

SYNTACTIC COMPONENTS OF CARTOGRAPHIC SENTENCE

Pavel Neytchev, D. Sc.

University of Gdansk , Cartographic Laboratory
POLAND , 80-264 Gdansk , R. Dmowskiego str., 16 A
Phone: (+ 48 58) 341 00 61 , Fax: (+ 48 58) 346 03 16
E-mail: neytchev@univ.gda.pl

1. Process of information transfer in psychic and in linguistic aspect

Let us take a look at the psychic processes occurring when information is created and transmitted among people (see Figure 1). Information is defined as a factor diminishing the level of ignorance of a given environment or phenomenon. It is constituted by a set of sensations created as a result of a reaction to the stimuli coming from the environment. On the basis of this set, the environment comes to be understood better by the individual experiencing these sensations. Since this set of sensations is created and processed in mind, it can be assumed that information is a psychic (mental) substance organized in a certain way. The very set of sensations is often called mental image.

Since people cannot transmit the mental substance directly among themselves, they use a physical conveyor. This medium is most generally called a communication channel. It is employed in two ways. In the first case, the transmitting person organizes the material substance of the communication channel in such a way so that the obtained formation was as similar as possible to the mental image e.g. an artist's picture. In the second case, the material substance of the communication channel is organized in the form of a set of signs of a chosen code, by means of which a description of a mental image is presented. In the most general sense, a code is defined a system of signs serving communication. As a sign can serve any physically perceivable object (or phenomenon) constituting a physical medium of an additional psychic contents being part of another meaning generally understood by a given group differing from what the sign represents by its form and shape.

The term "code" is used for all systems of signs serving for purposes of communicating. The codes can be simple and compound. The simple (directly defined) code is a group of signs as material objects and meanings corresponding to these. This means that this code includes two components of each code: the material structure (physical form) of signs and their meanings (semantics). So defined code is perceived as a single-articulated. When to these two components of code is added a third - syntax, then such a code will prove to be able to produce new signs in infinite numbers. It becomes a compound (complicatedly defined) code. That code also contains two kinds of formal units with different functions, i.e., units which have meaning (signifying units) and units which distinguish meaning (distinctive units). However, there is a difference between these two kinds of codes. The minimal signifying units of the compound code can be decomposed into distinctive units. So defined code is perceived as a double-articulated.

The double articulation is treated by linguists as a specific feature of natural human languages. The structure of all of them shows a surprising similarity. It is so, since it is based on a certain, common for all people, stereotype of human mind operation. Every one of the ethnic (natural) languages consists of two classes of system signs. One of them is a finite set of basic signs called the vocabulary (lexicon) of a given language. The other is an infinite set of combined signs, created on the basis of the basic signs. First class of system signs - the vocabulary - contains two kinds of formal units. The words with their meanings are signifying units. The letters of alphabet (so-called „basic forms”) with their vocal or graphical substance are distinctive units. Second class of system signs - the infinite set of sentences - also contains two kinds of formal units. In this case syntactic rules of natural language enable to join words

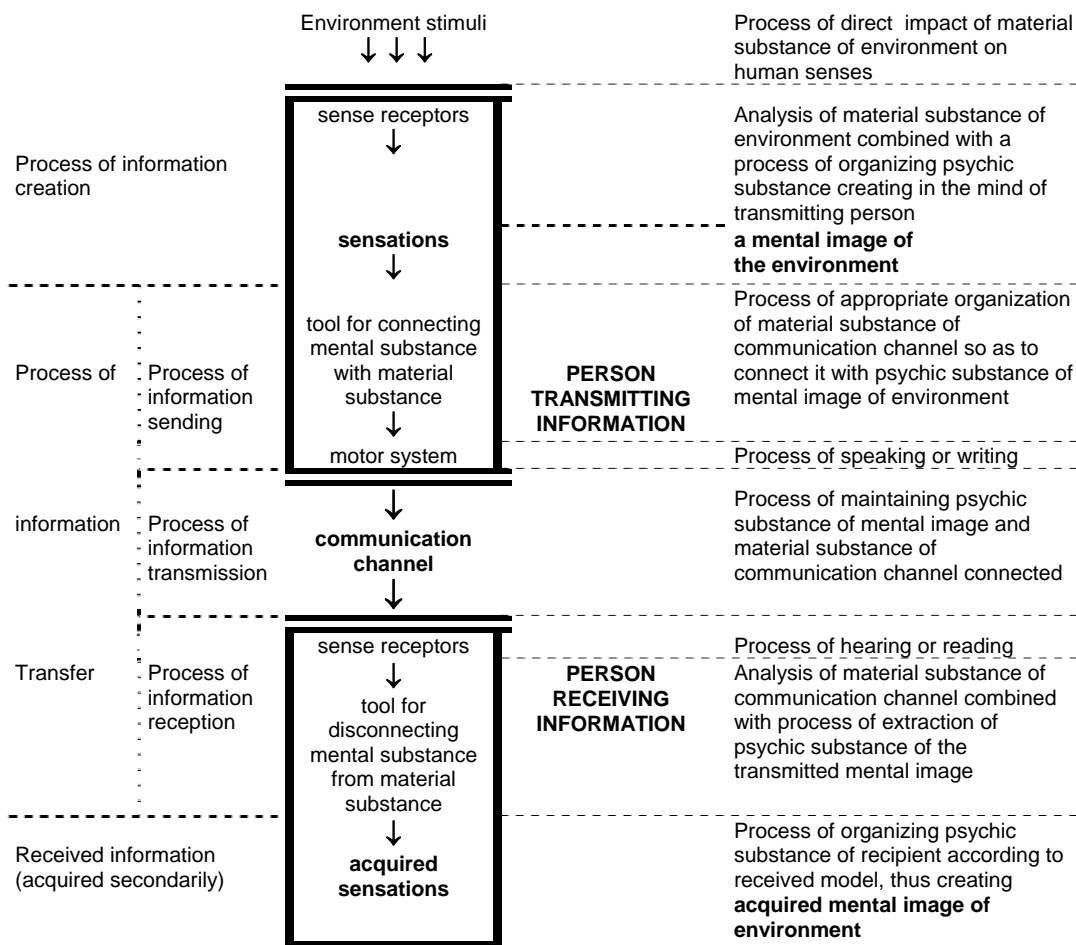


Figure 1. Information transfer among the people.

(basic signs) in sentences, producing in this way combined signs. Each separate sentence expresses a judgment. This means that its semantic contents are different from the simple sum of the meanings of its individual basic signs. It can be said that combined signs are signifying units. From this point of view, the basic signs can be perceived as distinctive units and the natural language as a double-articulated code.

According to linguists, „the concept of language includes two aspects: 1) it is a **system** understood as a set of formal functional units included in it, in juxtaposition to each other in terms of scope and contents and thus conditioning each other within the whole, 2) it is a **text** in the sense of a linear series of linguistic units, created in the process of communication [speaking – understanding] and based on a certain relative possibility of joining of these units” [Heinz, 1988]. Maintaining a linearity of the text (as a series of connected linear linguistic signs), and thus a transmission of information, depends on the anatomic structure and physiology of the operation of human organs responsible for the production and perception of linguistic signs. However, with respect to its sign function, the language has to have a structure based on an internal logic, which, in turn, conditions the understanding of the language as a system. The linguistic system is not a homogenous formation. It can be seen a multilevel structure offering

the possibility of composing more and more complex units. All abstract elements, which are semantically inseparable on a given level of an organization of the form and contents of these units, are assumed to be elementary units on this particular level. The very levels are here referred to as „organization levels”.

The rules governing the organization of the material substance of the communication channel in order to create a separate sentence have been called by linguists „grammar rules”. Grammar rules include two kinds of principles. First of them are principles allowing for the creation of basic linguistic signs. All so-called word-formation rules include those principles. Second kind of principles determine how basic signs can be joined in order to form combined signs. Syntactic rules are based on these principles.

The smallest linguistic unit, which constitutes a communication channel in the process of information transmission, is an utterance. Utterance is understood as a specific act of speech use in order to communicate. It is expressed by means of a sentence, which is at the same time its material realization (verbal or written) as well a realization of a speech act.

The use of each language takes place in a certain social situation and constitutes an organized entity with a beginning, an end and internal structure. This entity is called „discourse”. Discourse can be presented as an organized set of utterances. It can be a dialogue as well as a monologue in all its kinds: giving instructions, describing events, conducting lessons in school, transmitting specific information etc. The material realization of the discourse is a system of appropriately chosen sentences, called „textual work”. Its semantic contents (after a full perception) are not a simple sum of the meanings of individual sentences but depends on their arrangement in this composition. The rules determining the organization of a discourse are called „stylistic rules.”

However, in order to transmit certain information about the geographical environment it is necessary to transmit information about the spatial location of its elements. With these respect natural languages are insufficient tools of human mind. The person transmitting information of this kind uses a specialized code i.e. map language.

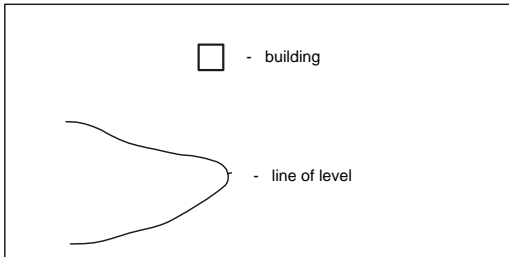
2. Map language as a double-articulated code

Map language is a human mental tool by means of which the mental image of the geographical environment, created in the mind of the transmitting person, is transmitted to the mind of the recipient. The communication channel is a map, whose material substance is appropriately organized by the cartographer.

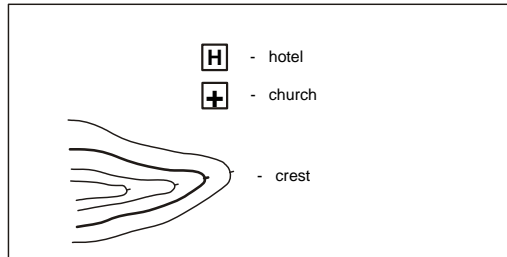
The author states that the map took shape primarily from the need to act as communiqué. Its main task is to transmit information concerning the spatial location of objects, phenomena or relations, together with their qualitative-quantitative characteristics, of interest to man. When cartographer is laying a chosen sign on the surface of map, he is using map language to transmit information, which concerns the spatial location of an object (phenomena, relations). With the shape of sign cartographer transmits information about the qualitative-quantitative characteristics of this object (phenomena, relations). It can be said that in this case cartographer is producing an utterance, so called cartographic utterance. When considering the way of map creation, it can be noticed that this process takes place in a particular social situation and constitutes a certain organized whole, with a beginning, an end and internal structure. It can be thus assumed that in this case a process called discourse takes place. Hence the map image constitutes an organized set of many cartographic utterances. After a full perception of this image, the transferred meaning contents, constituting the whole of the mental image, differ from the simple sum of the meanings of individual cartographic utterances. The manner of their organization, and hence the way of organization of map contents, in order to transfer the mental image properly, varies depending on the type of cartographic work.

Example 1: Separate cartographic signs (cartographic words).
/Basic signs of the map language./

a) simple

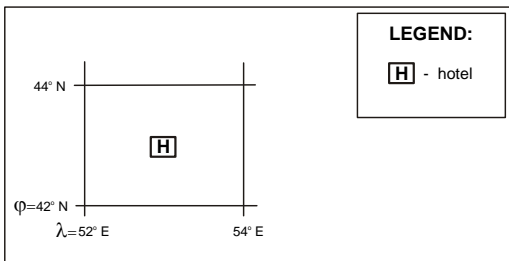


b) complex



Example 2: Compound cartographic signs (cartographic sentences).
/Combined signs of the map language./

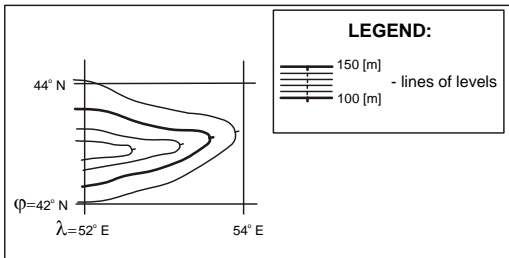
a) simple



Semantic contents presented by means of the natural language:

There is a hotel on the place of Earth surface defined with the aid of terrestrial coordinates $\varphi=43^\circ \text{ N}$, $\lambda=53^\circ \text{ E}$.

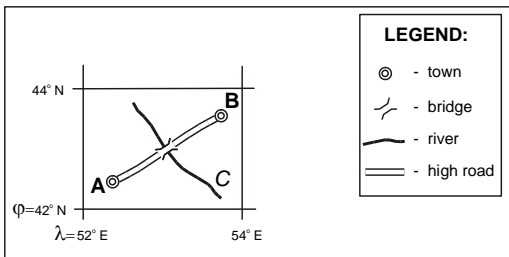
(The location of the hotel is defined with the aid of terrestrial coordinates $\varphi=43^\circ \text{ N}$, $\lambda=53^\circ \text{ E}$.)



There is a crest on the place of Earth surface defined with the aid of terrestrial coordinates $\varphi_1=42^\circ \text{ N}$, $\varphi_2=44^\circ \text{ N}$, $\lambda_1=52^\circ \text{ E}$, $\lambda_2=54^\circ \text{ E}$.

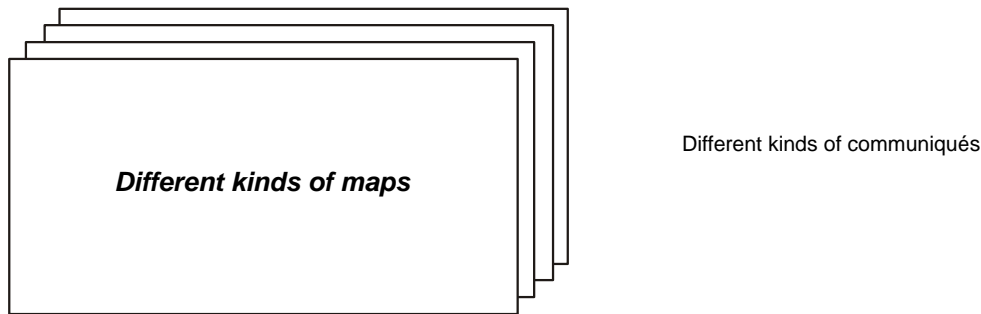
(The location of the crest is defined with the aid of terrestrial coordinates $\varphi_1=42^\circ \text{ N}$, $\varphi_2=44^\circ \text{ N}$, $\lambda_1=52^\circ \text{ E}$, $\lambda_2=54^\circ \text{ E}$.)

b) complex



The bridge, between the towns A and B, is laying over the river C, and its place on the Earth surface is defined with the aid of terrestrial coordinates $\varphi=43^\circ \text{ N}$, $\lambda=53^\circ \text{ E}$.

Example 3: Maps (cartographic textual works).
/Assembled signs of the map language./



Like a code the map language consists of two classes of system signs. One of them is a finite set of basic signs, presented in the form of a map legend. The other is an infinite set of combined signs, created on the basis of the basic signs. First class of system signs – the cartographic vocabulary - contains two kinds of formal units. Basic cartographic signs (cartographic words) with their meanings are signifying units. The shapes of signs (which can be simple or complex) with their graphic or plastic substance are distinctive units [see Example 1]. Second class of system signs also contains two kinds of formal units [see Example 2]. In this case syntactic rules of map language enable to place cartographic signs on map surface creating in this way cartographic sentences (which can be simple or complex too). Each separate cartographic sentence expresses a judgment. This means that its semantic contents are different from the simple sum of the meanings of its individual basic cartographic signs. Therefore it can be said that cartographic sentences are signifying units. From this point of view, the basic cartographic signs can be perceived as distinctive units. Three components enter into the reference relation: material structure (shape) of the signs, their meanings (semantics) and the syntax. Thus the map language can be classed as a double-articulated code. Its name can include the term “language” emphasizing its similarity to the natural languages.

The structure of map language system [see Table 1] looks just like the structure of the natural language system. The units, logic of rules and mechanics of transfers by means of map language are similar to the units, logic of rules and mechanics of transfers in natural language. They differ in the manner of organization of the material substance of the communication channel, but these are differences with respect to the appearance (external shape, form) of signs and not to the way of organizing the psychic contents of the mental image transferred by means of them.

It can be stated that there is a set of similarities between the units of natural and map languages [see Table 2].

Table 1. Organization levels in the map language system.

Levels	Units	Structure of a single unit	Manner of units creation	Information transferred	Rules
0	a) finite set of distinctive features of forms of basic signs ----- b) finite set of forms of local basic signs	a) basic components of material substance (e.g. graphic or plastic) ----- b) group of distinctive features of forms of basic signs	individually with public acceptance	none	creation rules of local basic signs, e.g. rules of using the three kinds of variables: - graphic (after Bertin, Dransch, Buziek, Kraak and others) - sound (after Krygier) - tactual (after Vasconcellos)
1 th	finite set of local basic signs (set of conventional signs given in map legend, so called cartographic signs)	form of local basic sign + content of meaning	individually, presented to the public acceptance by means of map legend	elementary information of basic concepts, generally accepted	
2 nd	infinite number of combined signs (infinite number of cartographic sentences)	system of forms of local basic signs + content of meaning	individually	information being a part of the mental image in the shape of judgment	syntactic rules (rules of positioning and joining the local basic signs on the map surface to create a cartographic sentence)
3 rd	infinite number of assembled signs (infinite number of maps)	organized set of systems of forms of local basic signs + content of meaning	individually	information being a whole of the mental image	stylistic rules (rules of positioning and joining the cartographic utterances on the map surface to create different kinds of maps)

Table 2. The similarities between the units of natural and map languages.

<i>Units of the natural language</i>			<i>Units of the map language</i>		
<i>in the system</i>	<i>in the text</i>	<i>in the speech act</i>	<i>in the system</i>	<i>in the text</i>	<i>in the map language usage</i>
basic sign	word	component of utterance	basic sign	separate cartographic sign (cartographic word)	component of cartographic utterance
combined sign	sentence	utterance	combined sign	compound cartographic sign (cartographic sentence)	cartographic utterance
assembled sign	textual work	communiq é	assembled sign	map (cartographic textual work)	cartographic communiq é

3. Syntactic pattern of cartographic sentence

Every language has two basic functions: generative and cognitive. The first one enables to create (generate) understandable texts. The second one allows to recognize the surrounding world. The map language also has these two functions, therefore maps fulfil two roles. First, they are understandable cartographic communiqés, because include a text generated by means of map language. Second, they are sources of potential knowledge, because with the aid of map language people can recognize the parts of reality presented on their surfaces.

We can easy translate a text in map language to the text in natural language [see

Examples 1 and 2]. When cartographer is laying a basic cartographic sign on the surface of map, he is using map language to transmit information, which concerns the spatial location of an object (phenomena, relations). In other words, cartographer informs in map language **“a selected object (phenomena, relations) is located in the surrounded world on the place with presented coordinates”**. So created integrated whole of linguistic signs (in natural language) presents a judgment (statement). This means that its semantic contents are different from the simple sum of the meanings of its individual basic signs. Therefore it can be said that this integrated whole represents the meaning of cartographic sentence. In this case cartographer uses a generative function of map language. Map user, perceiving this sign, interprets it in the context of cartographic sentence at the same (or very similarly) way: **“An object (phenomena, relation) (defined by the meaning of cartographic sign) has a spatial location in surrounded world (defined by the place of sign on the map surface)”**. The meaning of this sentence is very similar to that created by the cartographer. It follows that compound cartographic signs can be interpreted clear-cut, because cartographer and map user use the same syntactic rules. When the sign is on the surface of map legend, map user interprets it only like a cartographic word (basic sign with its meaning), but not in a context of cartographic sentence. The act of map language usage is an act of intentional laying cartographic signs on map surface, depending on the spatial locations of the objects (phenomena, relations) represented by those cartographic signs. Considering the fact that cartographic projection is of great importance about the correct transmission of objects spatial coordinates, it can be said that geometric relations of cartographic projection can be identified with syntactic rules of map language.

When map user want to recognize the part of reality, presented on the map surface, he is using the cognitive function of map language. For example, when there are five objects represented by cartographic signs on the map surface: town A, town B, river C, a bridge and a road [see Example 2.b], map user can interpret the relations between them with the sentence: „The bridge between the town A and the town B is laying over the river C.” He can affirm the same situation with another sentence: „The bridge, which is laying over the river C, is connecting town A with town B.” These two sentences have a different judgments (statements). They was created by the map user basing on the image of the geographical environment, which already exists in his mind. The image of this part of geographical environment was transferred by cartographer with five cartographic sentences:

“A town (with attributes: name A, population ...) has a spatial location (...).”

“A town (with attributes: name B, population ...) has a spatial location (...).”

“A river (with attributes: name C, ...) has a spatial location (...).”

“A bridge (with attributes: ...) has a spatial location (...).”

“A road (with attributes: high road, ...) has a spatial location (from the place defined with the aid of coordinates ... to the place defined with the aid of coordinates ...).”

Cartographer created this five cartographic sentences had used generative function of map language. Information about the relations between these objects follows from their location and attributes. Therefore, if cartographer wants to present some relations, he must create cartographic sentences, which apart **spatial locations** must include **adequate attributes** of objects or phenomena. Thus cartographer produces a text in map language, which is a source of potential knowledge.

Let us take a look at the smallest linguistic unit, which constitutes a communication channel in the process of information transmission, i.e. an utterance. It was already presented above that the material realization of an utterance as well a realization of a language usage is expressed by means of a sentence. With cartographic utterance cartographer is transferring information about the spatial location of an object (phenomena, relations) and its qualitative-quantitative characteristics. The structure of cartographic utterance can be presented by means of the natural language sentence:

*„I inform you, that **location** of the object (defined by the meaning of cartographic sign) is defined with the aid of spatial coordinates ...”* [The shorter form of this utterance is: **„Location**

of the object (defined by the meaning of cartographic sign ...) **is** defined with the aid of spatial coordinates ...”]

It can be said too:

„**Object** (defined by the meaning of cartographic sign) **has** a spatial location (defined with the aid of coordinates ...)”

These sentences contain the basic syntactic components: **subject** and **predicate**. (In first sentence - „**Location... is...**” and in second one - „**Object... has...**”). Using the graphic variables of basic signs, cartographer transmits qualitative and quantitative characteristics of the object (phenomena, relations). In this way graphic variables of cartographic signs determine the usage of **attributes** [see Example 2.a]. The next two syntactic components of cartographic sentence: **object** and **adverbial**, are defined by relations between the signs laid on the map surface [see Example 2.b].

4. Conclusions

Map language is a human mental tool by means of which the mental image of the geographical environment, created in the mind of the transmitting person, is transmitted to the mind of the recipient. The communication channel is a map, whose material substance is appropriately organized by the cartographer. Units, logic of rules and mechanics of transfers by means of map language are similar to the units, logic of rules and mechanics of transfers in natural language. They differ in the manner of organization of the material substance of the communication channel, but these are differences with respect to the appearance (external shape, form) of signs and not to the way of organizing the psychic contents of the mental image transferred by means of them.

The most significant difference between the natural language and map language is the fact that the set of basic signs (vocabulary) of the natural language, irrespective of the transfer kind and its transmitting, is fixed and unchangeable for a long period of time. In contrast, the set of basic signs (cartographic vocabulary) of the map language, presented in the form of a map legend, is unchangeable and fixed only for the given map.

It can be said that syntactic pattern of cartographic sentence is also very similar to the syntactic pattern of natural language sentence. Syntactic components of cartographic sentence reply to the same questions. For example subject reply to the question „who?”, predicate - to the question „what am/are/is doing?”, attribute - „which?”, „what?”, „how?”, object - „what?”, adverbial - „where?”, „how?”. Graphic shape of cartographic signs is different from that of natural language signs, but „syntactic logic” is the same.

References

- Heinz, A. (1988). *Jezyk i jezykoznanstwo*. Panstwowe Wydawnictwo Naukowe, Warszawa.
- Koch, W. G. (1999). *The graphic system of visual variables, its development and significance in a multimedia environment*. ICA Working Group on Map Semiotics, Meeting in Geneva.
- Neytchev, P. (1997). *The structure of the map language*. Prac. Kartografii i Fotointerpretacji UG, Gdansk.
- Schlichtmann, H., Wolodtschenko, A.; and Pravda, J. (1995). *Presentation of the collection „Cartographic thinking and map semiotics”*. 17th International Cartographic Conference and 10th General Assembly of ICA, Sept. 3-9, Barcelona, 1839-1842.