RETHINKING ARCHAEOLOGICAL PRACTICE AND REPRESENTATIONS OF SPACE AND TIME

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Abstract

This paper investigates the possibility of integration of local knowledge into Geographical Information Systems (GIS) for cultural applications, focused in the American Southwest. Many indigenous communities around the world live according to different principles and their knowledge system(s) differ significantly from the intellectual framework of western researchers. As GIS is now routinely being used in anthropological and archaeological applications we need to question the validity of these systems as interpretive frameworks for cultural understanding. Research presented in this paper focuses on identifying different concepts and ideas about space, time, geographical knowledge, and worldview among communities in New Mexico. It is then discussed if and how we can integrate this knowledge in our standard geospatial analytical practices to reach a better understanding of cultural differences and different patterns that will result from those differences, exemplified by pre-colonial settlement patterns.

1 Introduction

In traditional archaeological studies it is often assumed that human behavior answers to universal rules and therefore quantitative methods are adequate for this kind of research, regional and local research serves to test those rules. Alternatively, relativistic approaches shun the quantification of human expression and interpretation is always dependent on the viewpoint of the researcher. The position taken herein that human experience and as a result human behavior is neither to be investigated by focusing on universal rules nor cultural specific ones alone, but always a combination; subjective and non-subjective information is complementary in reaching world understanding. Introducing the concept of the ‘landscape as the map’, understanding navigation and movement in the landscape, i.e. a dynamic landscape, are essential for understanding why the cultural features are added to the total landscape at a specific location. The ‘landscape as the map’ is at the same time a collective memory for navigation and movement as well as useful for

measuring and understanding physical, cyclical and social phenomena by the inhabitants of that landscape. Therefore, research presented in this paper follows Llobera's theoretical viewpoint in that it does not seek objective results but is exploratory in nature, i.e. is humanistic in aim (Llobera 2000).

This approach for understanding location, function etc. of cultural elements in the past landscape diverges from site-prediction modeling approaches that have been widely used in geospatial applications in archaeology (Westcott etc.), whereas the focus in site-prediction modeling is heavily focused on subsistence and economy, the current approach presented here is primarily focused on human experience, and especially on incorporating human experience resulting from a worldview different from a western worldview dominant in most science applications. As stated by Freundschuh geometric data models, based on coordinate space, do not necessarily reflect concepts that are important when people think about geographic space (Freundschuh and Egenhofer 1997):364).

The assumption in this paper is that (the) Native population(s) possess(es) a large body of knowledge of the landscape they inhabit, and that this knowledge is communicated by different means and media, the complexity of which may not be easily understood from a western scientific perspective. Unlike ideas that population movement occurred in spurts of large groups in the American Southwest, it is much more likely that movement of people in small groups occurred on a regular basis, making analysis of movement more complex (Bernardini 2005).

The first part of this paper briefly discusses archaeological research focused on movement and –road- networks Progress and shortcomings of this research will then be assessed within the context of the next section, which discusses wayfinding and navigating research from a variety of disciplinary perspectives. Some of this research is directed specifically toward understanding cultural differences. The third section provides some ideas of differing conceptions of space and time that have been described by indigenous researchers. Even though the authors realize that generalization of indigenous ideas does not do justice to the nuances of concepts held by different tribes, the purpose here is to acknowledge that cultural understanding of human experience is not possible without acknowledging (and value) the existence of a different worldview. Research by Swentzell and Ortiz is therefore used as starting point for identifying concepts and terms that can redirect archaeological research focused on Puebloan communities (Ortiz 1972) (Swentzell 1990).

Incorporating findings of research discussed in first three sections, this paper presents the idea that physical elements in the landscape are used in wayfinding, movement and ongoing decisionmaking to add cultural features and perform activities and therefore have to be investigated from a horizontal –subjective- perspective in addition to the (mental) map that is created as general understanding of spatial relationships as a non-subjective view. In addition to navigation and wayfinding, the landscape can also serve as a measurement device to observe (physical) cyclical phenomena, the places (or nodes) that are created therefore are part of a larger repository of knowledge that is the landscape. Current GIS packages were not developed for investigating the human experience, even though –line of sight-, viewshed, and least-cost-path routines are important tools in expanding the role of GIS. The specific research presented in the fourth section employs capabilities of ArcGIS 9.1 and 9.2, field-, and archival research in order to develop a landscape model that can be used as an exploratory tool to enrich cultural understanding and communication.

2 Spatial concepts, routes and analysis in archaeology

Study of human, especially pedestrian movement and navigation is complex, let alone understanding these patterns in past landscapes where all we are left with is material remains of a specific culture. Study of patterns of cultural remains however, can give us insight in past human behavior. Moreover, experimental studies and ethnographies provide us with additional information to place those materials within an interpretive context. Even so, the study of human movement and navigation on a landscape scale in archaeological context has been limited, especially those that address the human experience. Notable exceptions are llobera, Forte and a number of researcher contributing to a recent special issue of *World Archaeology* (Evans 2006; Fitzjohn 2007; Lake 2007) (Llobera 2000) many of whom employ geospatial technologies as favored method to understand landscape dynamics. Not all are convinced that use of GIS is beneficial for understanding human relationships and experience, a concern that is voiced not only within the discipline of archaeology, but notably as a movement within the discipline of geography that is Critical GIS (Kwan 2002; Schuurman 2002; Harvey, Kwan et al. 2005; Schuurman 2006). Critical GIS however is focused on integrating models that can represent human experience.

The use of spatial technologies (remote sensing) was popular in the 70's and 80's in the Southwest, as a number of roads could be identified from above that were not readily detectable from the ground. After the initial excitement of what this technology would contribute, it quickly lost its appeal to the larger North American archaeological community, probably due to several factors such as cost, high level of expertise required, its focus on environmental components of society, and not the least the fact that most material of interest is buried and cannot easily be detected with remote methods. However, as these studies show, mapping of those road networks contributed enormously to the understanding and realization of the complexity of the Puebloan landscape, but focused primarily on the roads and routes as artifacts, i.e physical traces in the land (Trombold 1991). A more recent study by Kantner integrates the 'hiking function' developed by Tobler into a Least-Cost-Path analysis of the roads radiating out of Chaco Canyon and finds that least cost is not a main determinant of the placement of these roads and probably other socio-political factors are important (Kantner 2004). Visibility studies, either on its own or combined with Least-Cost-Path analysis and *Space Syntax* have become more popular in recent years for the study of the human use of space that are focused on the quantification of this use (Hillier and Hanson 1984; Ferguson 1996; Llobera 2003; Kantner 2004; Shapiro 2005; Cutting 2006; Llobera 2007). Fitzjohn employed photo-elicitation-interviews (PEI), to gain insight in how the archaeological landscape in may have been perceived. This qualitative method involves the use of photos in social science research, in his case study, subjects were asked if they recognized the landscape depicted. Positive responses were interpreted as the spatial extent of landscape knowledge. In Fitzjohn's case these responses corresponded well with other responses to question about regular routines and associated travel, suggesting this as a useful method for investigating spatial knowledge (Fitzjohn 2007).

3 Landscape experience (working title)- research in wayfinding

Archaeologists primarily study spatial relationships between and among cultural material remains from a 'map-view', geometric relationships can be viewed from a single perspective as if it is a small scale space (Freundschuh 1991). Human behavior is not often studied as a problem of wayfinding in archaeology, with a few already noted exceptions, as this tends to be studied within the fields of geography, psychology, cognitive science and urban studies, however integrating information on human perception appears to be beneficial, as shown by Fitzjohn and

others (Fitzjohn 2007). Freundschuh provides an excellent overview of different kinds of spatial knowledge that has been identified in previous research, - showing differences among researchers, but maybe not surprisingly, many overlapping categories, - and suggests a new model built on earlier defined categories. As research presented in this paper is focused specifically on cultural differences in spatial concepts we will present only aspects that are relevant to that topic. (Freundschuh 1991; Freundschuh and Egenhofer 1997). Rational for Freundschuh and Egenhofer's study is to improve GIS frameworks, integrating different concepts of space, because, even though experience based spatial research is not new, however a GIS framework is based on a Newtonian idea of space that is scale-independent, which has been criticized as being a western view of space, and as it claims objectivity, excludes other views of space (Smith 1999).

Psychologists have made a distinction between small-scale space and large-scale space. In this definition small-scale space refers to space that can be seen in its totality from one vantage point, whereas knowledge acquisition of large-scale space requires a person to move through the space and knowledge is thus acquired piecemeal. Spatial knowledge is therefore scale-dependent. Recent investigations have gone beyond this dichotomy and defined other, additional levels of types of space that provides a more nuanced framework for understanding human experience and knowledge (building) of space. A seemingly similar distinction as small-scale large-scale distinction, though not scale-dependent, is a distinction made within behavioral geography is that between perceptual space and cognitive space: perceptual space refers to space that is experienced at a particular time, on the other hand cognitive space refers to knowledge that is acquired over time, it is pieced together by the perceiver from multiple experiences: "perceptual space is comprised of displacements (movements) linked to perceptual structures, such as views, which in turn are linked to sensory images of salient vantage points. .. cognitive spaces link salient sensory images to the cognitive factors of beliefs, knowledge, and memory (due to the role of memory it is free of the constraints of physical space) (Freundschuh and Egenhofer 1997:366).

Based on previous research spatial knowledge can thus be viewed as a model existing of three different levels, according to Freundschuh (1991): the first level is geographic facts, these are facts about places that one believes to be true. The second level is route knowledge, which links together these geographic facts enabling travel between these places The third level is

configurational knowledge, which ‘threads’ together route knowledge to form a network. Rather than treating kinds of spatial knowledge as separate entities, in this integrated model spatial knowledge is seen as a dynamic process that is refined by time.

Empirical / experimental studies of human navigation and movement predate the development and popularity of GIS as a spatial analytical framework. A landmark study is research by Lynch on perception of urban environments (Lynch 1960). Lynch put forth a model to interpret the cognitive maps of his subjects and how these compare to reality. This imageability of surroundings of an individual is a result of a two-way process between the observer and the environment, “the observer selects, organizes and endows with meaning what he sees (Lynch 1960:7).” Therefore significant differences can exists of any given reality between individual observers. Lynch is not necessarily concerned with individual differences but with commonalities, or ‘public image’ that constitutes a common culture. It is recognized by many that cross-cultural differences exists in space conception and perception (Frake 1985; Mark 2003; Kwan 2004; Agarwal 2005; Wright and Ellis 2006). The elements in the analytical framework for understanding this ‘public image’ is limited to physical elements because its focus on form itself, but acknowledged are the effects on imageability of factors such as “social meaning of an area, its function, its history, or even its name (Lynch, 1960:47).” The elements listed are: paths; edges; districts; nodes; and, landmarks. These elements will serve as a stepping-stone in the exploratory case study presented below in combination with Freundshuh’s different levels of spatial knowledge. We interpret configurational knowledge as close to, but not the same as what cognitive space represents.

4 Landscape experience – ideas for developing landscape models

The metaphor ‘Earth as mother’ – is very different than’ Earth as (exploitable) resource’ a notion that is employed in Western society along with ideas that Nature needs to be conquered. These ideas are further ‘materialized’ in naming conventions, whereas indigenous names of landscape elements allude to the natural characteristics of the element and the importance in the larger landscape or cosmological order, such as –a place from which smoke and fire comes forth-, whether natural or human induced is not indicated. Western names, on the other hand, often refer to a person or entity that claims ownership of that element- in a way naming is appropriation

and/or conquest. Historic maps are therefore very informative in the way space is conceptualized and represented within a western framework (Monmonier 1996).

A number of indigenous researchers have verbalized indigenous ideas in written form (Ortiz 1972; Ortiz 1984; Jojola 1990; Swentzell 1990; Smith 1999) earlier, members of indigenous communities have voiced frustration over the inability of western researchers to understand the difference between, or even acknowledging the existence of other worldviews, and stubbornly retry again and again to persuade indigenous peoples to 'reveal' the truth about their past (Sturm 1990; Anschuetz 2005). Referring to the foundation of the western scientific framework the following quotation is explanatory for this inability.

"Both of them [Baumgarten and Kant] assumed a uniformity in human reasoning that implied common human experience and universal judgments. Kant's analysis of basic logical categories through which intelligibility was obtained is based on the depth-grammar structure of the Indo-European language family. It did not occur to him that there might be other language families with divergent grammatical structures from which alternative logics could be derived – in other words, that not all human thinking, or experiencing, was necessarily alike (Sturm 1990:13)."

Different worldviews can be said to have formalized in architectural components, the direction and focus of those components. In a Puebloan worldview, where earth is mother, human beings emerged from within and will return to the earth through the naval or middle place, this is represented within the pueblos as kiva and plazas, or can be specific sacred locations in the larger landscape, buildings were "not constructed and placed on the ground; rather they appeared to be extensions rising out of the ground (Sturm 1990:19)." In contrast, in the western tradition, especially Anglo, man is the center of everything; instead of stressing communalism, the west stresses individualism. Buildings for instance, are places on the land, they do not become part of the landscape, the landscape is a neutral space, for people to explore, exploit, appropriate and populate.

"The Pueblo world, first of all, is an altogether hallowed place where 'the breath' or life energy, flow through both the animate and inanimate realms of that breath and are essentially alive. The myths, stories, songs, and prayers tell about the cosmos as a vital and inclusive containment within which opposite forces are brought together and united by that energy, which flows through everything and everybody. Within

that cosmos, interaction and communication between all life forms – including house, kiva, and community form, is recognized. The myths demonstrate how structure at the physical level is integral with structure at the metaphysical level (Swentzell 1990:23)

The Pueblo cosmos exists of four levels and six directions, in which every direction has an associated house, mountain, lake, color, and animal. For instance, the four directions are represented as terraced elements on the rim of the earth-bowl representing the perimeters and enclosing the world space (Swentzell 1990). The landscape is integrated within Pueblo architecture in several ways; for instance the plaza may be oriented and the layout of the dwelling units permitting and framing a view of important landscape elements, examples are Taos or Sandia Pueblo, connecting man-made and natural features. Furthermore, the central open space within the Pueblo is a communal space, connected to the world space through vistas, and connected to other world levels through dances and rituals that take place within that place, directing movement inward as opposed to outward spatial orientation typical for European layout, in which man is central (Anella 1990).

In many indigenous worldviews and languages there are no separate –abstract- terms for space and time, if there is one at all (Smith 1999). “Space is only meaningful as the distance between two points, and time cannot be understood apart from the forces and changes in nature which give it relevance and meaning” (Ortiz 1984:136-137). The obsession of the West to cut time up into arbitrary units is irrelevant, and that is exactly what archaeologists are most concerned with, placing everything in its appropriate time-period, which are characterized by correlating specific cultural and organizational styles (Figure), excluding all others that come before or after, forming the basis for comparative analyses.

In short, the Pueblo world is one in which interconnectedness, inclusiveness, and simultaneity are important, in which houses are not (permanent) objects but are part of that cosmological view, where cyclical time is chosen, and movements are inward and spiral, instead of outward and dispersed (Swentzell 1990:29). The thesis in this research is that human experience and worldview significantly influences human thinking decision-making, therefore a traditional western scientific framework is not adequate for understanding all of human experience. Employing GIS in archaeological studies has proven to be fruitful, however, it is necessary to

rethink the spatial framework and explore different ways of using geospatial technologies that can include different formalizations of space and time.

5 Explorations in GIS methods for experiencing space

Taking the indigenous complaint to heart that -all has been told, but we don't listen-, the data approach taken in our research is focused on integration of already collected material. As we live in a data-rich era, our philosophy is that it is more useful to develop new methods that can make use of all those data, than to collect new data. For this specific research a range of data sources is 'mined'. Historic maps, representations of specific views of space, as well as ethnographic research and maps, in addition to cultural and environmental data and information from data clearinghouses (Harrington 1908).

To understand human experience it follows from the above discussion of spatial knowledge and formalizations of space that there are several levels involved. For sake of simplicity in this initial exploration we will use three, perceptual space, cognitive space, both as defined earlier, and map space, representing a geometric representation of reality as seen from above. The latter is usually employed in analysis of archaeological patterns. However, we believe that all these levels need to be included in analysis in order to understand human behavior and movement in the landscape. This will be exemplified by the concept of horizon, i.e. extent of visual space.

Research presented here is focused on the Galisteo Basin, New Mexico (Figure 1), as a definition of a cultural area its boundaries are fuzzy, within our research we have chosen hydrological units as analytical units, as they represent smaller system components within a larger complex system, in this case the Rio Grande River system. The Great Drought (13th century) caused population shifts in the larger Puebloan region, abandoning the previously densely populated San Juan Basin in favor of areas that were only sparsely populated prior and resulting in aggregation in others. This movement involved crossing the great river (Rio Grande) and moving closer, and infringing upon land that was part of the range of nomadic people. Even though the Puebloan people share a similar architectural and agricultural life style, linguistic diversity reminds us that inhabitants of this land are not as homogeneous as we might lump. Large Pueblos are located in the basin, which were occupied during the 14th century and some were still occupied when the Spanish entered.

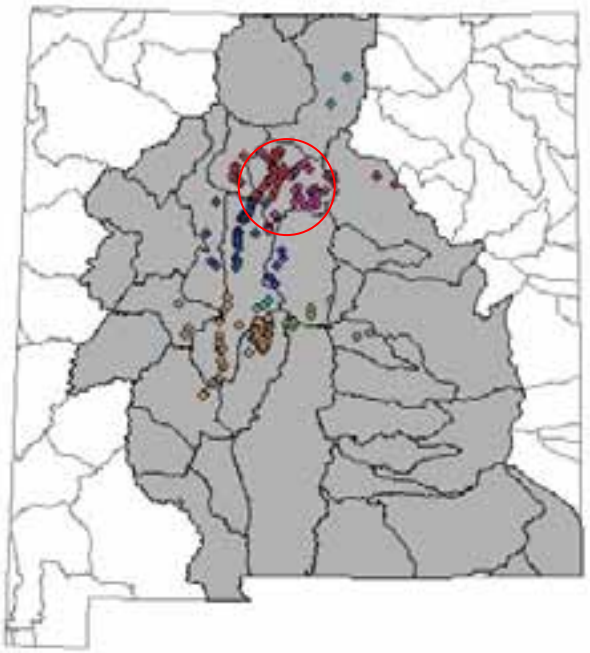

Figure 1 – Location of Galisteo Basin (Sub-basin 13020201) within the Rio Grande River Region of New Mexico, as indicated by red circle.

In earlier research we preliminary tested several ideas using geospatial methods about landscape patterns and hypotheses that were put forth in other publications for the Galisteo Basin (van der Elst, Richards et al. 2006). For instance, a Least-Cost-Path analysis from the large pueblos to a turquoise source showed how paths converged at some pueblo locations, however it is easy to recognize patterns, establishing whether they are meaningful within a specific worldview is not.

viewshed

Within the smaller study area (2 watersheds) there are 8 large pueblo sites located that are no longer inhabited. From performing a simple viewshed it follows that none of the sites are in direct view of another site. Including other site categories within the analysis may provide us with a different pattern that appears more meaningful, however we believe that this focus on sites and view from above ignores an important aspect of Native American worldview, in which architecture is not merely placed on top of the surface, but grows out of it and therefore is part of the landscape. It is therefore important to understand the view that includes the entire spatial

boundaries of the Pueblo world, not just sites related to each other, or sites correlated with specific environmental variable values.

Horizon – perceptual space

The ArcGIS 9.2 solar radiation graph capability was used to calculate the horizon from one of the sites, Pueblo Galisteo (Figure 2), this representation is similar as represented from a fish-eye lens (Figure 3), also called an upward viewshed. After initial excitement of calculating and visualizing horizon (Figure 4), we quickly realized that even though it can provide a profile of earth's surface against the sky background, it doesn't provide depth of field, information on spatial relationships of elements at different distances from vantage point. To illustrate this point we did a quick field-check and took photographs of several panoramas, however it proved that field sketches were more informative of spatial relationships, such as in front of, adjacent to, etc.

Figure 2 – upward viewshed generated using ArcGIS solar radiation tool –Pueblo Galisteo

Figure 3 – Fish-eye view Galisteo, New Mexico

Figure 4 – visualizing in ArcScene

In designing future research, it seems that a combination of methods would be most profitable. Another exploratory exercise involved creating profile graphs of concentric buffers around the site. Some of the buffer distances were based on Higuchi's visual distance decay model that was employed by Maples to create visual domains (Maples http://charlotte.utdallas.edu/mgis/prj_wrkshp/2004/Maples/ChavesViewshedPaper.htm). Integrating these graphs in aquick drawing and comparing it with the upward viewshed, it fails to take into account the viewing angle and the earth's surface curvature. In short, even though it is possible to create a horizon graph, at this point it is still hard to recreate perceptual space for analysis, however, as this research is in its initial stages, further research will focus on adapting the viewshed model and bringing elevation models into virtual (3D) environments. The importance of perceptual space, as argued here, is that spatial relationships (not necessarily absolute distance based on visual distance decay) result in focal points, for either navigation/direction strategies or for observation of cyclical phenomena, such as intersection points of foreground and background landscape elements. As exploratory alternative, important focal points can be hypothesized by calculating for instance moonrise/travel paths (http://www.astrocal.co.uk/moonrise.html), or places where for instance rock art is present, that may form nodes in a larger network. (Figure 6)

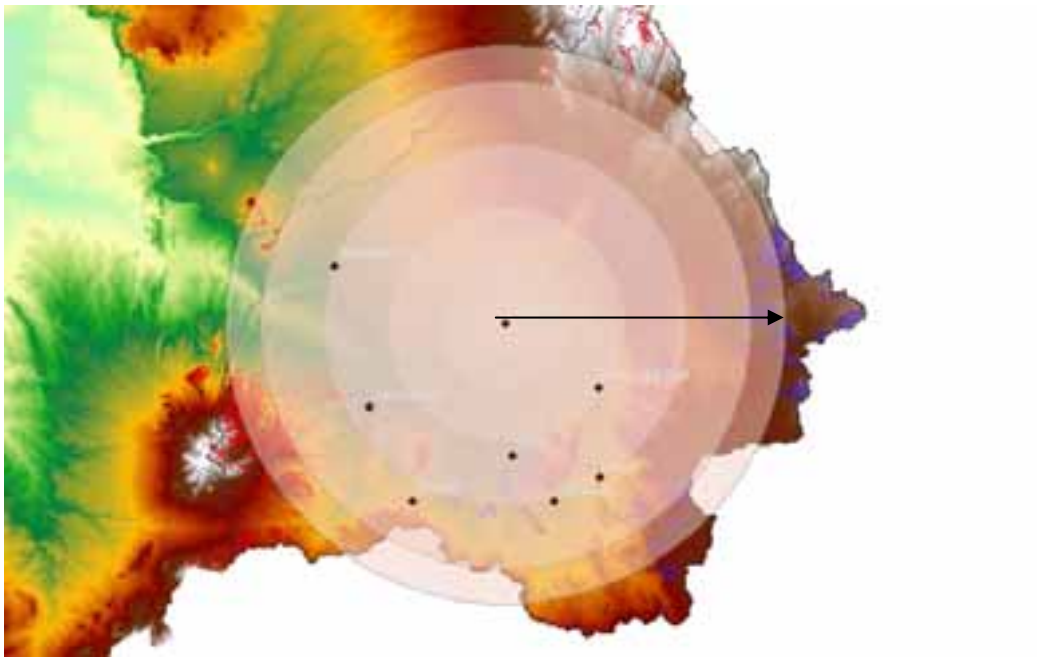

Figure 5 – buffers around Pueblo Galisteo used for generation profile graphs – largest buffer 21km

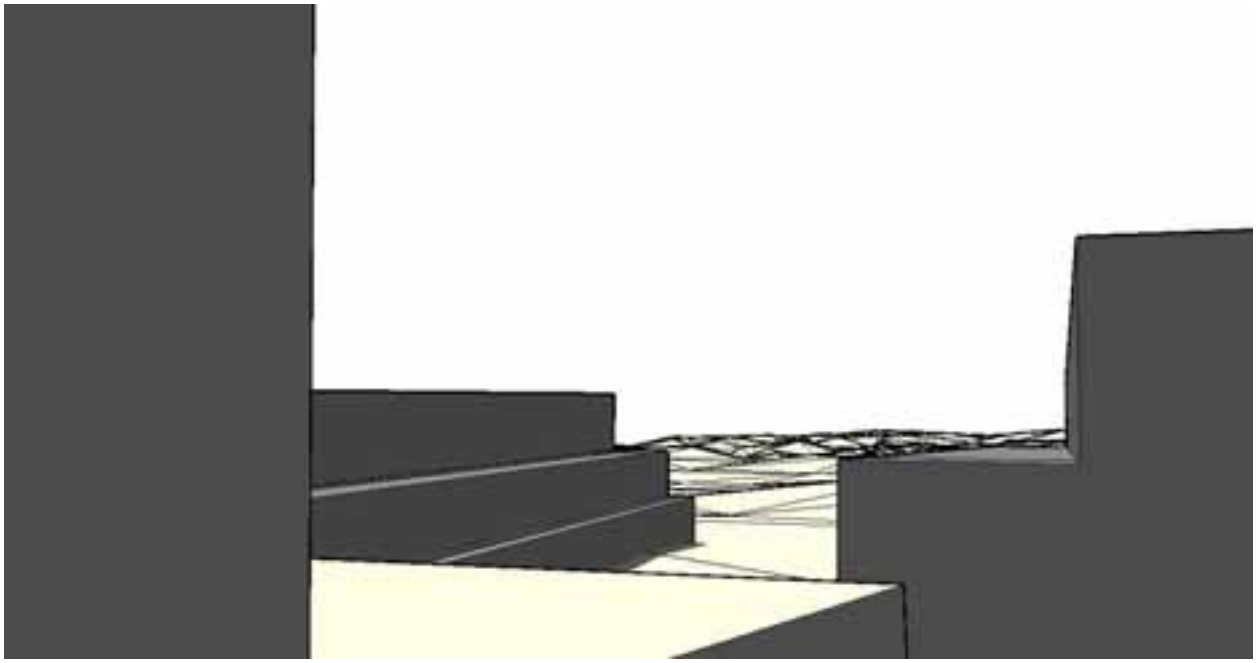

Figure 6 – A TIN surface generated in ArcGIS from a 10m DEM of the sub-basin extent is imported in Google Sketchup. Within this environment quick hypothetical models can be generated and 'vistas' framed by the architecture can be visualized. (Note: horizon only includes element within the basin boundaries).

Beyond the horizon - Cognitive space

It can be said that the perceptual space provides clues for what is beyond the horizon, to reach places already visited although not necessarily so. As cognitive spaces link salient sensory images to the cognitive factors of beliefs, knowledge, and memory, this space integrates elements other than physical space. For instance sites actively uses in previous time, once emerged will stay part of the landscape, even though these places may not always be visited frequently, they become integrated in stories and other intangible cultural expressions. Other cultural elements that are not specifically linked to one location, such as decorated ceramics, can provide insight into the use of visual metaphors used to communicate information on Pueblo world order (Sekaquaptewa 2004). A landscape model that integrates cognitive space is not pursued in the initial stages of this research, however the idea of continuous use of places changes our perception of time in archaeological framework and integrates memory at a very basic level.

Image of the Pueblo World

As a starting point for the study of human movement we use predominantly elements identified for navigation by Lynch (all citations of elements Lynch 1960:46-48) and hierarchical levels in the acquisition of spatial knowledge as described by Freundschuh (1991). As these were specifically identified for analysis of human experience in urban environments, employing these elements in a landscape setting needs to be tested. This initial model is primarily concerned with perceptual space. Needless to say that each new vantage point provides us with a different perceptual space, however our initial research is focused on travel between prominent focal points, hopefully dynamic perception can be integrated at a later point

Geographic facts:

<u>Landmarks:</u> (“*another type of point-reference, the observer does not enter within them, they are external. .. usually a rather simply defined physical object like a building, sign, store or mountain”).* In a landscape setting such as the Pueblo world landmarks refer to for instance the four sacred mountains, other mountains or passes, for instance as described in Harrington’s ethnography of Tewa place names (Harrington 1908)

<u>Districts:</u> (“*are the medium-to-large sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters ‘inside of’, and which are recognizable as having some common identifying character …recognizable from within as from the outside”)* In a

landscape setting this can consist of environmental zones, such as valley, foothills, or vegetation such as forest, grassland etc.

Edges (*"are linear elements not used or considered as paths by the observer, they are the boundaries between two phases, linear breaks in continuity. …these elements are for many people important organizing features, particularly in the role of holding together generalized areas, as in the outline of a city by water or a wall")* Obvious landscape elements in this category are rivers, mountain ridges, transition between above mentioned environmental zones, but can also include cairns.

Route knowledge: connecting the geographic facts

Paths (*"are the channels along which the observer customarily, occasionally, or potentially moves")* Within the archaeological landscape paths that people have occasionally traveled are not very likely to show up as artifacts, whereas customarily traveled paths might (Snead). Paths can be hypothesized employing Least-Cost-Path analysis taking into account a number of variables other than topography, environmental as well as socio-political factors, although the latter are more speculative. Environmental factors include temperature, such that for instance travel is most comfortable optimizing shadow during the summer. Travel between two points initially is then hypothesized as occurring between a starting-point and a focal point within the perceptual space (including sky patterns). Research on human trail systems will also be taking into account, which has indicated that for instance people rather take an already established path even if a shorter path opportunity is available (Helbing, Keltsch et al. 1997) One way of addressing this is to iterate a Least-Cost-Path model with different variable sets and see if 'common' segments are resulting.

Configurational knowledge: creating networks

Nodes: (*"are points, the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is traveling …break, crossover or convergence of paths, shift from one structure to another of can the condensation of some use or physical character, like a street-corner hangout or an enclosed square").* An obvious node within the Pueblo world is the kiva, or middle place. Connecting places that are important within perceptual and cognitive spaces, that are not limited to cultural sites, we can begin to weave a web of human experience in a world that is not focused on the individual but on the collective, not on linear, but on cyclical time. It can then be said that the landscape is the map.

6 Future research

Potentially, research in movement, navigation and perception can take place within virtual settings as research has shown that spatial experience is similar in virtual and physical settings (Vinson 1999; van der Elst and Ox 2006), and have been used in cultural applications (Thompson; Pumpa 2006). However, to record the results and combine these data with other (3D) landscape data a GIS is necessary for integrating and analyzing this data and information. For instance, a recorded attraction point from a specific vantage point in the landscape as indicated by research in an immersive environment may coincide with a specific timing of a cyclical phenomena or point to another important location in the landscape. Experimental research can be done that modeled on for instance PEI, in that it investigates people's preferences for navigation strategies and perception of spatial relationships in familiar as well as unfamiliar settings. Our future research efforts will include both qualitative analysis, such as described above, as well as employing ArcGIS and other geospatial methods and techniques in an effort to adapt these technologies to understand and analyze human experience and qualitative as well as quantitative spatial relationships (Galton 1995).

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