COGNITIVE PERSPECTIVE ON ARCHAEOLOGICAL SPATIAL DATA AND GIS

Associate Professor Dr. Tsoni Tsonev
Interdisciplinary Department
National Institute of Archaeology ad Museum- Bulgarian Academy of Sciences
E-mail: tsts1113@yahoo.com

ABSTRACT

This paper describes the initial conditions necessary for successful creation of GIS-based Information System that can effectively integrate various web-resources and datasets of archaeological spatial data. Opposite to the analyses applied by social semiotic theory which asks the question: 'How to convey in a best way an important message to particular audience?' GIS-centric approach answers the question: 'How to make featureless spatial data meaningful and appealing to wide variety of audiences?' At the conceptual level, the capabilities of GIS integration have to be met by a new framework of the theory of historical explanation. It involves the novel theory of manipulation of explanatory information. This forms the conceptual framework for creating personalized historical knowledge that is the basic source of computer-generated simulation of human-landscape encounter. This proposition is also grounded on analyses of empirical data that come from a study of the reaction of museum audiences in Sofia (2009) to GIS-based virtual museum presentation. The analyses of the data are presented at some length in the paper. Additionally, the GIS-centric approach is grounded on qualities so far neglected but which are important elements in any application for increasing the potential for creating meaning and explanation of archaeological spatial data. Some of these qualities are discussed because they constitute the social power of images from the past.

At the technical level, the GIS-centric approach opposes the existing similarity between the traditional descriptive historical knowledge and the creation of hierarchical data models. These are hierarchical structures that follow the physical process of archaeological (museum) descriptions of materials, rock art, and other inventories. The scheme starts with the original artifact (text, image), continues with bibliographical record and finishes off with XML markup and content markup that allow interaction with the respective database. This hierarchy operates within the classical knowledge extraction triangle established between: (i) common database; (ii) the upcoming data from fieldwork; (iii) the process of description and interpretation preserved in archives, catalogues, reports. At a higher level of interpretation this way of structuring archaeological/historical data fuels development of little effective 'predictive modeling' of past human-landscape interaction based on formal extrapolation methods. A possible solution for building a joint historical-geographic Information System is proposed that involves GIS-based integration in a more logical and meaningful way to archaeologists and their public. The analytical object models and data types can be maintained by 'archaeological services repository' (ASR) that has the potential for reuse across processes and with other services. Its starting point is based on the multiple meaning of popular terms used in historical knowledge. For example, the terms 'catastrophe', 'chaos', etc. have different meaning in natural and humanitarian sciences and in public understandings. This diversity of meanings requires a proper way of defining and addressing specific resources of information: historical resources that contain summarized archaeological data featured by descriptive marks of the underlying semantics and metadata. Further in the text a brief discussion of the organization and orchestration of services is presented.

Keywords: *GIS, semantic state space, Archaeological Services Repository (ASR)*

CONCEPTUAL BACKGROUND

GIS as a system of organization, management, and analyses of large amount of spatially distributed data has a number of advantages. However, there is one systemic feature that slipped away the attention of the mainstream GIS specialists. The ways people communicate through GIS and the ways they create new knowledge seem to receive little attention by the research community, GIS developers, and specialists in communication. To a certain extent this lack of research has been increasingly compensated by modern discourse analyses based on social semiotic theory [1]. The conceptual framework of this theory defines different semiotic resources other than language and analyzes their relations with each other, specified as inter-related semantic systems. These semantic systems are expected to fulfill four functions: to construe our experience of the world (experiential meaning); to create logical relations between experiential meanings (logical meaning), to enact social relations (interpersonal meaning) and to organize meanings into coherent messages in text (textual

meaning). In this way, this social semiotic framework accounts for multiple strands of meaning with semiotic resources and their underlying systems as tools for meaning-creation. On this basis discourse analyses of these multimodal phenomena can be organized in several ways. A relatively straightforward approach to such data may be the one that quantifies data coming from different semiotic resources such as linguistic choices, camera angle, gaze and framing [2]. Through application of a linear transformation of this data it is possible to find the best combination of semiotic resources that maximizes the impact of speakers to their audience. In order to perform this type of analyses, however, it is necessary to fulfill one important condition. The news that the speakers (in the present example) try to communicate at best to their audience have to be very important and interesting. This condition cannot be met by the most of the news and data that reach audiences via TV, Internet, Radio, scientific data. For example, archaeological spatial data lack such a direct relation to public and do not share immediate understanding of the public and even of professionals. But when the public acquires archaeological spatial data by means of GIS as an integrated historical-geographic presentation the otherwise featureless data become important and understandable. This behavior of the public and of professionals can be described and explained by introduction of the concept of a complex semantic state-space [3]. Through this formal procedure, it is possible to describe a real situation when humans are under the stress of great amount of incoming information. In order to facilitate its processing relatively stable cognitive explanatory schemes were established by biological evolution. Their work is supported by a specific way of processing the incoming information flow. Recent studies established that human brain reacts best to a distributed information processing [4]. Updating a cortical representation is likely to require a regulation system that broadly affects the population of related neurons [5]. Starting from the understanding that particular stimulation of brain activities leads to predominant influence of external stimuli which induces better learning of new representations, while alternate stimulation of brain leads to better recalling of previous learned information makes possible understanding of the importance of the increased connectivity between an external dynamical environment and the internal dynamic of information processing of the brain. Thus the already established cognitive explanatory schemata undergo a continuous process of updating and re-assessing. This is a complex process that acts in two opposing ways. Experimental data show that the museum public that acquires new information from a GIS-aided historical-geographic presentation experiences a continuous process of alternating explanatory concepts. Each participant undergoes a process of maximizing the capacity of his/her cortical representations that allows better conceptualization of cases when the up-coming new information converges within or diverges from the existing explanatory schemata. If the new information converges within their explanatory limits these schemata remain stable. In case of divergence a new explanatory scheme emerges in a gradual or in a more rapid way. It is set aside from the old one or completely opposes and replaces it. It is this conceptual network of creating meaning through the ways of improving the process of acquiring new information and recalling the old one that makes possible constitution of the concept of a complex semantic state-space [6] in brain processing of new information. The concept of a complex semantic state-space allows simulating the process of creating meaning out of spatial data and typifying human behavior in new learning situations. For example, in order to initiate a process of concept transformation within the existing set of explanatory schemata it is necessary to submit a group of people to: (i) a dynamic external presentational environment, and to (ii) set up for them explanatory tasks (game-controlled environment) in order to understand how far the process of concept transformation proceeds successfully. In the present paper some results from experiment with museum audience with GIS-aided historical-geographic presentation are given. The analyses of this data aim at revealing how humans conceptualize new

information within the framework of popular understanding of history. Some particularities within the general framework of a semantic state-space are being observed. The study showed that subjects acquire new information by manipulating counterfactual information and by creating their own hierarchies of newly created situated knowledge that have differentiated contribution to building one or more explanatory hypotheses. Thus the learning behavior of the public in cases when it acquires new information from an integrated historical-geographic presentation involves phenomena that are a combination between 'split attention' (attention divided between historical facts and geographic details) and 'split understanding' (hesitant behavior when neither of a range of rational arguments dominates). Thus, at the explanatory level of a semantic state-space, when we deal with geographic presentation of historical data our attention becomes split between an automatically generated historical explanation (mostly time-related) and individual examples presented by geographically different areas (working memory performs better with visualized spatial information). It is exactly this phenomenon of "hesitant" behavior of people that defines the two major ingredients of a semantic state-space: 'information band' (information that is understood and processed) and 'noise' (information that is not understood and rejected). According to the existing data, people are not uniform in providing historical explanations and often change their state between the group of "confident" and the group of "hesitant" people. There is an explanation of this complex reaction of public at a biochemical level of the functioning of human brain. In response to dynamic external stimuli the brain initiates specific biochemical reactions that result in chain-like structures and allow complex hierarchies of semantic structures to emerge in a relatively stable form. The analysis of this complex behavior requires additional experiments and mathematical modeling and goes beyond the scope of the present paper. It is worth noting, however, that this type of analyses is further complicated by important background conditions - the nature of the popular historical knowledge has also to be taken into account. Normally, people have evolutionist understanding of history and associate historical themes as stages of social evolution. In such a situation the most frequent question is 'when did this historical event happen?' This is the trivial question that does not provoke interest or deeper understanding. In general, factual questions about the time a given historical event happened are among the commonest ones because people do not have any other choice. GIS, however, through computer generated cartography is able to provide people with the new option to explore counterfactual information presented as geographically distributed historical examples that support one or more explanatory hypotheses. This possibility corresponds to the inherent human quality to seek for deeper knowledge of the past. As deeply rooted human behaviour this 'desire' is based on the fact that historical knowledge has been strictly controlled by state, religious, group's authorities. The public's understanding is that official histories hide the truth, and deprive people from their true knowledge of the past. In these circumstances the geographic scope (as bearing more easily memorable anchor points associated with counterfactual information) of historical knowledge has the potential to induce change in public understandings. For example, geographically distributed historical examples can break the evolutionary trend in understanding history and may provide different views on why certain historical event happened or not happened to the same degree in different regions. The basic drive of this 'la volonté de savoire' (popular will to know) is the node of questions: who are we as humans, peoples and society? As with M. Foucault suppressed sexuality [7] these questions emerge from suppressed knowledge of the past and seek explanatory schemes that involve additional information that is not included in official statements and explanations.

THE POWER OF THE IMAGES FROM THE PAST

GIS integrated presentations of historical-geographic information have another advantage. They incorporate in themselves the power of the images of the past. The question is whether

we can give a proper definition of this power or not and where does it come from? The answers to these questions has to be sought in finding out the place the knowledge of the past takes within the general human knowledge, and how its popular version becomes manipulated so that to be able to interact with the social world. Thus the definition of this phenomenon lies in the epistemological roots of historical knowledge. A question arises as to how what existed in past societies can now be identified and understood? The answer to this question is not a straightforward one and can be divided into two opposing trends of understanding history. The first one comes out from the understanding of past human culture as having universal symbolic expression. According to it universal cultural codes have been established which through the process of their "true" decoding enable us to better understand the past. For example, artefacts that seem important for contemporary political, economic, etc reasons are detached from their geographic context and used in public presentations of the past in an artificial environment – museum exhibitions. What is expected from the visitors to these museums is that by using their abilities to match, select, remember forms they have to understand the "true" syntax and meanings of these chains of exhibited artefacts accompanied by additional formal traits and attributes. Visitors unconsciously enter into an endless process of trying to grasp symbols by manipulating them according to the rules based on their forms, not on their meaning. This makes most of the attempts to discern the meaning from such an artificial sequence of symbols impossible.

The second trend that in its approach stays close to the process of engagement of diverse cognitive resources in an integrated GIS-based historical-geographic presentation is grounded on the assumption that meaning and context are dynamically emergent from activity and interaction, determined in the moment and in the doing [8]. The danger with this approach is to go further into extreme relativism stating that there is no pre-given knowledge and no fixed properties that can *a priory* determine what is relevant. For example, the notion of 'paradise' is tightly related to the notion of modernity. It is a personal, almost physical experience of abundance and endless pleasures. The relativity of this idea may be taken as culturally-specific that grows with a child in a given culture. Yet the universal or culturally-specific notions of paradise may develop with the growing experience of the child. These local vs. global understandings are not relevant in this case because for most of the people, even for culturally remote from one another, these images will have similar meaning and evoke similar feelings. In other words this image represents an invariant relationship established by human imagination that opposes the everyday reality of always limited resources with imaginative state of living in endless abundance and pleasures. Thus neither in the past nor in the present humans is able to reach a state of endless abundance and pleasures. On the other hand the conceptualization of the everyday state of limited resources and its opposing imaginative world of abundance turns out to be much more productive as an approach to understanding the semantics hidden in a sequence of artefacts by focusing on analyses of the process of evolution and transformation of concepts into culturally situated knowledge rather than to try to decode the "true" meanings from formal traits discerned from artistic depictions. According to M. Foucault, in order to be able to establish true relationship between the signifier and signified the images and their intrinsic interactions of similitude and resemblance have to be framed within the global relation established between micro- and macrocosms [9].

It should be noted that the popular historical knowledge takes a particular role that differs from the above described trends in understanding history. This role is best visible in the existing paradox with the visitors to historical museums. If we take that the first trend of authoritative and formal approach to the past is a dominant one than historical museums would have lost most of their public. Fortunately, this is not the case and there is a relatively numerous and devoted public to these museums. If we take the second trend as the dominant one then we would have expected numerous public. Also, this is not the case. The relatively

large number of visitors to these museums is due to the basic human pre-disposition to explain and justify his/her existence through grounding it in the past collective behavior. This is a personal experience that makes it powerful enough to detach itself from analyses of objective institutions, social organizations, modes of production and turns into intimate, grounded in bodily experience process of conceptualization. This constitutes the mystery that underpins the power of the images of the past. This feature of the knowledge of the past is well known and increasingly exploited by the modern advertising industry. For example, when images from the past are presented in a proper manner they perform an intricate play that evolves both in fronts of the eyes of public and in acts of a play in a kind of immersive reality. The two parts of this play are (1) the act of "discovering" authentic images from the past, and (2) the act of referring that "authenticity" to the qualities of the offered goods and services. The first part relates to the pleasure of "discovering" mysterious past and the second – to the pleasure of possessing a new product that has authentic qualities already recognized as useful by people from the remote past. Thus the public emerges in a performance where it takes an active role as attentive audience that recognizes the authentic qualities of the products and, at the same time, appears as the main actor that engages in a play with these products.

EXPERIMENT WITH THE REACTION OF MUSEUM PUBLIC TO GIS VIRTUAL MUSEUM PRESENTATION OF THE PAST

On this theoretical background there is no surprise coming out from the results of a recent survey of museum audience. Its aim was to test the reaction of visitors to a dynamic presentational environment - multi-layer virtual museum presentation available through Internet and through a touch-screen kiosk situated in the museum premises of the National Institute of Archaeology and Museum, Bulgaria. This study was part of the project 'kin 1001' 'Information Technologies and Archaeological Heritage of Bulgaria' (2006-2008) and the competition was organized and selected projects funded by an agreement between the Ministry of Education and Science, Bulgaria and the 6th Framework Programme, EU.

According to the study design only adult Bulgarians were randomly picked up and interviewed in the museum hall while working with the touch-screen presentation in the kiosk situated at the main entrance. Their education background shows that all are professionals with university degrees or are students in various universities. The proportion of the scientific disciplines represented by the participants is the following: four-fifths of them come from humanitarian and fine arts disciplines and one-fifth – from natural sciences. Most of the visitors are university students; the second largest group consists of employees in the state and municipality administration; the rest are professionals from universities and private companies.

The study itself consisted of observation how participants choose and acquire information from the information system and of an interview that aimed to reveal his/her confidence in dealing with it, his/her explanations of historical events, and his/her willingness to talk about wider issues related to/rooted in past societies. The task itself of the participants involved individual work with the presentation (GIS-based computer generated cartography) (www.naim-bas.com/arche). During their virtual visit participants had to make three choices for acquiring new information: (1) through an ordinary featured guide that represents the most interesting artefacts in the museum halls with preliminary information and a small picture attached to each of them that, according to the study design, had to target wider museum audiences; (2) through chronological tables of the main periods that had to target the audience of professional archaeologists and the other specialists of the past; (3) through the map user interface – visitors can navigate through a dynamic map of Bulgaria, pan, zoom in and out and find information by themselves independently of the two schemes presented by the first two options. After "digging" out the information about the chosen artefact given in the form

of a larger picture and structured text participants are asked to comment the choices they made and how they understand particular historical events associated with the artefacts. The starting point that provoked 'discussion' with them was the information about the 'symbolic significance' of the artefacts and their 'relationship with the environment' (available for the most of presented artefacts and monuments). Since all participants come from urban centers their comments focus on some of the urban values and pleasantries of the life in large cities. Thus visitors were concerned with the economic potential of the chosen by them geographic areas and imposition of a kind of an urban planning on them; women were focused on cosmetics (ancient cosmetic artefacts are well represented in the museum), and men's concerns were associated with development of military and sportive skills (weapons and armory constitute the main body of artefacts exhibited). In this situation I was able to observe all at once three domains of identity practices and constitution of personality: 'expression of national pride' (ethno-nationalism), 'labeling' for various identities involving affiliations to ethnic, religious, educational and other minorities, 'technologies of the self' – how visitors stimulated by ancient examples try to develop their personality and their knowledge and skills. Thus the conceptual richness of each of these responses represents a good illustration of J. Derrida's concept of contextual knowledge that mediates between the objective world of fixed objects and the mind or intuitive sensibility that constructs sense and meaning [10].

The experimental design included three types of measures.
Ratings of the importance of explanatory factors:

1. Direct cause-effect relationship
2. Non-direct cause-effect relationship
3. Simple agency-structure explanation
4. Complex agency-structure explanation

Subjects' perceptions of the control over working with the system:

1. Full control
2. Need additional help
3. Hesitant of choice of objects/artefacts
4. Hesitant in working with the system

Choice of means for solving the task:

1. Choices made through the museum
2. Choices made through chronology lists
3. Choices made through the map

On this basis a correspondent analysis and discriminant function analysis were applied to this data.

Three groups of visitors are well distinguished:

1. The group of "confident" people. They explain history with simple cause-effect relationships; participants show control over working with the system and use basically the museum presentation and (rarely) the chronology lists for acquiring information.
2. The group of less confident people. They explain history within the frame of indirect cause-effect relationships with elements of simple agency-structure explanations. Normally, they need help for working with the information system and are hesitant in the choice of objects/artefacts in the museum presentation.

3. The group of hesitant visitors. They explain history in agency-structure relationships and are hesitant in working with the information system. They explore the information in the system through the map and rarely through the museum.

The following interesting relationships were established in the correlations of the pooled within-groups matrices:

Perceptions	-0. 283	Ratings
Means	-0. 254	Perceptions
Means	0. 204	Ratings = Theoretical knowledge

From this table it becomes clear that the confidence in working with the system does not directly depend on theoretical knowledge and it is not able to influence it. On the other hand the 'means' of presentation (dynamic external environment in this experiment) are somewhat positively correlated with the theoretical knowledge of visitors. A question arises: is it possible to develop an approach to public that will increase the positive correlation of this relationship?

This study showed that the reaction of the public (as re-structuring of popular historical knowledge) is not uniform and cannot be expressed (as in traditional exhibitions) by a set of random variables with normal distribution and statistical noise that represents the residual rearrangement of its conceptual structure. Results reveal sharp division of the studied audience into separate groups with fragmented topography of their conceptual co-occurrences and different levels of personal and group abilities to manage independently the process of acquiring new information. The most important question that emerges is how to target this vast multi-modal field. A plausible approach to this problematic seem to be to use as stimuli several strongly correlated clusters of explanatory concepts and observe and study the accumulation and exchange of information between different hierarchical levels of a complex topology that fluctuates by small changes between two major components of a semantic state-space: information band and noise.

SOFTWARE SOLUTIONS AND INTEGRATION APPROACH TO WEB RESOURCES OF ARCHAEOLOGICAL SPATIAL DATA

The above presented theoretical background and experimental data of the reactions of public pose the question how it is possible to create GIS database and presentations of archaeological spatial data on the base of the old datasets and descriptions of archaeological/historical artefacts and sites. The answer may be sought in the conceptual similarity between the organization of traditional Data Models and the creation of historical descriptive knowledge. They both are hierarchically and sequentially organized: running multiple hierarchies over the same data for a single-purpose (or single-cause) application/explanation at a time. Thus they establish the basis for observation, representation and systematization (create correlative relationships) but remain little effective in providing prediction. Solutions that lead to an effective transformation of the above mentioned traditional approaches have to be sought in two directions: building a new theoretical framework of archaeological spatial data and new integration approaches through GIS' increasing capabilities of integrating other web resources and enterprise software packages. The novel theoretical framework may evolve around 'invariant relationships' that feature not only past human-landscape interaction but also the ways people react to present-day computer simulated human-landscape encounter. The invariant relationships of past and present human-landscape interaction comprise self-understandable or easily understandable concepts such as 'fertility' – 'non-fertility' of lands, 'rich-poor' lands, 'desert or sandy' lands, 'lowlands – high lands', 'pastoralism', 'farming', 'sacred' lands, etc. The historical and geographic variation of the meanings of these human-landscape interactions vary enormously. This variability of meanings makes them suitable for

their incorporation at the semantic level in the more efficient structuring and management of web-integrated GIS-based Information Systems. Also, it should be stressed the other humanitarian richness of the meanings of the 'invariant relationships' when they are focused on archaeologically recognizable historical-geographic collectivities: Neanderthals, modern Humans, first farmers, nomads, first urban centers. These invariant relationships (reflect the creativity of mind in connection to contexts and motivations) cannot be identified with the known "laws" of social evolution nor with spatiotemporal continuous processes. They are based on publics' 'quest for knowledge' situated within dynamic representational environment based on metaphors of liminal and authentic nature (conceptualizing present and past ideas about 'paradise', 'fertility', 'beauty', 'civilized manner of life', etc). These are transient states of contemplation over the origins (the process of emergence) of modern humans, the first farming technologies, the first urban centers, etc. by authenticating this new knowledge through multiplicity of origins, materials, technologies and their complex geographic expression.

The aim of this type of organization of spatial databases and presentations to users and to public is to free users (audiences) from their passive role as mere observers of luxurious artefacts and monuments from the past. The public will not be a passive learner "absorbed" by the new information technologies. Users will be engaged physically by running and manipulating the GIS presentations. Through actual manipulations on the computer-generated map and by viewing a number of controversial archaeological examples they will be additionally engaged in solving an intellectual task of finding out the dominant causal relationship that provide likely explanations of complex historical events. At a personal level such historical-geographic presentation is conceptualized as simulation of a past human-landscape interaction. The personalized knowledge and intimacy that such relationship induces make possible users to feel free to manipulate the process of acquiring new information in their own unique way and, on this base, create new meanings from the old, already familiar information, and thus create new knowledge.

In order to be able to create such GIS-based databases, web-resources, and presentations there is a need for developing new IT integration approach that supports cross-functional applications that cut across the hierarchical data models. Today GIS applications make possible integration of the already existing archaeological datasets and established classificatory schemes based on traditional logic: address-chronology-morphology-metric. In the center of such an 'orchestrated' GIS-based information system it is necessary to create the place of a composite-user that through a 'mapcentric' user interface can execute general and specific searches, manipulate the incoming information and thus increase its explanatory potential.

To a certain extent the GIS-centric approach and the manipulation theory of explanation [11] opposes the general process of formalization of archaeological documentation that converges in global data types that allow conducting queries and mapping applications within the frame of a standard ontology. These are hierarchical structures that follow the physical process of archaeological (museum) descriptions of materials, rock art, and other inventories. Traditional schemes always start with the original artifact (text, image), continue with bibliographical record and finishe off with XML markup and content markup that allow interaction with the respective database. This hierarchy operates within the classical knowledge extraction triangle established between: (i) common database; (ii) the upcoming data from fieldwork; (iii) the process of description and interpretation preserved in archives, catalogues, reports. At a higher level of interpretation this way of structuring archaeological/historical data fuels development of little effective 'predictive modeling' of past human-landscape interaction based on formal extrapolation methods. For example, these models are not capable of

providing insight into the sufficiency of site placement factors to explain the presence of a site, nor the mechanisms of how site selection processes are determined [12].
A possible solution for building a joint historical-geographic Information System is proposed that involves GIS-based integration in a more logical and meaningful way to archaeologists and their public. The analytical object models and data types can be maintained by 'archaeological services repository' (ASR) that has the potential for reuse across processes and with other services. Its starting point is based on the multiple meaning of popular terms used in historical knowledge. For example, the terms 'catastrophe', 'chaos', etc. have different meaning in natural and humanitarian sciences and in public understandings. This diversity of meanings requires a proper way of defining and addressing specific resources of information: historical resources that contain summarized archaeological data featured by descriptive marks of the underlying semantics and metadata. The overall functionality of the ASR will be governed by a conceptual filter that allows combination and reuse of services and data. The filter incorporates the metadata that describe in a sufficient detail not only the characteristics of these services and their applications, but also the data that drives them. The description of the data as they relate to services allows orchestration that associates services in a non-hierarchical way: each row of the source data will correspond to a folder. The folders will not depend on each other. They will be structured analogously to how archaeologists and their public think about the data and how different data relate to common explanatory themes. Thus the production of applications becomes realized through distinct unites and separate functions that are accessible via a network in order to allow their combination and reuse. This network facilitates the diversification of the underling semantic (different meanings of historical facts) and enables simultaneous calls (based on key concepts) for specific services (generated automatically by development tools in most cases) to appear in the user interface as a network of points and areas or as a list of selected features, texts, images, etc. This is the way to derive all possible conceptually related objects from a class defined by a set of concepts. For example, the concept of the influence exerted by 'natural disasters on social change' may model a resource application that returns all the sites with traces of volcanic ashes and traces of possible climatic oscillations within a geographic extent and work with another resource to get a distribution map of ritual places with social role that associates them with these natural phenomena.

CONCLUSIONS

The study of the ways past is presented to public and the purposefully created GIS-centric Information Systems with aim to better popular and professional understanding of history can be defined as an interdisciplinary matrix of disciplines and methods focused on multifaceted phenomenon of personally created 'meaning' of the origins of human civilizations. The ultimate aim is integrating methods and theories developed in disciplines such as humanities, social sciences, sciences of mind, computer science, and mathematics. Their joint application aims at providing insights into the realm of human signification through integration of historical facts and human values and their manifestation in personal identification, learning practices, and wider social and cultural interaction.

To the question how is it possible to make from otherwise featureless archaeological spatial data meaningful resource that is understandable by wider public and attracts audiences there is not a simple answer. Yet the novel geo-information technologies when coupled with the new manipulation theory of explanation provide means to artificially simulate human-landscape encounter. Made in a proper way such an information system meets some important cognitive necessities that stimulate human learning practices and general understanding of history. Through such system, it is even possible to break the firmly established 'evolutionary' understanding of historical processes as successive stages of social evolution. It was observed

that at the time when people acquire new information from such systems they temporary or more permanently "forget" about the already internalized explanatory schemata. Their new explanations tend to expand beyond the limit of simple cause-effect relationships and become governed by their personality, educational, cultural, or religious background. More importantly signs of hesitation over established theoretical knowledge become visible through subjects' exclusive focusing on favorite geographical places and on the histories associated with them. From the point of view of this complex behaviour it seems that a new threshold of our knowledge is reached that opens the door for further research, development, and applications of GIS into the process of structuring, management, and presentation of archaeological spatial data.

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