CULTURAL DIFFERENCES AND CULTURAL ASPECTS IN GEOGRAPHICAL INFORMATION SYSTEMS

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Abstract. Cultural issues are becoming important GIS research topics. Cultural issues affect the design and use of GIS technology. In this paper cultural issues are differentiated into cultural aspects and cultural differences. Cultural aspects and cultural differences in GIS are *per se* extremely ample in number. A review of current approaches shows the broad range of points of view. As GIS technology has several definitions, cultural differences and aspects have been considered, explicitly and implicitly, from various points of view. This paper describes and discusses some of the most relevant approaches following a simple taxonomy. Various and different issues are treated in their own contexts. A number of definitions for cultural issues as well as a framework for research approaches follow a survey. Actual and practical examples of cultural aspects and differences are shown. Suggestions are also made on how research may address the issues.

1. Introduction

Cultural issues in designing and using GIS are acknowledged research topics [15, 31, 32, 39, 75]. Many statements, critiques and claims that appear in the GIS literature hide cultural issues, albeit they have been rarely admitted. There has been reluctance to acknowledge cultural issues in GIS. The same reluctance occurs in other technological fields. Cultural issues are prevalently thought of as uncontrollable variables or part of subjective categories that are not worth treating. This has been for long the standpoint in the hard sciences, and has been transferred to technology studies. In addition, human and social sciences do not simplify the approach to the understanding of this interdisciplinary problem. Human and social sciences, to which cultural issues traditionally belong, enlighten the complexity of phenomena offering multiple viewpoints. Furthermore, the technological field reduces the complexity in simple models and unambiguous notions [1, 38]. The cultural issues stay at the convergent point of the complexity of reality, complexity of scientific methods and needs for technological simplification.

This paper aims to address cultural issues in GIS as a research topic in its own right. This includes many aspects of GIS development and its integration in different contexts.

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In this paper a conceptual framework where cultural aspects and differences can be treated as research topics for different sectors in the GIS field is proposed.

In section 2 a definition of cultural aspects and cultural differences in GIS is given. In section 3 basic reasons for accounting cultural issues in the GIS field are explained. To put some order to this complex matter for research purposes, a simple taxonomy of different approaches to cultural aspects and differences is presented in section 5. In sections 6 and 7 examples from practice and theoretical viewpoints in various sectors and for different components of GIS are shown.

2. Cultural Differences and Cultural Aspects in GIS: Definitions

> *Cultures are maps of meaning through which the world is made intelligible. Cultures are not simply systems of meanings and values carried around in the head. They are made concrete through patterns of social organization. Culture is the way the social relations of a group are structured and shaped: but it is also the way those shapes are experienced, understood and interpreted.*
> Jackson [53, p. 2] see also Clarke *et al.* [22].

2.1. CULTURAL DIFFERENCES

Cultural difference is a generic term including all aspects of designing, using and interacting with GIS by different communities. They correspond to the translation in specified *contexts*, of the relationships existing among: spatial processes, spatial structures, territorial forms, spatial cognition and technologies that deal with them or enable to relate to them. This definition involves the human dimension of GIS technology, hence spatial processes, spatial structures, territorial forms and technology depends on human intentionality. This is a very comprehensive definition and includes GIS design and use in a broad sense.

2.2. CULTURAL ASPECTS

Cultural aspect is a generic term that refers to GIS technology as a product of a specific society in a particular period. The major cultural aspect of GIS is that it is a conception of a part of Western civilization. Through its products, cultural models of the organization of space, the administration of land, the organization of work and the use of technology are transferred into other cultures and societies that already have their own models. This poses strong ethical questions about the methods adopted to fulfill such a transfer [80]. This topic is seldom considered from the point of view of the relationship between technology and environment [9, 26, 54, 55, 50], and from the specific point of view of the relationship between technology and the management of spatial information in different societies. Cultural aspects and cultural differences are interrelated topics. We would not be expected to talk about cultural differences in GIS if cultural aspects would have not shown a strong impact on the various societies to which they have been transferred.

3. Definition of Contexts

The definition of *contexts* that frame the cultural issues in GIS is grounded on those given by Bateson [4], Morin [78], Winograd and Flores [108], Varela *et al.* [106], Johnson [56] and Maturana [77]. The definition of *context* given by Johnson [56] fits with the cultural differences. The context is structured on the embodied experience culturally shared:

> *The embodied patterns do not remain private or peculiar to the person who experiences them. Our community helps us interpret and codify many of our felt patterns. They become shared cultural modes of experience and help to determine the nature of our meaningful, coherent understanding of our 'world'.* [56, p. 14]

The definition of *context* given by Maturana is based on the notion of consensus domain. It fits with the cultural aspects of GIS:

> *When two or more organisms interact recursively as structurally plastic system, the result is mutual ontogenic structural coupling. The behaviors are arbitrary because they can have any forms as long as they operate as triggering perturbations in the interactions; they are contextual because their participation in the interlocked interactions that constitute the domain. I shall call the domain of overlocked conducts [..] a consensual domain.* [77, p. 47]

In our case the two organisms are the societies on one side and the GIS technology on the other side.

3.1. CULTURAL CONTEXTS IN THE GIS FIELD

GIS deals with multiple contexts and multiple levels within each of them. Some contexts depend on GIS with an individual or institutional dimension. Contexts dealing directly with individuals are the everyday-life, the professional and the educational environment. An example is the educational environment in which users and designers develop their professional skill. The context is also the specific environment (both social and physical) in which users and designers develop their spatial ability and specific spatial mental models.

Public administration is an example of context at the institutional level. Each country has its own rules to organize the tasks of various levels of the public administration, and procedures within each of them and between them. This organization is strictly related to the local historical traditions in managing public issues. For instance, the control of territory is based on the historical tradition of regions and countries, and they are an essential part of the local administrative cultures. Traditions affect and differentiate the way to collect information from the processes of land control and, at times, the quality of information.

3.2. GIS AS AN ELEMENT OF A CULTURAL CONTEXT

GIS is an artifact belonging to the category of mediators. Mediators are the producers of other semiological structured artifacts. Mediators are an integral part of culture based on communication, as stated by Marshall McLuhan. GIS and its products are parts of a culture rooted in the broad use of mediators of information. GIS and its products (i.e., maps and data banks) communicate spatial information [88].

As GIS is integrated in a context it becomes part of it. It is a multi-level mediator of communication of spatial information within that context. However, whether GIS is seen as a tool to be *applied* to some field, sector, discipline, project, etc., the context in which the application occurs appears not to be relevant. GIS and application sectors seem not to affect each other. Instead, whether GIS is seen as a complex technology *integrated* in such sectors, the context of integration becomes relevant. In this case there is a recognized mutual influence between GIS and fields in which it is integrated. This is valid for the institutional level as well as for the scientific disciplines that adopt GIS as a new methodological technique [14].

4. Need for Discussion of Cultural Issues in GIS

> *Spatial order is one of the most striking means by which we recognize the existence of cultural differences between one social formation and another, that is, differences in the ways in which members of those societies live out and reproduce their social existence.*
>
> Hillier and Hanson [47, p. 27]

> *The culture is spatially constituted.*
> Gregory and Hurry [42]

GIS is a powerful technology through which different spatial orders are re-written. GIS products incorporate traditional spatial organiisation. As any other artifact, GIS interprets spatial orders through its constrained point of view. GIS is a culturally bounded technology that, at times, makes people believe that the way it communicates spatial information and establish spatial orders is universal. GIS is understood as being able to treat worldwide shared meanings while, currently, it treats meanings that belong to a particular professional and cultural tradition.

4.1. DESIGNER AND USER COMMUNITIES

The GIS world is composed of a multinational user community and by a designer community, essentially still mono-linguistic. The designer community prevalently consists of native English speakers (NES). Most of the users are non-native English speakers (NNES). They do not use English or standard English to communicate about GIS related activities. This is the case with different national and regional administrations that integrate GIS in the management of everyday procedures. They use their own language because they must communicate concepts in their local bureaucratic language. They have to understand legal issues and rules whose meanings are intrinsically associated with the national (and sometimes local) language. It is enough to mention the integration of GIS in the cadastral system, where not only space is locally conceptualized, but also time [2].

There are multiple ways to subdivide user communities based on differences. In a general case, hierarchically, first there is regional linguistic differentiation, then the disciplinary and the professional differentiation, and then the levels of professionalism. All levels are determined by cultural basic issues, that may be taken up to the highest level of the hierarchy: the regional linguistic ones [58, 88].

4.2. SPATIAL INFORMATION AND SPACES

GIS manages spatial information that is associated with a large variety of issues, as for instance: territorial forms, landscape morphology, administrative rules and common attitudes, ownership control, micro and macro scale environmental changes, disciplinary and interdisciplinary methodologies of research, disciplinary standards and interdisciplinary attempts, spatial cognition, etc. The interpretation of meanings, situations, rules and procedures, idioms, statements proper to those issues, occurs within precise contexts (i.e., academic, administrative, scientific, political, economical, historical, etc.). Meanings and statements are not universal. The cross-communication between different contexts is only possible by sharing the understanding of basic concepts. The understanding of concepts is mainly based on the consensus area in which they are used. The transfer of words and concepts between different contexts and consensus areas requires the re-discussion of their meanings. For instance, when an interdisciplinary work is undertaken the first concern is about the re-definition of meaning of the words. The GIS field is a meeting point of words and concepts from different contexts. Spatial concepts are very specialized concepts that make the transfer more difficult.

5. Approaches To Study Cultural Differences in GIS: Taxonomy

There are multiple viewpoints to address cultural differences related to GIS. Each viewpoint leads to a particular set of research questions, methodologies and outcomes. Separation and clear labeling are needed to avoid confusion. In the next sections, a simple taxonomy of approaches is given to make the discussion more systematic.

The taxonomy of approaches groups topics belonging to various sectors of GIS. The topics are related to the differences between user and designer communities, and to the differences in conceptualizing and describing spaces by heterogeneous disciplines and scientific fields.

At the highest level of the taxonomy are two major approaches that include topics *directly* associated with GIS and *indirectly* associated with GIS, as follows:

a) approaches directly associated with GIS. They involve the relationships among designers, users, artifacts and their components. The topics are:
- design and use of GIS software,
- use of GIS in a context of procedures,
- integration of GIS in procedures depending on culture,
- spatial data organization depending on cultural context,
- automated cartography and transfer of meanings, and
- GIS as an item of the material culture.

b) approaches *indirectly* associated with GIS; they have an autonomous disciplinary background with respect to GIS. They contribute to the understanding of the human dimension of GIS. The topics are:
- human spatial and temporal conceptualization,
- language, and
- human territoriality.

In some cases topics from the two main sets in this taxonomy relate at a methodological level. For instance, the analysis of GIS user interface cannot avoid the

discussion of general language issues; the understanding of spatial data organization should address the human territoriality problem.

6. Approaches Directly Associated with GIS

6.1. DESIGN AND USE OF GIS SOFTWARE

At first a set of issues related to the design and use of GIS software is discussed. Humans tend to reproduce cultural models in their tools [19, 20, 3, 108]. The influence of specific cultural models at the basis of GIS software design is based on that assumption. GIS designers combine their professional conceptual models [84, 35] with their own cultural models while they design, develop software and plan GIS applications. Designers are seen as the perveyors of cultural models through the artifacts they design, while users are the collectors and interpreters of those models. This approach is human-centered and contextually grounded [19].

The starting point to approach this topic is the study of the cultural, the educational and the professional background of GIS designer, and the analysis of the same variables in the user communities. The direct analysis of how different users perceived, understood and interpreted some component of commercial GIS is also a fundamental point. The two following examples, about interfacing systems and GIS data modeling, provide concrete cases of what is meant.

6.1.1. *User Interface*

The superficial level of user interface is the most approachable component to analyze cultural models reproduced in GIS. For instance, user interfaces based on command language allow the analysis of cross-cultural differences in interpreting GIS terminology that expresses spatial concepts. This specific cultural analysis is based on the methods pursued by fields as the common spatial reasoning [25, 63], qualitative reasoning [29, 30, 33, 34], spatial imagery [59, 65, 103], spatial cognition [104], cross-linguistic analysis [52, 64, 66, 101] and metaphor analysis [61, 62].

The Understanding of GIS Terminology by non-native English Speakers (NNES). GIS command languages are mostly written in English. NNES users have to interpret their meaning through the filter of their own language. We provide here an example about the understanding of the command APPEND by Italian users. APPEND is a common GIS command. The command APPEND performs the function to attach a map to the edges of another one. APPEND is also a word in English that assumes particular meanings when it is translated in other languages. For NNES the term APPEND refers to actions in everyday situations where objects are under the control of the user (i.e., a room, a desk) [17]. These spatial actions might not be corresponding to the performance of the GIS command APPEND. For example, the Italian verb *appendere* (the usual translation of the command APPEND) without the preposition *a* (to) means 'appending a thing to the bottom of another or on the surface of another'. The concept involves a top-down movement in space. An Italian GIS user who is performing the function APPEND would have to imagine a background surface on which the map is allocated, as a distinct object on the surface.

Another example of how NNES understand GIS terminology is provided by the term COVERAGE. The Italian translation of COVERAGE and COVER is *copertura*.

Copertura refers to two particular actions. The first refers to an act of covering something by another thing (in both literal and metaphorical sense). *Copertura* points to actions of hiding whole portions of objects with another object that fits with the morphology of the hidden object. Metaphorically, *copertura* has two meanings. The first one is to hide something making it unknown (*ignoto*). 'Unknown' supports the Italian metaphorical sense of the preposition *dietro* (behind), *sotto* (under) and *su* (over) [21]. Johnson [56] and Talmy [101] have interpreted these prepositions as due to the embodiment experience. *Dietro* (back) refers to a part of the human body. In metaphorical sense *dietro* is used to describe a position of inferiority, or a backward location, invisible to the speakers. *Su* (up) refers to an unreachable location with respect to the human bodily dimension. The second meaning recalled by COVER refers to the protection of something or somebody. The spatial metaphor of the sense of protection is expressed in Italian with the preposition *sotto* (under) or *dentro* (in). The latter refers to the CONTAINER metaphor [66]. The cover in GIS terminology is a virtual map that may be layered with other maps. The stratification of coverages layers is perceived by an Italian speaker as a real object where other objects are hidden inside. The actual meaning of stratification in GIS does not correspond to actions of hiding inside, but rather of putting on.

6.1.2. *GIS Data Modeling*

The data modeling for GIS tends to be over generalized, as a character inherited from computer science. Modeling for GIS should be adapted on the basis of the knowledge of actual structures and processes occurring in geographic space. To achieve this, geography and other disciplines interested in GIS should provide the modeling with the adequate knowledge and theoretical background. However, geography and social science were not offering a clear understanding of the types of space they need to represent. These disciplines offer various statements and approaches but not conceptual models of geographic space on which a modeling of related information can be based [87]. Despite this impediment, and the lack of a general background on cultural issues in computer science, research in the GIS field has recently moved in this direction [27, 18].

Isotropic and Anisotropic Models of Space. GIS implements an isotropic model of space and its primary formal means, the Euclidean geometry. The isotropic space is applied to model differently structured urban spaces. The differences in urban contexts are made by the type of structured space or combination of structured spaces and processes prevailing in some urban reality. The urban space is anisotropic. It is a structured space with a high degree of connectivity between components. Modeling urban structured spaces as isotropic space causes a loss of information about the actual structure of urban spaces [18].

The spatial model offered by GIS becomes prevalent with respect to the structured urban space when integrating GIS in planning procedures. A substitution of models occurs, and the isotropic model becomes prevalent. The provisional planning is based on the data structured on the isotropic model. In this procedure the model implemented in GIS becomes the actual model of the urban reality, although the process should be reversed. One may argue that this process may provoke a recursive relationship, as follows:

> **from** GIS isotropic model -> isotropic model of reality -> planning of real spaces **into** GIS isotropic model.

Many of the South European cities with an irregular morphology have been developed on hills [60, 106]. The modeling of information related to these urban contexts should allow the simultaneous accounting of the morphology and the topography. No current GIS provides tools to model simultaneously topography and morphology data (and the structures of the processes it affects) and data on the configuration of towns. Despite this, current GIS are applied to model urban spatial information in many of the South European cities.

6.2. USE OF GIS IN ADMINISTRATIVE PROCEDURES

Cultural issues are related to the subject of data represented in GIS, in particular the structural condition of land and the tradition in data collection (i.e., types of existing sources of data, traditions in land information mapping, usual procedures for land control). The major issue is how the data of those subjects are used for a single task, how they are collected, represented, managed and how the process of representation is applied. The cultural aspects are directly associated with the process triggered off by GIS. The two following examples are again about the urban data management and some aspects of the Environment Impact Assessment.

6.2.1. Urban Planning Procedures

The literature about GIS and urban planning is mostly related to the North American procedural model [10, 24, 51]. In North America the urban data management system interrelates various aspects of everyday life of towns and cities. Many examples exist for the cross-use of GIS for urban policy [10], taxation and crime control [89], with a daily view of the use of the system. This view refers to a concept of urban data management strictly related to short-term decisionmaking. Cowen and Shirley [24] have argued that there are more similarities than differences among planning needs around the world. However, the recognition of general and ideal needs is not the same as recognizing actual needs. These should always be combined with the tradition and culture of each society [43]. The background scenario, implicitly described by those positions, is metropolitan, typical of most of the North American cities. The European scenario, although there are large cities, is mostly composed by small and medium-sized cities. The everyday needs of planning in these urban contexts are not comparable with metropolitan areas.

In metropolitan areas of developing countries such a model of planning and the consequent use of GIS would be inadequate. To get an efficient application of GIS in short-term planning the availability of information already organized at its source is needed. This organization should be known by planners before applying GIS. That is quite simple in North American towns. The different levels of the urban land use classification, for instance, are easily obtained by planners, as blocks and buildings are regularly organized and the criteria of their organization are known. In cities of developing countries one can hardly get criteria of the organization of different levels of urban land use, not to mention the related information. The ideal process of completion of the GIS integration in planning turns out to be a failure in front of the most elementary evidence.

6.2.2. Environmental Impact Assessment Procedures and GIS

Environment Impact Assessment (EIA) is a set of procedural actions to be pursued when a modification of a territory is intended (i.e., construction of industrial buildings, new roads, etc.). These procedures were applied when GIS was becoming widely used. GIS

has offered a very powerful tool to EIA. EIA procedures *per se* force a synchronic and synthetic view of the territorial situation. The actions EIA requires must be fulfilled completely and fully. The conceptual integration of information is one of the main tasks to be accomplished. GIS is called to show its power to technically integrate the data associated with different types of information which are supposed to be consistently and already integrated at a conceptual level.

EIA as a Context of Administrative Procedures. Cultural issues are a constraint due to the type of organization of territory that is under EIA application. European territory is characterized by micro-realities. Each reality belongs to a particular authority. The European micro realities have a considerable stratification of local authorities. EIA procedures have to deal with these authorities and with the data they possess. While the geographical entities under assessment are easily identified, it is more difficult to identify the authorities the entities belong to. Many procedural difficulties occur in putting together all pieces of an integrated land information framework. Each authority has its own way to map land and environmental information, its own cartographic scales and sets of symbols. From their side, scientists offer other models to the administrators for mapping environmental information. On the other hand, one thinks that GIS may solve these problems at the technical level. What GIS currently offers is an robust approach to overlay techniques. However, this is only one way to compare thematic data at the same scale and for the same kind of space.

GIS may play a valuable role in these locally complex processes. It may help in affording cultural aspects. In Western societies the public consensus about a modification of a territory is an integral part of process of impact assessment. The consensus has to be based on the transparency of the processes that lead to the decisions. In this respect GIS offers a technical way to control the transparency of the process, because of the opportunity to re-trace the procedures of elaboration of information [93].

EIA as Operating in a Cognitive Context. In the EIA checklists some cognitive topics are present. Similar topics are accounted for in some sectors of the GIS field. Cognitive issues (i.e., interaction between inhabitants and landscape) appear in the checklists of the EIA as part of the aesthetical description of the land [79]. Posed in this way they are subjective points, unrelated to the technology integrated in the process of land description. However, the cognitive issues may be questioned in a way that relates them to the spatial information technology.

In EIA cognitive issues should resolve in understanding the sense of place that inhabitants have acquired living for a long time in a particular structured environment. The sense of place is a result of spatial cognition processes, perhaps it is its strongest result [82, 35, 36, 37]. It is affected by living in environments with particular spatial layouts. The spatial layout may affect movement in such places and the spatial and temporal reasoning about them. Approaching aesthetic issues from a cognitive point of view leads to a more structural interpretation of the way through which inhabitants live in their own home spaces.

GIS users are technicians that integrate technology in administrative procedures. However, they are also common people living in a particularly structured environment. They should be assisted in their everyday work by systems that match as much as possible their spatial cognition. This suggests that there is, at least, a common point between GIS and EIA that calls for an integrated analysis. Research in this direction would facilitate a move towards GIS application-oriented development [19].

6.3. SPATIAL DATA ORGANIZATION DEPENDING ON CULTURE

A few researchers have pointed to the role of cultural differences in geographic and administrative reality, and how they affect the building of inter-regional geographic databases and data banks and also how they affect the design of geographic data models [12, 13, 98]. During the last ten years a large number of projects of national and regional data banks have been built using GIS. Some of the international data banks are very limited and seldomly used and have been often filled in without any coordination. Each country applies to this activity its own traditional rules, existing sources, local criteria to collect data and to justify these activities. The absence of sufficient coordination has made some national and regional differences in local geographical data banks evident. These differences are not depending on GIS since the data banks have been built exploiting existing information.

Differences develop from deep traditions of each country in administering and controlling territory. The most common topic in the geographical data bank is the administrative subdivision, which relates to the way the territory is organized and controlled. The administrative information based on the hierarchical land subdivision or the form of land ownership are non-cultural. The hierarchical administrative subdivision may have various origins: religious (see Portuguese *Freguesia*), lay (see Italian *Comune*), ethnic, etc. Land parcels may have originated with taxation procedures. GIS is able to technically treat this data in the same way. The origin of a boundary-line is not important for its acquisition. But the semantic differences are present in the final results of the processing with GIS.

Differences in data banks have made authorities question their usefulness in a period in which the problems tend to be seen globally [76, 98]. However, if on one side problems like the environment should be faced globally, there are others, mainly in Europe, that will continue to be tied to the fragmentation of politics, ethnics and culture. As a historical irony, some of the 'national' databases from last year have become international, given recent changes in European borders.

6.4. APPLICATION OF CARTOGRAPHIC DECONSTRUCTIONISM TO GIS

Most of the GIS data sources and outcomes are cartographic products. Cartography has been recently involved in the deconstructionist process. Decostructionism is about the de-codification of texts to uncover the hidden meanings beyond the main and official messages they communicate. This literary and philosophical trend pursued the method initiated by Structuralism. The main figures have followed the French structuralism, represented in particular by Foucault, Deridda and Barthes. Their points were well known in some fields in Europe during the period of structuralism. The role of language in hiding symbols and meanings as part of a society out of power is the main point of this current. The deconstructive analysis of texts attempts an understanding of what has been omitted and what is the role of the part excluded from using the language of power [86].

Cartographic products are of particular interest for the application of deconstruction techniques [11]. A map is a text in an extended sense, with the peculiarity that it tells mostly about the control of territory by some particular institutional powers. Recently deconstruction techniques were applied in North America to understand cartographic products [44, 45, 5]. It has taken a long time to understand the alternative or hidden meaning communicated by maps. We are now in the position to understand how this

mechanism of communicating particular meaning is working for GIS too, before their products are fully consolidated.

The problems posed by deconstructionism are cross-cultural. Every map contains a hidden meaning that claims to be understood. However, as the official meaning could be understood within the conceptual models of main languages, the hidden meaning should be understood by analyzing the local realities and local languages.

6.5. GIS AS AN ITEM OF THE MATERIAL CULTURE

Material culture is constituted by human artifacts: from towns to a spoon, from houses to a computer. In some respect, and at different levels, GIS is an artifact and as such part of the material culture. In this realm, history of science and technology can already provide us with studies that could be applied to the GIS and its use. Material culture has a long tradition [67, 49]. It comes into play as a discipline when things become an item on the list of human success or failures [85].

The insertion of GIS in the frame of material culture points out the ambiguous nature of this technology. Hodder [49] claimed that the ambiguity derives partly from the non-discursive nature of many material meanings and partly from their greater contextuality. The material meanings of GIS are in the representation of objects that have a material existence in the reality. One refers to these objects by language, but they have some meanings that language hardly can express.

> *Speech and writing are linear. The reader knows where to begin, and follows the words through one by one in an ordered sequence. Faced with a room of objects, on the other hand, there is no set order pattern to the way in which reading takes place. Actions, movements or conventions may in some way 'lead the eye through' any complex setting, but the complexity of the message has a much greater potential for ambiguity than in language" [49, p. 74].*

The assumption of the branch of Human Computer Interaction, that refers to the 'ecological approach', is that *hought is shaped by tools* [90]. This position re-takes to an extreme materialism in the matter of culture, however, it is partly applicable to GIS. This is much more flexible than a simple tool, since it aims at the integration of spatial concepts and related information. For its nature GIS affects deeply the tasks humans are performing through them. Perhaps in a future archive of 'human artifacts' GIS will be labeled as 'cognitive artifacts' [85]. This latter definition mitigates the extreme materialism offered by the statement of Payne, which is also stressed by the position of Pylyshyn [94], who claimed that in very few cases the theories have substantially been suggesting a technical practice, not to mention an engineering one [68].

7. Approaches Indirectly Associated with GIS

Two main topics indirectly associated with GIS are cognition and spatial reasoning. They are topics that disciplinary belong to fields other than GIS, and they serve disciplines, like: environmental psychology, human cognition and linguistics. GIS may be affected by combining studies in the design and use of GIS [13, 23, 30, 61, 73], and in the methodologies of integration of GIS in various scientific and disciplinary fields [14].

7.1. HUMAN SPATIO-TEMPORAL CONCEPTUALIZATION

GIS researchers only recently have examined an important relationship between human spatio-temporal conceptualization and interaction with GIS [31, 32, 71, 73, 74]. How humans conceive of space and time and how they use spatio-temporal notions to organize their everyday life are core questions of this approach [37]. The theoretical framework is based on work of cognitive psychology and linguistics [46, 47, 52, 64, 66, 95, 96]. NCGIA research initiatives, especially Initiatives 2, 10 and 13, have made substantive progress in applying the results of this work to the GIS field.

Spatial concepts express the way of reasoning about the environment by professionals and scientists as well. Spatial concepts affect the design of the various landscapes (rural, urban, coastal, etc.), the administrative rules to govern the territory, the methodology to approach the environmental issues inside academic disciplines, the choice of objects of disciplines, and boundaries of those objects.

7.1.1. *Spatial Experience.*

Human spatial knowledge expressed by language and other abilities provoke differences in designing and using systems that manage spatial information. Some theoreticians neglected the role of experience in differentiating human conceptualization. Others stressed the subjective component of experience as impossible to arrive at a researchable point. Recently, attempts have been made to find out key-concepts to define experience [4, 106, 108]. Recursively over time, experience derives and affects the interaction with the environment [6, 36, 69, 107]. Through that recursive relationship, salient characters of both human and environment are developed and modified. Language takes an active role in structuring this relationship [100], and in organizing our sense of space leading the sense of *where you are* or the *method of loci* [81, 82]. The potential of language should also be considered together with other cognitive functions like movement, memory and imagination [41, 56, 69, 81, 83].

The value of the spatial experience in conceptualizing the world has been expressed by the *Experientialism* (or *Experiential Realism*). Major contribution to this topic has been offered by Rosch [95, 96] Lakoff and Johnson [56, 64, 66] Jackendoff [52] and Johnson-Laird [57]. The theories of *Experiential Realism* may offer basic constraints, and then some methodology, to understand cultural differences in human conceptualization of the world. The main basic constraints are:

- the existence of conceptual [52] or categorical [64, 95, 96] invariant structure of human thinking about the world,
- language as a means for recognizing invariant structure of categorization and variable meanings,
- the contextual value of meanings as a cross-cultural variable,
- metaphorical expression for everyday communication based on spatial and bodily experience.

The categorization of real entities is influenced first and foremost by interaction with the environment.

7.2. LANGUAGE ISSUES

The analysis of language is the most approachable level for identifying cultural variables involved in the invariant structures of human thinking about the world [56, 64, 72, 96]. There is a concept that makes the language issue crucial for GIS. The GIS task is to describe and analyze places by representation of spatial structure and processes [28]. Structures, processes and their formalization are carried on by a few professionals (perfectly able to communicate with each other in detail), while the knowledge and understanding of places should be approachable by anybody interested in them, even if he or she is not participating in the usual professional context. This should be achieved by the use of GIS, and the terminology of GIS should enable it. The main character of GIS users is the coexistence in their background of different constraints to think about space, together with common reasoning about it [91]. GIS communities express such constraints both in designing and interacting with the systems, but in particular through the will to understand spaces and places. The understanding of what GIS is performing is mainly a conceptual issue, and the language issues should be involved as conceptual rather than as lexical problems [16, 74].

In this context GIS is one of the concrete applications resulting from the interdisciplinary method of research in a spatial information science domain. Artificial intelligence, linguistics and semiotics concur to develop basic ideas on which to base a human oriented GIS. Issues relevant in the field of Human Computer Interaction are now becoming crucial for thinking about new interdisciplinary principles for spatial information management.

7.3. HUMAN TERRITORIALITY

Human territoriality represents the social and cultural dimension of the organization of space; [23]. It involves the complex relations among traditions, heritage and new needs. Tradition is about the transmission of professional skills in building forms and organizing spaces in respect to needs and social rules. What makes sense to a particular way of shaping space is the culture that accepts it and historically reproduces the pattern of the organized space [7, 99]. Human territoriality has also a cognitive role as it affects the perception of lived space, the interaction with it [40], the way to organize it in a consensus domain.

Sack [97] pointed out the differences in the sense of human territoriality. Differences here reach far, from cultures that lack a proper concept of 'private ownership in real estate', to cultures that consider land a 'free good', and there are extensive discussions of the clashes when such different cultures come into contact.

7.3.1. *A Conceptual Constraint in GIS Terminology to Express Territoriality*

GIS deals with cartography and forms of representing territory. Therefore, GIS deals directly with the function 'to map'. While in GIS 'to map' is considered only in the technical cartographic meaning, it has multiple uses and interpretations in other disciplines. However, while in cognitive sciences and natural sciences the verb 'to map' is taken metaphorically, in GIS it is taken literally, being a direct correspondence between the operation 'to map' and the product of GIS, the maps. While in other disciplines the mapping gives the method of thinking a pragmatic character [92], in GIS this should be the praxis. This speaks to the fact that disciplines other than GIS are supported more

clearly in defining their tasks metaphorically, making them more easily referred to as a general conceptual context. Somehow, GIS does not this freedom. It is forced to consider the metaphor 'to map' as its own 'task' and the maps its own 'reality'.

In GIS, mapping is a process to put boundaries (i.e., physical, legal, administrative) around territorial entities. To define entities by using boundaries may not be the way that all cultures organize life in a territory. For people and cultures who are not used to bounding their territory, the application of mapping with GIS for representing these territories may be an unsuitable way to face culture aspects by transfer of technology.

8. Conclusions

We have linked a number of problems in GIS design and usage to the general problem of cultural issues affecting GIS. This collects a variety of diffuse problems under a general subject. The discussion of cultural issues has recently gained some attention, addressing the issue from many different points of view. The problem is too broad and requires some subdivision into particular aspects that can be described and investigated individually. In this paper we have separated the following aspects of cultural issues related to GIS software differences in:

- the cultural background between GIS designers and users,
- how software is designed, and the two aspects related to the process in which GIS is used:
- the definition, collection and representation of spatial data, and
- the administrative process that uses the spatial data.

From a more scientific point of view, several other subcategories can be identified. There is an active area of research, dealing with how people conceptualize space, which affects the way GIS software is designed and used. A different strand of work relates to:

- differences in the administrative tradition and how it affects the construction of geographic data models,
- cultural differences in the sense of human territoriality, and
- GIS as part of the 'material' culture, in particular the perception of information technology and how it integrates with other technologies.

Much remains to be done, but from the few examples, it becomes clear that cultural differences affect the economic viability of GIS in many situations and thus influence the industry in a substantial way.

9. References

1. Aangeenbrug, R. T. (1991) A critique of GIS, in D. J. Maguire, M. F. Goodchild and D. W. Rhind (eds) *Geographical Information Systems: Principles and Applications*, Longman Scientific & Technical, Essex, 1, 101-107.
2. Al-Taha, K. (1992) Temporal Reasoning in Cadastral Systems; *Ph.D. Dissertation*, University of Maine.
3. Bannon, L. L., and Bodker, S. (1991) Beyond the interface: encountering artifacts in use, in J. Carroll (ed) *Designing Interaction*, Cambridge University Press, Cambridge.
4. Bateson, G. (1984) *Mente e natura*, Adelphi, Milan.
5. Belyea, B. (1992) Images of power: Derrida/Foucault/Harley, *Cartographica*, **29**, 2, 1-9.
6. Bjorklund, E. M. (1991) Culture as input and output of the cognitive-linguistic processes, in D. M. Mark and A. U. Frank (eds) *Cognitive and Linguistic Aspects of Geographic Space: An Introduction*, Kluwer Academic Publishers, Dordrecht, pp. 66-70.
7. Bourdier, J. P. and Alsayyad, N. (1989) (eds) *Dwellings, Settlements and Tradition. Cross-cultural Perspective*, University Press of America, Lanham.

8. Bourdier, J. P. (1989) Reading tradition, in J. P. Bourdier and N. Alsayyad (eds) *Dwellings, Settlements and Tradition. Cross-Cultural Perspective*, University Press of America, Lanham, pp. 35-52.
9. Bowers, C.A. (1988) *The cultural dimension of educational computing*, Teachers College Press, New York.
10. Calkins, H. W. (1991) GIS and public policy, in D. J. Maguire, M. F. Goodchild and D. W. Rhind (eds) *Geographical Information Systems: Principles and Applications*, Longman Scientific & Technical, Essex, pp. 233-245.
11. Campari, I. (1984) *Insediamenti rurali. Note di filologia del territorio*, Pacini, Pisa.
12. Campari, I. (1990) Accuracy vs. spatial statistical data. The Mediterranean region. The MEDASE project, in *Proceedings of EGIS'90*, EGIS Foundation, Amsterdam.
13. Campari, I. (1991) Some notes on geographic information systems: the relationship between their practical application and their theoretical evolution, in D. M. Mark and A. U. Frank (eds) *Cognitive and Linguistic Aspects of Geographic Space*, Kluwer Academic, Dordrecht, pp. 35-44.
14. Campari, I. (1992) Human impacts on coastal regions: an integrated conceptual framework, in *Proceedings of EGIS'92*, EGIS Foundation, Muenchen.
15. Campari, I. and Frank, A. U. (1993a) Cultural differences in GIS. A basic approach, in *Proceedings of EGIS'93*, EGIS Foundation, Genova.
16. Campari, I. (1993b) GIS commands cultural sharing of spatial meaning, *Technical Report No. 01-93*, Department of Geoinformation, Technical University of Vienna, .
17. Campari, I. (1994) GIS commands as Small Scale Space Terms: cross-cultural conflict of their spatial content, *Proceedings of VI Spatial Data Handling Symposium*, Edinburgh, September.
18. Campari, I. and Frank, A.U. (1994) Modeling realistic space: urban development as a case study, *ESPRIT Workshop "Advances in Geographic Information Systems"*, February 28 - March 4, Ascona.
19. Carroll, M. J. and Kellog, W. (1989) Artifact as theory nexus: hermeneutics meets theory based design, in K. Bice and C. Lewis (eds) *CHI'89, SIGCHI Bulletin*, 7-14.
20. Carroll, M. J., Kellog, W. A., and Rosson, M. B. (1991) The task-artifact cycle, in J. Carroll (ed) *Designing Interaction*, Cambridge University Press, Cambridge, pp. 73-102.
21. Casadei, F. (1993) The canonical places: an implicit (space) theory in Italian idiom, *Ph.D. Dissertation*, University of Rome "La Sapienza".
22. Clarke, J., Hall, S., Jefferson, T. and Roberts, B. (1976) Subcultures, cultures and class: a theoretical overview, in S. Hall and J. Henderson (eds) *In Resistance Through Rituals*, Hutchinson, London, pp. 9-74.
23. Couclelis, H. (1992) People manipulate objects (but cultivate fields): beyond the raster-vector debate in GIS, in A. U. Frank, I. Campari and U. Formentini (eds) *Theories and Methods of Spatio-Temporal Reasoning in Geographic Space*, Lecture Notes in Computer Science, Vol. 639, Springer Verlag, Heidelberg-Berlin, pp. 65-77.
24. Cowen, D. J. and Shirley, W. L. (1991) Integrated planning information systems, in D. J. Maguire, M. F. Goodchild and Rhind, D. W. (eds) *Geographical Information Systems: Principles and Applications*, Longman Scientific & Technical, Essex, pp. 297-310.
25. Davis, E. (1990) *Representations of Commonsense Knowledge*, Morgan Kaufmann Publishers, San Mateo.
26. Dobson, J.E. (1993) Consider both sides of GIS ethics, *GIS World*, September.
27. Edwards, G. (1993) The Voronoi model and cultural space: application to the social sciences and humanities, in A. U. Frank and I. Campari (eds) *Spatial Information Theory: Theoretical Basis for GIS*, Lecture Notes in Computer Science, Vol. 716, Springer Verlag, Heidelberg-Berlin, pp. 202-214.
28. Erikson, T. (1993) From interface to interplace: the spatial environment as a medium for interaction, in A. U. Frank and I. Campari (eds) *Spatial Information Theory: Theoretical Basis for GIS*, Lecture Notes in Computer Science, Vol. 716, Springer Verlag, Heidelberg-Berlin, pp. 391-405.
29. Frank, A. U. (1991) Qualitative spatial reasoning about cardinal directions, in *Auto-Carto 10: Technical Papers of the 1991 ACSM-ASPRS Annual Convention*, ACSM-ASPRS, Baltimore, VI, pp. 148-167.
30. Frank, A. U. (1992) Spatial reasoning, in *Proceedings of EGIS'92*, EGIS Foundation, Muenchen, 1.
31. Frank, A. U., Campari, I., and Formentini, U. (1992) (eds) *Theories and Methods of Spatial Temporal Reasoning in Geographic Space*, Lecture Notes in Computer Science, Vol. 639, Springer Verlag, Heidelberg-Berlin.
32. Frank, A.U., Campari, I. (1993) (eds) *Spatial Information Theory: Theoretical Basis for GIS*, Lecture Notes in Computer Science, Vol. 716, Springer Verlag, Heidelberg-Berlin.
33. Freksa, C. (1991) Qualitative spatial reasoning, in D. M. Mark and A. U. Frank (eds) *Cognitive and Linguistic Aspects of Geographic Space: An Introduction* Kluwer Academic, Dordrecht, pp. 361-372.
34. Freksa, C. (1992) Using orientation information for qualitative spatial reasoning, in A. U. Frank, I. Campari and U. Formentini (eds) *Theories and Methods of Spatio-Temporal Reasoning in Geographic Space*, Lecture Notes in Computer Science, Vol. 639, Springer Verlag, Heidelberg-Berlin, pp. 162-178.
35. Gardner, H. (1983) *The Theory of Multiple Intelligences*, Basic Books Publisher, New York.
36. Golbeck, S. L. (1985) Spatial cognition as a function of environmental characteristics, in L. Cohen (ed) *Development of Spatial Cognition*, Lawrence Erlbaum, Hillsdale, pp. 225-25

37. Golledge, R. (1992) Do people understand spatial concepts: the case of the first order primitives, in A. U. Frank I. Campari and U. Formentini (eds) *Theories and Methods of Spatio-Temporal Reasoning in Geographic Space*, Lecture Notes in Computer Science, Vol. 639, Springer Verlag, Heidelberg-Berlin, pp. 1-21.
38. Golledge, R., Richardson, G. D., Rayner, J. N. and Parnicky, J. (1983) Procedures for defining and analyzing cognitive maps of the mildly and moderately mentally retarded, in H. L. Pick and L. P. Acredolo (eds) *Spatial Orientation. Theory, Research, and Application*, Plenum Press, New York - London.
39. Goodchild, M. (1992) Hard challenge and opportunities in GIS related researches, Communication at the *University of British Columbia Meeting on GIS*, British Columbia.
40. Goodnight, J.A. and Cohen, R. (1985) The social cognition of spatial cognition: regulating personal boundaries, in R. Cohen (ed), *The development of spatial cognition*, Lawrence Erlbaum, Hillsdale.
41. Gould, P. and White, R. (1986) *Mental Maps*, Allen & Unwin.
42. Gregory, D. and Hurry, J. (1985) *Social Relations and Spatial Structures*, Macmillan, London.
43. Guttenberg, A. Z. (1993) *The Language of Planning*, University of Illinois Press, Urbana Champaign.
44. Harley, J. B. (1988) Silences and secrecy: the hidden agenda of cartography in early modern Europe, *Imago Mundi*, **40**, 1.
45. Harley, J. B. (1989) Deconstructing the map, *Cartographica*, **26**, 2, 70.
46. Herskovits, A. (1985) Semantics and pragmatics of locative expressions, *Cognitive Science*, **9**, 341-78.
47. Herskovits, A. (1987) *Language and spatial cognition: An interdisciplinary study of the prepositions in English*, Cambridge University Press, Cambridge.
48. Hillier, B. and Hanson, J. (1988) *The social logic of space*, University Press, Cambridge.
49. Hodder, I. (Ed.). (1991) *The Meaning of Things: Material Culture and Symbolic Expression*, Harper Collins Academic, London.
50. Hoesle, V. (1991) *Philosophie der Oekologischen Krise*, C.H. Beck'sche Verlag, Muenchen.
51. Huxhold, W. E. (1992) *An Introduction to Urban Geographical Information Systems*. Oxford University Press, Oxford.
52. Jackendoff, R. (1983) *Semantics and Cognition*, MIT Press Cambridge (MA).
53. Jackson, P. (1992) *Maps of Meaning*, Routledge, London.
54. Jonas, H. (1979) *Da Prinzip Verantwortung*, Insel Verlag, Frankfurt.
55. Jonas, H. (1984) *Philosophical Essays: From Ancient Greek to Technological Man*, University of Chicago Press, Chicago.
56. Johnson, M. (1987), *The Body in the Mind*, University of Chicago Press, Chicago.
57. Johnson-Laird, P. N. (1993) *Mental Models*, Cambridge Academic Press, Cambridge.
58. Kellog, W. A. and Thomas, J. C. (1993) Cross-cultural perspective on Human Computer Interaction: A report on the CHI'92 Workshop, *SIGCHI Bulletin*, **25**, 2, 40-45.
59. Kosslyn, S. (1980) *Image and Mind*, Harvard University Press, Cambridge (MA).
60. Kostof, S. (1991)*The City Shaped. Urban Patterns in Meanings Through History*, Thames and Hudson, New York.
61. Kuhn, W. (1992) Paradigms of GIS use, in D. Cowen, P. Bresnahan and Corwin, E. (eds) *Proceedings of V Spatial Data Handling Symposium*, IGU, University of North Carolina, Charleston, pp. 91-102.
62. Kuhn, W. (1993) Metaphors create theories for users, in A. U. Frank and I. Campari (eds) *Spatial Information Theory: Theoretical Basis for GIS*, Lecture Notes in Computer Science, Vol. 716, Springer Verlag, Heidelberg-Berlin, pp. 366-376.
63. Kuipers, B. (1985) Commonsense reasoning about causality: deriving behavior from structure, in D. Bobrow (ed) *Qualitative Reasoning about Physical Systems* MIT Press, Cambridge (MA).
64. Lakoff, G. (1987) *Women, Fire and Dangerous Things*, University of Chicago Press, Chicago.
65. Lakoff, G. (1988) Cognitive semantics, in U. Eco, P. Violi and M. Santambrogio (eds) *Meaning and Mental Representation* , Indiana University Press, Bloomington & Indianapolis, pp. 119-154.
66. Lakoff, G., and Johnson, M. (1980) *Metaphors We Live By*, University of Chicago Press, Chicago.
67. Leroi-Gouran, A. (1964) *Le Geste et la Parole. Techique et Language*, Gallimard, Paris.
68. Lewis, C. (1991) Inner and outer theory in human-computer interaction, in J. Carroll (ed) *Designing Interaction*, Cambridge University Press, Cambridge, pp. 154-161.
69. Lynch, K. (1960) *The Image of the City*, MIT Press.
70. Marchetti, C. (1989) Strategie provisionali per lo sviluppo ambientale, in I. Campari, A. Montanari and P. Mogorovich (eds) *Cultural dell'Informazione e Gestione dell'Ambiente*, Edizioni Scientifiche Italiane, Naples.
71. Mark, D. (1992) Spatial metaphors for Human Computer Interaction, in D. Cowen, P. Bresnahan and E. Corwin (eds) *Proceedings of 5th Spatial Data Handling Symposium*, IGU, University of North Carolina, Charleston, pp. 104-112.
72. Mark, D. (1993) Toward a theoretical framework for geographic entity types, in A. U. Frank and I. Campari (eds) *Spatial Information Theory. Theoretical Basis for GIS*, Lecture Notes in Computer Science, Vol. 716, Springer Verlag, Heidelberg-Berlin, pp. 270-283.
73. Mark, D and Frank, A. U. (1991) (eds) *Cognitive and Linguistic Aspects of Geographic Space*, Kluwer Academic, Dordrecht.

74. Mark, D., Gould, M. D. and Nunes, J. (1989) Spatial language and geographic information systems: cross linguistic issues, in *II Conferencia Latino-Amricana Sobre la Tecnologia de los Systemas de Informacion Geografica*, Universidad de los Andes, Merida, pp. 105-130.
75. Mark, D., Svorou, S., and Zubin, D. (1987) Spatial terms and spatial concepts: geographic, cognitive, and linguistic perspective, in *IGIS Symposium: The Research Agenda*, Arlington (VA).
76. Masser, I. and Salgé, F. (1992) *Meeting on Geographical Data Bases. Aix en Provence,* March 1992, Meeting Report, European Science Foundation.
77. Maturana, H.R. (1978) The biology of language: the epistemology of the reality, in G. A. Miller, E. Lenneberg (eds) *Psychology and Biology of Language and Thought: Essays in Honor of Eric Lenneberg*, Academic Press, New York, pp. 27-64.
78. Morin, E. (1986) *La Methode.III. La Connaissance de la Connaissance*, Editions du Seuil, Paris.
79. Munn, R. E. (1979) *Environmental Impact Assessment*, Wiley, New York.
80. NCGIA (1993) *Workshop "GIS and Society"*, University of Washington, Friday Harbor, November.
81. Neisser, U. (1976) *Cognition and Reality*, Freeman, San Francisco.
82. Neisser, U. (1986) The sense of where you are: function of the spatial module, in P. Ellen and C. Tinus -Blanc (eds) *Cognitive Processes in Animals and Man* Kluwer Academic Publishers, Dordrecht, pp. 293-310.
83. Norberg-Schultz, C. (1979) *Genius Loci. Paesaggio, Ambiente e Architettura*. Mondadori, Milan.
84. Norman, D. (1988) *The Design of Everyday Things*, Doubleday, New York.
85. Norman, D. (1991) Cognitive artifacts, in J. Carroll (ed) *Designing Interaction* Cambridge University Press, Cambridge, pp. 17-38.
86. Norris, C. (1982) *Deconstruction. Theory and Practice*, Routledge, London.
87. Nunes, J. (1991) Geographic space as a set of concrete geographical entities, in D. Mark and A. U. Frank (eds) *Cognitive and Linguistic Aspects of Geographic Space*, Kluwer Academic, Dordrecht, pp. 9-34.
88. Nyerges, T. (1993) How do people use geographical information systems? in D. Medyckyj-Scott and H. M. Hearnshaw (eds) *Human Factor in Geographical Information Systems,* Belhaven, London, pp. 37-50.
89. Parrott, R. and Stutz, F.P. (1991) Urban GIS applications, in D. J. Maguire, M. F. Goodchild and D. W. Rhind (eds) *Geographical Information Systems: Principles and Applications*, Longman Scientific & Technical, Essex, pp. 247-260.
90. Payne, S. L. (1991) Interface problems and interface resources, in J. Carroll (ed) *Designing Interaction*, University Press Cambridge, Cambridge, pp. 128-153.
91. Pederson, E. (1993) Geographic and manipulable space in two Tamil linguistic systems, in A. U. Frank and I. Campari (eds) *Spatial Information Theory. Theoretical Basis for GIS*, Lecture Notes in Computer Science, Vol. 716, Springer Verlag, Heidelberg-Berlin, pp. 294-311.
92. Piattelli Palmarini, M. (1987) (ed) *Livelli di realta'*, Feltrinelli, Milan.
93. Pozzana, G., Campari, I. and Franchini, D. (1992) *Valutazione di Impatto Ambientale e Geographic Information Systems*, Franco Angeli, Milan.
94. Pylyshyn, Z. (1991) Some remarks on the theory-practice gap, in J. Carroll (ed) *Designing Interaction*, Cambridge University Press, Cambridge, pp. 39-49.
95. Rosch, E. (1973) On the internal structure of perceptual and semantic categories, in T. Moore (ed), *Cognitive development of the acquisition of language* Academic Press.
96. Rosch, E. (1978) Principles of categorization, in E. Rosch and B. B. Lloyd (eds), *Cognition and Categorization*, Lawrence Erlbaum Publ..
97. Sack, R. D. (1986) *Human Territoriality*, Cambridge University Press, Cambridge.
98. Salgé, F., Smith, N. and Ahonen, P. (1992) Towards harmonized geographical data for Europe, in D. Cowen, P. Besnahan and E. Corwin (eds), *Proceedings of 5th Spatial Data Handling Symposiun*, IGU, University of North Carolina, Charleston, pp. 294-312.
99. Shils, E. (1981) *Tradition*, University Press of Chicago, Chicago.
100. Talmy, L. (1983) How language structures space, in H. L. Pick and L. Acredolo (eds) *Spatial Orientation. Theory, Research and Application*, Plenum Press, New York - London.
101. Talmy, L. (1993) How grammar structures concepts, in *XVI Wittgenstein Konferenz*, Communication, August, Kirchberg (A).
102. Taylor, R. (1978), Human territoriality: A review and a model for future research, *Cornell Journal of Social Relations*, **13**, 2, 125-151.
103. Tversky, B. and K. Hemenway (1983) Categories of Environmental Scenes, *Cognitive Psychology,* **15**, 1-29.
104. Tversky, B. (1993) Cognitive maps, cognitive collages and spatial mental models, in A. U. Frank and I. Campari (eds) *Spatial Information Theory. Theoretical Basis for GIS* Springer Verlag, Heidelberg - Berlin, pp. 11-25.
105. Vance, J.E. (1990) *The Continuing City: Urban Morphology in Western Civilization,* John Hopkins University, Baltimore-London.
106. Varela, F., Thompson, E. and Rosch, E. (1991) *The Embodied Mind. Cognitive Science and Human Experience*, MIT Press, Cambridge (MA).

107. Walsh, D. A., Krauss, I. K. and Regnier, V. A. (1981) Spatial ability, environmental knowledge and enviromental use: the elderly, in L. S. Liben, A. H. Patterson and N. Newcombe (eds), *Spatial Representation and Behavior Across the Life-Span*, Academic Press, New York.
108. Winograd, T. and Flores, F. (1986) *Understanding Computer and Cognition,*. Ablex Publishing Corporation, Norwood, New York.