular can be found in any of the three models, i.e., *generality*, *abstraction*, *simplicity*, and *representation*, however their manifestations are different, at least for some aspects, in each of them.

Let us clarify these concepts and associate them to each model.

A search for *generality* can be found as the base of all models. Tesnière's proposal is to provide the description of a *general syntax*, valid for any language. Chomsky's intention is to build up a *formalized general theory* with the aim to define the criteria for the choice of the best explanatory grammar for any language. And Shaumjan chooses to split his model's activity in two phases to dedicate the second one to the *correspondence* between the abstract objects generated in the first phase and the concrete objects of any language.

But this is not the only meaning of *generality* which can be found in the models: actually, all of them show the desire to reach a good way to describe the *invariance relations* which can explain the *deep structure* of language. Tesnière, on one hand, struggles for grouping linguistic phenomena by their analogies in the inner syntactic structure and against a classification based on superficial morphological differences. Chomsky and Shaumjan, on the other hand, use transformations to underline the deep relation existing between kernel and more complex sentences.

This search for generality seems to respond to one of the fundamental tasks of linguistics indicated by Saussure in his *Cours*, i.e., to search for the universal forces which operate in any language and to extract from them general laws for the explanation of all particular phenomena:

de chercher les forces qui sont en jeu d'une manière permanente et universelle dans toutes les langues, et de dégager les lois générales auxquelles on peut ramener tous les phénomènes particuliers de l'histoire<sup>47</sup>.

A form of *abstraction* is present in all models, but it is necessary to distinguish what this means for Tesnière, on one hand, and for Chomsky and Shaumjan, on the other hand. Actually, the term *abstraction* has a first meaning which can be found in any of the models, but then Chomsky and Shaumjan develop the concept in a further way.

The three linguists operate a process of abstraction to approach the deep *order* or *level* of language, i.e., the non-visible level of deep syntactic structure, Humboldt's *innere sprachform*. All of them leave aside the other levels of language to investigate the most abstract one. I will not examine closely which kind of relation the three linguists find to exist between this level of linguistic structure and the others, but all of them spend some words to relate the levels, underlying the *interdependence* existing between them, with partly convergent and partly very distant positions and opinions<sup>48</sup>. Moreover, in all the three models symbols and formulas are used to describe linguistic structures. But the

<sup>47</sup>[de Saussure, 1916, 20 (ed. 1972)]

<sup>48</sup>Cfr. §II-IV livre A in Tesnière [1959]; §9 in Chomsky [1957]; §3.1 in Shaumjan [1971].

substantial difference is that, while Tesnière uses symbols and formulas corresponding to concrete linguistic objects, i.e., words and sentences, both Chomsky and especially Shaumjan use symbols and formulas corresponding to abstract objects and they operate a correspondence with the concrete objects only after the *generative process*. Actually, Tesnière's model is not conceived to *generate*, but only to explain and describe linguistic structure, while both the others are generative models.

Here we find the biggest difference between the models, maybe the most evident signal of the different traditions existing beside the linguists' work.

Lucien Tesnière is a structuralist european linguist, deeply related with the saussurian school (in fact, the most quoted authors in his book are Charles Bally and Emile Benveniste), and strongly concerned with the idea of the existence of a deep correlation between mental and linguistic categories:

on discerne que les "catégories mentales" et les "lois de la pensée" ne font dans une large mesure que refléter l'organisation et la distribution des catégories linguistiques<sup>49</sup>.

with the consequent philosophical conclusion that natural language has, above all, a biological and social function:

le langage naturel [...] est simplement au service de la vie, non de la vie de quelques-uns, mais de tous, et dans toutes ses manifestations : sa fonction est biologique et sociale<sup>50</sup>.

Moreover, his analysis completely corresponds to Benveniste's very brilliant definition of the term *structure*, i.e., the disposition of the whole in parts and the solidarity shown by the parts, which are mutually influenced.

On entend par structure, particulièrement en Europe, l'arrangement d'un tout en parties et la solidarité démontrée entre les parties du tout qui se conditionnent mutuellement<sup>51</sup>.

Noam Chomsky begins his work as a linguist under the influence of the american structuralist school, initiated by Leopold Bloomfield, in which the idea of *structure* had taken a different meaning respect of the european one.

Pour la plupart des linguistes américains, ce sera la répartition des éléments telle qu'on la constate et leur capacité d'association ou de substitution<sup>52</sup>.

This different conception of *structure*, simply as the disposition of the elements and their capacity of association and substitution, finds its reason in a stronger research for practical stimuli, that led american linguists to follow another development pattern for their investigations and methodologies<sup>53</sup>.

---

<sup>49</sup>[Benveniste, 1966, 6]

<sup>50</sup>[Bally, 1926, 18]

<sup>51</sup>[Benveniste, 1966, 9]

<sup>52</sup>Ibid.

<sup>53</sup>[Lepschy, 1966, 96]

We can then find in Chomsky that Humboldtian idea of *the infinite use of finite means*, together with a search for more formal rigour to explain it within the linguistic description<sup>54</sup>.

Moreover, Chomsky's work has an highly formalistic approach to linguistics, influenced, above all, by Panini's first modern notion of generative grammar, by Zellig Harris' mathematical analysis of linguistic structure, and by Carnap's idea of transformation.

The search for formalism and scientific rigour reaches its highest extent in such a linguist as Sebastian Kostantinovich Shaumjan, which proceeds from the rigorous and rich logico-mathematical sovietic tradition, on one hand, and from the linguistic revolution happened in Russia after Stalin [1951]'s intervention to establish the sovietic politics on linguistic matters, on the other hand.

We find in his work some influence from linguists of the so-called *Copenhagen school*, as well. Especially Hjelmslev is often quoted in Shaumjan [1965] as one of his most important influences.

As shown by Lepschy [1966, 76], linguistic theory becomes more formal and abstract within this school. Linguists' interests are more concerned with phylosophical and logical matters.

La teoria linguistica diviene con Brøndal e Hjelmslev più formale e astratta di quanto non fosse con i loro predecessori; in entrambi si notano del resto spiccati interessi filosofici, e logici in particolare.

Despite of these substantial differences in the approaches the three linguists adopt in their linguistic analysis, which led them to different formulations and developments of their models, all of them embrace an intent of abstraction, which respond to the Saussurian metaphore of language, i.e. the idea that language is an algebra which only knows complex terms.

La langue est pour ainsi dire une algèbre qui n'aurait que des termes complexes. [...] Mais la langue étant ce qu'elle est, de quelque côté qu'on l'aborde, on n'y trouvera rien de simple ; partout et toujours ce même équilibre complexe de termes qui se conditionnent réciproquement. Autrement dit, *la langue est une forme et non une substance*<sup>55</sup>.

This is a very good reason to operate that principle of *simplicity* that the three linguists share. They all search for the most effective, efficient and immediate method to reach the aim of a linguistic description able to explain all phenomena in a particular language, as well as more general phenomena which can be found in any language. A search for simplicity should give the linguist the possibility of better understanding the intrinsic complexity of language facts.

Moreover, a form of *representation* is used in all three models, and it is conceived as a tool for better clarifying, simplifying and explaining something that could appear too complex to understand differently. The graphic tool is always seen as a good way to visualize a non-observable reality.

Finally, one last word about the main differences between Tesnière's model and the others. Using Shaumjanian categories, we shall say that, while Chomsky

---

<sup>54</sup>Cfr. Chomsky [1988, §VI].

<sup>55</sup>[de Saussure, 1916, 168-169 (ed. 1972)]

and Shaumjan himself use an hypothetico-deductive method to build up their models, in such a way that the model is able to predict different facts from the facts it has been conceived for, Tesnière uses a simpler deductive method and limits his model to the description of the linguistic facts it has been conceived for.

## 4 Epistemological considerations

To conclude my analysis, I will now introduce some remarks, which I consider important, when using models in linguistics (and, more generally, in any scientific discipline).

As Lepschy [1966] shows, the notion of *model* is very important in structural linguistics, but it has never been deeply investigated, except for some rare cases<sup>56</sup>. It is a non-univocal term which comes from exact sciences, where it is conceived with two different points of view. From a physical point of view, the idea of model refers to the reproduction into a laboratory of certain real conditions on a different scale. While, from a mathematical point of view, it refers to the representation of phenomena using abstract symbols. We are more interested in the latter, especially where the representation by means of formulas and equations refers to the syntactic functioning of a natural language. But, we are above all interested in the heuristic use of models, as Lepschy shows:

il punto che ci interessa qui è l'uso euristico dei modelli, nella descrizione dei fatti linguistici (sia essa destinata all'ulteriore elaborazione di un modello o no). Il ricorso a un modello si fonda sull'istituzione di un'analogia fra il modello ed alcuni aspetti del fenomeno da descrivere, e quindi sull'ASTRAZIONE di tali aspetti (che vengono considerati pertinenti) da altri (che vengono considerati non pertinenti). Questi aspetti pertinenti sono sempre scelti fra quelli che sono comuni a intere categorie di fatti linguistici.

The structural description that results from the use of a model is therefore based on *abstraction* and *generality*, which make the linguist choose some relevant aspects of the phenomenon to be described and build up some analogies by means of the functioning of the model, while he ignores the less relevant ones. The aspects to be chosen are the more general ones, concerning the highest number of linguistic facts. To illustrate the point on the importance for relevance to be preserved, Lepschy [1966] proposes a very suited parallel between the linguistic research and the work of an engineer in planning a building.

Non è forse inutile ricordare come [...] lo scienziato a cui spesso si attribuisce un atteggiamento tecnico per eccellenza, l'ingegnere, si trovi spesso a dover studiare i suoi problemi in maniera individualizzante: a dover progettare e costruire, poniamo, una casa, o un ponte, o una diga, tenendo conto delle condizioni specifiche [...] che rendono quella sua opera un individuo particolare, diverso da ogni altro, e non un esempio di leggi generali. [...] Ma la pertinenza dovrà sempre essere tenuta da conto, e su di essa si baserà anzi la distinzione dei

---

<sup>56</sup>See, e.g., Gross [1968] and Melchuk [1997].

vari aspetti da considerare. Per quanto concreta e individuale possa essere l'opera richiesta a un ingegnere nessuno dirà che le normali leggi della scienza non gli servono perché sono astratte e generali<sup>57</sup>.

The engineer, when planning a building, may have to consider the specific conditions that make that construction a particular individual, different from any other and far from being an instance of general laws. However, he should take into account the relevance of the aspects to be chosen and consider it in any moment of his work. Even if this process is really specific and refers to individual conditions, nobody could say that the laws of science are not suitable to work on it because they are too abstract or too general.

Therefore, while using models in this way, i.e., with the aim to simplify, abstract and generalize a phenomenon and better understand, study and explain it (both in the case of a linguistic phenomenon and in the case of any other kind of phenomenon), it is necessary to remember what Chomsky and Shaumjan themselves say clearly and overtly about using models in linguistics:

The grammar of L is a theory of L, incorporating the linguist's **hypotheses** [*bold emphasis mine*] concerning the elements and rules of L. [...] The theory of transformational generative grammar (or some other general linguistic theory) expresses a **hypothesis** concerning the "essence of language", the defining properties of human language. [...] The grammar that is constructed is an **idealization**.

What Chomsky [1975, 9] underlines is the aspect of *idealization* that a grammar of L (let us say a *model* of L) has, and remembers that it is constructed following the linguist's *hypotheses* on that language. While Shaumjan [1971, 62] recommend to be really careful in using models, especially to avoid the transfer of non-inherent properties from the abstract objects to the objects under investigation.

[...] As a tool for cognition, a model has not logical but psychological and heuristic importance. Visual images help us to think, make the ideas embodied in the symbols more tangible. Since definite analogues are connected with visual images, these analogues facilitate the investigator's search for new ideas and facts. However, we must note that it is essential to treat models with care: visual images and analogues not only help to find new ideas and facts at the same time they can cause the investigator to transfer properties to the objects under investigation which are not in reality inherent in them.

## Final remarks

I would like to conclude this paper simply by means of two quotations: the first one is from Chomsky [1988], on his methods of investigation, and the second one is from Shaumjan [1971], on thought.

As for my own methods of investigation, I do not really have any. The only method of investigation is to look hard at a serious problem

---

<sup>57</sup>[Lepschy, 1966, pp. 21-23]

and try to get some ideas as to what might be the explanation for it, meanwhile keeping an open mind about all sorts of other possibilities. Well, that is not a method. It is just being reasonable, and so far as I know, that is the only way to deal with any problem<sup>58</sup>.

Thought is essentially a ‘black box’ [...], which cannot be directly investigated but whose mechanism can be made known through knowledge of the laws of language, since the laws of grammar are similar to the laws of thought. From this point of view it is possible to say that in modelling linguistic processes we are in a certain sense modelling thought processes. Of course, it is important to remember that, although the laws of grammar and the laws of thought are similar, they are not identical<sup>59</sup>.

---

<sup>58</sup>[Chomsky, 1988, 190]

<sup>59</sup>[Shaumjan, 1971, 303]

## References

- Ahmanova, O. A., Melchuk, I. A., Frumkina, R. M. and E. V. Paducheva (1963). *Exact methods in linguistic research*. California University Press, Berkeley-Los Angeles. (translation from russian *O tochnyh metodah issledovanija jazyka*, Moskva: MGU, 1961 by Hays, D. G. and D. V. Mohr).
- Bally, C. (1926). *Le langage et la vie*. Payot, Paris.
- Benveniste, E. (1966). *Problèmes de linguistique générale, I*. Gallimard, Paris.
- Chomsky, N. (1957). *Syntactic structures*. Mouton, The Hague-Paris.
- Chomsky, N. (1965). *Aspects of the theory of syntax*. MIT Press, Cambridge, Massachusetts.
- Chomsky, N. (1975). *The logical structure of linguistic theory*. Plenum Press, New York-London.
- Chomsky, N. (1988). *Language and problems of knowledge*. The MIT Press, Cambridge, MA.
- de Saussure, F. (1916). *Cours de linguistique générale*. Payot, Paris.
- Gross, M. (1968). L'emploi des modèles en linguistique. *Language*, **3**(9), 3–8.
- Lepschy, G. C. (1966). *La linguistica strutturale*. Einaudi, Torino.
- Melchuk, I. A. (1997). *Vers une linguistique sens-texte*. Collège de France, Paris.
- Robins, R. H. (1997). *A short history of linguistics*. Longman, London-New York.
- Schneider, G. (1998). *A linguistic comparison of constituency, dependency and link grammar*. University of Zurich, Master's thesis.
- Shaumjan, S. K. (1965). *Strukturnaja lingvistika*. Nauka, Moskva.
- Shaumjan, S. K. (1970). *Linguistica Dinamica*. Editori Laterza, Bari. (translation from russian *Strukturnaja lingvistika*, Moskva: Nauka, 1965 by E. Rigotti).
- Shaumjan, S. K. (1971). *Principles of structural linguistics*. Mouton, The Hague-Paris. (translation from russian *Strukturnaja lingvistika*, Moskva: Nauka, 1965 by James Miller).
- Stalin, I. V. (1951). *Marksizm i voprosy jazikoznanija*. Akademija nauk SSSR, Moskva.
- Tesnière, L. (1959). *Eléments de syntaxe structurale*. Editions Klincksieck, Paris.
- von Humboldt, W. (1999). *On language. On the diversity of human language construction and its influence on the mental development of the human species*. Cambridge University Press, Cambridge.