# OVERVIEW OF THE SEMIOTICS OF MAPS

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**Abstract**

The semiotics of maps, a subfield of cartosemiotics, is the sign-theoretic study of maps. An overview of this research area is presented. Its subject matter is subsumed under five major themes: map symbolism (map language), sign processes, contexts in which signs and sign processes are embedded, marginal notes, and peripheral signification phenomena. Map symbolism, being the core subject of the semiotics of maps, is singled out for a more detailed discussion. It is considered under three aspects: its complexity, characteristics of its signs, and characteristics relating to its systemic organization.

## 1. Introduction

Cartosemiotics, also called cartographic semiotics, is the semiotic study of cartographic models (or cartographic representation forms), such as maps, globes, relief models, animations, and many others. These models have in common that they represent the space of the earth (or, by extension, of another celestial body or of the sky) by means of a model space. However, semiotic research has mostly been devoted to maps in the traditional sense, as defined in the *Encyclopedic Dictionary of Cartography* (Neumann, ed., 1997, entry 21.1 (German and Russian sections) and entry 811.1), that is, to the most versatile, most widely used and best studied kind of cartographic models.

As a distinct field of enquiry, cartosemiotics originated in the 1960s and has by now reached a fair level of maturity (for an international survey see Schlichtmann, ed., 1999). As research progresses, the need for overviews arises from time to time, so that achievements can be surveyed and research needs identified. Such an overview, albeit a sketchy one, is presented below. In view of the aforesaid state of research, however, its subject matter must currently be limited to the semiotics of maps.

In both the general field of semiotics and the special area of cartosemiotics, there are various conceptual and terminological frameworks or schools of thought. When reading the literature, it is not rare that we must "translate" between different conceptions. The following paragraph introduces the basic semiotic notions which underlie the present article.

Semiotics is concerned with signs. In the conception presupposed here, a sign consists of a conceptual item -- a (sign) content or meaning or item of information -- and a perceivable item -- an expression or sign vehicle. (Where required, a content is cited in single quotation marks and an expression between slashes.) The expression conveys the content. Expressions are coupled with contents by descriptive rules which collectively constitute a code. An object or event to which an individual sign is applied is its referent. Although the referent is kept conceptually separate from the sign, it is certainly taken into account where appropriate, e.g., when dealing with sign production. In any map, after all, a crucial part of its signs are images of objects, and their genesis and characteristics are clearly influenced by their referents.

## 2. Themes of the semiotics of maps

The subject matter of the semiotics of maps can be subsumed under five major themes (see Table 1, which also lists refinements to be introduced later). The following three may immediately come to mind. (1) Map symbolism (often called map language), that is, the type of sign systems that are manifested in individual maps (more exactly: in individual map faces). (2) Processes in which humans handle signs, or sign processes for short. They can be grouped into three major classes: (2.1) sign production; (2.2) sign reception, understood as the extraction and derivation of information from signs (cartographers speak of map use); (2.3) sign employment in dealing with the world and the participants in cartographic communication (map author and intended audience). (3) Contexts in which signs are realized and sign processes take place. Again three classes suggest themselves: (3.1) the territory to be mapped; (3.2) context factors relating to map creation and the map author; (3.3) context factors relating to map use and the intended audience.

This tidy overview is, however, incomplete. Two further themes require attention. (4) The assemblage of signs in a map face is complemented by marginal notes, which constitute a separate, auxiliary sign system. They have two functions: explaining what entries in the map face mean (that is, establishing the relevant code) and providing background information. Among the marginal notes, the most versatile one is the legend. Apart from being a symbol dictionary,

it presents items of information in some order and has several other functions (Schlichtmann, 1997). (5) While entries in a map face have the basic and criterial function of conveying information about the mapped territory, they may also permit to draw inferences about other context factors. In this case phenomena of peripheral signification are encountered. Most often they are style traits or reflect ideologies (of the map author and/or the intended audience).

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*Table 1. Themes of the semiotics of maps*

The framework laid out here and in Table 1 should not be seen as a bank of well-separated pigeonholes but rather as a set of searchlights which illuminate overlapping domains. It has proven adequate in accommodating current knowledge but remains open to revision and expansion.

Map symbolism is the core subject of the semiotics of maps. As such it has, not surprisingly, received most research attention. In view of space constraints, only this subject will be considered further. (For a more detailed discussion of all five themes and a more complete set of references see Schlichtmann, 2008.) Map symbolism will be considered under three aspects: its complexity (1.1, see s. 3), characteristics of its signs (1.2, see s. 4), and characteristics relating to its systemic organization (1.3, see s. 5).

## 3. Map symbolism: its complexity

When describing and analyzing map symbolism, one comes up against the following five facets of complexity.

(1) The sign inventory of a map comprises two major types of signs. Some of them are pictures, i.e., images of objects, in the first place images in plan view. Many of their perceptual traits as well as their spatial arrangements are ultimately derived from traits and arrangements of the represented objects. Other signs are what Eco (1976, pp. 227ff.) calls combinational units; they are artifacts, created primarily as instruments of signification and communication. In this respect they rather resemble signs of natural language and can in principle (although certainly not in every detail) be analyzed like the latter. Consequently, we must recognize a picture component and an artifact component of map symbolism. The difference between the two is most obvious where sign units are to be operationally isolated (s. 5.1) and where their combination to more complex units is studied (s. 5.3). The two components reflect different modes of sign production, i.e., invention and replication (Schlichtmann, 2006, pp. 24f.), and pose different analysis problems.

(2) On both the content and expression sides, map symbolism comprises plan-related and plan-free components. Thus, the cartographic information is divided into plan information (contents pertaining to the two-dimensional earth space as represented) and plan-free information (other contents). Plan information is usually expressed by plan-related expression traits (we leave aside coordinates and other numerical entries), but such traits are also widely used to render items of the plan-free information.

The two aspects mentioned up to now are conceptually separate but empirically intertwined. This is because in maps -- as opposed to aerial photographs -- image characteristics of objects are, in most cases, at the same time plan characteristics.

(3) Space is alternatively conceptualized in two ways: either as discretized into segments or as a continuous collection of points. A river, a meadow or a county cover segments in discretized space, while values of longitude, elevation or temperature are associated with points in continuous space.

(4) Expressions vary in provenance. Some are newly shaped in the mapping process, such as plan views of objects and many geometrical symbols. Others are imported from various extra-cartographic domains, including but not limited to figurines (side or oblique views of objects), emblems and cognate marks, writing, and diagrams.

(5) Closely related to the above distinction is that of pre-empted and abstract means of expression. Some entries (such as pictures, writing, emblems) come already endowed with meaning or at least with a basic core of meaning; thus, they are pre-empted for the rendering of certain contents. A greater part, however, are abstract in the sense that they are not pre-assigned to contents, so that the expression-content links must be specifically established by the map author. This way it is possible to re-use a limited stock of expressive items by assigning them, as the case may be, to different contents, a fact which makes for economy of sign production.

## 4. Map symbolism: characteristics of its signs

The present section concerns signs, more exactly: their components and constitution. When producing signs, a map author draws on two universes or stores of material. Both contain elements and relations (for simplicity, we usually consider elements only.) The first is the universe of concepts (or the conceptual universe); it contains all concepts which can function as sign contents in maps. The second is the expression material; it contains all percepts which can function as expressions in maps. From the two universes, items are taken to serve, respectively, as contents and expressions of signs. In the simplest case, a map author decides on the concepts which are to become sign contents, then selects perceivable entries which are to become expressions and couples these items with the selected concepts. The two latter processes are governed by codes. Characteristics of the two universes are, of course, also present in the sets of contents and expressions of signs which are encountered in maps. These characteristics will be considered below (s. 4.1, s. 4.2). Afterwards we shall shortly look at codes (s. 4.3).

### 4.1. Conceptual characteristics

The defining role of map symbolism is to represent territories. In principle, all information can be conveyed in maps that relates to places in a territory (or, as is sometimes said, to objects in earth space). To convey this information, one must be able to render the absolute location of each place by a position in the map face, which is done through the point-to-point matching specified by projection, reduction, and map alignment. The stock of conveyable concepts is inexhaustible. For example, there are indeterminably many observed and conceivable shapes of lakes. Further, all of them can, in principle, be expressed, including those which have not been observed before. The universe of concepts has various components and shows an intricate organization, just as we know it from the semantics of natural language. Only a few relevant points can be highlighted here.

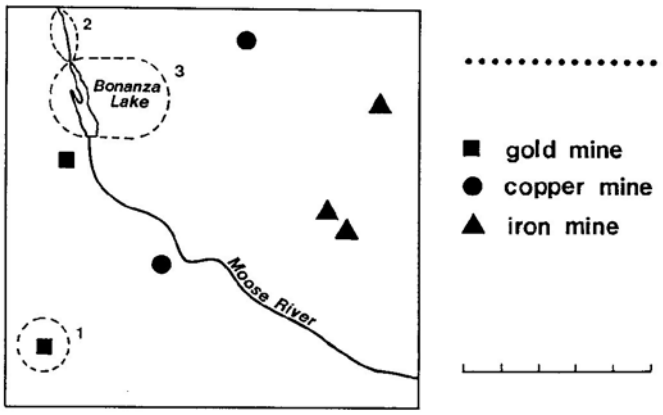


*Figure 1. Fictitious map. From Schlichtmann 1985, p. 24. For explanations see text.*

The mappable information is made up of units ('lake', 'bridge', '30-50 m deep') and relations ('beside', 'older than'). As for relations (by which the conceptual universe is structured), we exemplify one sort which is especially important in map design. In Figure 1 (to which we shall refer repeatedly), the contents 'gold', 'copper', and 'iron', apart from having a common core ('metal'), stand in the relation 'different from'. This is one of several paradigmatic relations (understood, in the broadest sense, as relations of equivalence), which are prominent in the organization of the contents (Schlichtmann, 2004). On their reproduction see s. 4.3. Moreover, the same global information can often be structured differently, depending, of course, on the intended message (ibid., pp. 30-32).

As for the subdivision of the universe of concepts, there are not only numerous classes of the plan-free information, from which, for each map, the relevant ones are chosen. We are also dealing with various categories of the plan information; these are more or less ubiquitous and present interesting problems of representation and interpretation (Schlichtmann, 1991).

Finally, some contents are directly coupled with perceivable entries; others are mediated or implied by other contents, i.e., conventionally or customarily called to mind by virtue of various relations. For example, 'vineyard' implies 'area' (as an obvious plan feature), and 'gold' and 'copper' imply 'metal' (as an included concept). Thus, a perceivable entry may be linked to a bundle of semantic features, and a semantic feature may be directly expressed, implied, or both. Such bundles call for a compositional analysis, discussed in general by Eco (1976, pp. 105-129) and exemplified for mapped information by Du (2003, p. 1522).

### 4.2. Formal-perceptual characteristics

The expression material is usually visual in nature. (Tactile and auditory items, used in special cases, will not be considered here.) It comprises, in principle, all visible items that can be intentionally inscribed in the map face. These include elements which come already endowed with meaning (s. 3). The expression material has an autonomous perceptual order, which is frequently put to service in signification.

Putting it most generally, the stock of expressions in a map consists of marks, traits (like shapes or colours), and relations which hold between marks and between traits. Marks are also called symbols. Traits are usually inherent in marks but may also be associated with points in continuous space (as holds for positions in the map face). Traits are values of visual variables (or graphic variables); for example, a specific symbol shape is a value of the variable of shape. Many cartographers have systematized visual variables. The list proposed by Bertin (1983, p. 96) is the most familiar one and easy to memorize, but it is incomplete and has been extended by other authors (e.g., MacEachren, 1995, pp. 270ff.). As regards relations, paradigmatic ones, which hold between values of a visual variable (such as /red/, /green/, /buff/), play a prominent role in map design (s. 4.3). Further, marks stand in spatial relations (disjunction, overlap, coincidence, and inclusion).

How the expression material is employed depends – or should depend - on the intended map-use (or map-reading) tasks and anticipated practical applications. In this context it bears noting that Bertin's familiar summary concerning the

suitability of visual variables (Bertin, 1983, p. 96) conflates two kinds of tasks: reading for difference, rank order, etc. (which tasks are not inherently spatial) and derivation of spatial distribution phenomena. Summaries developed by some later authors incorporate the required distinction (Geels, 1988, p. 18; MacEachren, 1995, p. 279).

### 4.3. Codes

A code, in a wide understanding of the term, is a set of rules which govern two processes: the coupling of perceivable entries with concepts (this way the two kinds of elements become expressions and contents, respectively) and the selection of items of the expression material which are suitable to serve as expressions of specific concepts (these rules reflect intended map-use tasks and practical applications). Both processes, although conceptually distinct, are in practice not easy to keep apart and are often subsumed under the common head of transcription (of information). Finally, in the analysis of a sign inventory, often several codes or code components can be recognized (this point will not be pursued further).

Rules that govern transcription are of various degrees of stringency. For example, plan traits of places are, in principle, reproduced rather faithfully, while the symbolization of the plan-free information is often relatively free (although not completely so).

Cartographic practice has given rise to several, partly incompatible principles of transcription, on which the relevant rules are based. The most common and important one is the principle of expression-content homology, that is, of reproducing relations between contents by relations between expressions. In Figure 1, a gold mine is indicated by a square and a copper mine by a circle. Now, /square/ and /circle/ are related like the corresponding contents ‘gold’ and ‘copper’: they have something in common and are different, but not ranked. (For simplicity, the content component ‘mine’, shared by all relevant items, is not considered here.) Thus, the organization of the expressions is homologous (or isomorphic) to that of the contents. In transcribing the plan information, homology is usually brought about automatically by point-to-point matching, but when plan-free contents are rendered, it must be deliberately created. Most frequently (as in the above example), it is the paradigmatic order of the contents which is reproduced by that of the expressions. This transcription principle is prominent in geographical mapping, chiefly because it facilitates spontaneous recognition of spatial distributions.

## 5. Map symbolism: characteristics relating to its systemic organization

When considering systemic aspects, we must deal with three topics: units, relational order, and combinatorics. To elaborate: (1) an analysis presupposes units, which may or may not be distinctly delimited; (2) units are linked by relations and this way organized into systems; (3) units may combine to form units of higher order, and greater complexity, according to combination patterns.

### 5.1. Units

Units of map symbolism are defined by various criteria and are more or less complex. One may identify content units, expression units, and sign units (considering content and expression at the same time). As for the latter, the present author recognizes signs at three levels: topeme (on which Schlichtmann, 2001), topeme complex, and minimal sign.

A map informs about places in its territory (s. 4.1). A place is mentally singled out under a focus of interpretative interest (on this concept see Koch, 1971, pp. 302-308). It may be spontaneously recognized as a single item (an island, a railway line, a benchmark) or as an assemblage of items which are considered to belong together (a group of islands, an industrial town surrounded by commuter villages). Different foci may be applied at the same time or in sequence, therefore the places identified may overlap, or one may be included in another.

Topeme. If a place is shown as a single item, the corresponding sign is a topeme. This is the smallest self-contained entry in a map, hence it can, in principle, occur by itself. Its content is a complex concept of a place along with relevant characteristics of this place, including its absolute location. Its expression usually contains exactly one locator. This is a visually unitary symbol (i.e., a symbol that can be spontaneously seen as a single mark), the position of which in the map face expresses the absolute location of the mapped place. A symbol which is not a locator is a complement. In Figure 1, the expressions of three topemes are enclosed in dashed lines. Examples 1 and 2 are locators, example 3 combines a locator and and a complement (in this case a writing mark).

It is the map author who establishes the unity of the topeme by entering a locator. In creating a topeme, a map maker singles out a segment of earth space and treats it as homogeneous. For example, one maps the corporate area of a town as a whole and disregards houses, streets, parks, etc., within it. This way the corresponding segment of space in the map face becomes free for the employment

of means of expression which convey information about the place as a whole (such as ‘town’ or ‘7,500 inhabitants’).

Topeme complex. If a place is an assemblage of items which are considered to belong together, a complex sign may be identified which is made up of several topemes (Schlichtmann, 2001, p. 56). In a typology of such complex units we will encounter all the descriptive models of spatial organization which are familiar to geographers: distribution area, patterned assemblage of points, network, mosaic, partitioned area, and others.

Minimal sign. A topeme is composed of minimal signs (the term is provisional). These are signs the expressions of which cannot be broken down into units which are themselves expressions, i.e., which convey meanings. If, in Figure 1, /square/ stands for ‘gold’ (as noted in s. 4.3), then ‘gold’ and /square/ jointly form a minimal sign. Further, each point within an area symbol has a position in the map face which, in turn, stands for the absolute location of the corresponding point in earth space. Each location value and the entry indicating the matching position value jointly make up a minimal sign. Thus, some minimal signs within a topeme relate to the mapped place as a whole and others to points within it. Here we are encountering the two space conceptualizations noted in s. 3.

### 5.2. Relations

Relations hold between content units and between expression units. Both kinds contribute to organizing signs into systems. As they have already been commented upon in s. 4 (see especially the note on homology in s. 4.3), they need not be discussed further. Certain relations underlie the combination of units (dealt with in the next section).

### 5.3. Combinatorics

Units may be combined to form more complex ones. The underlying rules and patterns constitute a combinatorics. One may study how either contents or expressions are combined or deal with both components together and consider how complex signs are built up of simpler ones. A combinatorics of the latter sort is a syntax. Two fundamentally different kinds of map syntax are recognized, a local and a supralocal one.

The local syntax pertains to the combination of minimal signs within topemes, and the underlying combination patterns are artifacts of the sign system. An important objective of syntactic analysis is to derive rules for combining

expression units in the map face. Their combination depends not only on the underlying organization of the contents, but also, and sometimes in the first place, on visual requirements and on characteristics of the expression material (Schlichtmann, 1994).

The supralocal syntax covers the arrangement of topemes and their integration into larger configurations, and the underlying combination patterns ultimately reflect factual arrangements of objects in earth space (s. 3). This combinatorics pertains to the internal structure of topeme complexes (s. 5.1).

## 6. Conclusion

In this paper an (admittedly sketchy) overview of the semiotics of maps was presented. The subject matter of this field falls under five major themes: map symbolism; sign processes; contexts in which signs and sign processes are embedded; marginal notes; and peripheral signification. Map symbolism, the core subject of the semiotics of maps, was singled out for a more detailed discussion and considered under three aspects: its complexity; characteristics of its signs; and characteristics relating to its systemic organization.

The aims of cartosemiotic research are intellectual enlightenment as well as practical application. The latter fact is easily understood if one considers that map makers engage in various activities of sign production: they structure the information which is to be conveyed, select and use means of expression, and (ideally) see to it that a map can be read as intended. As a consequence, map symbolism is deliberately shaped with a view to the ends which it is intended to serve and thus constitutes, to some extent, a "constructed language".

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