Investigating Epistemological Implications of Geospatial representation in the Making of Histories of the Pueblos, Using an Exploratory Mixed Methods Approach

Judith van der Elst

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INVESTIGATING EPISTEMOLOGICAL IMPLICATIONS OF GEOSPATIAL REPRESENTATION IN THE MAKING OF HISTORIES OF THE PUEBLOS, USING A MIXED METHODS APPROACH

by

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DISSERTATION
Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy
Anthropology

The University of New Mexico
Albuquerque, New Mexico

July, 2012
DEDICATION

To Mother Earth
ACKNOWLEDGEMENTS

I thank the members of my dissertation committee, especially Beverly Singer, for continuing to encourage me.

I also thank: all who have supported me over the years, leading to the completion of this thesis, my family, friends, colleagues, and the breath that connects us all.
Title
Investigating Epistemological Implications of Geospatial representation in the Making of Histories of the Pueblos, Using an Exploratory Mixed Methods Approach
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Abstract:
The claim that epistemological differences between western science and indigenous research methodologies are the roots of contention of the interpretation and construction of histories is investigated. An exploratory mixed methods approach is employed to test whether current systems of geospatial analysis and representation are suitable for understanding different ways of knowing, focused on the spatial domain as a fundamental cognitive domain.
Recent studies indicate that spatial cognition is significantly different among speakers of different language groups and that spatial ontology is not universal across the human population, providing the theoretical underpinning for questioning the organizational principles of currently used systems of geo-representation.
The emerging theory of multimodality is used to explore this problem in practice, as a combined social-, and bio-semiotic approach. The premise is that no mode of representation can cover all meaning, and that epistemological implications are expected among different cultural constellations of modes of perception and representation are used. This research explores the relationship between perceptual grounding of ontologies and possible modes of representation in current models of archaeological research and within American Indian discourse.
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CHAPTER 1 INTRODUCTION

1.1 Research overview - Statement of the problem

This study is focused on the ancestral Pueblo culture of the Northern Rio Grande region of New Mexico. It investigates the usability of geospatial technologies for cross-cultural understanding and integrates several avenues of research focused on the spatial domain in an effort to develop an alternative framework for interpreting archaeological material. The supporting evidence to carry out this research is threefold. The first source of evidence is a review of publications by indigenous scholars. These works indicate the existence of epistemological and ontological differences between Western and Indigenous thinking (Mihesuah & Wilson, 2004; Peuquet, 2002; L.T. Smith, 1999). The second source is a survey of the history of mapping, specifically regarding the mapping of the New World. The available literature indicates that mapping practices have developed according to certain standards, and as a result alternative or non-traditional representations of spatial relationships have been ignored (Anders & Jansen, 1988; Harley, 1992; Mundy, 1996; Reinhartz & Saxon, 1998). Third, a current research trend in Geographical Information Science (GISc) is focused on naïve geography and the development of spatial ontologies (Michael F Goodchild & Janelle, 2004; Harvey, Kwan, & Pavlovskaya, 2005; Mark & Frank, 1991; Schuurman, 2006). This critical Geographic Information Systems (GIS) research is paralleled with current research in psycholinguistics, which shows significant differences in human spatial thinking.
across language groups (Carlson, 2005; Levinson & Wilkins, 2006). Therefore, in order to use geospatial technologies in support of cross-cultural understanding, the presumption of universal landscape categories as used in current spatial information frameworks and other new media needs to be reassessed. A critical overview of the history of, and current archaeological research in the Northern Rio Grande region, as they relate to spatial analysis, will be the setting for the the study (Adams & Duff, 2004; Adler, 1996; Spielmann, 1998b).

1.1.1 Study focus – definition of the problem

Three research foci are defined: anthropological, representational, and epistemological. First and foremost, traditional anthropological interpretive frameworks employed in understanding history of the Pueblos and past human behavior can be considered biased due to the difference in worldview between research and researched group (Snead, 2008; Watkins, 2000). Much of what we currently know about human behavior and cognition, especially in the field of cognitive science, is based on experiments with Western subjects. If, as stated above, significant differences exist among language groups in spatial cognition, a fundamental human cognitive ability, this knowledge of human behavior represents only a partial picture of human experience of the world population. In addition, bias in anthropological studies, predominantly as studies of “The Other”, may be attributed to the fact that people see themselves differently from how they see others. Distortions in perception come from the source of perception, (emotions of
self, behavior of others), resulting in belief of one’s own objectivity and the others’ bias (Pronin, 2008).

Furthermore, many models of interpretation of behavior in anthropology/archaeology are rooted in economic models, for the most part based in the market principle of production and consumption that considers nature as exploitable, free resource, controlled by humans. Attitudes toward nature in many indigenous cultures are holistic; in this view resources are not free in the sense of “available for human exploitation” (G. Cajete, 1999; Grim, 2001). A current branch in the field of economics, ecological economics, approximates this view by incorporating nature’s wealth as an asset in its models with the goal of maintaining environmental health.

The worldview concept and the problem of representation

Worldview is a term that is widely used in anthropological literature but is not often well defined, serving as a catchall term for aspects and patterns of different cultures that fail to fit into, or be explained by employed (scientific) models. In the research described here, worldview is a common thread that binds the different sections, along with the problem of representation.

According to Aerts (2007), and research at the Center Leo Apostel (CLEA) the term world refers to “the totality in which we live, and to which we can relate in a meaningful way” and should not be confused with “earth” or “cosmos”. Based on the worldview research at CLEA “A worldview is a coherent collection of concepts and theorems that must allow us to construct a global image of the world, and in this way to understand as many elements of our experience as possible” (Aerts,
D’Hooghe, & Note, 2005). “it is a system of coordinates or a frame of reference in which everything presented to us by our diverse experiences can be placed. It is a symbolic system of representation that allows us to integrate everything we know about the world and ourselves into a global picture, one that illuminates reality as it is presented to us within a certain culture” (Aerts et al. 2007: p8-9). In this way, worldview can be considered on different levels, individually to (varying kinds of) community. The focus within this research will be at the level of community, which in itself is a flexible concept that can indicate groups of varying sizes, interests and composition. For instance, the current “Western worldview” encompasses a varied group of people, but can be generally characterized as democratic societies based on free-market principles (capitalism) and an objective to control nature.

Modern science, developed in large part within the confines of a western worldview and therefore more appropriately indicated as western science, can be considered to have its own worldview within the larger western framework. Further division can identify worldviews (also described as paradigms) for different science methodologies (Creswell, 2007). In this research, communities will be discussed based on these levels of worldview, allowing for comparison between for instance archaeological research paradigms and indigenous methodologies (L. T. Smith, 1999).

In relation to the representational focus, new technologies, specifically geospatial technologies, are increasingly used, not only in the natural sciences but also in the social sciences (Michael F Goodchild & Janelle, 2004) for analysis and visualization of spatial relationships (e.g., adding a spatial component to socio-economic, and
ecological relationships). Geospatial technologies include, but are not limited to, Geographic Information Systems, and even though these technologies in representational systems can be considered neutral per se, their use by humans is not. Their development is driven by special interests, (Levinson, 2008b), whereas ideally they need to provide the ability to reflect and understand different human perspectives and knowledge systems. Necessarily then, this research is concerned with perception, conceptualization, and representation.

Following Raper (Raper, 2000), the “process of representation can be defined as the projection of entities, relationships and processes of the conceptualized world onto symbolic ‘facsimile’ objects with their associations and transformations” (Raper, 2000, p. 4). This means that any representation (in any symbolic representational system, e.g. natural language, visualization) is never an independent copy of a world outside the human mind, be it a photograph, map, painting, written document, data-visualization, or, whatever (Fisher & Unwin, 2005; Mirzoeff, 2002; Singer, 1996; Smiles, 2005). Representations are understood best within the culture/worldview in which they originated, and they carry epistemological implications (Augusto, 2008; Barthes, 1988; G. Kress, 2010).

1.1.1.1 General Problem

The general problem that provides the larger context for this study consists of the epistemological and ontological differences argued to exist between the dominant scientific community, developed within a western worldview, and non-western (scientific) communities, especially prominent in representations of history (Mihesuah & Wilson, 2004; Nesbitt, 2003; P. R. Schmidt & Patterson, 1995; Waters,
As more non-western individuals identify themselves as members of the larger scientific community, the issue of worldview and its methodological implications becomes more apparent. Representations, long considered to be neutral or to represent universal values, are often biased and influence not only popular opinion but the development of scientific models as well (Singer, 1996; Smiles, 2005).

Within this framework of an expanding global research community, the development of information technologies, encompassing geospatial information technologies, is often assumed to fuel a democratization process through which more and more people around the world become connected via information networks (see McLuhan, 1964; Mirzoeff, 2002; Urry, 2007). This is only partly correct. The use and development of geospatial technologies as with other representational systems and media, is not value free, often rooted in historic conventions, and is therefore not necessarily democratic. This issue was initially addressed within Geographic Information Science as Critical GIS (Harvey et al., 2005) and is currently part of a broader research focus, for example as qualitative spatial reasoning, ontology research, and multimodality (Fisher & Unwin, 2005; Galton, 2000; G. Kress, 2010; Mark, Turk, Burenhult, & Stea, 2011; Raper, 2005; Schuurman, 2006), investigating the metaphysical foundation of these systems. The case study exemplifying this problem focuses on the history of the Northern Rio Grande region during the last 800 years, specifically the ancestral Pueblo cultures immediately prior to European arrival. It investigates the argument that current Pueblo communities cannot serve as a model for behavioral interpretations of a
time prior to modern history writing, due to the disruption of “Puebloan life” by colonization (Lekson, 1999). Nevertheless, the official history of this region in the time prior to European exploration and colonization has been written predominantly by non-indigenous individuals, primarily English speaking (Adams & Duff, 2004; Adler, 1996; Bandelier, 1910; Cordell, 1984; John Peabody Harrington, 1916; Kohler, 2004; Mera, 1940; Nelson, 1914, and many others). Given the finding that spatial cognition differs among speakers of different language groups, the fact that American Indian languages continue to be spoken in the Northern Rio Grande Pueblos suggest that a different epistemology supports the historic development of the Pueblo communities. This assumption can be investigated through several questions:

1) Is it possible to represent different ideas of space and time within current geo-representational systems?

2) Assuming that epistemological difference and differences in spatial cognition exist, what is the nature of these differences, and how can they be identified with available methods?

3) Is it possible to test potentially different ideas and identify how systems of representation need to be changed to accommodate such research?

1.1.1.2 Theses – the specific problem(s)

Archaeological research on the Northern Rio Grande Ancestral Pueblo cultures has long been overshadowed by research focused on the “Chacoan Phenomenon,” defined as a regional system centered in the San Juan Basin of northwestern New Mexico. This regional system was prominent during a time in history prior to the
development of the large Pueblo communities in the Northern Rio Grande valley region, which, for a long time, were considered to represent a post-Chaco degradational phase (D. Roberts, 2004; Zubrow, 1974). The Northern Rio Grande Pueblo communities were spread out along the river valley to the edge of the Plains, including the Galisteo Basin, immediately prior to and during the time of Spanish occupation and conquest and included areas such as the Galisteo Basin; these communities are ancestral to modern day Pueblo communities.

In an effort to better understand the ancestral Pueblo cultures of the Northern Rio Grande region prior to Spanish conquest, much of the archaeological research in this area has focused on ceramic analysis: this region and time period is characterized in the archaeological literature by the production, use, and exchange of glaze ware ceramics (Huntley, Spielmann, Habicht-Mauche, Herhahn, & Flegal, 2007; Mera, 1940). Broad, interdisciplinary-based research programs include research on Pajarito Plateau, Arroyo Hondo (Dickson, 1979; Kelley, 1980; Kohler, 2004; Rose, Dean, & Robinson, 1981; Shapiro, 2005; Wetterstrom, 1986), and a recent landscape analysis by Snead (2008).

As noted above, it is often argued that modern Pueblo life cannot serve as a model for understanding the past given the changes in circumstances and the acculturation processes that have taken place as a result of European exploration and colonization, and that standard scientific/archaeological research methods are therefore most suitable for understanding and representing human behavior in Northern Rio Grande history. This dissertation disputed this. The specific problem can be defined as follows:
Spatial thinking is crucial in everyday life, and coordinate systems or frames of reference play an important role in human thought and human behavior, from "navigation to the design of our cultural environment, from moving our eyes to scientific models of the universe" (Levinson, 2003, p. 3). Taking into account the research showing that significant differences in spatial thinking among language groups, the use of models of human behavior that are based on the universality of human spatial thinking (Talmy, 2000) is not necessarily valid. How space is structured is widely discussed across disciplines, from diverse theoretical angles, increasingly incorporating research on spatial cognition. The argument made here follows the Max Planck Institute (MPI) research model (Levinson, 2003, 2008b): differences in space-time conceptualization affect the way we navigate, design, interact with, and understand the world around us. Differences in spatial thinking between native speakers of American Indian languages, specifically those spoken in the Northern Rio Grande region, and native speakers of Indo-European languages results in a specific, or affects a worldview. Worldview underpins design and representation of our surroundings.

Understanding Pueblo worldview(s), therefore, should be a primary research goal in archaeological research. As we learn more about the diversity in spatial thinking across human populations, analytical models for understanding cultural expressions will become more refined. As is argued by many, spatial cognition is a fundamental aspect of human thinking and conceptualization. The development of Spatial Information Systems (SIS) provides novel avenues for exploring this diversity in human thinking and expression as it relates to understanding and interacting with
the world around us (Bateson, 1972; Fauconnier & Turner, 2002; Ingold, 2000; Lakoff & Johnson, 2003; Levinson & Wilkins, 2006; Mark et al., 2011; Nesbitt, 2003).

In order to broaden our framework for cultural understanding it is necessary to address the fundamental issue of spatial cognition:

1) What is the nature of differences in spatial cognition across the human population?

2) What is the effect of these differences on, and how does it result in, cultural expressions investigated by archaeologists in the form of material cultural remains?

3) Within the confines of this research, how can these questions explored as part of a mixed methods approach?

A further assumption underlying this research is that linguistic continuity of indigenous languages in the Northern Rio Grande region has been demonstrated, and that from the close relationship between language and spatial thinking that has been empirically shown and the absence of universal spatial categories, it follows that linguistic data and documented indigenous space-time concepts provide a valid foundation for evaluating differences in the pursuit of knowledge, in what constitutes knowledge, and in how we obtain that knowledge.

In addressing the defined problem, I will focus on two general aspects of perceptual, conceptual, and representational issues that can be explored using current spatial analytical frameworks. One is the problem of spatial categories (ontology), following the research of (Burenhult & Levinson, 2008a; Mark & Frank, 1991) and the other is the problem of spatial framework related to the current focus on the human
perspective in the landscape, following Llobera (2003) and others. Exploration of spatial categories in the Northern Rio Grande starts with place names collected from the Tewa by Harrington (1916), keeping in mind that the collection strategy has already influenced what the collected terms represent.

The exploration of the human perspective focuses on the relationships between what we call archaeological material and the natural environment, starting with the assumption that a western idea of nature as exploitable resource is not necessarily valid, in contrast with a view in which focus is not on cultural accomplishment and conquest but more likely on maintaining a sustainable relationship with the environment (Grim, 2001). The human perspective within a geospatial framework has been pioneered by Higuchi based on and ecological approach to perception, and is more suitable to understand man's relation to the environment than the traditional “view from above” used in spatial/mapping sciences (Higuchi, 1983; Llobera, 2005). Employing this approach allows for a better understanding, for instance, of human movement and navigation strategies

1.1.2 Background sources – availability of data

1.1.2.1 Research paradigms

Epistemologically, many of the social sciences developed along similar paths, especially during the late 20th century resulting in tension between post-positivist and post-modern research approaches. Within the discipline of archaeology, the focus of the New Archaeology on the (deductive-nomological) scientific models of the 1960s was followed by critiques initiating different research paradigms along a
continuum including both post-positivist and post-modern approaches (Trigger, 1989). Spatial approaches in Southwest archaeology initially embraced technologies such as GIS and remote sensing applications (Camilli & Cordell, 1983; Lyons, 1977). However, GIS was criticized as being overly environmentally deterministic, leading to a marginalization of the use of geospatial analysis in archaeological research. Current research efforts employing geospatial technologies are heavily focused on site-prediction modeling (Mehrer & Wescott, 2001), but besides this use in cultural resources management (CRM), on a broader scale it is increasingly geared toward the integration of geospatial technologies within a landscape archaeology research paradigm (Bender, 1993; David & Thomas, 2008b; Lock, 2000; Thomas, 2001; Ucko & Layton, 1999).

The development of geospatial technologies has been associated strongly with the discipline of geography, within which the accusation of environmental determinism has led to a different direction, such that geographic information systems and technologies and theoretical discussions of these approaches has moved beyond disciplinary and epistemological boundaries (Michael F Goodchild, 1992). This development provides the theoretical context for this research, integrating a discussion on spatial approaches in anthropology and archaeology within a larger framework of the study of space and spatial cognition in Chapters 2–4 of Part I. Moreover, in Part I the GISc worldview is discussed from the perspective of the history of thinking about space and time, from space as infinite to space as place (Peuquet, 2002; Raper, 2000; Tuan, 1977).
The current development of geospatial analysis and representational systems is firmly rooted in this history of thinking of space and time and their related, inherent technological limitations. The relationship between thinking and technological development as well as historical (and political) context is then of significant influence on our current research models and paradigms. The paradigm followed in Part I is based on critical GISc approaches in which spatial ontologies are investigated, with a specific focus on the findings of diversity in spatial cognition across language groups. In Part II, Methodology, I build on these concepts by incorporating semiotic approaches to communication and design.

In short, our perception, conceptualization, and representation of the world influence how we understand the world. Given the reflexive relationship between epistemology, cognition, and representation, I contend that cultures exhibit epistemological and ontological differences in the spatial domain expressed across modes of representation and communication. Based on recent research in Spatial Information Theory, psycholinguistics, and non-western philosophies, I develop a theoretical framework for this research in Part I. Within this framework, a methodology is outlined in Chapter 5, for evaluating and exploring this issue in practice, based on semiotic approaches of perception, cognition, and representation (Farina, 2006; G. Kress, 2010; MacEachren, 1995), to question assumed universality in representations of space and move from a Critical research paradigm toward a paradigm of Design. As argued by Kress, critique is oriented backward and toward superior power, whereas design focuses on interests now, and the likely future effect of action.
1.1.2.2 Data Sources

To use geospatial technologies to their fullest potential, many data are currently directly collected (such as satellite imagery), but (older) analogue sources have been, or can be, converted, digitized, and so forth. For instance, elevation data can be digitally collected with remote sensing instruments such as LIDAR (Light Detection and Ranging), but elevation data sets also have been or can be created through digitization of topographic maps. Once created, these data become powerful for their ability to allow analyses at varying spatio-temporal scales. Just as environmental data can be created through digitization or newly collected by remote sensing instruments and then integrated, so can many other data that have spatial relevance, including non-spatial attributes of specific locations, such as archaeological sites. Also, socio-economic data are spatially affected, spatial relationships between those and other data are often significant. Potentially, all data that have ever been collected for a specific archaeological site or site location can be attached or integrated into a spatial database. The approach taken here is to “reuse” archaeological and ethnographic data that have been collected through past research efforts, based on the fact that currently we move from data-poor to data-rich situations, and fostering sustainable digital environments will become part of new research paradigms (BlueRibbonTaskForce, 2010; Judith van der Elst, Richards- Risssetto, & Garcia, 2010). Current geospatial technologies provide the potential to analyze large, multi-variate datasets. Whereas in the recent past the need for data inhibited many large-scale research projects, currently this situation has reversed: availability of data often exceeds the analytical
capability. This demands a new way of thinking about data, methods of analysis, and ultimately theoretical underpinnings.

Digitization and digital collection of certain kinds of data have become the norm and not only for environmental data. For instance, the availability of historic, written records in digital form through digital scanning is increasing. Within the field of cultural heritage, digitization of archival information is on its way; however, many of these efforts are not intended for analytical purposes, but as a repository aid. This is related to the issue of who owns the collected material, and its relevance in the larger context of this research concerns contested ownership of many of the cultural material collections. By showing that meaningful research can be undertaken using previously collected data, I argue that: 1) material collected and derivative data are part of a specific worldview; 2) digital facsimiles can often function in research, allowing the original collection to be returned; and 3) accessibility to specific collections can be improved, and its underlying ontology evaluated (Diaz-Kommonen, 2002).

In addition to environmental data, data sources used in this research include, but not limited to, archaeological site information derived from the New Mexico Cultural Information System (NMCRIS) and digitized files of recorded toponyms from ethnographic research conducted during the early 20th century (John Peabody Harrington, 1916).
1.1.3 Intended outcome – steps toward the intended outcome

The intended outcome or objectives of the research are: first, to identify differences in categorization of space-time, that is, comparison of spatio-temporal objects suggested by the exploratory research in this case study with those that currently underlie many spatial analytical frameworks; second, to suggest ways to explore and integrate alternative ideas; and finally, to show more generally the ways in which geospatial technologies can be used in archaeology/anthropology, through integration of the humanistic perspective with scientific research frameworks by suggesting new directions in technological, representational system development.

Many current and recent efforts in Northern Rio Grande archaeological research are supported by chemical analysis of cultural remains. These studies provide a “factual pattern”, but still need a contextual framework for understanding the facts (Wylie, 1995a). A contextual framework for interpretation of facts needs to take into account the perceptual and conceptual differences that may exist between cultural frameworks or worldviews. The outcome of this research is the creation of a more flexible framework for understanding these cultural facts.

The value of this research is that it provides more evidence for and better gradation of our understanding of the relationships among environment, human subsistence, and spatial organization. As it becomes apparent that human spatial cognition is much more diverse than previously thought, it becomes necessary to question assumptions that spatial patterns that are detected by archaeologists are based on universal spatial thinking.
Thus, the use of interpretive frameworks and models based on this assumption need to be reassessed, especially as geospatial technologies become more ubiquitous in world archaeology. This research shows that differences in spatial cognition can be identified, and that some of these difference can be integrated within current systems of representation, whereas other aspects of spatial cognition and experience, particularly regarding perceptual grounding, require structural change in systems of representation, and distinct epistemological implications can be inferred.

In addressing the research problem, this study builds on a current research direction in GISc that is focused on naïve geography (Egenhofer & Golledge, 1998), that is, by visualizing and analyzing human spatial thinking through development of alternative spatial ontologies. It is further based on the empirically shown diversity in spatial categories used in different languages and cultures through a mixed method approach.

Within the theoretical background section (Part I), the history of thinking of space and time as well as the history of the representation of that thinking in the form of maps/cartography will be introduced (Peuquet, 2002). The linguistic relativity hypothesis, and specifically recent research loosely based on this hypothesis, is discussed, as it provides reason to believe that human spatial cognition shows significant differences among different populations. This discussion, and the following discussion on space/time approaches within anthropology and archaeology provide the foundation for understanding historical worldview
contexts. The theoretical perspective taken in this research takes its cue from critical approaches in GISc explored in the last decade.

Supporting evidence underlying the argument in this research is that most Geographic Information Systems presume a universal spatial ontology, but that it has recently been shown that no universal landscape categories exist (Burenhult & Levinson, 2008b) necessitating a re-valuation of spatial categories. Furthermore, there is no simple correlation between type of environment, subsistence, and the spatial language used by a specific group; whether language determines thinking or vice versa is unclear at this moment (Majid, Bowerman, Kita, Haun, & Levinson, 2004). Landscape categories, therefore, can provide basic insight into human spatial cognition, or more precisely, the diversity of human spatial cognition, and seem to be mostly determined by “affordance” and cultural ideas more than perceptual salience (Levinson, 2008b). In addition, to investigate and understand the spatial perception and organization of a specific human population, it is necessary to integrate culturally specific ideas with spatial analysis instead of using reductionist approaches that rely on the assumption of universality in human spatial cognition. Similarly, the metaphor of linear time, based on the concept of Euclidean space, is usually employed in archaeological studies; however, at least two major metaphors are known for time in human thought, linear time and cyclical time (Cheng, 2005; V. Evans, 2003; Ott & Swiaczny, 2001; Raper, Miller, Guhathakurta, Muetzelfeldt, & Cheng, 2005), each requiring a different way of reasoning. Different frameworks for analyzing and representing space-time are therefore preferable, and in this research cyclical time is emphasized based on indigenous research (Ortiz, 1972a), providing
a possible different viewpoint. Finally, the idea of geographic representation limited to two dimensions seems to have developed within the western framework, as have other representational conventions that have become standards, and dimensionality of representation will be addressed related to spatial cognitive diversity (G. Kress, 2010; Raper, 2000).

In Part II of this document, the study area section, the description of the methodology is followed by a discussion of the history of anthropological/archaeological research in the Northern Rio Grande region within the historical context of thinking regarding space and time. The history of the Ancestral Pueblo culture as constructed through archaeological interpretation is paralleled with Native American critiques (Mihesuah & Wilson, 2004; P. R. Schmidt & Patterson, 1995; L. T. Smith, 1999; Watkins, 2000). In addition, the history of the Rio Grande region is presented in a series of temporally sequential maps, correlating mapping traditions, governmental policies, and academic research. Through these maps it can be argued that cultural continuation provides a foundation for the use of collected toponyms and landscape knowledge in the exploration of Ancestral Pueblo landscape categories (Chapter 6).

This part of the research is framed in the context of methodological differences between indigenous and western scholars, indicating the limitations of current research paradigms used in archaeological research. The goal of this section is to identify the strengths and weaknesses of current research approaches in archaeology and anthropology in terms of understanding and integrating Pueblo worldviews (paradigm/epistemology). The methodology that is followed within the
broader theoretical context integrates recent social- and bio-semiotic approaches, by means of which the theoretical issues can be investigated in practice. The specific aspects of this methodology as a mixed method approach are defined in Chapter 5.

It is argued here that modern Pueblo communities can be considered historically and philosophically linked to prior Pueblo community life (i.e., cultural continuation is assumed). This assumption is contrary to many studies that consider that the changes that have taken place since European exploration and colonization preclude such a link. The argument for cultural continuation is based on two lines of evidence. First, linguistic studies show strong evidence of historical continuity in the different native languages spoken in this region. Second, cognitive research provides several models on the development of spatial cognition in humans. A well-known model was set forth by Piaget (1952), who proposed a developmental path that each individual/child follows through a number of stages to fully reach human potential to conceptualize and reason about space. This model has been tested and criticized in a number of ways. Most importantly, this development is not necessarily linear-sequential, but may occur through enrichment of already existing abilities. Using these lines of evidence, the argument that differences in spatial cognition does not necessarily represent specific stage in a linear hierarchical sequence.

In addition to the comparison of ideas about space/time between indigenous and western thinkers and scientists, a specific focus in this research will be on ecological relationships, as it impacts agricultural strategies, among other things. A literature review will show the breadth / diversity of strategies used in the Tewa region; a
number of studies have been undertaken to “map” and understand these practices as well as water harvesting techniques (Anschuetz, 1998; Maxwell, 2000). The assumption is that these strategies and ways of life form an integral part of the conceptual framework.

Within the subsequent exploratory analysis section of this research (Chapters 7, 8) the potential, the limitations, and some proposed new directions for geospatial analysis and representation for cross-cultural research will be introduced, thereby integrating the findings of the theoretical background discussion. Archaeological research focused on the Northern Rio Grande then serves as a case study.

1.2 Research Strategy – mixed methods: exploratory sequential model

Kuhn (1970) has argued that both qualitative and quantitative research are necessary components of successful scientific investigation. Qualitative research can be considered exploratory or hypothesis-generating, whereas quantitative research aims to test (those) hypotheses using mathematically based measurements and analyses; neither can claim to be more conclusive or true than the other.

Within a mixed-method research approach, worldview, according to Creswell and Plano-Clark (2007) can be used interchangeably with paradigm, to indicate how we view the world; in research, it indicates how we approach the work. In scientific research, Creswell and Plano-Clark distinguish four main worldviews: post-positivism, constructivism, advocacy and participatory, and pragmatism. Of these worldviews or paradigms, post-positivism is primarily associated with quantitative
research. Pragmatism, on the other hand, is deemed by many to be most suitable for mixed methods research approaches. However, paradigms can be mixed, depending on the specific research goal (Bauer & Gaskell, 2000).

The research described here employs an *exploratory mixed methods approach*, which includes both a qualitative and a quantitative phase, to investigate the role of spatial reasoning in the manifestation of cultural patterns in the archaeological record of the Northern Rio Grande region. I contend that cross-cultural differences in space/time conceptualization influence worldview, and therefore, the way knowledge is pursued, constructed, communicated, and used. This means that material cultural expressions, such as these recorded in archaeological contexts can only be interpreted correctly within, with knowledge of, or through dialogue in a specific worldview. The basic underlying assumption is that spatial thinking, an inherent component of worldview, is reflected and can be represented in different kinds of languages or modes, from natural (verbal), to morphic (e.g., architecture, visual design), to mathematical (Brusasco, 2007; Hillier, 1996; Hillier & Hanson, 1984; Kanekar, 2001; G. Kress, 2010; Regier, 1996). However, the nature of these relationships needs to be investigated instead of assumed.

Rejecting the long-held belief in the universality of spatial cognition suggests that material *manifestations* and *representations* of that thinking possibly reflect those differences as well (Levinson, 2003). Current spatial analytical practices may therefore not be suitable for understanding and analyzing patterns reflecting this diversity of space/time conceptualization. The ontological foundation needs to be
assessed before proceeding to evaluate spatial relationships between elements of (a) culture. The methodological framework for investigating this issue further is outlined in Chapter 5.

1.2.1 Mixed Methods approach

Many of us employ a mixed methods approach but do not call it that, as the qualitative (or intuitive) aspect of research is often ignored, based on the idea that observations supporting quantitative research are objective and non-problematic. Even though previous scientific investigations have included both qualitative and quantitative data and methods, the explicit use of a mixed methods approach is a recent development. A mixed methods approach is not applicable to all research, according to Creswell and Plano-Clark (2007), and different mixed methods approaches are used for different research objectives, and based on their suitability. Creswell and Plano-Clark argue that the strength of a mixed methods research approach lies in its ability to offset the weaknesses of both qualitative and quantitative research. Quantitative research is often considered to be weak in understanding context, voices of participants are seldom heard, and personal biases and interpretations of the researchers are hardly ever discussed. Qualitative research, on the other hand, is often considered deficient because of the personal interpretations of the researcher and the bias this creates. Therefore, a mixed methods approach helps answer questions that cannot be answered by either qualitative or quantitative analysis alone.
The most appropriate research design for the current study is an Exploratory Mixed Methods Research Design. “The intent of the two-phase Exploratory Design is that the results of the first method (qualitative) can help develop or inform the second method (quantitative). In general, this design is based on the premise that an exploration is needed for one of several reasons: measures or instruments are not available, the variables are unknown, or there is no guiding framework or theory. Because this design begins qualitatively it is best suited for exploring a phenomenon” (Creswell, 2007, p. 75).

Typically, this is a two-phase approach, also referred to as Exploratory Sequential Design, with two common variants, the instrument development model and the taxonomy development model. In the current research the second model is used. The first phase is conducted to investigate spatial ontology, not often considered within archaeological studies, but important to understand human spatial behavior. In the second phase a preliminary test is conducted to determine if the results can be represented and integrated with currently available geospatial software. The qualitative component addresses whether mapping as representation is biased toward western scientific ideas, and if scientific inquiry using these representations is therefore biased as well, or limited in its logic and understanding. If this is the case, the quantitative methods used to understand spatial behavior need to be adjusted before proceeding with analyses. Second, place names, from Tewa ethnogeography recorded during the early 20th century, provides a rich dataset from which to begin an investigation of diversity of space-time conceptualization.
1.2.2 Qualitative phase

Exploring the spatial language of American Indian societies through the analysis of historic maps and place names constitutes the first part of this research. Several previous studies of the “Encounter” of European and Indigenous peoples based on analysis of cartographic traditions and changes have indicated that particularly in Mesoamerica a strong cartographic tradition was in place. Influences of indigenous practices are clear in the early maps created for the Relaciones Geográficas program, as indigenous mapmakers were employed as cartographers. Over time, this syncretism was usurped by and redefined as the European standard, obliterating an indigenous tradition of mapmaking of connecting (hi)story and geography (Mundy, 1996; Reinhartz & Saxon, 1998). Conceptualization of space-time can also be explored through spatial language. Within a spatial language framework, several major semantic subfields can be distinguished. For instance, toponymy is a subdivision within a non-angular specification. Landmark systems or cardinal systems, on the other hand, are subdivisions of an absolute, horizontal coordinate system, using angular specification, further discussed in the following chapters (Levinson, 2003).

The study of place names, as discussed by Levinson, is one of the oldest traditions in linguistics, but it has received little theoretical attention. Renewed interest is evident in recent studies (Hunn, 1996; Kari, 1989; Williams, 2000). Questions of interest concern density of place names, and the relationship between landscape categories and proper names, among others. Simple measures of density such as ratio of place names per unit area can provide valuable information. The data
explored for this research, recorded by Harrington (1916) as the *Ethnogeography of the Tewa Indians*, offers the possibility of additional analyses. To clarify, this research does not entail in-depth linguistic research; however, it is based on recent linguistic findings regarding diversity in spatial cognition across languages and cultures and provides suggestions for further exploratory analysis.

Research conducted as part of a research program at the Max Planck Institute (MPI) for psycholinguistics (Levinson & Wilkins, 2006) and ethnophysiography research as part of GISc (Mark, Turk, & Stea, 2007), and its findings are used to structure the exploratory research design with a focus on integrating human cognitive abilities within a spatial analytical framework. To analyze and understand archaeological cultural remains, based on the assumption that conceptualization of space/time is a significant factor in spatial organization of cultural space, is reflected not only in natural language, but also in other modal expressions. It is paramount to recognize differences in worldview, or space-time conceptualization, and the implications this will have for the investigation of cultural material remains.

The objective of this qualitative phase is to investigate possible differences between a common western spatial ontology, underlying much of the spatial analytical frameworks used in academic research, and indigenous conceptualizations. This investigation employs an analytical framework based on current knowledge, standards, and practices in the history of mapmaking (MacEachren, 1995; Mundy, 1996). Place names that were recorded during the early 20th century for the Tewa region are investigated for the relationship between proper names and landscape categories (Cablitz, 2008; John P. Harrington, 1910; Speirs, 1975). The place names
are integrated into modern mapping systems and databases for analysis. The analytical framework is based on Levinson (2008). The intended outcome of this investigation is to gain insight in differences in spatial cognition, the existence of which is argued in several publications by indigenous scholars (G. Cajete, 2004; L. T. Smith, 1999; Waters, 2004b).

1.2.3 Quantitative phase

Insights regarding spatial cognition and its ontological foundation, along with outcomes of the qualitative phase, underpin the exploratory analyses performed within the quantitative phase. Several ideas are explored within this section of research. The quantitative research phase primarily employs current geospatial technologies, allowing the exploration of several datasets simultaneously, such as sociocultural and environmental data. In chapter 5, the mixed method research design, the rationale for using this technology is further examined and the use of these technologies in archaeological and other, related, cultural applications is discussed. This background will position this research in a current research trend integrating a humanistic approach within a GIS. The two main data models in geospatial analysis applications, raster and vector, will be discussed in detail along with their use for this specific research.

Several analytical approaches are employed in this section. The first is landscape knowledge as it is related to the concept of zones around the Pueblo and other cultural material. The main data source is based on digitized place names and the attached gazetteer. The place names as recorded provide information on location
and the etymology of all associated names in different languages and dialects. For instance, the high density of place names around Ohkay Owingeh (formerly San Juan Pueblo) may concern primarily names known to Ohkay Owingeh people, whereas place names beyond the immediate surrounding may be known to many groups. Analyzing the density and distribution of the place names, not just as an overall pattern but distinguished by dialect and language, is expected to provide information on the type of pattern and possible differences in patterns of landscape knowledge, as well as elucidate associated issues. The outcome of this analysis will provide the basis for the subsequent analyses.

Further analyses will extend these findings by correlating this information with landscape data related to the physiographic setting. Theoretically, these subsequent analyses are based on ideas of landscape related to the role of texture, light, and other qualities as discussed in environmental archaeology (J. G. Evans, 2003), and on the study of mereology and topology as related to category construction (Bibby, 2005; Casati & Varzi, 1999; B. Smith, 1996). For instance, on a basic level in an archaeological research framework, a Pueblo can be identified as a cultural artifact, a self-contained unit. However, it can also be seen as part of a larger ecological whole, in which the built components create in-between spaces that may be of more importance, such as a plaza and its relationship to other elements in the Tewa landscape.

Most of the subsequent analyses will make use of the raster data model, prominent in environmental analysis, using remote-sensing data and image processing methods. These methods have been used only sparingly in socioeconomic and
cultural spatial applications, but are becoming more common (Batty, 2005; Gimblett, 2002; Kohler & van der Leeuw, 2007; Ratti, 2005). The outcome of these analyses or explorations will show the potential and limitations of current geospatial technologies, particularly related to the geometric space model and the close link between the visual spatial structure of landscape that underpins these systems and technologies.

### 1.3 Delimitation

Due to the exploratory nature of this research, it is inherently more broad-based than in-depth and detailed. It is looking at several avenues simultaneously, such as the history of thinking of space and time through the concept of worldview, in correlation with the historic developments of the Northern Rio Grande region and the policies of its subsequent governing institutions. This broad framework provides the stage for understanding the fraught relationship between archaeological and indigenous communities today. This relationship, and the documented dissatisfaction of the indigenous communities with the way their history is treated and represented, are the starting points for this research, stated as a general concept: that interpretive frameworks used in archaeological research fail to take metaphysical differences into account (Cameron & Kenderdine, 2007; P. R. Schmidt & Patterson, 1995).

To reach the planned goal, the parts and sections are organized in such a way that sub-questions and intermediate goals logically lead to the next chapter, following a traditional linear outline; however, the research itself was conducted in an iterative
manner. Following this introductory chapter is the theoretical component (Part I), followed by the methodological component (Part II). The overall problem addressed in the theoretical section is whether differences in concepts of space-time can exist in science and more generally, in human thinking, and if so whether this phenomenon leads to different ways of representation and understanding. To address this question, the theory section is divided into three chapters: the first of these (Chapter 2), discusses the space-time conceptual history, primarily from a western science and philosophy perspective. This discussion includes Critical Theory, the relevance of which will become apparent in subsequent chapters. The following chapter (Chapter 3) is dedicated to space-time as it is conceived in anthropological and archaeological research, with a specific focus on the paradigm shift from modern to postmodern approaches, specifically the landscape approach. The last, (Chapter 4) is focused on worldview, perception, and representation, and new geospatial technologies. As will become clear, epistemological and ontological differences discussed in the Chapters 2 and 3 will influence how or if these novel technologies and systems of representation can be used. In order to make these technologies useful for cross-cultural understanding, as is the underlying goal/methodological basis of this research, the theoretical foundation needs to be clearly defined.

In Part II, the methodology is outlined (Chapter 5), the case study is discussed (Chapter 6), the exploratory analysis is presented (Chapter 7) and discussed (Chapter 8). Within the broad framework resulting from the discussion in Part I, the methodology framework integrates emerging approaches for understand
communication based on social and bio-semiotics, preliminary defined as comprising an immersive epistemology. The case study area chapter starts with a general critique by indigenous researchers of how their history (and knowledge) has been interpreted and represented, especially in scientific discourse, and will provide the context for evaluating some ethnological and much archaeological research that has been done in this region. This chapter will delimit the study geographically and temporally. Geographic boundaries are chosen based on watersheds that encompass the Tewa world as delimited by the Tewa cardinal mountains; the Galisteo Basin is a special focus, even though no modern Pueblo is located here, as this area is recognized as comprising the Tewa world (Harrington, 1916; Ortiz 1972). Temporally, this discussion includes time relevant in the Tewa world; however, archaeologically it is focused on what is known as the period of glazeware production in the Northern Rio Grande region. The “archaeological landscape” is be presented within a context of changing landholding practices and governmental policies toward descendants of the former inhabitants of that landscape (Forte, 2004).

Finally, this research is exploratory. As such, it provides a broad survey of research across disciplines to outline future directions in development of systems of spatial representation and the epistemological implications for inter-cultural dialogue.
PART I AGE OF REASON

The first part of this research discusses the theoretical issues that underlie the general problem posed in the introduction. Given that the investigation of possible epistemological differences between western research and indigenous worldviews is intricately related to metaphysical and ontological issues. This discussion therefore needs to start by clarifying what knowledge is or what it can be.

Knowledge within the confines of scientific research is often narrowly defined as the result of inferential methods that can be empirically, thus (presumably) objectively, tested. The concept of knowledge used herein does not exclude other sources and validation methods beforehand, rather, investigates to what extent other cognitive, affective, and perceptual processes are necessary to understand the world around us. The initial diagram (Figure 1) is based on Bacon (Klein, 2011), but similar classifications of what knowledge is have been used by others. Knowledge is not just the result of logic and reason, but also of memory and imagination or creativity.

Within the modern research framework these capacities are linked to the broad categories of human endeavor: science, humanities, and art. True knowledge is often considered to be the result of scientific research, based on the scientific method, which ensures testability and replicability. Using this diagram as an initial guideline, the following chapters will discuss perception and representation of what are considered fundamental organizational principles underlying human thinking, SPACE and TIME, and the role of different cognitive aspects in knowledge creation. This research has a focus on cultural research, but broader-based implications,
starting from the premise that knowledge in all knowledge systems is the result not only of logic and reason, but also of memory and imagination to greater or lesser degree.

Figure 1 cognitive components of knowledge
The title of Part I, the Age of Reason, refers to the current era, which originated with the Enlightenment and in which the scientific method triumphed over metaphysics to provide true knowledge of the world. Within this positivist program, however,
scientists failed to address a fundamental issue: the distinction between the physical world and the world of the mind. In this part of the document this issue is addressed through an inquiry into perception and conception in human cognition as part of the knowledge structure. This dualistic framework, known as the Cartesian mind-body problem, still underlies modern science, dividing practices along oppositional lines of inquiry into human existence and experience.

Chapter 2 provides a brief overview of thinking about space and time within western science, which has resulted in two basic research agendas: 1) the physical sciences, based in empirical epistemology, and 2) the humanities, based on hermeneutics. The social sciences straddle this divide, which is not to say that they have merged the two approaches, and practitioners in the social sciences are divided among themselves (Root, 1993).

Archaeology can be understood as operating at the crossroads of all of these issues, and Chapter 3 provides an overview of how the division described above manifests itself in anthropology and specifically in archaeology. Chapter 4 is focused on representation, facilitating communication of space and time from a broader disciplinary perspective. The binding theoretical starting point is Critical Theory and its subsequent methodological developments, exploring communicative spheres and focusing on the need for cross-cultural understanding.

Before starting a discussion on knowledge representation, a term often used interchangeably with representational systems, the term knowledge itself needs some clarification. Introduced in Chapter 2, the specific understanding of knowledge in science
is ‘justified true belief’, the result of research by means of the scientific method, and is considered the only (cross-culturally) true knowledge. Other types of knowledge can be distinguished, the most basic distinction being between knowledge of and knowledge how, or propositional knowledge and procedural knowledge. Further, true or scientific knowledge is also considered different from traditional, or folk knowledge. For the purpose of the argument presented here, knowledge is also distinguished specifically from information and data, following a line of reasoning that is well supported in the literature, even though the terms information and knowledge are often used interchangeably (Tergan, 2005). As addressed by Breton (2007) however, knowledge is considered as a result of scientific practice and of rhetoric, based on whether the variability of the definition of knowledge is not in fin a social variability and whether the role given to the audience in the communication of knowledge is not central to the definition of knowledge.

The terms Traditional knowledge, Indigenous Knowledge, and local knowledge, generally refers to long-standing traditions and practices of indigenous and local communities, and this type of knowledge is set apart from scientific knowledge. Even though the methodological basis for upholding this distinction, which implies that scientific knowledge is ranked higher, is problematic, as is clear from philosophical discussions within the academy itself (Wautischer, 1998b). Acceptance of traditional/indigenous epistemologies as supporting equal knowledge systems appears to remain marginal. Efforts to validate truth claims of traditional knowledge are often focused on exposing the political motives of dominant epistemologies. Wautischer (1998), even though
acknowledging this motive as a factor, argues that this perception has dominated postmodern critique at the expense of investigating the philosophical underpinnings of the diverse claims to truth. Within the current academic culture, the acceptance of multiplicities of viewpoints is one of the important features associated with postmodern thinking. However, along with its inherent relativism, the role of political power in control of knowledge tends to be overemphasized at the expense of other human traits in comparing different knowledge systems (Bender, 1993).

Several scholars have discussed ways in which different knowledge systems can be compared from a philosophical perspective, even though these efforts remain minimal. For instance, “the epistemological function of narratives is underappreciated in western cultures as relevant device for human interaction” (Wautischer, 1998b, p. 10), but recent investigations have recognized the importance of stories in human spatial cognition (Gluck, 1991; Paelke & Elias, 2007). In addition, comparison of different knowledge systems often overemphasizes differences that are presented as dichotomous relationships, such as stressing the community aspect in traditional knowledge as opposed to the importance of the individual in western cultures. Several scholars have addressed the notion of Self and individuality within non-western cultures to counter this narrow focus (Edge, 1998; Ryser, 1998).

Moreover, scientific practice often supports the rhetoric of development, which has long been characterized by a focus on economic growth and technological innovation as its primary driving force. Today’s focus on sustainable development, however, has many researchers reconsidering the value of traditional knowledge rather than an obstacle to development, seeing it as essential for sustainable practices. This shift in focus is long
overdue, but also presents new problems in the relationship between local and indigenous communities and other knowledge-producing institutions (Agrawal, 2002).

Within the social sciences, traditional knowledge has long been studied within the discipline of anthropology, with recording and representation within a general mindset of changing or disappearing cultures that needed to be preserved. These ethnographies either served as descriptions of assumed earlier stages or were used to invalidate philosophical traditions. The treatment of traditional knowledge within that framework sets traditional knowledge apart as more embedded in the environment and representing a primitive way of thinking, unlike the results of analytic reasoning rooted in a larger dualistic-framework, underlying most western scientific endeavors. In a way, knowledge is then objectified and frozen: similar to the treatment of tangible artifacts that are collected from those environments and preserved in museum settings.

For instance, in an article discussing Maori epistemology, Roberts and Wills (R. M. Roberts & Wills, 1998) draw upon and referenced one of the few studies that have compared traditional knowledge systems and western science by Horton, who listed a number of general attributes fundamental to all epistemologies. Using these as guidelines, Roberts and Wills conclude that for all considered attributes, Maori knowledge contains theoretical models that are comparable to modern science. Moreover, fundamental in Maori epistemology is the use of metaphor, a characteristic that is also underlying western scientific thinking (Forceville & Urios-Aparisi, 2009; Lakoff & Johnson, 2003), as will be further discussed in the following chapters.
The main difference assumed to exist between these knowledge systems is whether they are closed or open; whereas “in traditional cultures there is no developed awareness of alternatives to the established body of theoretical tenets, in scientifically oriented cultures on the other hand, such an awareness is highly developed” (R. M. Roberts & Wills, 1998, p. 63 citing Horton). Roberts and Wills, however, show that this strict boundary is blurred on both sides, arguing that science has become a way of doing instead of a way of seeing and is no longer subject to philosophical inquiry. Traditional knowledge, as exemplified by Maori epistemology, is said to be dynamic, while maintaining its epistemological foundation. It is this dynamic characteristic of traditional knowledge systems that has led to the employment of innovative digital technologies to maintain and disseminate traditional knowledge in new ways (Ushahidi).

The relationships among knowledge, communication, creativity, and memory have come to the fore in the current Knowledge and Information Age, with its associated innovation ideology and development rhetoric. Critical voices have been raised arguing, for instance, that “innovation is correlated with a devaluation of what things have been in favor of what things may become,” and a related argument stating that in many cases the “absence of collective memory is what makes people capable of recognizing achievements as innovative. In many ways then, innovation is a form of repackaging” (Sales, Fournier, & Senechal, 2007, pp. 13-14). Therefore, in addition to logic and reason, creativity and imagination are increasingly considered as important cognitive abilities in knowledge building.
There are several lines of argument for considering creativity and imagination as part of the knowledge structure, especially in respect to the current focus on innovation and development:

1) Perception can be shown to be subjective (see Chapter 2), calling into question the assumption of objectivity in scientific research and indicating that the distinction between percepts and concepts is not always straightforward.

2) A related argument originates in the Conceptual Metaphor Theory, developed by Lakoff and Johnson in 1980 (2003). This theory is based on the assumption that besides being used in communication, metaphors also shapes the way we think and act and that most of our concepts are based in metaphor. Therefore, in order to create a model for interpretation in a specific domain, we need to use a different structure or (source) domain that can serve as a model for the structure and/or processes that operate in our target domain. To conceive of such models, different cognitive capacities are at work, including memory and imagination.

The relationship, however, of imagination and creativity to science is an uneasy one, as discussed by Daston (2005, p. 17), who provides an overview of the history of this relationship, especially as “the polarization of the personae of artist and scientist, and the migration of imagination to the artistic pole”, as either subjective or objective, whereas facts, as nuggets of pure experience are considered to be given by nature, an attitude perpetuated by Enlightenment thinking. Although it has been repeatedly shown and argued that science cannot progress without imagination, the nature of this relationship remains unacknowledged for the most part. However, a current interest in creativity as a prerequisite for innovation has resulted in new studies that have shown, for instance, that
scientific breakthroughs are mostly attributed to scholars who can draw on rich experiences beyond their scientific interest, whether in the artistic realm, in sociopolitical activism, and/or in multicultural experiences, are indications of necessary cognitive complexity (Hollingsworth, 2007).

Memory is based in perception, and even though this is the same source of knowledge that is drawn on in science, understanding perception as observation makes perception appear more active in scientific practice. The inverse relationship between innovation and memory has been expressed in different ways throughout the history of philosophy, as “innovations are reactivated lost futures” and the notion that “a highly innovative society wastes its potential by making poor use of its past” (Sales et al., 2007, p. 14). This exclusive focus on innovation at the expense of memory has drawn attention from scholars in cognitive sciences, notably in spatial navigation; the ability to successfully navigate an environment is greatly enhanced if people make use of mnemonic devices, especially stories (Kowalski, Claramunt, & Zucker, 2007; Paelke & Elias, 2007). In addition, historic accounts, written or oral, are important in understanding the history of epistemological differences between groups of people and the nature of this development, for instance, as linear or non-linear thinking.

Within chapters 2, 3, and 4, several widely held assumptions regarding space-time knowledge are investigated. In chapter 2, I challenge the objectivity of empirical observation that forms the foundation of modern research. In Chapter 3, I investigate current anthropological and archaeological theories for their suitability to address the problem posed and for understanding epistemological differences across the human
population in general. In chapter 4, I discuss the ontological basis of systems of
information and knowledge representation based on certain concepts of space-time, and
examine the capacity for cross-cultural communication they offer. Together these chapters
provide evidence from a wide variety of sources that commonly held assumptions
regarding human spatial cognition are not supported, and therefore the notion of
methodological superiority of current western scientific approaches in knowledge pursuit
is not warranted.
CHAPTER 2 – THINKING OF SPACE AND TIME: A BRIEF OVERVIEW

Modern science developed within the confines of the western world, even though many preceding developments on which that science is founded originated outside the western world. The position of science within western society — according to Wallerstein (2004), and taken as a proposition herein — is embedded within the larger system that socio-politically strives for democracy and economically is based on free-market principles. However, a general (mis)conception is that science is trans-cultural (Cobern, 2000), independent, and value-free, that is, its justification is intellectual, not moral or political. In this broad context, my research is concerned with conception, perceptual grounding, and representation of space and time. Specifically, it addresses how current scientific practices use spatio-temporal frameworks, and what the influence of those frameworks is on understanding ecological processes and eventually on informing human decision-making practices, ecological strategies, and spatial design. The thesis I investigate builds on prior research that shows that representations of space/time are not value-free, and that linguistic differences exist indicating differences in space/time conceptualization among human groups. This chapter provides a brief intellectual overview of ideas focused on a specific cognitive domain that is assumed to be crucial to many, if not most, aspects of our lives, namely, the spatial domain, and how these ideas underlie our research efforts (Lakoff & Johnson, 2003).

Much of scientific research has taken place within the framework of classical mechanics, originating in the Newtonian model of space-time, in which space and
time are treated as absolute and constant. The Cartesian coordinate system introduced by Descartes during the 17th century enabled the development of calculus by Newton, through which rules governing the movement of objects on the earth and of celestial bodies can be calculated and inferred. Wallerstein (2004) summarizes the current crisis in academia in relationship to the persistence of the Newtonian framework, which, according to Wallerstein, keeps in place artificial divisions between science and the humanities and the study of the West and of other cultures, and thereby prevents the development of necessary new approaches to global issues. The division between the sciences and the humanities that historically can be traced back to the Renaissance and Enlightenment eras has developed into a current mindset of preference for pursuit of scientific knowledge over humanistic inquiry (truth over beauty and good). However, emerging research communities intend to break down these old disciplinary boundaries and seek to create new frameworks for understanding.

This general problem is related to the specific research question, and within the context of this research this means challenging the assumption that human spatial thinking is universal that is, that it is an innate human trait. Even though cultural differences are known to exist, the phenomenon itself is assumed to be physiologically universal. Therefore, these differences are not generally a topic of study in the sciences, but are relegated to the humanities, especially the study of other cultures, as the difference in focus on the general vs. the particular. This issue is discussed in Chapter 3.
The question of the origin of differences in spatial cognition in the traditional division within the academic world will determine within which discipline these differences are investigated. Emerging research communities, as described by Wallerstein (2004), can provide a broader framework; for instance, the emerging field of Geographic Information Science permits the investigation of what is space and how we experience space within a given framework. Variation in spatio-temporal cognition and understanding of that variation will allow us to approach problems from different perspectives and gain different insights into related fields of inquiry. In this study the assumption of universality is argued to be unfounded and solely based on cultural dominance of the notion of the primacy of empirical evidence. Critical approaches can be employed to assess these issues.

The concept of *worldview*, a concept that is closely related to the notion of paradigm, that is, a basic frame of reference in which our everyday experiences can be understood, will be used to organize the discussion of the relationship between perception and representation of space and time in Chapter 4. To provide a basis for the overall theoretical framework used to address the research question, this chapter will address the following issues:

- Space and Time are considered fundamental concepts in human cognition; therefore, it is important to discuss the history of ideas of space/time, as they underlie many of our scientific efforts to understand and explain the world (metaphysics).
• The nature of knowledge pursued in science and in the humanities, and ways of acquiring that knowledge and the role of sense and post-sensory aspects, (epistemology).

• Spatial cognition and the role of language: reconsidering space/time categories, and frames of reference

The primary objective of this chapter is to show that two main opposing viewpoints regarding our ability to know about the world perpetuate scientific thinking. However, the universality of human spatial cognition is not contested in either of these viewpoints. Within the literature these viewpoints are associated with underlying metaphysical foundations of different research programs. For instance, Kövecses (2006) identifies these foundations as objectivist and subjectivist respectively, and within the latter a further important distinction can be made between representationalism and phenomenological approaches. Briefly, these viewpoints conceive the physical world to exist 1) independent of our interaction with that world, 2) based on a collection of experiences, or 3) only in our minds, respectively. These viewpoints, after being introduced in a brief overview of thought about space and time, are discussed by distinguishing sensory, post-sensory, and cognitive aspects of human sense and meaning-making systems.

New insights as a result of cognitive research can support hypotheses that question the universality principle in spatial cognition. The linguistic relativity hypothesis, underlying many recent efforts, is reconsidered and provides a starting point for the research described, based on findings that show differences between the use of spatial categories and spatial frames of reference among language groups. There are
several important issues to investigate if spatial cognition cannot be assumed to be universal based on Levinson (2003):

1) Are spatial categories and categories in general universal. If not, to what extent are these categories culturally constructed (ontology)?

2) Even if categories differ, is the basic spatial frame of reference still universal, that is, egocentric?

3) Even if spatial categories and frames of reference differ, can Space and Time as geometric organizational axes still be considered fundamental principles in human thinking?

4) What are the implications for cultural research if spatial categories, frames of reference, basic principles or a combination of these differ across populations?

This chapter will show that the metaphysical foundation of a group or culture influences or defines ecology (basic characteristics of the relationship with nature), ontology (categorization of things in the world), and underlying principles of design (gestalt, affordance). If, as suggested by recent cognitive research, cognitive domains show differences along linguistic lines, culture may be a much greater or more significant factor across the sciences, than have been assumed. Below is a table showing main research topics in this thesis.
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2.1 Modern science: concepts of space and time

Philosophical Foundation - the nature of reality

Inherent in the current organization of the sciences is a positivist grounded approach to many research problems, even though the positivist paradigm has been criticized and replaced or redefined in most disciplines. The classification of the sciences and the philosophy of science as conceived by Comte (Bourdeau, 2011) during the early 19th century holds that the sciences build knowledge in a hierarchical, nested manner; sociology and anthropology are placed at the top and integrate knowledge about the world and the role of humans within it, resulting in a positivist research paradigm. The positivist and subsequent neo-positivist and post-positivist paradigms have been criticized for their underlying assumption of Comte’s original conception, namely, that the (material) world is/can be known through empirical sense experiences, and that through the study of its parts we can arrive at an understanding of the whole (Giddens, 1974; Habermas, 1974; T. S. Kuhn, 1970). Kuhn’s suggestion that the evolution of science was at least in part determined by social factors opened up new research directions questioning the objectivity and validity of science practice, resulting in opposing (but not new) viewpoints of reality with associated epistemologies and hermeneutic approaches.

Knowing Space and Time

That things occur in space and time is the underlying rationale for the importance of space-time models in scholarly research. Many of the current ideas are rooted in the ideas put forth during the Renaissance and the Enlightenment, during which the notion of abstract space was developed, primarily through the work of Newton.
However, because we cannot sense absolute space, we use relative spaces, defining all places relative to the positions and distances of things from any body that is considered immovable. Knowledge of the world is then mapped to our underlying frame of reference, constituted by space and time as fundamental concepts.

The main objective of scholarly research is the generation of new knowledge. It is distinguished from other types of knowledge based on its specific claim to truth. Scientific knowledge, considered as propositional knowledge, is dependent on justification. "Perceptual beliefs about the physical world are based on sensation or experience in a way that precludes the possibility of knowing with absolute certainty propositions about physical objects" (Fumerton, 1985, p. 105). A proposition can therefore be supported only by the current evidence, or be shown to be false, but it can never be proven true, – hence justified true belief. Outcomes of any scholarly research endeavor can thus continuously be tested as new data become available, as new methods are developed, or as paradigms shift. Thus, knowledge, as justified true belief hinges on the method of its justification.

Traditional knowledge, on the other hand, generally refers to longstanding traditions of practices of specific communities and is not always recognized as knowledge due to the understanding that it is based on beliefs, values, and practice, synthesis rather than analysis (Agrawal, 2002).

A paradigm provides a philosophy or framework, necessary for any research endeavor, within which the totality of our experiences and research results can be placed to form or infer a coherent whole. The scientific method is considered fundamental in the natural sciences and increasingly used as a model in the social
sciences, as it purports to provide evidence and reliability for its knowledge claims. Moreover, to know the world, it is a fundamental part of the scientific method that all hypotheses and theories must be tested against observations of the natural world, rather than resting solely on *a priori* reasoning, intuition, or revelation. Therefore, today science is considered to be *methodologically* empirical in nature and always approximate.

To believe a statement about the physical world based on direct experience, the employed principle of justification, whether inferential or non-inferential, (also known as coherentism and foundationalism), needs to be accepted. In either case, the truth claim of a proposition is dependent on the truth of another proposition or axiom. Non-deductive inferential justification, based on empirical observation, not on *a priori* reasoning, is what we commonly refer to as theories of probability, such as the relative frequency theory. All of which hold that “when a meaningful probability assertion is made there is always implicit reference to a reference class” (Fumerton, 1985, p. 65). According to Fumerton (1985), there are a number of problems with the use of a theory of probability for making truth claims, “the most obvious being the problem of distinguishing between accidental or coincidental statistical correlations and the kind of statistical correlation that would support a statement of relative probability.” (Fumerton, 1985, p. 66).

Traditional knowledge systems are based on different principles of justification, but they can be closely related to practice —and long-term empirical experience— especially when communities depend on their place-based knowledge for survival. The underlying idea of reality is thus important in determining for making truth
claims, and instead of an abstract model of space, the land provides the reference frame in support of knowledge (Black, 2011).

*Metaphysics* is a branch of philosophy that investigates principles of reality, providing the theoretical grounding and conceptualization of the world that crosscuts disciplinary boundaries: the ideas regarding possible worlds. It attempts to clarify the notions by which people understand the world, including existence, objecthood, property, space, time, causality, and possibility. A fundamental branch of metaphysics is ontology, concerned with existence, that is, what types of things there are in the world and the relations these things bear to one another (Raper, 2000).

Questions regarding experience in, and knowledge of, the world are known to have been central to philosophical (metaphysical) discourse since antiquity. Even though metaphysics is not a central component of modern science practices, many of the pre-Enlightenment conceptualizations of the world still underpin current debates within and between the sciences and humanities. For instance, *materialism* is based on the idea conceived by Galileo of a separate, mathematically defined external world. *Idealism* is based on the idea that the world is a collection of experiences in the mind and is opposed to *Realism*, which holds that the world exists independently of our perceptions of it (Peuquet, 2002). *Dualism*, a view set forth by Descartes, purports that while the world of matter and motion exist, simultaneously and separately from it a world of the mind exists, making it impossible to ascertain whether an experience belongs to one or the other. *Phenomenalism*, an extension of idealism, proposes that the mental world is dependent on local circumstances
According to Raper, these early positions suggested that metaphysics was a choice between accepting that the external world is not accessible because it does not exist or that it is accessible because it does exist. Only the latter can provide a foundation for empirical research.

The rejection of metaphysics during the Enlightenment, with Comte as protagonist, can be interpreted as a democratization of access to knowledge; the truth was no longer determined by religious authority. The positivist paradigm held that the external world exists as a single reality based on a Newtonian model of space, and that the only source of knowledge and its justification regarding that world consists of empirical sense experiences. Moreover, metaphysics at that time was considered to be associated with rationalist epistemology (a priori knowledge) and dualist theology; the verification or justification of knowledge within these frameworks was dependent on religious authority and clergy. In addition, the positivist program was based on the idea that progress in science would lead to corresponding progress in society (value). Therefore, though relevant in its time, it can be questioned whether the historic context in which science developed in the West still provides a valid model for the verification of current research (Lemaire, 1976).

Kant argued (Levinson, 2003) that while the external world does exist as the absolute space conceived by Newton, human minds do not have direct access to it. Kant suggested that human knowledge is produced by the interaction between the innate abilities of the mind and the sensory data being produced by the external world. While critiquing traditional metaphysics, he proposed a division of
metaphysics into the transcendental kind concerned with what lies beyond sensory experience and the critical kind concerned with the most general structures in our thought about the world. The means by which these general structures in thought could be investigated were termed conceptual schemes by Kant, and have become a focus of much contemporary research” (Fauconnier & Turner, 2002; K`vecses & Koller, 2006; Lakoff & Johnson, 2003).

The innate characteristic of spatial cognition as suggested by Kant is rarely challenged. This view holds that our apprehension of space is based on a egocentric and anthropomorphic model and its main characteristics can be summed up as follows: human spatial thinking is always relative in character; and it is primarily egocentric and anthropomorphic, meaning that spatial coordinates are derived from planes through the body (Levinson, 2003, pp. 10-11). Therefore, the framework of spatial knowledge is considered universal along the spectrum of realism – idealism.

These ideas provide the roots for later theories of perception, such as Gestalt theory. With the rejection of the positivist paradigm and naïve realism, one is, however, confronted with a number of metaphysical and epistemological questions. Current insights into the diversity of spatial cognition provide a basis for questioning these long-held beliefs.

As discussed by Raper (2000), realism is widely accepted in science today. In his discussion of the metaphysical foundation of GISc specifically, however, he proposes that realism does not necessarily imply a certain epistemology and ontology and should therefore not be uncritically accepted (Raper, 2000, p. 8). Realism, or scientific realism, “holds that the characteristic product of successful scientific research
is knowledge of largely theory-independent phenomena and that such knowledge is possible (indeed actual) even in those cases in which the relevant phenomena are not, in any non-question-begging sense, observable” (Boyd, 1980). This position does not address any criticism regarding theory-dependence of methods (sensu Kuhn 1970), or more recent ideas that science, knowledge, evidence, and truth are social constructions, rejecting the idea that the outcome of scientific practice is an approximate representational fit with reality or the world. The issues surrounding phenomenology are left out in this discussion, for brevity’s sake, but will be addressed in more detail in Chapter 3 as a theory/paradigm adapted for anthropological and archaeological research.

2.1.1. Epistemological foundations of the western worldview

Epistemology constitutes the procedures by which knowledge of the conceptualized world is established and evaluated, that is, the nature of knowledge and how we acquire knowledge. Our epistemological foundation rests on our basic idea of reality, and can be narrowly defined as the study of knowledge and justified belief. Regarding knowledge, the main questions are: “What are the necessary and sufficient conditions of knowledge? What are its sources? What is its structure, and what are its limits? As the study of justified belief, epistemology aims to answer questions such as: How are we to understand the concept of justification? What makes justified beliefs justified? Is justification internal or external to one’s own mind? Understood more broadly, epistemology is about issues having to do with the creation and dissemination of knowledge in particular areas of inquiry” (Steup,
Some of these issues were addressed earlier, further in depth discussion is beyond the scope of this research, except on conceptions of space-time being interrelated with ontology and epistemology.

Classical epistemology is concerned with the pursuit of truth, and has been concerned with rationality or epistemic justification, as set forth by Descartes early on, and is based on proper use of reason and other faculties such as perception and memory, belief can be warranted. As discussed earlier, principles of justification, either inferential or non-inferential, in scholarly research need to be accepted in order to make truth claims valid. In addition, because of the dominance of realism and associated empirical research, the acceptance of a single reality conceptualizing the world is widespread. The idea of multiple realities is often understood in a Newtonian sense; namely, that each of us can only experience part of that reality. The question then arises as to how differing realities can be investigated and understood, from a metaphysical and epistemological viewpoint. Classical epistemology has been critiqued. For instance, social constructivism in its strong form purports not only that human representations of reality – either linguistic or mental – are socially constructed, but that in fact the entities themselves, to which these representations refer, are socially constructed (Goldman, 2010). Problems of perception can therefore be distinguished as either epistemological or metaphysical: for instance, the epistemological problems refer to issues such as: whether “perceptual beliefs about the physical world [are] based on sensation or experience in a way that precludes the possibility of knowing with absolute certainty propositions about physical objects”, whereas metaphysical problems
refer to issues such as: “what are physical objects; is there a component of perception we can separate as sensation? And if so, what is its relation to the whole of which it is a part?” (Fumerton, 1985, pp. 5-6)

2.1.2 Critical Theory and foundation of alternative epistemologies

In their critique of the Enlightenment and its positivist program, Critical theorists of the Frankfurter School presented an alternative way for developing real democracy. Jurgen Habermas, of the second generation of this school of thought, proposed the theory of communicative action, based on an alternative sociology of modernity, in which social differentiation and pluralization are considered positive features that open up spaces for contestation and deliberation by citizens and their involvement in new social movements as they need to respond to crises. (Ushahidi platform can be considered modeled on this idea) Critical theory has also informed current directions in geospatial sciences, in which categories of space and space-dependent attributes are questioned. This issue will be addressed in more depth in later chapters (Harvey et al., 2005; Johnson, 2005; Schuurman, 2006; Sheppard, 2005).

To investigate the underlying differences that contribute to current disagreements regarding the interpretation of indigenous histories (P. R. Schmidt & Patterson, 1995), and specifically the history of the Pueblos (Swoentzell, 1990), the initial focus will be on experience as a basic knowledge source, as an immersive practice.

Traditionally, five basic sense systems are assumed to underlie human experiences:
sight, hearing, touch, smell, and taste. However, based on current knowledge of how sensory integration and perceptual systems work, this classification, attributed to Aristotle, is disputed, although no single alternative classification has been agreed upon. Other sources of knowledge that are accepted include memory, testimony, introspection, logic, and reasoning (inductive, deductive, and abductive). To start this exploration the focus will be on a common aspect, namely, sense experiences as a source of knowledge accepted by all current epistemic positions (epistemic pluralism, except perhaps idealism), and a discussion of how these experiences are defined and used, and in how they function in claims of truth, or justification.

2.1.3 Perceptual salience and the ElectroMagnetic (EM) Spectrum: an example

Senses are the physiological methods of perception, can be defined as systems that consist of a group of sensory cell types that responds to a specific physical phenomenon, and that corresponds to a particular group of regions within the brain where the signals are received and interpreted. Disputes about the number —and kind— of senses typically arise around the classification of the various cell types and their mapping to regions of the brain (Wikipedia). Sources of knowledge include, but are not limited to, our sense experiences. If we accept some form of perceptual subjectivism (such as representationalism or phenomenalism), that is, the sense system is not a passive receptor in the Cartesian sense and that reality is not a given, but at least partly constructed or mediated by our minds, our sense experiences are a fundamental source of variation when making inferences about the world around us. If, on the other hand, a single reality
exists and our sense systems are physiologically the same, objects of the physical world will likely be perceived as being the same. Inferential differences may then be considered to be due to flawed reasoning. The role of perception in knowledge building, however, has been subject to revision over the last decades, shifting toward the idea of a dynamic relationship between percept and concept in how we understand the world (Galton, 2000; Gibson, 1977; L. B. Smith & Heise, 1992). These new ideas challenge long-held existing beliefs of natural kinds, focusing on perceptual grounding of ontologies that are not universal and providing an important parameter for the methodology of this research.

Careful observation of some aspect or property of matter and collecting data regarding that aspect is usually defined as the first step in a scientific study. Modern physics defines matter to include all things comprising mass and/or energy and existing in space-time (Lewis & Macgregor, 2006, p. 225), and can therefore be observed or experienced by our senses. It is here assumed that our sense experiences are influenced by cognitive processes, at a fundamental level, a phenomenon which has earlier been demonstrated as the theory-laden aspects of our collected data and that form a dynamic process (Kˇvecses & Koller, 2006; T. S. Kuhn, 1970). The discussion that follows differs, that it is not focused on the theory-laden aspect, but on how we perceive things from a physical standpoint as influenced by our basic understanding of our relationship to the natural world, following ecological approaches to perception (metaphysical and ontological issues). In later chapters this approach underpins the methodology here.
That a difference exists between “what is” and “how it is” perceived by humans has long been realized. How we perceive the world is the result of the dynamic interaction between matter, energy and our sense (and cognitive) systems. A basic aspect of our visual system is our ability to perceive color, where color is not a property of physical objects, but a quality constructed by the visual brain that allows us to discriminate surfaces. What we see as different colors is actually a difference in wavelength of electromagnetic waves in the visible part (light waves) of the EM spectrum. It is the relationship between light source, refraction surface of an object, and our visual sense (Figure 2).

The ElectroMagnetic spectrum indicates the range of all possible frequencies of electromagnetic radiation. The visible part of the spectrum ranges approximately from 380nm to 740nm and can be detected by the human eye through three types of cones, labeled according to their spectral sensitivities: S(hort), M(edium), and L(ong), conventionally labeled blue, green, and red cones. Perception of color occurs through these color receptors, which contain pigments with different spectral sensitivities. The electromagnetic spectrum of an object is the characteristic distribution of electromagnetic radiation emitted or absorbed by that particular object (surface, and texture gradients). Whenever EM waves exist in a medium with matter, their wavelength is decreased, but they are usually expressed in terms of vacuum wavelength. We perceive light only when it is interacting with matter; we cannot see light waves (Jensen, 1996). Even though this seems obvious, the way we categorize the physical world often forgoes, among others, atmospheric objects; for instance, a blue sky is considered as empty space, the backdrop in which things
occur (Figure 3). Understanding perception in relation to energy and matter opens up the problem of objecthood, and the foundation of ontologies.

Similarly, the mechanical vibrations that can be sensed as sound are able to travel through all forms of matter: gases, liquids, solids, and plasmas. Matter that supports soundwave propagation is called a medium. Unlike EM energy, mechanical waves cannot travel through vacuum. For humans, hearing (sense and perception of sound) is normally limited to frequencies between about 12 Hz and 20,000 Hz (20 kHz), although these limits are not definite. Earth’s atmosphere, water, and virtually any physical phenomenon, such as fire, rain, wind, surf, or earthquake, produces (and is characterized by) its unique sounds (pressure waves) that can be perceived by humans (termed geophony) (Pijanowski, Farina, Gage, Dumyahn, & Krause, 2011). It is not that these phenomena produce sound, but that matter and motion generate pressure waves.

![Figure 2 The ElectroMagnetic Spectrum (Wikimedia)](image-url)
Figure 3  Color perception
2.1.4 Mapping the physical world to our mental world

The way in which our brain processes this sense information has been modeled in
different ways, for instance, within the parameters of Gestalt theory, and currently
the concept of blending is a dominant model for understanding human cognition
(Fauconnier & Turner, 2002). Gestalt theory is based on the idea that the mind
perceives wholes out of incomplete elements, such that things are better described
to be more than the sum of their parts. Gestalt principles include figure and ground;
similarity, proximity or contiguity, continuity; closure, area, and symmetry. Many of
these are still considered fundamental design principles in visual perception. Even
though mostly discussed in relation to the visual domain, Gestalt principles are
theoretically cross-modal (Bregman, 1990).

Color perception as investigated by Berlin and Kay (Berlin & Kay, 1969) has shown
remarkable universality across the human population, but, as discussed by Kövecses
(Kövecses & Koller), the color domain may be unique in human perception and
cognition and is related to the physiology of our visual sense system. The fact that
color categorization, as an example of a basic domain, shows cross-cultural
similarities, however, has contributed to the common assumption that spatial
cognition is universal; however, color universality has also been recently
challenged/contested (Levinson, 2000). The question is whether perceptual salience
determines our spatial cognitive ability, such that spatial cognition can be
considered universal, that is, is characterized by little or no variation across the
human population. For the hypothesis in this research to be supported however,
variation in this domain is expected. (Mark et al., 2011)
2.2 Linguistic relativity and spatial cognition

The spatial domain is of interest in that it is considered to be a fundamental cognitive domain, and is innate, that is, our spatial framework is not based on experience. Our spatial experience, considered as based on a combination of senses, is mapped on this underlying framework. The innateness was argued by Kant, but was also considered universal by Whorf (Carroll, 1956; Levinson, 2003; Subbiondo, 2005), and the fact that many concepts in our language are expressed as spatial metaphors supports the idea of it being a fundamental human cognitive domain (Lakoff & Johnson, 2003). Interestingly, as a result of developments in the cognitive and neurosciences, a shift in research focus has taken place recently from studying space geometrically to how humans experience space, seeking to understand not only how humans experience, but also how they reason about space. This has led to current research efforts directed toward spatial ontology and spatial language.

Similar to the color spectrum with infinite colors, many sources of our experiences are not necessarily made up of discrete objects, or natural kinds, therefore it is of interest to briefly review how categorization takes place in the human mind; based on current research many previously held assumptions are reconsidered (Casati & Varzi, 1999; Galton, 2000; Regan, 1999).

Analysis of natural language has provided insight into object-categorization, for instance topological notions and conceptual structuring can be illustrated through the use of prepositions (Carlson, 2005; Levinson & Wilkins, 2006). In representations of geographic space/categories, an additional problem is related to
the nature of geographic entities that are currently used, many of which have no clear boundaries (Casati & Varzi, 1999; B. Smith, 1996). Natural language, however, is not the only source for investigating categorization and conceptualization. A general ontology, as argued by Smith, would draw from “other cognitive modes of access to reality, including perception, scientific theories, the map-making activities of the geographer, knowledge-sharing systems, and so on” (B. Smith, 1996, p. 295). It is within the discipline of linguistics, however, that most of the information regarding the diversity of human spatial cognition is generated.

### 2.2.1 Kinds of objects – ontologies of space

Often scientists operate under the assumption that the objects of study and the taxonomies used to order these objects correspond to natural kinds in nature, that is, that the grouping or ordering (of objects, of properties, or of characteristics) does not depend on the human mind. This assumption of real and independent existence justifies scientific inference and practice (Bird & Tobin, 2010). Object in philosophy refers to a thing, an entity, or a being, but it can have multiple meanings. In the broadest sense, an object can be anything that we think or talk about, or it can refer to things that have properties and relationships to other things but are contrasted with them. In the most restricted sense, objects only refer to physical bodies located in space and time, material bodies, or simply inanimate matter. What are things and how things are classified is dependent on the metaphysical framework used, and its associated ontology.
For example, Galton (2000) discusses several object classes and the principles by which these object classes can be organized (also discussed in Chapter 4). Objects that possess spatial attributes, he argues, must be dependent in some way on matter. This dependence forms one of the organizing principles by which objects are classified into three kinds: material, parasitic, and perspectival. Material objects refer to a piece of matter that exists in the same form over an extended period of time; this is not always straightforward, as shown by his example of “pebble,” which changes form due to erosional processes (temporal aspect). Parasitic objects depend on the existence of other objects. Examples are shadows and holes. The object of shadow, for instance, involves a four-place relation: \( x \) is a shadow cast by \( y \) on surface \( z \) in the light coming from \( w \). A perspectival object depends for its existence on a particular point of view. A good example is the horizon, a category that involves a three-place relation: \( x \) is the silhouette of \( y \) as seen from point \( z \) (Galton, 2000). It has also been documented for several languages that objects can have different names depending on the position of the viewer (Mark et al., 2007).

*Linguistics:* As argued by Levinson, the Kantian idea of a universal framework for human thinking, an *a priori* spatio-temporal framework to which we “map” our experiences that assumes man as the center and is egocentric, is a framework that underlies many scientific efforts and representations of space and time. It provides the foundation for phenomenology and support for the ideas of space as fundamental, which also comes from the spatialization in our language (Levinson, 2003) If different underlying conceptual frameworks are possible, as suggested by non-western philosophical discourse, it does not necessarily negate Kant’s ideas
about knowing and knowledge construction; it merely indicates that the way the world can be known based on human sense-experience and reasoning is much broader than previously thought (Augusto, 2008).

*Linguistic relativity and the spatial domain*

The linguistic relativity hypothesis (LRH) concerns the relationship between the language we speak and the way we think. It became best known through the writings of Benjamin Lee Whorf (Carroll, 1956). Two versions are known, a strong and a weak version. The resistance to the strong version has long resulted in rejection of this hypothesis, but was also due to the direction in linguistics toward general rules underlying grammar as developed by Chomsky (Cook, 1988).

Currently, renewed interest in the linguistic relativity hypothesis, primarily its weak version has led to new insights regarding human cognition. In short the LRH states that:

*Strong version:* The language we speak determines the way we think

*Weak version:* The language we speak influences the way we think

A landmark study by Berlin and Kay (Berlin & Kay, 1969), cited in many studies and mentioned above (K’vecses & Koller, 2006; Ware, 2000) supported the alternative hypothesis. Their cross-cultural study in the color domain of human cognition showed it to be universal, rejecting the LRH in this domain. However, further studies have shown that the color domain may be unique in human thinking (although it must be stated that even though similar categories exist, the meaning given to
different colors varies cross-culturally). The focus here is on category construction per se.

Indication that significant differences in human spatial cognition exist comes from an empirical research program of the MPI in psycholinguistics and is finding growing support in different disciplines. This program, led by Levinson (2003), is characterized by many separate research efforts sharing the same methodology, enabling a cross-linguistic comparison at a scale rarely ever accomplished. It is loosely based on the Sapir-Whorf hypothesis of linguistic relativity (Gumperz & Levinson, 1996). This research program has shown that significant differences exist among different language groups across spatial subdomains, indicating that differences exist in the use of spatial coordinate (directional) frameworks (i.e., not all groups use a relative-, or egocentric- frame of reference), but also that there seem to be no universal landscape categories, such as mountain and river, as indicated by toponymic and ontological research. (Figure 4 diagram based on spatial sub-domains (Levinson, 2003, p. 66)) These differences cannot be attributed to environment or subsistence strategy alone (Majid et al., 2004; Majid, Enfield, & van Staden, 2006)
The consequence is that cognitive research in the spatial domain, thus far almost exclusively based on western test subjects (biased toward Indo-European language speakers), possibly represents only a fraction of the human spatial cognitive potential. In a similar vein, the focus on the visual (two-dimensional) in efforts to understand transmodal mapping has been argued to represent a Western preference (Gillings & Goodrick; Ox & Elst, 2011).

The MPI research program has developed several novel ways of investigating differences in human spatial cognition, but only a few subdomains are considered suitable for linguistic research, primarily toponomy and the use of coordinate systems. A brief introduction of those subdomains, as they are relevant to the study presented here are given below.

Frames of reference, as discussed by Levinson, are considered in two main ways, those that refer to the underlying coordinate system, and those that refer to the objects that may invoke them. In this discussion and the remainder of this document
the former notion, frame of reference as underlying coordinate system, will be the subject indicated. The notion of frame of reference can be traced back to medieval theories of space. However, the phrase was defined as part of the Gestalt theories of perception during the early 20th century as “a unit or organization of units that collectively serve to identify a coordinate system with respect to certain properties of objects, including the phenomenal self, are gauged” (Levinson, 2003) (Levinson, 2003, p 24 citing Rock, 1992 p 404).

Levinson distinguishes three main frames of reference and variations thereof – intrinsic, relative, and absolute – and compares the use of these systems as represented across modalities, e.g., in vision, gesture, and touch, in addition to how spatial cognition is encoded in language and the translatability between these modalities. The use of a particular reference system is not exclusive, that is, more than one frame of reference can be in use to reason, communicate, and navigate space. For instance, the use of a relative frame of reference implies the use of an intrinsic frame as well. The MPI methodology employs these three basic coordinate systems in human spatial cognition in its research, distinguished by logical (inferential) properties and rotational properties (Levinson, 2003, p. 314). Briefly, these are:

*Intrinsic* coordinate framework: an object-centered coordinate system, closely linked to topological systems; does not support converseness or transitivity.

*Relative* coordinate framework: presupposes a “viewpoint” V (given by the location of a perceiver in any sensory modality) and a figure and ground distinction from V. It thus offers a triangulation of three points, and utilizes coordinates fixed on V to
assign directions to figure and ground. The coordinate system, based on viewer V, seems generally to be based on planes through the human body, giving up/down, back/front, left/right sets of half-lines (polar coordinates); supports converseness and transitivity under preserved viewpoint.

Absolute coordinate framework: one of the uses of the term, as described by Levinson “refers to the fixed direction provided by gravity (or the visual horizon under canonical orientation). Less obviously of psychological relevance, is the same idea of fixed directions can be applied to the horizontal. In fact, many languages make extensive, some almost exclusive, use of an absolute frame of reference on the horizontal. They do so by fixing arbitrary fixed bearings, ‘cardinal directions’ corresponding one way or another to directions or arcs that can be related by the analyst to compass bearings” (Levinson, 2003, pp. 47-48); supports converseness and transitivity without exceptions.

Based on the Kantian notion, it is expected that all humans employ a relative framework; however, the research results show that all combinations of frameworks are possible, whereby all languages use at least one frame of reference and never more than two. The use of a relative frame of reference implies the use of an intrinsic frame of reference (Levinson, 2003, p. 316) The use of an absolute frame of reference was therefore a surprising result.

In the previous sections, the notion of differences, or more precisely the difficulty in distinguishing between universal and cultural aspects of our sense experiences, was briefly introduced. These sense experiences are mapped on cognitive frames of
reference. Spatial cognition is the cognitive domain that is considered universal across the human population, such that our entire conceptual framework can be considered as expressed in spatial terms, even time. This characteristic, use of spatial metaphors to describe other concepts, has been extensively discussed and demonstrated by Lakoff and Johnson (2003). The frame of reference for our sense experiences is considered to be egocentric in this universality perspective, as determining our basic relationship with the world around us, that is, the mind is based on the body (K\'vecses & Koller, 2006). The work by the research group at the Max Planck Institute suggests otherwise, namely:

- Spatial cognition is not universal, as shown in differences in use of frames of reference and spatial categories
- The concept of the mind as being based on the body (as characterized by an egocentric framework), as the research suggests, is not universally valid

Further implications of these findings can help understand differences in the nature of (human) ecological relationships and worldview, for instance, the difference between the notion of the human being as the center of the universe, regarding nature as an(exploitable) resource, or the human being as an integral part in cosmology.

Toponymic research, better known as the study of place names, is specifically used within the MPI research framework to investigate spatial categories. The model used investigates three main factors influencing landscape categories and place names – perceptual salience, affordance, and cultural ideas – to investigate whether
spatial/landscape categories are universal (Levinson, 2008b). This idea, for instance that categories such as mountain and river are used cross-culturally, has been questioned recently within a framework of ethnophysiography, and indications that this may not hold true warrants further research (Mark et al., 2007).

*Space – Time; Flow and Movement*

Although research into spatial cognition is growing and is essential as a fundamental cognitive domain, *time*, being more elusive, has received less academic attention. Time, as argued by Evans (V. Evans, p. 3), adds an “important and necessary dimension to our understanding of the world and our place in it.” From a linguistic perspective, Evans states that we “spatialize time”, and that therefore, our concept of space is closely related to our concept and experience of time. Yet, the nature and status of time are elusive. Evans conducted an in-depth study of time from a metaphysical and linguistic perspective, addressing this problem. Is it an attribute of the physical cosmos, is it dependent on relationships between events, or is it not an attribute of the world but a consequence of it? Given that time is not a unitary phenomenon, and is experienced and conceptualized in different ways, investigating temporal cognition requires an approach that takes into account the complexity of the physical, cognitive, and phenomenological aspects of this experience (V. Evans, 2003, pp. 4-5). Based on the diversity within the spatial domain and given the interrelation between space and time, it can be expected that temporal cognition may prove to be more diverse across the human population as well.

The brief introduction of sense and perception and their interrelationship with matter and energy as sources of experience allows not only for reconsideration of
ontologies of space but also of concepts of time, and emerges as the central tenet
during my research, which is clarified in more depth in the following chapters.

*Indigenous philosophies:*

Smith has discussed the difference in conceptualization between western and
indigenous thinking and research methodologies, especially as it has been affected
by colonization. The notion of moral behavior, not as a societal construct but as an
innate (universal) human quality as suggested by Rousseau (*Du Contrat Social*), has
developed within western philosophy of science and later theories of social
evolution as a unilineal development of human thinking (L. T. Smith, 1999). The first
of such theories was formalized by Comte in the three stages (theological,
metaphysical, and positivist) and underpins modern science. Colonialism, however,
confronted European thinkers with different ideas and worldviews, but
conveniently, the idea of unilineal evolution could be exploited to justify economic
and political domination, allowing Europeans to argue that the indigenous people
they encountered were less developed. In this way scientific inquiry and
political/ideological interest have stayed intertwined, represented and reified, for
instance, through cartographic practice and commodification of knowledge
(Habermas, 1974; Root, 1993; Whitt, 2004). Because these other/different
knowledge systems were hypothesized to be simple, early stages of human
development, they could be studied to understand the presumed linear history of
classification systems and modes of thought (L. T. Smith, 1999, p. 50). With regard
to the concept of space and time, Smith notes that western ideas about space and
time are encoded in language, philosophy, and science, but that this does not hold for a number of indigenous languages.

Other fundamental concepts or frameworks underlie many nonwestern worldviews. For example, Burkhart (Burkhart) describes a Native American epistemology as lived experience; this pertains to a more general knowledge that can be called synthesis, incorporation, or understanding. The validation (or justification) of knowledge is therefore different; it can be considered as based on practice instead of theories of probability and reductionist approaches or analysis. According to Burkhart, a native philosophical understanding, akin to a phenomenological approach, must include all experience, not simply one's own, all experience that has passed down in stories (Burkhart, 2004, pp. 16-25). However, a phenomenological approach is suitable when the underlying worldview to which all these experiences are “mapped” is the same or similar; understanding human experience and expression that is based on a different conceptual framework or metaphysics is much more complicated (Birnbaum, 2008).

An important underlying principle in Native American philosophy is relatedness; for instance, all things in the universe are related to air and are all made up of the same basic element. Flow, movement, and change, as well as interstitial spaces, are mentioned as fundamental underlying concepts, compared to space and time as fundamental axes in western philosophy, indicating a complex, but diverging, worldview (G. Cajete, 2004, 1999; Cordova, 2004; Jojola, 2004; L. T. Smith, 1999; Swentzell, 1990; Waters, 2004a)
In summary, scholars can no longer assume that spatial cognition is universal, and therefore new ways of understanding spatial reasoning need to be developed. Based on an understanding of the epistemological (and metaphysical) differences that exist between western and nonwestern ways of thinking, whether these differences can be addressed within current scientific research frameworks, which are ultimately rooted in space-time models, needs to be investigated. The epistemological foundation of Native American philosophy in general is based on synthesis and concepts of relatedness, process, and flow (Sventzell, 1990). This is different from Western scientific traditions, which are based on concepts of geometric space and time and propositional knowledge. Only recently have other ideas begun to be explored, challenging the epistemological and ontological foundation of scientific research (DeLanda, 2000; Manson & O'Sullivan, 2006).

As argued by Manson and O'Sullivan, the epistemological and ontological foundation of systems based on complexity is flexible and holistic; however, its dominant epistemology is based on computational modeling driven by the need to focus on entities and their relationships across multiple scales. Challenges in employing complexity models in space- and place-based research, such as verification and validation and the linkage between pattern and process, among other things, are beyond the scope of this research. In short, the research directions in the spatial sciences overlap in efforts toward understanding epistemological and ontological foundations for human experience. This intersection provides a basis for exploratory research investigating whether current geospatial technologies can provide a basis for different interpretive frameworks in archaeology.
This overview has shown that long held beliefs about space-time frameworks can be questioned. The indication is that the space-time framework as a structure for understanding the physical world and the framework that is supposed to underlie human understanding of the world is not singular and unique. This research is primarily focused on surveying these differences and their implications for cultural research. The notion of space-time as used in the natural sciences is, however, of importance, because it underlies systems of representation and as such influences the way we analyze, synthesize, and communicate information regarding the world around us.
CHAPTER 3  SPACE AND TIME IN THE ANTHROPOLOGY AND ARCHAEOLOGY OF LANDSCAPE

In the previous chapter different conceptualizations of space in western thought were primarily discussed, especially the difference between anti-metaphysical and metaphysical positions regarding the physical world, from either objectivist or subjectivist perspectives. Whether the physical world is thought of as existing independent of our experience and conception of it, or if the way we can know the physical world is only through our perception/conception, a universality principle underlies both positions. The recent cognitive linguistic research that was briefly introduced in the previous chapter counters that basic assumption for spatial cognition (Burenhult & Levinson, 2008b; Mark et al., 2011), which has profound implications for epistemological research foundations in cultural research, specifically, as will be discussed in this chapter, for the contentious approaches within archaeological research commonly known as processual and post-processual. Processual archaeological approaches, which tend to be objectivist or realist, as well as post-processual approaches, under which critical and phenomenological approaches are categorized, currently converge under the umbrella of landscape archaeology. Landscape approaches are inherently spatial (as well as temporal and material). From the literature it seems that the basic conceptions of space and time, as objectively measurable or subjectively experienced/interpreted by humans, that support these epistemological foundations constitute the heart of the problem (Ingold, 2000; Zubrow, 2006). In order to integrate human experience within an
objectivist/realist paradigm, archaeologists have embraced advances in cognitive sciences. Cognitive approaches, often are equated with Artificial Intelligence (AI) approaches or agent-based modeling, are rejected from a critical perspective, within which the preferred approach is phenomenologically based.

The discussion of current landscape approaches in anthropology and archaeology will focus on several important issues. First, how well can either of these epistemological positions integrate the possibility of differences in spatial cognition that underlies cultural expression, that is, is the concept of space within these approaches fixed or flexible? Associated with percept and concept, as discussed earlier, is the fact that a different ontology and related categorization of space may be employed in different cultures. Second, if the spatial frame is fixed within a paradigm of study, is this associated with a specific temporal frame? What are the different concepts and models of time that are used to interpret cultural phenomena? Third, and most important, considering that fundamental cognitive differences exist, how can we understand “the other”; in other words, between the objectivist, third-person view and the phenomenological first-person perspective, the plurality of experience can be considered constituting as objectiveness (Birnbaum, 2008). If these experiences (perceptual/conceptual) differ significantly among humans and across human groups, the focus should shift toward ways of accessing these experiences and understanding the implications for human behavior, design, and communication (Birnbaum, 2008; Edelman, 1992; Habermas, 1974).
3.1 Theoretical themes

A vast body of literature exists on spatial cognition, especially related to cognitive linguistics (Fauconnier & Turner, 2002; Ramachandran & Hubbard, 2001), and even though this discussion is relevant to the research described here, the focus will be primarily on the possibility of diversity regarding space and time conceptualization in the environment. Research that indicates differences in spatial cognition between speakers of different language groups, introduced in the previous chapter, will have implications for future cultural research. The MPI research program (as mentioned before) is focused on specific subdomains of the spatial domain that are most suitable for linguistic research (references). Studies conducted within this program are characterized by unity of method across research initiatives and regions. One of the important underlying premises is that differences in thinking can be understood through the study of language and other modes of representation (Forceville & Urios-Aparisi, 2009; G. Kress, 2010; Levinson, 2003).

The spatial cognitive domain and subdomains will be discussed more in depth in the methodology chapter; for the discussion here, it will suffice to introduce the differences that have been identified regarding the use of frames of reference within and among language groups.

In summary, it has long been assumed that humans understand the world through an egocentric, relative frame of reference. Levinson and others, however, contest this assumption and posit that three basic frames of reference are used that are not necessarily mutually exclusive: relative, intrinsic, and absolute. As spatial cognition
is a factor in the spatial design and configuration of the environment, the implications for cultural research become apparent.

In similar vein, two models of time have long been recognized, the “moving ego” and “moving time” models. Time is even less well understood than space; the current, common-place view of time, but rooted in ancient ideas, is based on the belief in an absolute physical idea of time, embedded in the external world (V. Evans, 2003; Munn, 1992). However, it is hard to express the sense of time, especially compared to space. The fundamental aspects of spatial cognition can be understood as they are related to the physical world; expressions of concepts of time are metaphorically expressed in terms of space (Lakoff & Johnson, 2003). Even though time and temporal cognition have received less attention than space, given that it is an essential underlying concept, and a fundamental organizational principle in archaeological research, time deserves a closer look.

If similar variation exists in temporal cognition as was indicated for spatial cognition, the simple distinction between an absolute model of space and time and the egocentric model of spatio-temporal cognition currently dividing empirical and humanistic approaches in archaeology may be misleading, and epistemological underpinnings need to be reassessed. In this chapter, an overview of current landscape approaches will provide insight into the spatio-temporal models underlying current research efforts.

Truth and understanding

Epistemologically, landscape approaches differ along lines similar to those in processual and post-processual approaches in general. Processual approaches
modeled after the physical sciences are empirical, based on the fact that objective observations can be made based on the senses. Post-processual approaches, on the other hand, are rooted in hermeneutics.

Considering the unique position that anthropology and archaeology, as the study of humankind, take up in academia, this is not surprising. It follows a historical dualistic tradition of interest in mind and body, internal and external world, expressed in the humanities and sciences. The goal of empirical research, through the scientific method, is to strive for and attain justified true belief. In contrast, as truth is considered an abstract concept, the goal of hermeneutically based approaches is to gain understanding. It is a philosophical tradition (movement) not a theory of knowledge.

Modern philosophy is rooted in the subjectivist mode of thinking that (following Descartes) ascribes a deep epistemic and ontological significance to the first-person perspective, the reflecting I. (Ramberg & Gjesdal, 2009). Main associated issues related to this position, such as problems with validity, knowledge, and mind-world relations, have been taken up by thinkers within the hermeneutic tradition. (the space for dialogue). Historically, the dualistic notion of Descartes was criticized by Vico, who argued that thinking is always rooted in a given cultural context. As argued, this cultural context is historically developed, moreover, it is intrinsically related to ordinary language, evolving from myth and poetry to the later phases of theoretical abstraction and technical vocabularies. This notion expressed by Vico, a contemporary of Descartes, is a recurring notion, but not well addressed. That is, the dualistic framework, i.e. mind-body, subjective vs. objective based epistemologies,
can be considered as problematic abstractions, (becoming essentialist or objectified epistemological positions) (Ramberg & Gjesdal, 2009).

The previous chapter was primarily focused on the physical science model associated with the dominant (scientific) method as its means for obtaining true knowledge, from a third-person perspective, also referred to in the literature as the god-view (Zubrow, 2006). It was argued that objectivist approaches, adhering to the idea of an independent world with essentialist categories, cannot be upheld and cannot provide the framework for understanding human behavior and experience (Edelman, 1992). No mind-independent access to the world is possible, only to the projected world. The projected world, as described by Evans, is that level of information, that has achieved mental representation via the perception processes that organize such raw sensory input (V. Evans, 2003, p. 5).

The focus will shift within this chapter to include subjective and hermeneutic approaches. Even though the history of hermeneutics can be traced back to ancient times, it is the philosophical turn of the 19th century that provided the stage for the ontological basis of hermeneutics during the 20th century. Hermeneutics covers theories of understanding and interpretation of linguistic and non-linguistic expression (history), but during the 19th century it "turns to the conditions of possibility for symbolic communication as such" (Ramberg & Gjesdal, 2009), laying the groundwork for an even more fundamental shift, triggered by Heidegger; now hermeneutics is concerned with human life and existence per se, also known as phenomenology.
Phenomenology is based on the idea that *experience* is the source of all knowledge, originating during a time of, and reaction against, a strong positivist orientation in science. Husserl, as the founder of phenomenology, intended to provide an alternative or replacement paradigm for positivism. Heidegger, in a more radical fashion, specifically questioned traditional ontology and the ability to understand the *sense* of being. This fundamental understanding of being, or *Dasein*, precedes any other way of knowing (Woodruff, 2011).

### 3.1.1 Intersubjectivity and sense of time

Although it is Heidegger’s seminal work, *Being and Time* that provides the theoretical foundation for many recent and current landscape approaches in anthropology, I will first turn to the “founder” of phenomenology, Edmund Husserl, who influenced Heidegger’s work, and specifically to his notion of intersubjectivity, as discussed by Birnbaum (Birnbaum, 2008). There are (at least) two different but related ways to understand intersubjectivity (V. Evans, 2003). The first can be discussed as the “problem of otherness” in Husserl’s phenomenology and is concerned with the ability to access a transcendental space of common experience, *Fremderfahrung*. A second notion of intersubjectivity, is internal to the human brain, and refers to our ability to verbalize visual-spatial information. The focus in this section will be on the former, as transcendental space of common experience. The suggestion of communication spheres as a way to solve the dualistic nature of understanding the world around us as set up in the Cartesian framework was briefly introduced in the previous chapter. This ability, or necessity for a means of
communication to bridge the dualistic gap, has been advocated by thinkers such as Habermas and McDowell (McDowell, 1994) and addressed in cognitive approaches (A. Verhagen, 2010; Zhang & Patel, 2006), but this idea finds its origin in the phenomenology as laid out by Husserl, in which it is the fundamental aspect of *intersubjectivity*. The problem with the Cartesian approach, as stated by Birnbaum (Birnbaum, 2008, p. 32), is that it depicts the transcendental subject as isolated. What this entails is the dualistic nature of the mind/body problem, the fact that we can never be certain whether our experiences are based on our perception of the physical world or our mental world, the two are separated, as objective and subjective. In Husserl's philosophy, what constitutes the objective world is the plurality of interrelated subjects. (For a thorough discussion the reader is referred to Birnbaum 2008.) As argued by Birnbaum, the notion of intersubjectivity is central in Husserl's phenomenology.

What things are themselves (ontology) and how we acquire knowledge of them (epistemology, methodology), are central questions in philosophy, addressed by Husserl, and more radically by Heidegger, and recently by McDowell (McDowell, 1994) as the 'Myth of the Given' that perpetuates modern science, (that is, the idea that natural kinds exist independent of our perception of them). As was briefly shown in the previous chapter, our perceptual systems play a crucial and active role in the way we experience the surrounding world; this is described as the phenomenological reduction, the “bracketing” of the objective world as we know it in everyday life (Birnbaum, 2008, p. 17). This idea, according to Birnbaum, is a radical shift from the focus on objects to the focus on the *modes of givenness* of
objects in consciousness, which can be translated as transcendental subjectivity. Even though it is tempting to interpret the transcendental sphere as isolated from other egos and hence not allowing for plurality of perspectives, this, according to Birnbaum, is a misinterpretation of Husserl's intent and can be best approached through ontology. The constitution of the objective world requires an intersubjective starting point, which is different from an external third-person perspective (Birnbaum, 2008, pp. 33-34). Even though intersubjectivity can be regarded as fundamental in Husserl's phenomenology, both subjectivity and intersubjectivity are essential to constitute the objective world. "If the constitution of the world necessarily involves more than one ego, then a close study of the single ego must be able to exhibit the ways it lets the Other enter into the constitutive process." (Birnbaum, 2008, p. 34), recently described by Verhagen as the unique ability of humans to “take another’s perspective” (A. Verhagen, 2010, p. 2). That this is not an easy feat is clear from the discourse in phenomenology since Husserl, and a number of scholars have commented that works by Husserl, Heidegger and their followers are characterized by their incompleteness and open endings (Birnbaum, 2008), but this is currently addressed on a more experimental basis within related cognitive science approaches (Zhang & Patel, 2006).

I will now turn to the discussion of time and the other, which are closely related in Husserl's later developed views, as discussed by Birnbaum. in Husserl, otherness, can be understood as a collection of concepts, first as the non-presence of otherness given re-presentationally as empathy and recollection, or presentationally as
retention, protention, and associative pairing. Retention of a perceptual act retained in consciousness, and protention as perception of the moment to come, together with the immediate present make up the (temporal) flow of perception. Retention here is different from memory, as memory is an instance of re-presentation (as is empathy). Second, “otherness” can pertain to the not-now, or it can pertain to the transcendence of the subject’s temporal framework altogether (alter ego). This distinction makes clear that time and otherness are linked in experience in multiple dimensions, that is, the way and degrees to which perceptions are accessible in the present. However difficult and though criticized later, Husserl’s ideas can be interpreted as a break with the understanding of time based on Aristotle’s work, namely the present as a point-like instance or nothing at all.

“The present is a richer phenomenon, and Husserl would no doubt agree with Merleau-Ponty’s account: ‘as my living present opens upon a past which I nevertheless am no longer living through, and on a future which I do not yet live, and perhaps never shall, it can also open up on to temporalities outside my living experience and acquire a social horizon.’” (Birnbaum, 2008, p. 178). Following that, because the present is not limited to the now, it opens up through retention and protention, but also through nesting of other acts of re-presentation inside the flow of presentations. This not only supplies a model for memory (recollection), but also for empathy and phantasy, or imagination, as well (Birnbaum, 2008, p. 179).

Experiences of time and “the other” are therefore closely related. According to Wallenstein (as quoted in Birnbaum), “Ever since Greek ontology, time has been pre-comprehended on the basis of the present” (Birnbaum, 2008). Even
though Husserl’s programmatic work seems to be deeply rooted in a commitment to
objectifying consciousness, a closer look at his alternative views points to new
directions of understanding time and the other, according to Birnbaum, as discussed
above. Heidegger then proposed, as a response to the official program of
phenomenology, an ontological break such that we think through the relation of
being and time. However, according to Wallenstein this project (**Being and Time**)
remains unfinished and even though it upsets Cartesian coordinates, it still retains
the essential Cartesian structure of the **being** (subject) as a source of origin. The
interpretation of Husserl’s later work by Birnbaum provides therefore an
interesting and needed, but not-often addressed, aspect of experience.

*Time*

The central proposition underlying a recent study of the concept of **time** states that
time constitutes a phenomenologically real experience, and ultimately derives from
perceptual processes (V. Evans, 2003). Evans’s in-depth investigation of perception
and conceptualization of time provides the background for the discussion of
possible differences in temporal cognition. According to Evans, a construct such as
time comprises a multiple number of concepts of senses at the synchronic level that
are independently stored in semantic memory. These are derived from a historically
earlier sense organized in a semantic network (diachronically). This is defined as
the principled polysemy approach. Evans has identified eight distinct senses or
concepts of time, which “are the result of a dynamic process of meaning extension,
which is a function of language-use, and the nature of socio-physical experience” (V.
Evans, 2003, p. 104). The large array of concepts of time are stabilized in memory
for the purpose of external representation in language and other modes of representation.

The following concepts are analyzed by Evans: duration sense of time; moment sense of time; instance sense of time; event sense of time; matrix sense of time; agentive sense of time; measurement-systems sense of time; and commodity sense of time. Of these, the latter four are considered less foundational phenomenologically and constitute concepts that seem to be derived from sociocultural imperatives, indicated by Evans as primary (the first four) and secondary temporal concepts, respectively. Without going into further detail, it appears that anthropological and archaeological studies rely on only a limited number of concepts of time, whereby often a measurement-system sense (rooted in a primary, duration sense of time), especially a linear absolute notion of time, organizes materials of study (V. Evans, 2003).

3.1.2 Landscape, the conceptual connection, and models of time

In a broad historical framework two models of time can be distinguished, a linear model and a cyclical model. Models and concepts of time are mostly elaborated in terms of motion, indicating a close relationship in our experience between time and motion, which underlie the broad models of time, but in different ways. The currently dominant model of time as motion along a horizontal path, that is, linear time, is suggested to be derived from a Judeo-Christian worldview, which places the highest priority on personal spiritual progress culminating in salvation. Within the
cyclical model, on the other hand, which cannot accommodate this final personal stage, time is associated with motion of the heavenly bodies (V. Evans, 2003, p. 202). The latter model was fundamental in the classical Greek worldview and probably is in many other, nonwestern, societies (Jojola, 2004; L. T. Smith, 1999). The linear egocentric model, often considered universal (but more likely a result of cultural dominance), can be subdivided into two basic models of time, Moving-time, and Moving-ego. (V. Evans, 2003; Zerubavel, 2003). Evans argues, based on the Conceptual Metaphor Theory (CMT) (Lakoff & Johnson, 2003) that these basic linear models cannot be considered universal in human cognition, implying cultural diversity in temporal cognition similar to diversity in spatial cognition. This is not surprising considering that space and time are closely related in terms of Being.

Landscape, being, and time

The question then is how well frameworks developed within the disciplines of anthropology and archaeology are suited to analyze and interpret cultural experiences and expression. The broad spatio-temporal framework of landscape has been employed based on diverse theoretical perspectives and therefore provides a conceptual connection through which the different ideas of space and time underlying anthropological and archaeological research can be compared. First, however, I will briefly discuss the term landscape, which, as I will argue, includes inherent ideas of space and time.

Landscape is rarely defined explicitly but is often assumed to mean similar things to different people. Ingold (Ingold, 2000) distinguishes landscape from land, nature, and space; for example, in the case of space, meaning is attached to the world,
whereas meaning is *gathered from* the landscape. Body and landscape are complementary concepts, each implying the other; both forms are sustained through the process of embodiment, the total field of relations that cuts across the emergent interface between organism and environment (Ingold, 2000). Within his discussion of landscape, Ingold sets the experience of space and time apart from the absolute notions that are measured in standardized units of length and duration. Landscape, etymologically, can be derived from the word *Landschap* in Dutch: a term that was introduced in Renaissance Europe to indicate a novel direction in painting and literally means land “created”, or “shaped land” by humans (*land - schap*, from *scheppen*, to shape or create), representing a variety of natural and cultural phenomena within its frame, often composite or idealized. One of the major technical changes that characterizes Renaissance painting is the use of linear perspective, assuming a single viewer in a specific relationship with the scene on the painting. Landscape painting as a representation of the surrounding world during the Renaissance was closely related to chorography, providing a bird’s eye views of cities, regions, and towns. Chorography together with cartography constituted the major methods of geographic representation, which soared during the Renaissance. Chorography fell out of favor after the Renaissance, and cartography (third-person perspective) has since then become the main method of geographic representation (D. Cosgrove, 1999; D. a. S. D. Cosgrove, 1988). Of these two different perspective representations of space, cartography developed into current spatial analytical methods and underlies spatial representation systems.
The notion of landscape as related to a specific representation, or model of space-time, influences the way we construct frameworks of interpretation of cultural experience and expression, mostly from either a first- or third-person perspective, which also underlies the distinction between landscape painting/chorography and cartography. This distinction, as will be shown here, also underpins landscape approaches in anthropology and archaeology. There are several issues with these systems of representation.

First of all, the common assumption is that our visual modality takes primacy in our perception and experience of the world around us. This has been questioned (Gillings & Goodrick; Lock & Brown, 2000), however, due perhaps to the transient nature of other sense experiences—smell and sound for instance. Vision and space are closely linked, and many research efforts focus on visual aspects of sense-experience. (Ascher, 1991; V. Evans, 2003). This is similarly true for landscape approaches in anthropology and archaeology that increasingly integrate the notion of place into understanding of space, even though other senses are considered. The notion of place or topos in the history of thinking is the idea of space as material and not as void. “Aristotle viewed space as a nested series of places, up to the outer sphere containing the universe, and even though Aristotle moved away from the development of space toward modern physics, his focus on naïve spatial reasoning was concerned with what we today call a “frame of reference” (closely related to the idea that we only have access to a projected world) (Levinson, 2003). Moreover, the concern of many landscape studies encompasses the full range of activities of a
human settlement or a number of settlements. Environments, according to Evans, can be seen as being used by people to mediate their social worlds (V. Evans, 2003). There are different definitions of the concept of landscape, ranging from it relating to topography, to an object, or to experience. Defined as an object of investigation, nature is understood as being composed of a series of discrete entities that operate in a law-like fashion, because these entities all possess spatial extent and spatio-temporal motion (Thomas, 2001). A modern western notion of landscape is based on the conception of the world as image and object, that is, as form over process, and of human beings as external observers. According to Ingold however, landscape is ever-changing through processes operating at different timescales. Human beings are part of the landscape and therefore take part in the landscape-shaping processes. Human beings are also observers of the landscape, but we can never place ourselves/or our species outside the landscape that we are viewing or analyzing. Ultimately we are part of the larger system (Ingold, 2000).

Following this idea, Ingold introduces an example through which we can access landscape experience as an intersubjective space, through paintings. This relates to the fact that painting is also a process, not only its final form, but introducing temporality of landscape as a process in which the rhythms of the biophenomena resonate with human activities. The painting The Harvesters, by Pieter Bruegel the elder (1565), serves to illustrate the points raised by Ingold regarding temporality and rhythms of landscape. Even though Bruegel is thought of as being the first Western artist to depict the life of peasants providing a window into the physical and social life of 16th century northern European life, he built on a tradition in
European painting, creating a series of landscapes representing different parts of the year. Ingold does not discuss the art history aspects and uses this painting to invite the reader to “enter” the world and image by imagining being in the Bruegel landscape, instead of viewing the picture as an outside observer, becoming part of the activities that are taking place, looking around, becoming aware of associated sounds. The Breugel landscapes can, however, be interpreted as integrating multiple aspects of a story. The Harvesters, for instance, can be thought of as depicting different times in the daily life of the harvester, and the temporal perspective is therefore multiple, whereas the spatial perspective is linear. This egocentric spatial frame of reference, assumed to be universal, is but one frame of reference used across the human population.

In a way the choice of this painting is unfortunate, as it is a western representation of landscape, from a single-perspective spatial framework. This exercise is easy to follow coming from a western worldview/background, as the way of representation and the elements within the painting are familiar (Barthes, 1988) and can be placed within an existing mental scheme, even though, as pointed out by Schama the connection with the (actual physical) landscape within a western worldview needs to be rekindled (Schama, 1995). Nonetheless, a complementary example of nonwestern representation of landscape might have made this position more clear. For instance, as stated by Myers, “anthropologist and art historians have long struggled with Indigenous imaginings of landscape, that are not simple objects, but of having some sort of presence or sentience, or an articulated relationship beyond subject-object” (Myers, 2009, p. 55). His statement refers specifically to Australian
Aboriginal paintings, the permanent representational medium of which is a recent response to the interest of the western-art market. Entering a painting in that tradition and experience the landscape, would be possible only if the conceptual framework is known or familiar, even though it is possible to value and appreciate this work for its aesthetic aspects.

The way land or landscape is understood and represented is culturally specific, and based on traditions of world conceptualization and representation (R. M. Roberts & Wills, 1998). From a Western perspective, landscape painting and cartographic maps have dominated the way in which we see and come to know our worlds over many centuries, and they have historically developed into current systems of representation. Diverging representations of world conceptualization (by “Others”) are not easily accessed without further metaphysical understanding and through different modes of expression and communication. The next chapter will specifically focus on these representational aspects of worldview.

### 3.1.3 The study of “the Other”

The histories of Native American cultures, and many other histories of nonwestern societies, for example Aboriginal Australian peoples, have been studied within the related disciplines of anthropology and archaeology. Archaeology, the discipline of “things”, within which material cultural remains of past humans are studied, especially of cultures that do not have written records of their history in the western sense. Things as cultural material objects are of interest, but it is the relationship between things and their location in space and time that provides information about
how these things or artifacts were used and the role they played within a larger organization of space, geographical, social, or other. That is, archaeologists infer past socioeconomic organization based on patterns of cultural remains observed in the present landscape, interpreted within a certain conceptualization of space and time. Many models that are used to interpret past human societies are based on anthropological studies and/or on derived, and assumed to be universal, human behavioral rules.

The position of anthropology within the organization of the sciences has been (re)directed primarily to the study of “the Other,” which developed historically within a framework of cultural evolution; recently it has been called into question as a relic of an outdated world order (I. Wallerstein, 2004). A recurrent theme within this framework even today is the oppositional viewpoint of different cultures as noble savages or barbaric primitives, a polemic that has accompanied the justification of overt and covert colonial activities for centuries. Originally, the justification was based on a theological foundation but changes within the intellectual sphere in Europe restructured this idea based on the necessity of attaining civilization through education (Lemaire, 1986). This polemic famously was played out between de Las Casas and Sepúlveda during Spanish colonization efforts in the Americas, in which the latter based his argument on Aristotle’s *Política*, providing the philosophical justification for slavery (Lemaire, 1986; I. Wallerstein, 2004; I. M. Wallerstein, 2006) The response by de Las Casas is not so much an objection to slavery as such, as he argued that the category of slave did not apply to Indians. The argument rests on the definition of “barbaric” as a subordinate state;
the prerequisite to being equal human beings rests on the ability to reason and reach a civilized state, later formulated by Rousseau in *Du Contrat Social*. It was argued by de Las Casas that Indians were capable of reasoning. The notion of “The Other” acquired through colonial activities and the epistemological revolution of the Enlightenment in western science culminated in the discipline of anthropology (Lemaire, 1976, 1986), with its pervasive idea of opposition between Self and The Other, or Civilization and Barbarism. The development of anthropology in the United States provided a successful framework that could link evolutionary theory with historic materialism, in which the position of the Indian played an essential role (Morgan – in Lemaire p 229). This framework, developed by Morgan however, drew considerable criticism and as a consequence different, particularistic approaches (cultural relativism) began to prevail (Boas – in Lemaire). One of the results was the realization of the correspondence between language and worldview or cognitive order (Lemaire, 1986, pp. 229-232). As argued by Lemaire, 20th century anthropology is characterized by cultural pessimists, investigating the intersection of cultures, intent on recognizing or rediscovering the “pure”, such that the dissatisfaction with the rational mind of Western society can be countered through the understanding of the “original mind” (Levi-Strauss referenced in Lemaire ) (the search of the west for the lost paradise) (Lemaire, 1986, p. 236). The study and the notion of The Other has therefore prevailed in anthropology, as a subject that serves to set apart and understand the history of the civilized citizens of the west. (In a way this still can be considered an essentialist view.) Therefore, the question raised by Lemaire is whether anthropology as a
discipline can be objective towards the understanding of The Other, or is trapped in the sociopolitical context of the West (Lemaire, 1986, p. 243; I. M. Wallerstein, 2006).

In summary, several issues have been raised:

- Significant variation in human spatial cognition exists, at least with regard to spatial frames of reference. Whether similar differences also occur in temporal cognition is not clear yet, although indications are that assumed universal frameworks cannot be considered universal, but are culturally specific.

- Given these differences, the plurality of subjective experience will show greater variation. The ability to access the subjective space of The Other will require different methods. As spatial and temporal frameworks cannot be considered universal, the experience of one individual is not necessarily adequate to access the subjective space of another individual. This was shown by the brief example based on Ingold’s temporality of landscape.

- Anthropology as the study of The Other needs to come to grips with lingering social evolutionary aspects, influencing the way nonwestern cultures are regarded. The differences in world conceptualization, as evidenced through different spatial cognitive frameworks, can aid in developing parallel models of histories. The notion of “other” and intersubjectivity, based on Husserl’s philosophy as interpreted by Birnbaum, provides a starting point for this effort.
I will now turn to the epistemological foundations of current landscape approaches in anthropology and archaeology, which will be discussed with these issues in mind.

### 3.2 **Archaeology as Anthropology**

A general trend historically in the discipline of archaeology is a shift from focus on artifacts and artifact collection (Wylie, 1995a, 1995b) toward social and spatial context, resulting in varying approaches that, however, still adhere to one of two basic philosophical positions. As described by Thomas this trend has resulted in a distinct “social archaeology” and a related but epistemologically different interest in the settings within which artifacts are encountered. Examples of approaches in the latter category include ecological, geomorphological, and behavioralist approaches, as well as the empirical school of “landscape archaeology”, according to Thomas (Thomas, 1993, p. 19). Since then landscape archaeology, here characterized by the use of geospatial technologies such as Geographic Information Systems (GIS) within an empirical analytical framework, has further developed and currently also encompasses cognitive and humanistic approaches to understanding human behavior and experiences alike (K. S. Allen, Green, & Zubrow, 1990; Lock, 2000; Lock & Stancic, 1995; Zubrow, 2006). Even though these different approaches, social anthropological (hermeneutic) and spatial scientific (empirical), both seek to bridge the dualistic gap, fundamental disagreements seem to prevent this. A route taken by empirically based landscape archaeology is to integrate cognitive approaches, whereas these are rejected as being too focused on uncovering general cognitive rules by its critics (Ingold, 2000; Pinsky & Wylie, 1995; Thomas, 1993) Instead, to
understand human-environment relationships starting from a social-
anthropological perspective, a phenomenological approach is preferred. This
however, is not considered valid within an empirical paradigm, like that of many of
the landscape approaches based in Geographic Information Science (Zubrow, 2006).
It appears that the respective first- and third person perspectives, (subjective, and
objective respectively) are incompatible. The phenomenological approach as based
in Heidegger's philosophy leaves little room for the development of a theory of
knowledge (Ingold, 2000).

Even though on a theoretical level post-modern critique has led to many intriguing
insights, the development of new methods to address these insights on a practical
level appears to be minimal. On the other hand, innovations in geospatial
technologies have led to innovative methods to address landscape questions at
multiple scales, though the theoretical underpinnings to validate these methods
seem inadequate or lagging (Lock & Brown, 2000; Wheatley & Gillings, 2002).

Observations are never “objective” in the way this is conceived within positivist
thinking tradition. This is the nature of the critique of postmodernism that has
resulted in research becoming more focused on the social and political aspects of
human-environment relations, and allowing for multiple perspectives. McGlade
distinguishes two strands of research within this paradigm: first, a theoretical
direction which includes symbolic, structural, and phenomenological perspectives,
and second, a cultural heritage perspective, in which the landscape as political
discourse is the central tenet (McGlade, 1999). It changes the conception of
landscape as a container of human settlement from earlier deterministic approaches to an *active* context. The problem, however, as formulated by McGlade, is that this renewed interest in landscape has not led to integration of social practice and ecological dynamics. Landscape archaeology that developed from earlier ecological approaches embracing geospatial technologies has been criticized as being overly environmentally deterministic (Thomas, 2001), whereas post-processual approaches are considered non-scientific. According to McGlade, it is not simply a methodological issue but a conceptual problem, the solution to which, he suggests, “lies in replacing the natural-science model that pervades the current environmental discourse with an interpretive framework that promotes pluralistic outcomes rather than the reductionist search for a single solution” (McGlade, 1999, p. 459). A few of the landscape approaches within an interpretive framework will be evaluated in this section, geospatial approaches in the next section, and the cultural heritage perspective in the following section.

The close relationship between archaeology and anthropology was forged on the idea that “living” nonwestern cultures could be studied to provide models for interpretation of the material remains of past societies (Wylie, 1995b). Though initially focused on extrasomatic aspects of human behavior, a shift in focus is apparent toward human experience, place, and identity. Place has thus become an important concept in anthropological studies, especially distinguishing landscape as the place of human experience from geometric space.
As discussed by Casey (Casey, 2008, p. 44), “all events...occur in place”, and the fact that many if not all language have ‘where’ questions, confirms this basic notion (Carlson, 2005). Place is also essential for “identity”, however normative frameworks of space and time used in many of the sciences ignore this basic phenomenon, according to Casey. It is in the anthropology and archaeology of landscape that place regains its importance. Phenomenology, understood here as a disciplinary field of philosophy, is concerned with the study of structures of experience, most commonly from the first-person point of view. It underlies many current approaches that seek to understand the “sense of place” (sensu Basso) (Feld & Basso, 1996). The notion of “lateral universals”, acting as place variables across cultures as defined by Merleau-Ponty, according to Casey, can serve to investigate cultural experiences that span geographical and cultural locations (Casey, 2008, p. 45).

I contend that the problem is that first-person perspective is mostly taken primarily as bodily experience, within the egocentric, relative frame of reference, as the universal framework of human experience. This premise (or assumption) allows the researcher to take his or her own experiences as “raw data” to represent past human experience, encompassing different perspectives. This section is not intended to provide an overview of all of post-processual critiques and approaches, but merely a demonstration of the difficulty of developing practical approaches for integrating pluralistic views in truth claims. Traditional methods such as participant observation are still considered valid in achieving intersubjective understanding (Layton & Ucko, 1999). This method is, however, not
available to the archaeologist, except as proxy or analogy. In addition, the
postmodern method based on the treatment of systems of meaning as self-defining
is in error, according to Layton and Ucko. Alternatively, the landscape approach
provides opportunities, as meaningful practices may leave their mark on the
landscape, though this approach presents several problems for archaeology: one,
cognitive systems are influenced, but not determined, by the environment \(v\) (Majid
et al., 2004), and two, the material may represent multiple cultural systems within
the same ecological space.

As suggested in Layton and Ucko (Layton & Ucko, 1999, p. 13), the structuralist
approach has been embraced as a solution, which “looks for evidence of the
structuring of material settings that can be read as signifying universal cognitive
oppositions. Such oppositions are, according to Levi-Strauss, intrinsically generated
by the way in which the human mind works and therefore have cross-cultural
validity.” Ortiz (Ortiz, 1972a), however, employed a structuralist framework to
analyze the conceptual basis of the Tewa world, but came to the conclusion that is
was not an appropriate framework for understanding Tewa organization, indicating
that it may not be universally valid. Rather than looking for universal patterns, a
number of scholars have recently explored the extent to which contemporary,
intersubjective (pluralistic?) readings of the landscape are consistent with
patterning of archaeological remains (Lahiri & Singh, 1999). I suggest that the
assessment of the “accuracy” of these readings depends on the spatio-temporal
cognitive framework within which the readings are placed for validation.
3.2.1 Human-environment relationships and the theory of affordance

According to McGlade, the renewed interest in landscape (as evidenced by numerous edited volumes organized around this theme, e.g. Bender 1993, Ucko and Layton 1999, and more recently David and Thomas 2008), especially regarding the social construction of space, has narrowly focused on a subject-centered approach, at the expense of understanding human-environment dynamics (McGlae 1999:p 461). For instance, the phenomenologically based method suggested by Tilley (Tilley, 2008) prescribes documentation of subjective landscape experience through writing and photographs to provide insight into past landscape experience. This method of understanding is not only restricted in its subjective approach, it is also based on western representational modes. A more appropriate avenue of research includes ways of understanding lived experience, which includes not only the land and its embedded cultural remains, but also other spheres as part of a worldview (Ingold, 2000; Patterson, 2008). In this view, advocated by Ingold, the environment is not considered a “set of constraints” for organisms that live within it, but the organism and environment together form an integral part of an ecological system. In his discussion and overview of perception and cognition, Gibson’s theory of affordance is proposed as an underlying framework onto which the phenomenological ideas advocated by Heidegger and Merleau-Ponty can be grafted, as both are concerned with being-in-the-world. The theory of affordance is, in short, defined as all “action possibilities” latent in the environment, objectively measurable, and independent of the individual’s capability to recognize them, but
always in relation to the actor, and therefore dependent on the actor’s capabilities. Later, this idea was adapted by Norman to include only the actions possible that are readily perceivable by the actor, or ‘perceived affordances’, supporting Norman’s theory of Design (Gibson, 1977; Norman, 2009).

Cognitive science, on the other hand, is regarded as an obstacle to further development of a phenomenological approach, as it is considered “experience distant”, and algorithmically based, even though the affordance theory has been adopted within the cognitive frame as well (Zhang & Patel, 2006), albeit within different disciplinary boundaries. However, by rejecting any technological/scientific development that leads to different approaches in cognitive sciences and information science, methods available in phenomenological approaches remain dependent on specific representations that have developed within western paradigms, resulting in limited practical impact.

Even though the critique of empirically based research is well taken and provides important insights into shortcomings within that paradigm with regard to understanding human history, many of the methods proposed as alternatives have no clear objectives, nor is it made clear if and how experiences differ across the human population. The underlying assumption appears to be that naïve spatial reasoning is based on a universal egocentric, relative frame of reference. Place-based studies, for example Basso (Basso, 1996), have resulted in a realization of differences in landscape experience across cultures, but these studies remain largely within the realm of ethnographic accounts with limited impact on the epistemological underpinnings of research (place = location + meaning). Studies
such as that conducted by Lahiri and Singh (Lahiri & Singh, 1999) address this
crucial issue regarding how history is conceived, that is, not within a single spatio-
temporal framework that influences worldview and provides a springboard for new
approaches. Other recent approaches focus on networks and relationships more
than on objects (Urry, 2007).

**3.3 Archaeology as Spatial science**

Contrary to the development of landscape approaches within a social-
anthropological context, landscape archaeology is driven by development of
innovative methods and technologies. The early applications employing GIS were
primarily focused on site-prediction modeling efforts and investigating
environmental constraints to human settlement. Currently they have broadened to
include humanistic approaches, intent on incorporating post-processual critique,
especially the importance of human *movement*, thus continuously changing the
perspective (Llobera, 2000). It is these latter approaches that serve a bridge
function and will be the focus of this section. In general, application of geospatial
technologies has moved beyond mere cartography and is concerned mainly with
spatial analytical efforts, in academic research as well as within cultural resource
management settings (Curry, 1998; David & Thomas, 2008a; Evans, 2006; Lock,
2003; Wheatley & Gillings, 2002). Geospatial approaches are specifically suitable for
multivariate analysis within the realm of environmentally and ecologically related
disciplines.
Digital archaeology, based on these new technologies, is becoming part of mainstream archaeological practice, and this technological development has led to significant changes in the way data can be collected and analyzed. Not only can large datasets be analyzed at multiple scales and integrated in multivariate environments, opportunities are provided to simulate “what-if” scenarios, such as agent-based modeling approaches (Batty, 2005; Kohler & van der Leeuw, 2007). The objective in this section is to evaluate co-occurring/underlying theoretical developments.

Spatial information systems are primarily concerned with quantitative applications and a third-person geometric frame of reference. Humanistic approaches, such as those described in the previous section, are not considered appropriate within this framework, however, considerable efforts have been made toward the goal of integrating a first-person, phenomenologically based perspective as part of the analytic capabilities that are now available (Llobera, 2003, 2005). Others prefer cognitive science approaches toward incorporating human spatial understanding (Gimblett, 2002; Kohler & van der Leeuw, 2007; Renfrew & Zubrow, 1994; Zubrow, 2006), grounded in biological theories of human behavior. Even though language is considered a variable in some of these studies, it is mostly considered as an attribute in a mathematical multivariate approach, not from a spatial cognitive perspective (Jordan, 2007).

Many of the humanistic approaches are based on visibility and accessibility analyses and have co-developed with spatial/architectural design and planning application requirements, based on the assumption that visual perception is the most important
of the senses. In addition, due to the technological restrictions involved in representing other, more transient modes of perception (Ascher, 1991; Gillings & Goodrick).

Briefly, the focus will be on two developments. One can be defined as sense-scapes, that is, how are sense experiences modeled and what are the interpretations based on these models. Second, human movement has been evaluated through accessibility measures, most well known in archaeology through space syntax (Bustard, 1999; Cutting, 2003, 2006; Ferguson, 1996; Shapiro, 2005).

**Sense-scapes**

Visibility analysis, as an effort to integrate human perspectives applicable in both planning and design and in archaeological studies of space experience, employs viewshed analysis within a geographic information system. Viewshed (metaphorically based on watershed, *Wasser-scheide*, water-division) distinguishes the visible from the non-visible parts of the landscape based on specific point of view and algorithmically derived from a topographic model, or Digital Elevation Model (DEM). It was realized early on that this algorithm does not exactly model human vision and that adjustments needed to be made (Tschan & Daly, 2000) For instance, the notion of topographic prominence (Farina, 2006; Llobera, 2007) integrates Gibson’s theory of affordance to evaluate the importance of landscape features at different scales, or radii, from a specific point of view. Related to this notion is the area or radius of focus of the human sensory system (Higuchi, 1983; Maples), that is, the distances at which certain visual elements can or cannot be distinguished. In addition, a cumulative viewshed is frequently used, representing
areas that are visible from multiple points and testing, for instance, the assumption
that important monuments/architectural features are placed in such locations
(Llobera, 2003; Lock, 2000)
Even though interesting insights have been gained, the exclusive focus on visual
perception has attracted criticism for the assumption that vision is the most
important of the human senses. As discussed by Zubrow (Zubrow, 2006),
experiments based on other senses are also being undertaken, such as sound-shed,
and smell-shed. These kinds of “sheds”, or divisions, are more complex. One, the
supporting data are more transient, and two, they are much more dependent on
source and intensity of sound and smell, as the active agent. The focus on visual
perceptions at the expense of other sense perception is argued to be a function of
representational technology and preference, not a reflection of importance or
fundamentality (Bregman, 1990). Acoustic analyses have begun to be conducted
within architectural complexes (Watson, 1999) and it is the architectural spatial
configuration to which I will now turn.

3.3.1 Architectural theory as the basis of investigation of
spatial configuration

Spatial configuration, as argued by Levinson, (Levinson, 2003) is influenced by
spatial cognition. The study of space in archaeology is focused either on landscape
as a whole or is concerned with the built environment, the spatial relationships
within and among man-made structures and the surrounding environment. The
objective is to infer spatial design principles underlying spatial patterns that are
identified by archaeologists. The assumption therefore is that identified patterns are meaningful in the same or a similar way across cultures (meaning inherent, “myth of the given”). As identified by Cutting (Cutting, 2006), six broad approaches or focuses can be distinguished within archaeological studies of space: architectural form; spatial distribution of activities; continuity and standardization; relationship between built and non-built space; human patterns of movement; and ethnographic observation and analogy. Even though these studies have a long history in archaeology preceding the advent of geospatial technologies, technological developments have resulted in novel quantitative approaches, especially concerning human movement that will be briefly reviewed here. The focus on human movement through space is based on an analytic- or configurational architectural theory developed during recent decades, currently known as Space Syntax (Hillier, 1996; Hillier & Hanson, 1984). The Space Syntax program currently encompasses methods and techniques such as viewshed analysis to enhance its analytical power.

Hillier states that the assumed relationship of form and function that underlies common-sense notions of built space has proved resistant to analysis. One reason is the fact that buildings or built spaces can change function easily. A second reason is the preconceived notions, or social ideas, that are related to the idea of buildings, and vice versa: ideas about social institutions come with specific social ideas of associated spaces or buildings, that is, there is a form-meaning relationship. The space syntax framework is a response to earlier, unsuccessful architectural design paradigms, the paradigm of the machine, and the organism environment paradigm.
The former is rooted in social engineering, the idea that spatial configuration influences or determines human behavior, while the origin of the latter can be traced back to Aristotle. Environment, as something that surrounds, implies a subject at its center that it affects and influences. These deterministic ideas have continued to underpin architectural theories.

Space within the space syntax framework, as the name implies, is based on space as a mode of expression and employs configurational analysis to evaluate these patterns of movement, the interface of shaped space and human movement through that space, providing relational identity to discrete objects through its arrangement or configuration (Hillier, 1996). It is based on qualitative (topological) as well as quantitative (geometric) spatial reasoning.

The language of space, as described by Hillier and Hanson (Hillier & Hanson, 1984) can be considered a morphic language (mode of representation), and it can be theoretically placed between two other main languages (modes) through which we communicate our understanding of the world: natural language and mathematics. (It is important to note that a distinction is made between abstracting modes of expression and intensifying modes of expression; art belongs to the latter category)

Whereas a natural language is characterized by a relatively restricted syntax and large lexicon, mathematical languages have small lexicons but very large syntaxes. Morphic languages can be considered as a combination of these that have a "small lexicon (homogeneity of primary morphic units, the primacy of syntactic structure over semantic representation, the property of being built up from a minimal initial system and the property of not meaning anything except its own structure... From
natural languages, morphic languages take the property of being realized in the experiential world, of being creatively used for social purposes” (Hillier & Hanson, 1984, p. 49). What is different from natural language, however, is that a syntactically well-formed sentence expressed in morphic language guarantees and specifies a meaning (meaning is the abstract structure of a pattern). Therefore, if, as argued by Hillier and Hanson, “space organization and social encounter patterns are both morphic languages, the construction of a social theory of space organization becomes a question of understanding the relations between the principles of pattern generation in both” (Hillier & Hanson, 1984, p. 50). (In this section the focus will be on archaeological studies that have employed *space syntax* methods and the critiques and implications of this method. (Cutting, 2003) In Chapter 5 the relationship between modes of expression, or multimodality, will be discussed in more depth.

One of the main assumptions of this social theory of space is the universality of syntactical rules underlying human spatial behavior and cognition, indebted to Chomsky’s (Cook, 1988) idea of universal grammar. Based on variation in human spatial cognition, this assumption may not hold, as suggested by several ethnographical and archaeological studies (Shapiro, 2005). Critique of space syntax has also pointed to some inconsistencies regarding its focus on topology, its disregard of building height (three-dimensional aspects), land use, and problems of geometric transformations producing different results for similar configurations (Ratti, 2005). An additional problem is the fact that this model was developed for urban analysis, in which objects and relationships are defined within an
architecturally bound space; the community as defined by its built space does not integrate the larger landscape/environment within its social sphere.

In summary, even though spatial technologies and cognitive approaches have been regarded as ill-suited to further the phenomenological approach, considerable efforts have been made to include the human perspective in digital technology-based research to further our understanding of human spatio-temporal experience. The main problem, as pointed out here, is the assumption of universality in spatial cognition that underlies phenomenological as well as geospatial methodologies, defining the different perspectives as either third-person or first-person, and forgoing any effort toward integrating pluralistic views. Human spatial cognition has been shown to be more diverse, the stance taken within this research is therefore that the focus of research should be on evaluating these systems of representation, and creating mechanisms for understanding across linguistic and cultural boundaries. The next section will clarify some of the issues involved that are related to the recognition and acceptance of different knowledge systems and theories of knowledge. I will now shift the focus toward contested landscapes, different ideas of space and time, and history.
3.4 **Cultural heritage – from land to landscape**

The “landscape as now” is often referred to as a palimpsest of cultural expression (tangible/intangible), inscribed in the landscape through lived experience. This cultural heritage is recognized as universally important to all of humanity, and cultural expressions of past people and cultures are to be valued and preserved. Architectural monuments such as Egyptian and Mesoamerican pyramids are obvious tangible examples, but currently less obvious and/or intangible aspects of cultural expression are included in current policies of preservation (Alanen & Melnick, 2000; L. Smith & Akagawa, 2009a) Examples of the latter two consist of “landscapes” and “vistas”, as well as languages, cultural practices, and stories. Even though this is a promising development, many aspects of recognition of what to maintain and preserve and how to do so remain contested. The notion of intersubjectivity will be used here to frame this discussion.

Archaeological research conducted under the umbrella of cultural resource management is related to compliance with regulations described in governmental and international laws. Hence, while CRM is directed and restricted by these laws and not easily changed, issues of contestation should be addressed within academic and participatory research settings to assess the validity and applicability of these regulations (Watkins, 2000). Participatory research has come to the fore in recent years to give voice to local communities in decision-making processes that have practical implications (Corbett & Keller, 2005). Other initiatives, overlapping with participatory research in approach, have focused on bridging the “digital divide”
addressing the issue of unequal access to technology and information creating disparity where democratization is intended (Schuler, 2008).

With respect to cultural heritage, these issues revolve around preservation and conservation of tangible and intangible cultural resources, and the narratives within which these are placed. Social anthropology has addressed these issues, but as discussed above, the methods for creating alternative histories, based in phenomenological approaches for instance, appear insufficient to provide practical solutions. According to Schmidt and Patterson (P. R. Schmidt & Patterson, 1995) this is due to the absence of a common language and mutually respected methodologies, primarily between the so-called developed and developing worlds. This problem reverts back to the notion of reality and spatio-temporal frameworks within which certain events and processes are deemed important. The nature of reality (including social categories) and what we know and how we know about the world varies across cultures; however, western science-based epistemology is often considered as the only way of seeing reality (truth) (R. M. Roberts & Wills, 1998).

These epistemological differences underlie many current sociopolitical issues; the question raised here concerns the basis of epistemological authority regarding cultural heritage. As argued by Wautischer (Wautischer, 1998b), the current academic trend is to focus on political motives undermining acceptance of different knowledge systems as alternatives to the dominant scientific epistemology. Instead, he continues, the discussion should distinguish between philosophical and political grounds for evaluating knowledge systems. In academic settings, traditional knowledge is primarily studied within the discipline of anthropology; resulting
Ethnographies have been used to either describe earlier stages of human development or argue against the general philosophical tradition within western science (Lemaire, 1986; Wautischer, 1998a). The latter, as discussed by Shah (E. Shah, 2008), has led to imagined and constructed premodern histories and knowledge foundations considered to be superior to modern science and associated with other desirable traits, such as decentralization, bottom-up planning, and so forth; however, are not necessarily based on scholarly analysis. Moreover, political motives have taken precedence, and since understanding these is important, some are briefly discussed below. The main interest within this larger research is primarily on the comparison of knowledge systems based on philosophical grounds; the historic development of western science, by denying metaphysical underpinnings of knowledge, has effectively made this discussion difficult, deeming it unnecessary or impossible. Even though this scientific rigidity has been criticized within academia (Habermas, 1974; T. S. Kuhn, 1970), only a limited number of studies have been undertaken to compare nonwestern traditional knowledge systems and western science (R. M. Roberts & Wills, 1998)

3.4.1 Alternative Histories and the problem of “otherness”: a political problem

Otherness was earlier discussed in two different ways: “the other” as distinct from ego (Birnbaum, 2008), or as culturally distinct and subject of research in anthropology (Lemaire, 1986). In a changing global sphere of interaction and
communication, it is the appeal to universal values that justifies certain behaviors toward others. These global relationships are, however, historically developed out of colonial power structures; the notion of universalism and the related concept of global democracy is masking preconceived or remnant misconceptions regarding nations not formerly belonging to the dominant sphere (P. R. Schmidt & Patterson, 1995; I. M. Wallerstein, 2006). One example, described above, regarding the status and conception/image of “the Indian” was firmly established in European consciousness, especially since the writings of de Las Casas were not transcribed or translated until relatively recently (Lemaire, 1986). However, the fact that Indians were not uncivilized and were considered capable of reasoning, according to de Las Casas, may have had little effect even in his time, as a later movement known as Orientalism originating during the Romantic period shows. Even though Asian and Arabic cultures, on which the Orientalist movement was focused, were considered highly civilized, these civilizations were deemed incapable of reaching “modernity”, the hallmark of western society. Unlike European cultures that were thought to be inherently progressive, these civilizations were assumed to be more or less frozen in time. Orientalists, scholars who studied Asian cultures, primarily came from the Occident (Said, 1979; I. M. Wallerstein, 2006). The philosophical basis of their studies is considered essentialist, investigating their “subjects” from a third-person perspective, but with differing approaches that have been tentatively classified by Sen (Sen, 2005) as either curatorial, magisterial, or exoticist. The latter of these is most associated with Orientalist scholarship, focusing on, as the term implies, exotic aspects of a culture. In the case of the history of India,
discussed by Sen, the mystical aspects of the culture are emphasized. On the other hand, those studies that can be classified as magisterial in approach, based on rulers priorities, stressed the poverty of Indian intellectual tradition and its primitive society [sic]. Some of these authors (Mill, Macaulay, as discussed by Sen) had never visited India nor did they posses any knowledge of Indigenous languages, their accounts are reminiscent of judgments passed on the Indigenous populations in the Americas.

The central aspect of curatorial approaches revolves around systematic curiosity (Sen, 2005), a commonality with most current cultural heritage studies, and slants toward a focus on differences (and is the least political). Using the West as a yardstick of modernity, however, automatically implies that what is different in other cultures can never be considered superior. Fortunately, pluralistic views and indigenous accounts of histories have become more common recently within mainstream academic literature.

3.4.2 A philosophical problem

*Europe and the people without History*(Wolf, 1982), as well as critiques of Orientalists approaches by non-western scholars (Sen, 2005), led to a widespread realization in western academic settings that history (or knowledge) is not limited to what is recorded in written documents. Written language being only one mode of knowledge expression and dissemination, albeit a dominant one in western thinking, has since been supplemented by studies into other modes of expression, including but not limited to oral (and other auditory/sound/performance) language
and visual/spatial language. Several scholars have discussed ways in which different knowledge systems can be compared from a philosophical perspective, even though these efforts remain minimal and often are phrased in dichotomous relationships—subjective-objective; holistic-reductionist; natural-supernatural—to distinguish western from nonwestern knowledge systems, mainly in terms of differences. However, pursuit of knowledge within the western scientific framework can be argued to be limited, where objective and subjective approaches are strictly separated. For instance, “the epistemological function of narratives is underappreciated in western cultures as relevant device for human interaction (Wautischer, 1998a), even though a few recent investigations have recognized the importance of stories in human spatial cognition (Gluck, 1991; Paelke & Elias, 2007). Historically this can be understood as a strategy to limit the role of imagination in science to a minimum (Daston, 2005). In addition, comparison of the different knowledge systems often overemphasizes differences, such as stressing the community aspect in traditional knowledge as opposed to the importance of the individual in western cultures. Several scholars have addressed the notion of Self and individuality within nonwestern cultures to counter this narrow focus (Edge, 1998; Ryser, 1998).

The acknowledgement of pluralistic viewpoints, such as exposed by Wolf, provides opportunities to investigate and compare different epistemologies, including western science. Different from phenomenology, as subjective experience focused on the individual, different knowledge systems can be compared based on their epistemological and ontological foundation. A knowledge system can be defined as
having four major attributes: a theory of knowledge; how knowledge can be transmitted and learned; how knowledge is distributed internally and externally to a community; and to what extent and how knowledge can be changed or modified (R. M. Roberts & Wills, 1998, p. 44). Traditional knowledge, on the other hand, as exemplified by Maori epistemology, is shown to be dynamic while maintaining its epistemological foundation (Roberts and Wills).

The investigation of organisms based on physical principles, reducing analysis to empirical questions of material constituents in 20th century science, has precluded any critical discussion of the metaphysical foundation of this method. This, according to Roberts and Wills, appears to suggest that there is no rapprochement possible between the way modern science investigates human-ecodynamics and the approaches of other knowledge systems; however, recent developments in complexity theory have challenged the mechanistic and reductionist notion of science and demonstrated that “systems comprised of large numbers of components with very simple properties can display dynamic behavior of enormous complexity that often appears to be virtually independent of any of the fine details of the mechanics of their material constituents” (R. M. Roberts & Wills, 1998, p. 60). These ideas, as argued by Roberts and Wills, have much in common with traditional knowledge systems and provide a basis for dialogue. The land as a source of knowledge in such efforts is a crucial parameter, as opposed to the landscape as a framework that is based on cultural concepts that are not necessarily shared universally. Employing new methods and insights to understand perceptual grounding of cultural knowledge therefor plays a central role (Black, 2011).
Many formerly colonized nations need to come to terms with both the political and philosophical aspects of varying worldviews in redefining global relationships. This, as argued herein and following Watkins (Watkins, 2000), is not solely a responsibility of nonwestern societies. Understanding knowledge systems and development of systems of knowledge representation should also be the result of broad-based dialogue and multi-faceted approaches. These approaches function to: 1) reevaluate official histories and expose cultural biases; 2) create participatory and collaborative projects, focused on possibilities for integrating pluralistic viewpoints; and 3) provide venues for discussing philosophical as well as practical issues in efforts toward epistemological equality. A few examples will serve to illustrate this point.

*The Deccan Plateau*

"Pre-modern knowledge systems and artifacts are often made into reified objects of virtue irrespective of their social and historical location" (E. Shah, 2008, p. 655). The focus of Shah’s work is on tank technology in South India, a technology rooted in pre-colonial tradition that is often considered a sustainable water management practice. Her analysis shows that to label colonial practice as detrimental and pre-colonial practices as sustainable simply because these are based in traditional knowledge is faulty. The history of the South Indian landscape, in particular Karnataka, is rich and diverse, and besides the study by Shah on the history of tank irrigation technology, this landscape is also the focus of a recent publication by Mathur and Da Cunha (Mathur & Cunha, 2006). The latter traces socio-economic
and political history, from the English efforts to bring this “naked” land under control by imposing administrative boundaries through large-scale survey efforts and creation of botanical gardens, to describing elements in the Mysore tableland, including the numerous tanks, that are often considered indigenous. As described by Mathur and Da Cunha, many of these elements represent earlier efforts to settle and perhaps colonize the land. Pre-colonial history can therefore not be considered separate from present-day developments. The objective of Mathur and Da Cunha’s study is to present new ways to redefine the Deccan plateau based on its richness of cultural intersections.

In similar vein, Shah explores the history of the region from the perspective of irrigation technology in an approach indebted to Wolf. The technology of tank irrigation is often considered indigenous and therefore more in tune with the land than European colonial land management practices. What is needed, however, as argued by Shah, is a “pluralistic appreciation of knowledge, that can only come from the study of cultures over a long time”, in itself, a critique of western universalism contributes nothing (E. Shah, 2008, p. 658). Her approach is based on Ricouer’s notion of collective memory (discussed by Shah) that underlies the establishment of any community and defining lessons for future generations. Shah then combines her engineering background with stories collected from individuals belonging to the Vodda caste, who contributed labor to tank construction, and songs and narratives from the higher-caste farmers and priests describing the large number of Voddas employed for these tasks. The Voddas are rarely mentioned in inscriptiveal sources or in South Indian historiography. The widespread assumption that pre-modern
technologies were always “environmentally non-intrusive and harmoniously embedded within a culture” (E. Shah, 2008, p. 673), results in this specific case in the perpetuation and reproduction of old power relations. The tank technology, heralded as pre-modern, therefore environmentally sound and desirable, according to Shah was never sustainable in this landscape, but has nevertheless been modernized. The creation of essentialist historic categories such as pre-modern, colonial, and modern, with their associated characteristics, can lead to undesirable outcomes, and denial of histories, and misunderstanding of underlying knowledge systems.

The acknowledgement of multiple stories and realities discussed above is the underlying rationale for participatory approaches. Within the spatial sciences, participatory approaches are an emerging field known as PPGIS (participatory geographic information systems), which seek to empower local communities through “making GIT&S [Geospatial Information Technologies and Systems] available to disadvantaged groups in society in order to enhance their capacity in generating, managing, analyzing and communicating spatial information.”(Community, geographic information, Craig, Harris, & Weiner; Corbett & Keller, 2005). This practice owes its philosophical foundation to Critical theorists such as Habermas and Rorty, who have advocated the social responsibility of science within the larger society. “A good PGIS practice is embedded into long-lasting spatial decision-making processes, is flexible, adapts to different socio-cultural and bio-physical environments, depends on multidisciplinary facilitation
and skills and builds essentially on visual language. The practice integrates several tools and methods whilst often relying on the combination of ‘expert’ skills with socially differentiated local knowledge. It promotes interactive participation of stakeholders in generating and managing spatial information and it uses information about specific landscapes to facilitate broadly-based decision making processes that support effective communication and community advocacy” (Rambaldi, A.P, P, M, & Weiner, 2006). For this practice to succeed, besides technical skills brought to the project by ‘experts’, a thorough understanding of community history and dynamics is essential.

For example, within the context of landscape archaeology McGlade (McGlade, 1999) has addressed the social and political aspects of human-environment relationships, that is, human ecodynamics, by developing a model for interdisciplinary research implemented as the Empordá project in southern Europe. This model combines several research axes, environmental dynamics, landscape history, and landscape management, all of which inform future landscape and heritage management policies and practices. Contextualizing current conflicts within long-term historic relations and engaging communities within the decision-making process can lead to the development of novel approaches for landscape and heritage “preservation”.

The Empordá project exemplified that archaeological concerns cannot be separated from current socio-political contexts (McGlade, 1999).
3.4.3 Indigenous epistemologies/ontologies/ heritage management and self-determination

As the examples discussed above have demonstrated, it is necessary to integrate multiple realities. Failure to do so exposes the limits of standard scientific practice. Alternative knowledge systems are not necessarily unscientific, as they can also adhere to the basic characteristics of knowledge theory (R. M. Roberts & Wills, 1998). Independent facts are the hallmark of western science, supposed to be strictly segregated from interpretation or hypothesis. Facts are “givens” by nature as opposed to artifacts, which are created through human imagination (Daston, 2005). This example of basic opposition that is threaded through western thinking, especially since the Enlightenment, is often stated as another basic difference between western and nonwestern philosophical traditions, in which this distinction between subject-object does not exist, and nature is not conceptualized as existing separate from or outside of oneself (McDowell, 1994; R. M. Roberts & Wills, 1998). It is not the intent here to generalize nonwestern philosophical tradition; the example of Maori epistemology given below only functions to demonstrate this basic difference.

Besides metaphor, the second fundamental aspect of “Maori epistemology is the notion of ‘place’, representing the connection and reciprocal relationship of people to their origins, material, historical, and spiritual” (R. M. Roberts & Wills, 1998, p. 54). Humans are thus an integral part of nature, and this connectedness is, for instance, expressed as place names, locating knowledge in place and time. This knowledge rooted in place is activated through different means, such as narratives
and song, in different cultures. As such, the features in the landscape are not objectified as existing “out there,” but are integral to individual or tribal identity (R. M. Roberts & Wills, 1998, p. 55).

A renewed interest in traditional knowledge has been spurred by current global environmental crises, as it is assumed that access to this knowledge will help address these issues. Traditional knowledge is considered to be an important component that can contribute to the understanding of environmental processes and issues concerning biodiversity and sustainability efforts, and interest in it represents a shift away from earlier centralized, technically oriented solutions. Even though this attention is long overdue, it also highlights the controversies surrounding ownership, access, and preservation of tangible and intangible resources. As discussed by Agrawal (Agrawal, 2002), the preferred strategy, similar to earlier anthropological approaches, is ex situ conservation, encompassing documentation and storage in international, regional and national archives and in digital databases. Given the dynamic nature of traditional knowledge, this seems a defective strategy, as argued by Agrawal. It is considered suitable for knowledge and information conservation within western scientific and governmental modes of knowledge, and therefore “likely to benefit more powerful constituencies,” but undermines access, rights, and ownership for traditional communities (Agrawal, 2004).

Technological development of systems of representation needs to take these issues into consideration. My research addresses the role of modes of representation, how
these are linked to political motives and how they imply epistemological constraints.

3.4.5 Summary and preliminary conclusion

The question posed by Lemaire (Lemaire, 1986) as to whether or not anthropology as a discipline can be objective towards the understanding of The Other, or if the discipline is trapped within the sociopolitical context of the west, well defines the challenge of anthropological and archaeological research today. Within the history of modern science anthropology is specifically focused on The Other and/or non-western societies, whereas aspects of western society are investigated through different disciplines, –economic, sociology, and so forth. As argued by Wallerstein (I. Wallerstein, 2004), anthropology from this perspective is outdated and as the study of human kind it needs to be rethought and re-purposed. An alternative approach should provide the means to explore and understand human relationships and communication within frameworks that can value and accommodate different methodologies. Challenges to do so were laid out in the above sections, the narrow focus of current archaeological and anthropological practice, defined along Cartesian dualistic lines, being the primary obstacle. Research examples of nonwestern scholars served to illustrate different approaches that can start to frame a paradigm of communicative action in order to integrate and (re)define research methodologies.
This research does not question the value of science, but it does question the role of science and the limits of scientific practice in defining social relationships in which universalism and truth are pillars of science and modernity.

Focus:

• How well are current systems of representation suited to integrate different space-time ideas, addressed not only from ethnographic standpoints but also from the employed conception of space-time?

• The space-time framework used in representation is not really addressed as an issue in scientific research, and even though phenomenology is interested in experience of place it accepts the general space-time frame used at a specific time and place within a general linear framework.

• How to understand “the other”, is also not really addressed in ecological research, and is primarily limited to cultural heritage approaches.

The research ‘gap’ here defined is the lack of attention on what the effects the use of methods and systems of representation is, and how these are interrelated to 1) political motives and 2) have inherent epistemological constraints. This research addresses this research gap.
CHAPTER 4  SYSTEMS OF REPRESENTATION

Systems of representation imply and facilitate the translation of thought and ideas into a language that can be understood and communicated beyond the individual. Natural language is one way to express our thoughts and experiences of our surrounding world. The total number of different languages around the world is estimated at between 5000 and 8000 (International). The global reach of digital networks, however, requires communication across natural language boundaries, and as English is the language most commonly used to accommodate that need, a large part of the population may be prevented from having access to available information (Dutta, 2009). Visual media are fast becoming an (if not the most) important component of digital communication, and visual messages are often assumed to be universally understood.

Chapter 2 introduced the concept that modern science is based on the idea that we can know the world, and that we are able to express and communicate that knowledge in the languages available to us. The creation of a universal scientific language has been attempted, (notably by Leibniz and later Frege) but never successfully (Rey, 2012); formal logic and mathematical languages are most universal, but cannot be used to express certain aspects of experience, such as emotions or intent, aspects that are increasingly recognized as essential in understanding and anticipating human behavior (Farina, 2006). The assumed universality in human thinking is questioned within several disciplines, identified as cognitive approaches. In Chapter 3, it was made clear that many anthropological efforts toward cross-cultural understanding are hindered by a reliance on the
universality principle in human experience, dividing approaches according to a subjective-objective dichotomy. In the last section of that chapter the idea that epistemological differences between knowledge systems can account for cross-cultural misunderstanding was also discussed.

The premise addressed in this chapter, following from these preliminary discussion, is that the development of new, especially digital, systems of representation are based on categories and structures many assume are universal, whereas others consider them to be biased culturally (Agrawal, 2004; Augusto, 2008; Raseroka, 2008; Sen, 2005). Differences in technological access, for instance, have been considered under the broad movement of Digital Divide, addressing sociopolitical aspects of this problem (Dutta, 2009). Even though many of these issues are politically ingrained, few address the philosophical foundation of these differences and the implications for scientific and cultural research (Wautischer, 1998a). The main intent here is to contribute opening that issue.

4.1 **Worldview – representation and reality**

In this chapter, the relationship between metaphysics (including its sub-disciplines of epistemology and ontology) and conceptual metaphor will be investigated, providing a broad framework within which the concept of “worldview” can be understood. Metaphysics, by many considered no longer relevant to modern scientific practice, can be argued to have resurfaced in cognitive studies. For instance, Lakoff and Johnson, have shown successfully that in order to express
concepts or abstract thoughts, humans make extensive use of figure of speech, especially metaphors. “Our ordinary conceptual system,” as they argue, “in terms of which we both think and act, is fundamentally metaphorical in nature” (Lakoff & Johnson, 2003, p. 3). Increasingly, it is argued that metaphor not only underlies our daily communication and our ordinary language, but also our scientific models. That is, many concepts are difficult to express other than in metaphor. The “way we think” as a topic of research has garnered renewed attention, and resulted in new theories of human cognition (neural theory, blending) (Fauconnier & Turner, 2002). Though the relationship between language and thought was briefly touched upon in the previous chapters, in this chapter specifically, current research will be discussed regarding representation beyond natural language (especially written language), known as multimodal literacy. The linguistic relativity hypothesis has been reevaluated and adapted in recent decades as an alternative to the notion of universal grammar, as at least certain aspects of human thinking are closely related to culture or language spoken, sociopolitical relationships, and decision-making and so forth (Mignolo, 2009; Nesbitt, 2003).

The particular use of “natural language” also has to be specified; whether natural language is used in written or in oral communication can make a difference, as hearing words activates a different region of our brain than seeing words (MacEachren, 1995; Ware, 2000), and these can thus be considered different modes of expression. In addition, speaking as performance is complemented with other forms of bodily expression that can enhance or downplay the message conveyed (facial expression, gestures) (McNeill, 2005). Furthermore, mathematics and logic
are well-developed formal languages intended to express abstract thoughts unambiguously. Though they can be used for only a limited number of concepts, they can be used to test real-world experience or be tested by real-world experience (even though axioms and postulates are often conflated). Visual and morphic languages as modes of expression, are less well-understood, but are related to spatial language or cognition and mostly assumed to be universal and innate. The framework of the Conceptual Metaphor Theory (CMT) (Lakoff and Johnson 1980), is based on their hypothesis that metaphor is not a figure of speech but a mode of thought. Based on this premise, the source domain and target domain can be in different modes, that is, they are not restricted to natural language (Forceville 2009). This research is often focused on the use of visual language as distinguished from written text; however, it is pointed out from indigenous perspectives that both are visually oriented and are different from orally based knowledge and communication systems (Adjaye, 2008b; Augusto, 2008). Even so, the realization that written documents constitute only one of several ways (modes) of knowledge representation and dissemination is an important start and has implications for the following argument, namely, that if underlying cultural concepts can be translated between different modes of expression (intermodal mapping), the premise that archaeological material (and modes of cultural expression in general) is an expression of thought is then reasonable.

In addition, based on the findings of conceptual differences between different language groups, it can be assumed that an understanding of languages used is necessary in order to apprehend associated cultural expressions. Furthermore,
Levinson (Levinson, 2003) argues that non-linguistic expressions reflect the use of a preferred frame of reference in spatial natural language. Individual research efforts hint at the fact that translation between modes is not the same in all cultures or language groups, that is, metaphors used may be different and diversity in one mode may be different between cultures than in another mode.

Current technological developments in digital communication have increased our ability to disseminate information multimodally, but also require our understanding of the complexity involved; in addition to text and sound, visual images (still or moving), interactive spatial information, virtual experiences, all belong to the realm of systems of representation. Socio-political as well as philosophical problems concerning database design, access, and management, for these systems have begun to be addressed (Augusto, 2008). For instance, geospatial technologies with applications such as on-line mapping can provide real-time spatial information, but are largely based on spatial categories common in the English language. Levinson (Levinson, 2008b) argues that the assumption of this universal “folk ontology” is bound to result in cross-cultural misunderstanding. To employ systems of representation in cultural (international and intercultural) context, the universality principle underlying many of the ruling ideas about human learning and experience needs to be reassessed for its influence and limiting factor in cross-cultural communication.

To summarize, human thinking is closely related to the language we speak and likely to other modes of expression and communication we employ as well. The resulting differences in spatial thinking that exist between different language groups is found
to be significant, as discussed in Chapter 2, with major implications not only for the way we interpret archaeological material but also for the way we develop preservation methods and technologies. For instance, preservation of language as a digital recording may not do justice to the complexity of a language that is lost. To preserve, or more accurately, maintain diversity in thinking it is necessary to maintain (continue) language practice – though this also dependent on how diversity in thinking is valued, which is ultimately dependent on (the dominant) worldview. Moreover, the exclusive focus on a specific mode of expression as preferred for knowledge dissemination obfuscates the existence of and wealth within different knowledge systems, as information comes with embedded codes that are not natural but rather cultural and historical, intelligible only if one has learned the signs (Augusto, 2008).

Worldview is a vague concept that is used frequently but seldom defined. In archaeological and anthropological studies it often refers to the philosophical underpinnings of a culture that are not understood and serves to provide justification for unexplained patterns (Schaafsma, 2000; Snead, 2008). As quoted by Roberts and Wills (R. M. Roberts & Wills, 1998, p. 44), “cultures pattern perceptions of reality into conceptualizations of what they perceive reality to be: of what is to be regarded as actual, probable, possible or impossible”; a worldview consists of the total of these conceptualizations, and is closely related or similar to metaphysics (possible worlds). The position taken in this study is based largely on ideas positing relationships between thinking and languages/multimodal expression and communication, as well as the notion
that (a) worldview is constructed from knowledge obtained through different knowledge sources. The western scientific worldview, for instance, is considered to be empirically based; sources and justification of knowledge are both based in the physical world. The idea that the validity of entities is dependent on whether or not they are accessible to the natural sciences (with its specific concept of physical world), is considered untenable, as it is argued in the literature that many models used in science are based on metaphor and originate in imagination (Daston, 2005).

Worldview is discussed within several disciplines or paradigms, most of which are culturally oriented. Worldview is also often associated with religion or cosmology, as defining the structure of the universe provides guidance in people’s lives. It is therefore understandable that scientific studies do not have much use for this concept, other than in studying the worldview of others. However, a brief discussion of how this concept is defined will show that the concept of worldview cannot be equated with the content of the worldview of a specific ethnic group. The concept of worldview is useful for understanding how our scientific practice (“way of doing”) is related to the inferences or interpretation of that practice (“way of seeing”).

As the set of possible worlds in intersubjective space, worldview can be considered based on several philosophical questions, and the “construction of integrating worldviews” then begins from fragments of worldviews offered to us by the different scientific disciplines and the various systems of knowledge. (Aerts et al., 2005). The Following table is based on the worldview research at The Center Leo Apostel for Interdisciplinary Studies (CLEA), at which the research by Aerts et al. is conducted.
Table 2 - worldview (Based on research at Centre Leo Apostel)

<table>
<thead>
<tr>
<th>Question</th>
<th>Philosophical Branch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is it?</td>
<td>Ontology (model of reality as a whole)</td>
</tr>
<tr>
<td>2. Where does it all come from?</td>
<td>Explanation (model of the past)</td>
</tr>
<tr>
<td>3. Where are we going?</td>
<td>Prediction (model of the future)</td>
</tr>
<tr>
<td>4. What is good and what is evil?</td>
<td>Axiology (theory of values)</td>
</tr>
<tr>
<td>5. How should we act?</td>
<td>Praxeology (theory of actions)</td>
</tr>
<tr>
<td>6. What is true and what is false?</td>
<td>Epistemology (theory of knowledge)</td>
</tr>
<tr>
<td>7. What constitutes the building blocks?</td>
<td>Etiology</td>
</tr>
</tbody>
</table>

All these questions are related, but not all are considered equally important in different worldviews. For instance, a scientific worldview is based on 1, 2, 3, and 6, but does not explicitly consider 4 or 5. In this research, therefore, I will specifically focus on these elements and what the scientific knowledge system claims about them.

Knowledge, what is considered knowledge, and how we know what we know are philosophical issues; however within our current Information Age, these concepts are redefined, they are related but take on slightly different meaning. Ontology, for instance, as a fundamental branch of metaphysics concerned with the nature of being, is redefined in information science as a data model that represents a set of concepts within a domain and the relationship between those concepts. As it became clear from the previous chapters, linguistic differences have indicated
different underlying framework of how people organize and conceptualize the
world. Systems of representation, then, being built upon a philosophical foundation
reflect the conceptual view of its designers, that is, information system ontologies
are based on, or at least related to, philosophical ontologies. Presuming this, the
question can then be raised whether systems of representation allow for multiple
conceptualizations to exist within the same system.
Do conceptual frameworks and the use of certain metaphors in that framework
underlie visual languages in the same way as natural languages? (Some argue yes,
(Washburn, 2001). It is only now becoming clear how figures of speech are
embedded in our communication, the relationship between different modes of
expression is only beginning to be questioned (Forceville & Urios-Aparisi, 2009).

These issues are a part and the focus of a research direction based on qualitative
spatial reasoning. This new direction in GIScience, for instance, has its roots in a
movement known as Critical GIS (Harvey et al., 2005; Kwan, 2002; O’Sullivan, 2006;
Schuurman, 2006; Sheppard, 2005), based on the idea that space is not experienced
by all people in the same way, such that general spatial (social) categories are not
suitable in all situations. The term Critical GIS has several connotations, and the
frequent implication is that critical research is not considered practical, but falls
within the realm of post-modern critique, in this case is a misconception. In
addition, the objective of many researchers identifying with Critical GIS approaches
is to question and change the direction of technological development in order to
facilitate more socially responsible research. So even though many efforts consist of
theoretical contributions, the goals of Critical GIS are practical as well and emancipatory in nature.

Most research along these lines has since focused on spatial ontologies – how humans experience space, qualitative spatial reasoning from a philosophical interest – and is gaining broad-based interest beyond the research community that specifically identifies with Critical GIS, which is often focused on sociopolitical aspects. Many of these efforts currently are addressed in Spatial Information Theory.

### 4.1.1 Spatial Information Theory and ontologies of space

Geometric models have long been used to understand space and spatial change. However, as discussed by Galton, there are many aspects of space, time, and movement, that cannot be addressed with these models and new paradigms are originating within a broad framework of information theory to account for these issues (Galton, 2000; Seuront, 2010). As argued by Tanasescu (Tanasescu, 2007), spatial representations are dependent on social or geographic context and “things” are defined in relation to a single purpose. Ontologies therefore are an important component in paradigms of knowledge representation and can be defined as: “the method[s] to extract a catalogue of things or entities (C) that exist in a domain (D) from the perspective of a person who uses a certain language (L) “ or, as “logical theor[ies] accounting for the intended meaning of a vocabulary” (W. Kuhn, 2007). Of particular interest are qualitative aspects of spatio-temporal organization and disciplines such as linguistics, geography, philosophy, Artificial Intelligence, and
Geographic Information Science, among others, have all contributed to this effort (Galton, 2000).

The common-sense notion regarding the distinction between quantitative and qualitative reasoning is that the former relates to what is measured or is measurable and considered objective, whereas the latter does not and is therefore subjective. Topology, however, is a qualitative spatial framework concerned with spatial relationships that we use in our everyday spatial reasoning, and even though these relationships can be understood mathematically, there are other aspects, such as salience, and idealization in spatial understanding and representation, that are more difficult to grasp. As used by Galton, salience refers to “something that stands out”; the world as we perceive it is filtered through physiological and psychological mechanisms, influencing our focus. A related aspect, idealization, refers to the representation of real-world phenomena. As described by Galton, the justification for using idealization is that the world is too complex to grasp without simplification and abstraction. The details lost are considered irrelevant for current concerns, following that idealizations are useful only within a limited range of conditions, and their use is therefore always circumspect, similar to Tanasescu’s argument (Galton, 2000, p. 26).

Models of space, such as Euclidian geometry, are well known and widely used and provide the foundation of geographic information systems, but they are not well suited for understanding naïve spatial reasoning, that is, how people understand (through memory, perception, and anticipation) and navigate their surroundings. The many different aspects related to the development of models of space that can
incorporate human experience are addressed within the overarching framework of spatial information theory (Egenhofer & Golledge, 1998; Fitting, Wedell, & Allen, 2005; Freundschuh, 1991; Hegarty, 2004; Hutcheson & Allen, 2005; Klippel, 2003; Kwan & Lee, 2004; Moratz, Nebel, & Freska, 2003; Ragni, Tseden, & Knauff, 2007; Shelton & McNamara, 2004; Tversky, 2003; Xiao & Liu, 2007). Models based on Euclidian geometry and those derived from point-set topology (graph theory, for instance), are well established. Others, more recent models, such as those based on mereotopology, have developed within the context of philosophy and Artificial Intelligence (Galton, 2000, p. 102), and have been explored by numerous scholars for addressing (differences in) human spatial conceptualizations lately (Casati & Varzi, 1999; Hegarty, 2004; B. Smith, 1996).

As argued by Raper (Raper, 2000), in order to represent the world in GIS, the existence of a physical world needs to be at least accepted. The mainstream approach, however, has been to accept dominant paradigms of knowledge representation as reflecting an (or the) objective representation. Current efforts in spatio-temporal representation do not question the existence of a physical world, but address the complexity of that world, and the knowledge lost when focusing on (assumed) similarities represented within a dominant paradigm, at the expense of differences.

Efforts to address the complexity of geospatial semantics include approaches such as multiple-representations, conceptual spaces based on image schemata, and those based on affordance theory (Janowicz & Raubal, 2007; W. Kuhn, 2007). Image schemata (Lakoff & Johnson, 2003) are “models of human perception and cognition
defined as small number of parts and relations by virtue of which it can structure indefinitely many perceptions images and events.” Affordances (Gibson, 1977), represent the interconnection between subject and environment, but as argued by Tanasescu are deeply rooted in perception, such that “we are immediately aware of the elements of our own environment that allow us to express our abilities in terms of ‘action’,” but less suitable for more abstract concepts (Greeno, 1994; Tanasescu, 2007, p. 101). Ontologies of space-time are thus influenced (if not determined) by social and geographic variability. The proposed approach by Tanasescu is based on differences, following Deleuze, that all identities are derivatives from differences, that is, “identities do not exist logically or metaphysically prior to any differences” (Tanasescu, 2007, p. 104).

Moreover, spatial concepts and theories have been derived from mereotopology, which combines the disciplines of mereology and topology. Mereology is the theory of parts and wholes. The entities whose parts form the subject matter of mereology are variable, and can be either abstract or physical (Galton, 2000, p. 70). As a theory of spatial reasoning, however, mereology lacks a key component, i.e. the notion of connection or relationship, therefore topological notions are added to provide a qualitative description of space (Bibby, 2005; B. Smith, 1996; Whitehead, 1919). For example, within the geospatial sciences the suitability of mereotopology is explored by Mark and Frank (Mark & Frank, 1991) in an approach defined as ethnophysiography, and by Bibby (Bibby, 2005). In addition, analysis of natural language has provided insight into object-categorization. For instance, topological notions and conceptual structuring can be illustrated through the use of
In representations of geographic space, however, an additional problem is related to the nature of the geographic entities that are currently used, many of which have no clear boundaries. (B. Smith, 1996). Natural language, however, is not the only source for investigation of categorization and conceptualization. As stated earlier, general ontology, as argued by Smith, would draw from “other cognitive modes of access to reality, including perception, scientific theories, the map-making activities of the geographer, knowledge-sharing systems, and so on.” It is within the discipline of linguistics, however, that most of the information regarding the diversity of human spatial cognition is generated (B. Smith, 1996, p. 295).

As argued by Levinson, the Kantian idea of a universal framework for human thinking, an *a priori* spatio-temporal framework onto which we “map” our experiences that assumes man as the center and is egocentric, underlies many scientific efforts and representations of space and time. It provides the foundation for phenomenology and support for the ideas of space as fundamental, which also comes from the spatialization in our language (Lakoff & Johnson, 2003; Levinson, 2003). If different underlying frameworks are possible, as suggested by nonwestern philosophical discourse, it does not necessarily negate Kant’s ideas about knowing and knowledge construction; it merely indicates that the way the world can be known based on human sense-experience, memory, reasoning, and imagination (intersubjectively) is much broader than previously thought from scientific practice.

In summary, as discussed by Tanasescu (Tanasescu, 2007, p. 96) the use of spatial ontology for spatial information systems (committed to particular
conceptualizations of the world) presents several issues that are difficult to overcome, given the apparent universality on which these are based. These issues are related to object representation in geographic space, especially concerning cultural and subjective discrepancies and representing vagueness and are treated as philosophical problems. It is thus acknowledged that a single semantic framework that will accommodate these problems is difficult to construct. Several avenues are explored within digital scholarship. Recognizing that knowledge is situated in place, many of these efforts are pursued within spatial information theory. For example, the geospatial community, which is concerned with naïve spatial reasoning, whereas others focus more specifically on (indigenous) knowledge systems and epistemological differences between knowledge systems.

Within the geospatial community practical solutions are sought based, for instance, on approaches derived from the cognitive sciences and psychology, such as image schemata and affordance theory. The approach suggested by Tanasescu shifts the focus away from objects and categories common to ontology modeling toward difference spaces, an approach which “constitutes networks of meaningfully related discernable differences’ (Tanasescu, 2007, p. 97). Reasoning in difference spaces allows flexible object identification as objects are defined based on differences in attributes between it and other objects, allowing for emergence of new elements, a distinction hardly possible in ontology, according to Tanasescu (Tanasescu, 2007, p. 111).
Other efforts to investigate object categorization are often based on the theory of mereotopology. Galton has discussed different ways of identifying kinds of objects for qualitative spatial reasoning as discussed in Chapter 2.

Often scientists operate under the assumption that the objects of study and the taxonomies used to order these objects, correspond to natural kinds in nature, that is, that the grouping or ordering (of objects, of properties, or characteristics) does not depend on human thinking. This applies to physical objects, but often to social categories used as well (Root, 1993). This assumption of real and independent existence justifies scientific inference and practice. Social categories are not objects in the sense of natural kinds, however, in social science research, categories referring to ethnicity and other demographic entities are often accepted as representing real or ideal social situations (Aitchison, Hopkins, & Kwan, 2007).

From a Critical GIS perspective, Kwan demonstrated that generalizing statistical measures to investigate social issues obscures the complexity and the effect of different behavior through visualizing space-time paths of daily and recurring behavior and spatial mobility and access for different individuals (Kwan & Lee, 2004).

This identification of kinds of objects, used here as a starting point, allows the inclusion of relationships and the exploration of “interconnectedness,” concepts that are noted as being fundamental in indigenous thinking. The temporality of objects has much to do with cycles in nature, and the related changes in relationships
between objects. Objects change, and the changing dynamic of the relationships between these objects can be reaffirmed through context or stories.

Formal frameworks based on these models have yet to be devised (the critique of current frameworks is relevant for the development of these), but efforts to design prototypes are and have been undertaken.

### 4.1.2 Spatial Ontologies in geographic information systems

Since the mid 1990s, as described by Kwan, critical GIS approaches have made considerable progress, especially in public participatory GIS (PPGIS), which addresses issues of both empowering and marginalizing effects of GIS in local politics, as well as ways in which local knowledge and multiple realities can be represented to counter these marginalizing effects (Kwan & Schwanen, 2009; O'Sullivan, 2006). Other, recent developments pertaining to qualitative research can make substantial contributions to the Critical GIS research agenda according to Kwan. The first of these novel research efforts, described by Kwan, often seeks to integrate traditional quantitative GIS approaches with qualitative data and methods. The second development is focused on the importance of emotion in social life and knowledge production, while the third important development involves using GIS as a digital art medium to contest the objectifying vision in conventional GIS practices and to protest against social injustice and violence. In general, then, these critical approaches focus on sociopolitical aspects of systems of representation and dovetail with the interest of understanding and representing human spatial thinking from a
philosophical perspective. This discussion provides a starting point to address representation of different knowledge systems and, specifically, the epistemological differences underlying the different interpretations of histories of the Pueblos manifested in these specific representations.

In general, the problem with current systems of representation is that they are based on a narrow idea for their underlying framework that mimics human thinking and knowledge systems. However, the differences in human thinking that are identified through the research program of the Max Planck Institute (MPI) of Psycholinguistics, discussed earlier, are shown to be significant and these differences cannot be attributed to environment or subsistence strategy alone (Majid et al., 2004; Majid et al., 2006). The consequence is that cognitive research in the spatial domain, thus far almost exclusively based on western test subjects (that is, Indo-European language speakers), possibly represents only a fraction of the human spatial cognitive potential.

In similar vein, the focus on the visual at the expense of other perceptual qualities (oral and haptic, for instance) has been argued to represent a Western preference (as noted in previous chapters). The MPI research program has developed several novel ways of investigating differences in human spatial cognition. Within the linguistic research framework, reference systems and spatial categories are most suitable for investigation in the spatial domain. Levinson’s method of category research identifies three main factors that influence the construction of landscape categories and place names: perceptual salience, which would be indicated by the
existence of universal categories, affordances (*sensu* Gibson 1977); and cultural ideas. In his study, Levinson found that landscape categories are most influenced by affordance and cultural ideas, supporting theses posed within spatial information theory (Levinson, 2008b). Studies such as those conducted by Mark and Turk to assess the presumed existence of universal geographic categories, such as *mountain* and *river*, have catalyzed cognitive approaches to investigating the relationships among spatial cognition, language, and systems of representation. The failure to identify such universal categories has important implications for the development of spatial technologies, if the intent is to provide (democratic) systems that can enrich cross-cultural understanding.

### 4.1.3 Movement: Landmarks and Wayfinding

To analyze and understand human spatial (and landscape) experience, many systems of representation and analysis are considered insufficient due to their static character, as it is movement we seek to understand (Klippel, 2003). The static character would be well suited in an essentialist model, however, as discussed above, the complexity of geographic spaces in relationship to human spatial experience and reasoning is the current focus. How people navigate space (or their surroundings) can now be assumed to differ cross-linguistically as well, as navigating requires a coherent framework of percepts and concepts to understand the dynamic relationships in which we engage. In this respect it is interesting that narrative and stories have come to the forefront of spatial reasoning for movement and navigation purposes. Many efforts to understand human movement are currently focused on the use of landmarks. As these studies often are conducted in urban contexts or indoor spaces, landmarks consist of man-made
buildings and configurational design (that is, refer to visual landmarks (Elias, 2003; Vinson, 1999). Relatively few studies have addressed navigation in natural environments, in which landmarks as object are less clearly defined and the scale is often differently perceived (Helbing, Keltsch, & Molnar, 1997). Even so, to expand the landmark model experiments with stories as route descriptions for pedestrian navigation in urban environments were conducted to validate that story-based descriptions can aid recall of route descriptions of significant length, which was supported by the experiment results. Inspiration for these experiments and subsequent digital model design comes in large part from Australian Aborigine songlines (Pumpa, 2006). At this point, however, most experiments are conducted in controlled (digital) environments. Even though it can be hypothesized, based, for instance on songlines and other indigenous examples, that the use of stories for navigation in nonurban environments is an important spatial cognitive ability and strategy (Williams, 2000), the challenge for the development of information systems is to test the applicability of stories in “outdoor” environments for a broad based population (Paelke & Elias, 2007). The shift away from static spatial entities is also clear within sociological discourse, in an effort to understand human spatial behavior through networks and mobility (Urry, 2007).

4.2 **Cultural heritage: Information and Knowledge**

**Visualization**

Representation is inherent in the process of communication of our knowledge and understanding. Humans have the capability to represent or express thoughts and
concepts in various ways or modes, and current technological developments increase and/or change our ability to do so. Similar to the impact of the printing press in the western world in the 15th century, allowing the dissemination of information to a large audience, the current age, also known as the Knowledge Society or Information Age, has widespread global consequences for the way we acquire and disseminate information and knowledge. This globalization is heralded as a democratization process on an unprecedented scale. Critical voices question this overly optimistic characterization of these new technological developments. (Adjaye, 2008b), but certain paradigms shifts are apparent or emerging, indicating a change in the world order catalyzed by digital development (Giridharadas, 2010; Paulos, 2008; Puma, 2006; Raseroka, 2008; Ushahidi).

The advancement of modern technologies has clearly revolutionized the way we do things, how we relate to one another, and the methods we use to preserve cultural heritage for future generations. Under this need for cultural preservation the need to make it readily available for present and future generations, the United Nations Educational, Scientific ad Cultural Organization (UNESCO) defines cultural heritage as “our legacy from the past, what we live with today, and what we pass on to future generations”(UNESCO). Cultural preservation, in this context, is seen as an endowment for future generations. Even though everyone might agree that saving cultural vestiges using digital media is a positive step toward preserving a legacy for future generations, not everyone agrees on who really benefits from cultural heritage preservation or how to go about preserving culture. Archaeological research provides the underpinnings of many cultural preservation practices;
research methodologies therefore should represent the interest of local and/or descendant communities whose culture is to be preserved.

Globally, the dominant ideology based on the concepts of progress and development (modernity), and the supporting concept of control underlies many efforts at digitization, database design, and construction of cultural and natural heritage projects. Both progress and development have positive connotations, whereas their opposites, stagnation and regression, are considered undesirable outcomes of any process. However, as was discussed in the previous section, cultural and linguistic differences are now recognized as significant factors for understanding human cognition, which has led to a renewed interest in indigenous knowledge as an important resource in addressing global issues of development. An examination of some of the current databases containing cultural content is reviewed by several scholars, specifically focused on how it is created and who benefits from it, and the “epistemological contradictions at its heart” (Agrawal, 2002, p. 288). The practice of archiving material removed from its context, supporting analytical practices, sporadically is contested from a scientific standpoint. The assumption of modern science, employing reductionist approaches, that the whole can be understood through its parts has been shown to be flawed in an increasing number of cases (B. Pijanowski et al., 2011), often with detrimental consequences. Analytical approaches should go hand in hand with syntheses.
This section will be organized around the opportunities in and critiques of these new technologies and systems of representation as discussed in the literature. The main objective of this chapter is to show that given these opportunities and critiques there are some additional issues that have only begun to be addressed in the literature, concerning the understanding and use of different modes of expression and their epistemological foundation. This section is focused on how, by whom, and for what purpose digital heritage content is created (and maintained).

### 4.2.1 Data: collection, storage and retrieval

*Indigenous Knowledge, Intellectual property rights*

The concept of digital heritage has several connotations. Broadly speaking, it can refer to new artistic work that has been created using digital technology, or to any kind of preservation of cultural heritage using digital technologies, from scanning of documents, photographing objects, recording performances, and three-dimensional (3D) digital reconstructions of monuments to Virtual Reality (VR) environments in which past worlds can be experienced. Preservation of digital heritage refers, then, to the creation, maintenance, and updating of these digital records. For instance, a film created using high definition (HD) technology can be viewed with current technology (platforms, devices); however, as technology develops, this film may not be viewable with future systems. Therefore, digital preservation strategies include the preservation of the original medium as well as conversion and updating to new formats so that the *content* of the film can still be accessed. This is also true for analog material that is recreated as digital records. These new records, acquired, for
instance, by means of scanning technologies, in essence become new artifacts that
need to be preserved. Maintenance and upkeep of digital records is a continuous
process within digital heritage management and requires economic strategies
(BlueRibbonTaskForce, 2010). In this section, the focus is on archaeological records,
most of which are not currently originally acquired as digital data, and on broader
cultural knowledge used to provide context for these materials.
Examples of digitized cultural material include three-dimensional reconstructions of
architecture and artifacts, but also scanned documents such as excavation records.
(Baltsavias, Gruen, Van Gool, & Pateraki, 2006; Kalay, Kvan, & Affleck, 2008). Most of
this material is already archived, protected within existing repositories for which
digital counterparts are often considered as replicas (Cameron & Robinson, 2007),
inferior to the originals from which it is derived. As discussed by Diaz (Diaz-
Kommonen, 2002), however, the digitization process (and creation of facsimiles, for
that matter) creates not just copies, but new artifacts: ones that can be annotated
with additional information not attached to the original artifact. These objects can
then be explored in ways not possible before, and new insights can be gained into
the subject of study. A clear example is a virtual environment in which a visitor can
explore a past landscape, monument, or setting, as contextual information no longer
present can be simulated and experienced (Forte & Siliotti, 1997). Another major
advantage of digitization is its potential for broader reach and better access, hence
accessibility to more people simultaneously. The original artifacts in many cases are
no longer needed for study, as the digital facsimiles will suffice. This means, for
instance, that people in different geographic locations can communicate and
collaborate working with the same objects or topic of study shared over digital networks. In other cases, the original objects, monuments, or structures may no longer be extant, so that the digital facsimile is the only object available (Forte, 2004). For instance, in the case of Bamyan, the original monuments were destroyed in political conflict and now are accessible only in virtual reconstruction (Gruen, Remondino, & Zhang, 2004).

These examples show some of the advantages of digital data and databases that have not been explored fully in archaeological research (further discussed in the following section). The integration of these technologies, however, also present new problems, some of which can be discussed within overarching topics such as sustainable digital environments and the digital divide. The former is a general matter of responsible technological development, often focused on economic sustainability, whereas the latter is specifically focused on the sociopolitical aspects of this development (BlueRibbonTaskForce, 2010). Thus, along with its advantages, several issues are surfaced in digital storage that are not given adequate attention, but as will become clear in this document, are critical for its development as a means for cross-cultural understanding.

Pursuit of “sustainable digital environments” refers to several current issues, such as the increasing ability to generate data that needs to be stored (storage and maintenance), the development of methods and technologies to make use of these data, dynamic interfaces that facilitate access to and interaction with the data, and interoperability among other things.
The digital divide refers to differential access to digital technology among different populations and increasingly addresses issues of knowledge commodification and intellectual self-determination in the creation of digital databases and heritage. (Judith van der Elst et al., 2010).

In the traditional paradigm of cultural heritage management, the stakeholders are typically representatives of government agencies and non-governmental organizations (NGOs), academia, and industry – as such, these bodies become the determinants, or producers, of heritage content, and the “public” constitutes the consumer (Judith van der Elst et al., 2010). Digital heritage, a relatively recent phenomenon as a growing part of cultural heritage management, is characterized by different paradigms that originate in different parts of the world (Augusto, 2008; Cameron & Kenderdine, 2007; Dutta, 2009; Johnson, 2005; Raseroka, 2008).

According to UNESCO (UNESCO, 2003), “digital heritage is made up of computer-based materials of enduring value that should be kept for future generations”. The limitation of such a generalized definition is that the focus is on preserving the material aspects of cultural heritage rather than on understanding cultures as dynamic and adaptive entities that constantly deal with and adjust to global circumstances. Given these circumstances, digital content cannot continue to be constructed by only the traditional stakeholders, but instead the concept of stakeholders must become more encompassing to include communities; otherwise the process of cultural heritage management becomes simply a reflection or continuation of colonial practices in which indigenous peoples’ histories and voices
are not included, as the tradition of collection and preservation has its roots in practices of appropriation and commodification (Augusto, 2008).

Cultural heritage, with its assumed universal value (UNESCO), is a generalization of material originating in different cultures and knowledge systems, the intangible aspects of which have attracted increasing interest lately. The preferred strategy of storing specific elements of information in databases is, according to Agrawal (Agrawal, 2002), an example of *ex situ* conservation, with its prime objective being to protect it and demonstrate its relevance to the global community. Over the last decade efforts to preserve indigenous knowledge have received significant support from large donor agencies and scholars, among them the World Bank and UNESCO. Even though this recognition of Indigenous Knowledge (IK) is in itself a positive development, several critical voices have been raised over the strategies of data storage, access, and retrieval. These issues will be discussed here under the topics of objectification, ownership, and the benefits of storing cultural material and immaterial content.

Well-known examples of databases containing indigenous knowledge relate to a widespread interest in biodiversity and environmental sustainability. Indigenous knowledge and information are recognized within this arena as providing a necessary but under-utilized resource. Advocates of the creation of databases and catalogues highlight its twofold objective: one, to develop a local capacity to “capture” and maintain local knowledge, and two, to develop methods of dissemination and exchange of that knowledge, especially for its use in scientific applications/studies. Critique of the creation of these databases focuses on its
epistemic foundation and the practical and political implications. As discussed above, the assumption that indigenous knowledge differs from scientific knowledge and that universal knowledge criteria (i.e., western scientific knowledge) are therefore preferred as underlying design principles, is no longer tenable (R. M. Roberts & Wills, 1998). Design and classification are often argued to serve a western knowledge structure in which the “indigenous” is construed in terms of its possible utility for development (Agrawal, 2002, p. 294), thereby disregarding indigenous spatio-temporal conceptualizations and intersubjective aspects (synthesis) of construction of knowledge. A number of scholars have initiated projects to address these issues outside the western world (Sen, 2005).

For instance, Augusto (Augusto, 2008, p. 212) argues that traditional perspectives such as those drawn from anthropology are insufficient guides in the development of digital systems of knowledge representation that are epistemically complex. Her discussion traces the history of knowledge construction of a South African botanical specimen, scientifically known as *Hoodia triebneri*, placed within a larger context of science/IK interaction. The hoodia, at present mostly known as an appetite suppressant, has long been in use by various indigenous societies for this and other applications. As an archival object, it was first documented during colonial times in the 18th century, according to the custom in European imperial botany. As such, as argued by Augusto, its epistemological and ontological characterization was defined. This history, sociopolitically embedded, provides a foundation for later classification systems used in databases, the development of which is therefore already compromised with regard to its knowledge foundation. Such objects, catalogued
within these databases, are argued to be "narratively stripped," as most of the associated indigenous knowledge and cultural context was not of interest when these specimens were first documented as part of western scientific endeavors. Digitization efforts to record and protect both tangible and intangible heritage no longer originate in western academic centers exclusively, but are increasingly initiated by local communities and/or based on collaborations between local communities and institutional partners. In respect to botanical databases, it is often stressed by traditional doctors that besides the issues of protection, benefit-sharing, and access to computers, the epistemological aspect of the multiplicity of traditional knowledge systems is hardly addressed in database design, that is, the modes of cognition informing traditional classification include not only empirical observation but forms such as dreams and messages from ancestors (Adjaye, 2008a; Whitt, 2004). Databases, as stated by Augusto (Augusto, 2008, p. 217), “help reinforce or overturn knowledge hierarchies, settle on what is useful in ‘nature’ and from different cultures, determine research activities and inform curricula, shape what gets recalled or forgotten.”

A number of scholars have demanded that attention be directed toward the need for integration of different knowledge systems within Information and Communication Technologies (ICT) (D. Brown, 2007; Cameron & Kenderdine, 2007; Milekic, 2007; Raseroka, 2008).
4.2.2 New technologies: opportunities and implications for cultural heritage

In the design of digital cultural heritage applications, the goal is often to provide content for a broad-based public. Content is therefore generalized and not focused on, or sensitive to, specific user groups; in other words, creators of cultural content assume that meaning is universally understood, similar to the universality assumption in spatial cognition and a visual mode of representation. Content is often tailored to a “public” that is well aware of the importance of heritage preservation, protection, and outreach within a specific dominant paradigm. However, such a worldview is not always in concordance with the worldviews of specific cultural groups (P. R. Schmidt & Patterson, 1995); that is, cross-cultural differences exist in the beliefs about the ways cultural material should be protected, represented, and communicated. Several examples can serve here to show how different groups have used new technologies.

Cultural histories of distinct groups are often incorporated into a larger universal heritage (Cameron & Robinson, 2007; Srinivasan, Enote, Becvar, & Boast, 2009), whereby specific knowledge systems and cultural ideas are often overlooked in favor of dominant views or representations. Digital technologies offer many opportunities to manage cultural heritage; however, in doing so they have also brought issues of differential access to the forefront. Even though more and more people have access to digital information, through personal computers, handheld devices, and so forth, the digital divide, originally defined as the difference between the haves and have-nots, has not disappeared. Moreover, it is now clear that the
issue of access is not merely a matter of who can acquire digital tools and technologies, but it is also a matter of who creates digital content and who has access to such content, for instance, in terms of required education. If digital heritage content serves primarily the needs of an affluent audience, then based on a measure of “content relevance,” the gap may become wider instead of narrower (Judith van der Elst et al., 2010).

Keeping these issues in mind, a number of applications exhibit the advantages of digital technology for cultural heritage compared to traditional ways of storage and curation. Most importantly, new paradigms give rise to novel ways of communication and information exchange that change traditional hierarchies of knowledge production and claims to truth and are not focused just on analysis and preservation but increasingly as spaces for experiencing different times and places. Unlike spatial information systems that are analytical and archival, virtual systems provide a way to experience space and are in principle suited to understand different perceptions of space and time. And unlike geographic information systems which are geometric representations of space and serve analytical needs, virtual environments are developed for experiencing different real-world settings as virtual reality (simulacra). The clearest examples of the advantages of virtual heritage are those that provide an experience of places and objects that no longer physically exist because they were destroyed as cultural symbols in conflict. The Bamiyan project was begun to reconstruct the destroyed Buddha statues in virtual setting; employing high resolution laser scanning of the niches and statue remains in addition to terrain modeling, the researches were able to reconstruct the statues
virtually from the scanned pieces, as well as provide a record of a dramatic event that occurred in 2001 as a consequence of the war in Afghanistan (Baltsavias et al., 2006; Gruen et al., 2004).

The difference between the real and the simulacrum can, however, become blurred (Baudrillard, 1994), if the experience of the simulacrum is favored over the original and considered more real, while the original becomes obsolete in perception in such a case the danger exists of preserving the digital/virtual instead of the original. This can have serious consequences, given that in many such simulations the multi-dimensionality of the original and or original context is not captured and understood (Krause, 2012), even though the replication or reproduction can be enhanced to become a new object (artifact) (Diaz-Kommonen, 2002). It is therefore important to understand the relationship between virtual reconstructions and the physical source.

Technological advances have resulted in more affordable and available data-recording instruments and software that can be used for cultural heritage studies and management, which has led to an increase in digital data, the maintenance of which proves to be one of our biggest challenges. Many of these applications focus on the digital/virtual reconstruction of buildings and smaller artifacts, following a traditional heritage approach. This leads to a data-rich environment that is not paralleled by sufficient methodological innovation to capture what these technologies have to offer. A recent report on the future of sustainable digital development by the Blue Ribbon Task Force addresses these issues; however, the report is concerned primarily with economic issues, while traditional communities
as potential stakeholders in the development of sustainable systems are not specifically included (BlueRibbonTaskForce, 2010) (Judith van der Elst et al., 2010).

**Summary: part I**

Having identified these issues as epistemic and sociopolitical, the focus within what follows in this document is primarily directed toward the philosophical underpinnings (i.e., epistemological consequences) of representational systems used in the case study, but within a broader context of the need for systems that allow for multiple representations and questioning of the old paradigms of collecting and preserving cultural material that may not represent the needs of the majority of the human population. This broader context is based on the history of “contact” of the case study in reference to the value and verification of knowledge within and among different knowledge systems and the resulting hierarchies that underlie current global relations.

In Part I the following issues were addressed:

In Chapter 2, the history of thinking about space and time and perceptions and conceptualizations that have led to our current understanding and consensus of space and time models in scientific thinking were briefly laid out. Cognitive science approaches, especially in linguistics and spatial information theory, have questioned this consensus and initial results point to a fundamental diversity and complexity of human spatial thinking that cannot be attributed to, or explained by, evolutionary “progress.” An increasing number of (nonwestern) scholars have conducted critical studies that indicate that these approaches are too limited to explain the diversity in
human experience, and some examples of practical approaches were discussed that
enrich our academic endeavors.

Traditionally, nonwestern culture, language, knowledge, and practice are studied
within the disciplines of anthropology and archaeology. In Chapter 3 whether
current approaches within these disciplines are suited to address different ways of
thinking as assessed, and it was found that the majority of approaches are divided
along the lines of western scientific dualistic thinking, impeding the inclusion of
diverging models of space-time and experientially based knowledge.

Chapter 4 presented some of the challenges of representation of space and spatial
thinking, addressed from an epistemic and sociopolitical viewpoint within
geographic information science. Many of these efforts overlap with cognitive
linguistic studies in identifying diversity in human spatial thinking, considered a
fundamental domain in human cognition.

Implications for the remainder of this study are:

Based on these findings, a tentative interpretive framework is outlined and will be
expanded upon in the next, methodology part of this document. From this
exploratory approach, in which I will address how histories of the Pueblos have
been constructed, I suggest different approaches and present scenarios that have
been preliminary tested, and generate new hypotheses and ideas for research
approaches.

This framework is built on three research strands: 1) research in Spatial
Information Theory, current effort in which seek to integrate geometric
representations of space with experience of space; 2) psycholinguistic research, as a
stepping stone toward understanding the variation in human spatial cognition, which is presumably cross-modal, but it is in language where currently most research on this topic is conducted; and 3) given the doubt that is raised about previous assumptions, nonwestern philosophies are examined to provide essential insights and opportunities for broadening research, exposing the metaphysical constraints of western (scientific) thought (Figure 5).

Figure 5  Theoretical framework components

The framework will be built on the intersections of the different approaches discussed in Part I, from which the following assumptions can be derived:
• A close relationship between language and thinking exists. Even though whether this relationship is deterministic or not is unclear, it is accepted that language at least influences thinking.

• Based on the Conceptual Metaphor Theory, accepting that metaphor is not a figure of speech but a mode of thought allows the investigation of metaphor underlying multimodal literacy (perception, representation, and communication), questioning the variability in expression of thought within and among modes.

• Knowledge results from different cognitive processes making use of different knowledge sources. Knowledge is shared and validated within intersubjective spheres.

• Spatial categories are based primarily on a combination of affordances and cultural factors, disproving the existence of universal spatial categories based on perceptual salience or environmental determinism.

• The relationship between language, other modes of expression, and culture can be addressed based on these assumptions.

• Worldviews (and knowledge systems) of different communities can be compared through standard philosophical questions.

• Current spatial systems of representation are not designed with diversity of human thinking in mind. (Given that, this research explores whether these systems can be adapted to accommodate different ways of thinking)
PART II METHODOLOGY

The epistemological and ontological foundation of western science is often taken for
granted; nonwestern and indigenous methodologies are often set apart on
sociopolitical grounds, as many indigenous methodologies are rooted in Critical
Theory and decolonization efforts (Denzin, Lincoln, & Smith, 2008), often employing
qualitative research methods. According to Wautisher (Wautischer, 1998a), this
focus is often at the expense of the significant philosophical differences that underlie
these approaches. These issues, related to philosophical differences are for instance
addressed by Agrawal (Agrawal, 2002), who investigates the way politics and
philosophical underpinnings are intertwined in (scientific) classification schemes,
for example, biological databases.

The discussion in Part I, connecting research developments in the fields of spatial
information science, psycholinguistics, and American Indian philosophical
discourse, provides the theoretical underpinning that validates the research
question. Several insights regarding the relationship between perception,
conceptualization, and representation, outlined in the discussion in the previous
chapters, form the foundation for Part II, the practical component of this research.
Specifically, empirical research results regarding two subdomains [non-coordinate
including toponyms, deixis, and topology; and coordinate, e.g., spatial Frames of
Reference [FoR]] of human spatial cognition provide insights that require
reevaluation of long-held assumptions that have profound implications for cultural research.

Research strategies that are being developed to further this research within the broad disciplines of linguistics, spatial information theory, and neuroscience are only tangentially applicable to archaeological research problems. These recent insights are therefore combined and adapted to outline an interpretive ad hoc research framework which allows for broadening these strategies to address identified aspects related to spatial cognition as environmental design problems for the case study. As proposed by Levinson (Levinson, 2003), differences in spatial cognition (frames of reference and ontology) are not only influencing or even determining other cognitive domains, but also underpin the organization/design of the physical environment as a representation of that conceptual framework. The challenge is to devise methods to explore the structure and content of non-linguistic representations of the domain.

Rising up to this challenge, the second, methodological, part of this thesis is comprised of four chapters and outlines means and methods for addressing spatial representation and organization of the Rio Grande landscape as it falls within the domain of archaeological research. Its objective is to generate, develop, and preliminarily test ideas regarding different spatial concepts that underlie spatial organization of material considered part of the archaeological record. Indication of the characteristics of the spatial conceptual framework for the material studied for the case study is based on American Indian philosophical discourse and the fact that languages spoken belong to language groups other than Indo-European that can be
compared with traditional archaeological approaches. A connecting theme in indigenous discourse is the connection to the land, encompassing the role of community, and the specific nature of that connection, in which the spatiality is emphasized more so than the temporality, which is considered more important in a western conceptualization of linear history. A connection however, that is lost in Western thinking according to Schama (Schama, 1995), with detrimental effects. The approach used here to explore spatial conceptual differences therefore specifically focuses on representation, communication, and characteristics of ecological relationships (Black, 2011; G. Cajete, 1999).

Methodology identifies specific practices in pursuit of knowledge or scientific support for the posed thesis (and can be considered the practical side of metaphysical epistemology). It therefore not only refers to methods used, but also includes the theoretical underpinnings that inform the research design. Methodology is important, as argued by Smith (L. T. Smith, 1999, p. 143), because “it frames the questions being asked, determines the set of instruments and methods to be employed, and shapes the analysis.” Considered in this way, the methodology used determines the nature of the resulting body of knowledge gained through research.

*Spatial cognition: frames of reference and ontology*

Research on spatial navigation is conducted within the broad fields of geoscience and neuroscience; insight obtained in neuroscience, however, is in large part based on experimental research conducted with other species, but also on spatial
awareness of human subjects tested in virtual environments. The distinction between *egocentric* (from the viewer's) and *allocentric* (outside the viewer's) perspectives or frames of reference used is one of the most salient parameters in research in cognition and spatial navigation. Whereas certain studies have found that individuals employ a certain framework consistently in both linguistic and nonlinguistic modes and tasks, others have found variable results between, and even within, spatial description tasks (Kataoke, 2001).

Research on spatial navigation and perspective taking and linguistic coding to spatial cognition is finding common ground. The three main frames of reference used in studies initiated by the Max Planck Institute are *intrinsic*, *relative*, and *absolute*, and initial findings have shown that in representing space linguistically, different language groups use different frames of reference, –one or two but never all three, and never absolute and relative as a pair. In an effort toward an integrated approach, research on spatial perspective taking/navigation has sought to identify common features between linguistic and spatial behavior research. Egocentric and allocentric perspectives, where allocentric can be subdivided into survey and route perspectives, are suggested to correspond generally to the three main linguistic frames of reference.

Research indicates that in spatial navigation tasks survey and route perspectives are often used in tandem, with a general observation that in environments at multiple scales and routes a survey perspective is often preferred, whereas in single route, single scale environments a route perspective is favored (Kataoke, 2001). Given the description and ethnographic examples of use of absolute frames of reference,
however, this effort toward integration seems to exclude some salient aspects of spatial competence demonstrated in individuals who use an absolute frame of reference in linguistic coding, in which the speaker’s view is irrelevant to the encoding and decoding of spatial relations (Kataoke, 2002). Notably, the use of an absolute frame of reference has never been identified in speakers of Indo-European languages.

In addition to this issue, there are two important factors that, due to current lack of adequate knowledge, inhibit an integrated approach. First, even though several studies have shown a correspondence between linguistic coding and gestures (Levinson, 2003; McNeill, 2005), little is known about the implicit relationship between spatial perspectives and other modalities of mind. Second, studies on spatial behavior and navigation are often conducted in controlled (virtual) environments and/or urban settings, but rarely in natural environments, a different kind of context that requires different conceptualization (Kataoke, 2001, p. 66). The latter may be correlated to the lack of understanding of the use of absolute frames of reference. This research builds on previous research by focusing on the ecological aspects that need to be addressed.

Conceptual Metaphor Theory and the underlying conceptual framework

In an effort toward understanding spatial aspects of cross-cultural differences, Conceptual Metaphor Theory allows for consideration of conceptual frameworks as underpinning multimodal representation. Many ideas and thoughts are expressed in spatial terms, that is, as spatial metaphors, indicating that the spatial domain is
fundamental in structuring our conceptual framework and can be hypothesized as being cross-modal; that is, a single conceptual framework underlies linguistic as well as other modal expressions of a culture. Initial research efforts are focused on still and moving images and sound/music (Ashley, 2004; Forceville & Urios-Aparisi, 2009; Lakoff & Johnson, 2003). The implication is that meaning is represented and communicated (discourse) in other modes besides language, where mode (or modality) is difficult to define but generally indicates both somatic (gestures, speech) and extrasomatic (artifact) representation such as images, still or moving. According to Forceville and Urios-Aparisi (Forceville & Urios-Aparisi, 2009), however, one mode’s potential to render “meaning” can never be translated completely into that of another, as both have inherent possibilities and limitations as to what they can convey. The choice of modes or mode complex used for representation therefore has inherent epistemological implications (G. Kress, 2010).

*Multimodality and the applicability to archaeological research*

If, within cultural modal complexes, a single conceptual framework underlies their material manifestations, material expressions studied as part of archaeological context can be evaluated based on a variety of “knowns”: knowledge about different modal expressions within the same context; knowledge of the same or different modal expressions in different temporal contexts, provided that conceptual continuity can be assured. Based on the strong correlation between spatial language and spatial cognition and given that spatial cognition is a fundamental cognitive domain, linguistic continuity serves to assure conceptual continuity.
Multimodality as social semiotic approach

Knowledge is gained through different modes of representation, each with its specific reach and affordances for meaning making, and in discourse (knowledge is considered to be socially constructed). The emerging theory of multimodality as a social semiotic approach asserts, among other aspects, that different cultures have different modal constellations to pursue knowledge, and given that the choice of modes has epistemological implications, it follows that differences in knowledge result from these efforts. Current developments in representation and communication technologies have elucidated that the use of a single mode, such as written language in scientific discourse, is limiting our ability to understand the world and has generated new ideas regarding what knowledge is and how it is produced through multimodal expression and communication. The challenge of multimodal research is to understand the epistemological implications of multimodality within a framework that is general enough in its terminology to encompass all modes of semiotic production.

Adapting a multimodal framework for this research accomplishes two things simultaneously: 1) it addresses the sole reliance on written language to obtain scientific knowledge that has dominated and determined archaeological research results, and 2) it allows investigation of other modes of expression in the pursuit of knowledge. In other words, it acknowledges that certain aspects of spatial understanding are only understood in specific modes, and that written language is no longer believed to cover all meaning.
In such a new configuration of information sharing and knowledge production (Urry, 2007), design has come to the forefront (replacing competence and critique) as playing a central role in multimodal knowledge production, where the process of representation is identical to the shaping of knowledge (G. Kress, 2010, p. 27) (and production is the implementation of design with the resources available in the world in which the communication takes place) “In an unstable world with differing distributions of power, design offers a paradigm which keeps the insights offered by critique and turns them into means for action in the designer’s interest, an interest focused on the future” (G. Kress, 2010, p. 22).

_Design paradigm:_

Multimodality as a theory advocated by Kress (G. Kress, 2010; G. Kress & VanLeeuwen, 1996) can be considered a mutation of discourse analysis, and as a social semiotic approach it is indebted to the triadic Peirce model of semiotics. The developmental history of this “mutation” is thoroughly discussed by Iedema and the term multimodality “was introduced to highlight the importance of taking into account semiotics other than language-in-use, such as image, music, gesture and so on” (Iedema, 2003, p. 33). The aim of a social semiotic approach is based on the presumption that members of communities have access to the semiotic and other cultural resources essential to act in their social world on their own behalf and for their own benefit and that technologies of representation and communication are subject to social, cultural, economic, and political givens (G. Kress, 2010). In addition as members of a community (e.g., science, ethnic), however, each member should be
able to contribute by designing, representing, and communicating solutions to new cultural, semiotic, and social problems (G. Kress, 2010, pp. 18-19).

Design as a new paradigm for communication is based at least partially on equitable participation in the shaping of the social and semiotic world. Current technological developments (communication and geospatial technologies) demonstrate the reshaping and restructuring of sign and meaning making where former consumers now also become producers of content. An example of such restructuring is the rise in participatory research efforts, in which different stakeholders collaborate as equal partners toward a common goal, incorporating research, reflection, design, and implementation as an iterative process (Judith van der Elst et al., 2010). This process of research that taps into different ways of creating and sharing knowledge can otherwise be thought of as design thinking, which, rather than being a series of sequential steps, takes place in a system of spaces: inspiration, ideation, and implementation.

Whereas inspiration encompasses the problem or opportunity that motivates people to search for solution through careful observation and dialogue, within the ideation space insights are distilled through synthesis that can lead to new ideas for solving the problem. The implementation space turns the best ideas into concrete plans (T. Brown & Wyatt, 2010). As an exploratory research design, my research operates primarily within inspiration and ideation spaces. It seeks new avenues for system design that can incorporate different ideas of space and time based on understanding of perceptual grounding of ways of knowing.
Framing this research as a multimodal approach has several implications, and provides several new ways for approaching the research question posed: 1) material cultural expressions in the archaeological record can be considered as representations of a specific conceptual framework, even though the “reach” of different modes can vary – modes include architecture, but also dance and pottery; 2) American Indian philosophical discourse provides guidance in the nature of differences between conceptual frameworks; and 3) insights gained (1 and 2) encourage multimodal research design (epistemic expansion) of future research methodologies.

To develop the understanding of ecological relationships, the participation of humans in the larger biosphere, multimodality as a social semiotic approach is placed within the context of biosemiotics. Both a social semiotic and biosemiotic approach are rooted in a Peircean model: i.e. “the idea that the basic structure is a triad of sign, object, and interpretant, and that making sense [of signs beyond human-made symbols] is an essential component of semiosis” (Barbieri, 2009). A semiotic system can then be understood as a linking of two worlds, one perceived and one represented by means of established (code) or rules, where there is no deterministic relationship between sign and meaning.

*Notes on Research design:*

The above elements provide the ingredients to form a provisional interpretive framework to outline a research design as a mixed methods approach (Creswell, 2007), in order to explore the structure and content of nonlinguistic representations
of spatial knowledge, and to generate and test ideas regarding spatial concepts underpinning cosmology of the Ancestral Pueblo communities of the Northern Rio Grande and the possibility of exploring these ideas within current spatial information systems.

The practical approach is based on the asserted epistemological consequences of cross-cultural differences in modes used for representation and communication (G. Kress & VanLeeuwen, 1996). Understanding of these consequences is still in its infancy, as the exclusive focus on written text in scientific discourse has affected our ability to employ and understand other modes of meaning-making, including that for pursuit of scientific knowledge. An exploratory framework is outlined specifically for this research, based on multimodality research within a larger framework of biosemiotics that aids in furthering this approach for archaeological and anthropological research. Biosemiotics has developed out of a realization of the inadequacy of the ecosystem approach for addressing meaning and intention in the biological world, and serves here to encompass perceptual worlds beyond human-to-human relationships, primarily to include the relationship between humans and their surroundings.

To investigate the nature of epistemological differences between the archaeological research community and descendant Pueblo communities for the case study, the research design should therefore also include ways to distinguish between political and epistemic factors in order to distill spatial cognitive characteristics that can be used to test the possibilities and limitations of geospatial technologies and representations for understanding human spatial cognition at large. A mixed
methods approach provides a means to distinguish these different factors within the case study discussion, which furthermore provides an overview of archaeological research, but this is set within a larger context of cultural resource management and national policies affecting self-determination of indigenous populations.

Within the exploratory analysis in Chapters seven and eight, the focus is then on understanding spatial perception, its ontological effects, and epistemological implications for exploring the design of space and its underlying principles.
In his mathematical story *Flatland*, exploring the fourth and even higher dimensions, Abbot (Abbott, 2006), originally published in 1884 describes a two-dimensional world inhabited by geometrical figures, all of which have the ability to think, speak, and have human-like emotions. The different inhabitants in Flatland all occupy a different dimensional world: Square, Line, and Point have adventures in Spaceland, Lineland, and Pointland, respectively. In Flatland, however, all the different forms are recognizable only as Lines, thus as all forms and dimensions can only be seen from a specific dimension (or single reality); their true character cannot really be appreciated, such that line, triangle, and square look just the same.

As stated in the Introduction to this research document, the overall objective is to identify and better understand the factors underlying disagreement in the creation of Indigenous histories, in general between western scholars and indigenous scholars and communities, and more specifically, as relevant to histories of the Pueblos as reconstructed and manifested through archaeological research and Indigenous responses and critiques of those reconstructions, serving as the case study in the next chapters. The approach taken to address this problem is based on the assumption that disagreement in scientific research often is due to different worldviews among researchers (and between researchers and researched community) who increasingly come from different cultural backgrounds, with inherently different conceptual frameworks underlying their respective research efforts, and different means of fixing meaning. This increasing realization of fundamental conceptual differences has first of all an effect on development of
future scientific methodologies, which are currently still dominantly western-oriented, (reductionist, therefore limited), but furthermore it impacts (and can expand) our ability to understand and interpret cultural material remains that originated from different worldviews. A methodological strategy centered on multimodality allows epistemological differences to be hypothesized by studying cultural representations focused on the spatial domain, based on the notion of a reflexive relationship between cognition, epistemology, and representation (Table 3).

Table 3 Research Overview

<table>
<thead>
<tr>
<th>Qualitative Analysis</th>
<th>Quantitative Analysis</th>
<th>Topic addressed</th>
<th>Main Research Reference</th>
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<tbody>
<tr>
<td>Evaluating conventional models of cultural ideas</td>
<td>Testing conventional systems of spatial analysis and representation</td>
<td>Multimodality</td>
<td>Spatial Information Theory</td>
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<td>Interventions</td>
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<td>Critical Interventions</td>
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<td>Maps and Mapmaking history and conventions</td>
<td>Mapmaking has developed into current standards of practice of geospatial technologies</td>
<td>Vector and Raster models</td>
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<td>Landscape Categories and Toponyms</td>
<td>Ontology / Categories / Objects</td>
<td>Mundy</td>
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<td>Objects</td>
<td>Differences in spatial understanding and representation and its functions - worldview models and its position</td>
<td>Levineon 2008</td>
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<td>Morphology</td>
<td>Ontological basis of landscape categories and placenames</td>
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<td>Affordance</td>
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Efforts in the previous chapters were focused on elucidating issues surrounding human spatial cognition: its purported universalism as an assumption in many
spatial theoretical and experimental studies and the implications of its demonstrated differences among language groups. Situating critical Indigenous approaches within this context, it was argued and shown that through a better understanding of the relationship between spatial cognition and representation, these issues can be addressed practically. A multimodal framework supports this effort.

In this chapter the methodological strategy for the case study is outlined, linking the theoretical discussion in previous chapters with a practical framework and associated methods to explore the nature of spatial representations and the message(s) these representations communicate. A multimodal framework as social semiotic approach is framed within a larger context of biosemiotics to encompass ecological dynamics (dialogue, discourse) providing the parameters within which the specific qualitative and quantitative methods are defined. Whereas “social semiotics is concerned with the way people use semiotic ‘resources’ both to produce communicative artifacts and events and to interpret them in the context of specific social situations and practices “ (O’Halloran, 2008), biosemiotics as an overarching research agenda allows the investigation of the myriad forms of communication and signification found in and between living systems. It is the study of representation, meaning, sense, and the biological significance of codes and sign processes, including human semiotic artifacts such as language and abstract symbolic thought. It introduces meaning in the discipline of biology, in the study of human behavior (Studies).
Whatever an organism senses also means something. The semiosphere, a concept within this research agenda, indicates the world of meaning and communication in which each organism occupies a semiotic niche and will have to master a set of signs of visual, acoustic, olfactory, tactile, and chemical origin in order to survive in the semiosphere (Hoffmeyer, 1997; Studies).

By adapting and contributing to the theoretical framework of multimodality, the exclusive focus on a single mode and specific conceptual framework in western scientific knowledge pursuit (Gillings & Goodrick; G. Kress & VanLeeuwen, 1996), and the implied epistemic limitations of this focus, can be addressed. Positing that scientific methodologies are often narrowly focused (stressed in a number of recent research publications across disciplinary boundaries and in different aspects of research (Ruse, 2005), the specific objectives in this chapter therefore are to:

1. **Show how**, within the context of multimodal research framework (5.1)

2. **Outline an exploratory mixed methods research design** within a multimodal framework to: (5.2)
   a. Identify possible ontological and orientational differences (*qualitative component*), and (FoR and spatial ontology (5.2.1.)
   b. Explore potentials and shortcomings of past and current systems of spatial representation to analyze these differences for the case study (*quantitative component*) (5.2.2)
Specifically, a mixed methods research design, comprising a qualitative and a quantitative component, is outlined in this chapter. Through this research design the theoretical issues introduced in earlier chapters will be investigated through several practical examples (as design problems – not necessarily sequential). Through a better understanding of multimodal aspects in knowledge production, research frameworks can be broadened, mediating cross-cultural dialectics.

**Paradigmatic requirements**

In general, all research conducted within a specific research paradigm shares an ontological and epistemological foundation. In short, epistemology and ontology are closely related metaphysical components; epistemology (as the theory of knowledge) is concerned with how we know what we know, (e.g. empiricism), whereas ontology is concerned with the nature of reality (and encompasses and determines category making, and is fixed in modes). Within modern science a broad ontological distinction can be made between objectivists and subjectivists; the former assuming that there is one (knowable) reality that can be discovered, whereas the latter recognizes the existence of multiple realities dependent on the observer. As expressed by Abbot this means that by taking an objectivist stance, flatland is the only recognized world, and fundamental categories are uncontested. Scientific discourse (and learning) is still largely organized based on the classic understanding of logic, grammar, and rhetoric, which provides structure and stability in its objective of competence. Where “competence leaves arrangements unchallenged in the objectivist ontology, critical approaches or critique are oriented backward and towards superior power (challenging objectivist ontology),
concerned with the past actions of others and their effects” (G. Kress, 2010, p. 6).

Whereas many archaeological studies, emulating physical sciences and employing economic approaches, are conducted within the general confines of a objectivist ontology and post-positivist paradigm and primarily employing quantitative methods, pragmatism is in general considered the most suitable paradigm for mixed methods research approaches; critical approaches across disciplines are mostly conducted within pragmatic parameters.

Within a paradigmatic context of pragmatism, the question and consequence of research take precedence over a specific analytic method, and diverse methods are used to address the research question, the dialectic method is its means of justification. Research within a pragmatic paradigm, following Rorty, is critical of the philosophical idea “of knowledge as representation, as a mental mirroring of a mind-external world” (Ramberg, 2009).

Design, as a new paradigm, moves away from the semiotic goals of both competence and critique, but builds on insights from both. As such it underpins a theory of communication and meaning based on the potential of equitable participation in the shaping of the social and semiotic world (G. Kress, 2010, p. 6).

5.1 (Escape) Flatland

The moral of Abbot’s tale underlies the specific research question of whether current systems of representation of space-time and geospatial analytical technologies that are (here purported to be) based on western concepts are suitable
for investigating, understanding, and representing different conceptualizations of space-time or worldviews (given that all technologies come with preconceived notions of space-time (McLuhan, 1964). The consequence of conducting research employing a multimodal approach within a design paradigm is that new or different structures and terminology need to be adopted.

Current research methodologies can be considered limited due to their restrictive use of modes of representation (language, grammar) and dissemination (rhetoric) and reliance on those for validation (logic). Increasingly, scientific visualization is considered as a complementary or even an alternative means to gain insight and perspectives into existing research problems (Card, Mackinlay, & Ben, 1999; Ware, 2000). This focus on the visual sense has similarly drawn criticism, as being based on an unfounded assumption of the visual sense as the prime perceptual source of knowledge in human thinking (Gillings & Goodrick), even though the idea that different modes of representation carry epistemological consequences and that the relationship between the sensoral and perceptual information sought and the representation of that information is unclear. Several studies in neuroscience have employed VR–VE technologies (immersive environments) to test the relative importance of sense stimuli in experimental settings. While these research efforts are motivated by different research questions, a general trend indicates that, for instance, for successful spatial navigation/behavior, the visual sense is but one source of information, neither significantly more important, nor essential (Gell, 1985; Gluck, 1991; Janzen & van Turenhout, 2004). (Hutcheson & Allen, 2005). (Amedi, Malach, & Pascual-Leone, 2005)
Moreover, what we know is a matter of how we know it: taking the spatial domain as the fundamental domain for our thinking, the creation of “media” of perception, and in sharing representations (in dialogue) some form of realism is assumed, such that it is argued that the metaphysical grounding must be limited by the physical world and everything in it. This metaphysical grounding is taken from coherence between knowledge and the nature of the world of objects and of other minds, as argued by Trigg (Raper, 2000, p. 32). One such coherence model that has long dominated spatial representation and perpetuated in modern science is rooted in the conceptual separation of space and time (in western philosophy) that resulted in the development of Euclidian geometry and eventually the dominant two-dimensional representation of geographic space during the Enlightenment in Europe (Ascher, 1991; Krause, 2012).

This raises the question whether the widespread use, and the dominance in development, of –visual, two-dimensional geographic representation is a function of technological factors, cognitive factors, perceptual factors, or a combination of these. Only recently has doubt arisen about the notion that spatial cognition is universal across human populations, and cognitive science and spatial information science thus far have been based on the idea of universality in spatial reasoning and understanding. Within this frame of understanding the two-dimensional map representation was argued as rooted in “naïve geography” for modeling common-sense knowledge and, by extending the “naïve physics” model, Egenhofer and Mark (Egenhofer & Mark, 1995) formulated a number of axioms for ‘naïve geography’ which included the following: “naïve geographic space is two-dimensional, implying
that the horizontal and vertical dimensions are decoupled and that the third
dimension can be reduced to a \( n \) attribute of position; the earth is thought of as flat
because the shortest path on a sphere is not part of common-sense knowledge;
geographic space is better represented by a map-based configurational view of
space than by memories of our experiences” (Raper, 2000, p. 37), (now being
revised, primarily by Mark). Since then substantial revisions have been made,
notably by the authors themselves. Also, Levinson (Levinson, 2008b), has argued
that due to differences in category making and frames of reference in different
language groups, the use of current spatial technologies to understand these
differences may be inappropriate.

Raper furthermore argues that technologies are no longer limited by two
dimensions, while others have demonstrated that stories are better mnemonic
devices for navigation than cartographic maps, an idea also supported by research
indicating that our mental space is not Euclidean.

Furthermore, as argued by others (for instance, (Short, 2004), these developments
were equally driven by colonial programs in which the commodification of land,
navigational needs, and annexation of colonial territory directed innovations in
surveying and mapmaking technologies, envisioning while at the same time
appropriating a new world (B. Schmidt, 2001; Short, 2004). Indigenous scholars
have specifically criticized this geometric representation of space-time as a key
epistemological difference (Black, 2011; L. T. Smith, 1999; Waters, 2004b).
In summary, as a fundamental cognitive domain, differences in spatial cognition indicate different worldviews. Spatial concepts are expressed through language, from which frames of reference and spatial ontologies can be inferred (Levinson, 2003), but are largely assumed to crosscut several cognitive modalities, such as language, imagery, music, tactile perception, and motor activity (Ashley, 2004; Forceville & Urios-Aparisi, 2009; Kataoke, 2002; Lakoff & Johnson, 2003; McNeill, 2005), and it has been empirically shown, for instance, that the same spatial frame of reference underlies both language and gesture, within single cultural contexts. Moreover, the existence of significant spatial cognitive differences between language groups generates additional questions regarding spatial (worldview) representation: 1) which technologies of encoding are used and preferred within a culture, based on what sensoral information and modes of perception, and 2) how is cross-modal translation within and between cultural complexes structured. This aspect (representation) is addressed within the emerging theory of multimodality, which has as one of its tenets that different cultures employ different modal constellations and that the choice of modes used carries epistemological implications (G. Kress, 2010; G. Kress & VanLeeuwen, 1996). In other words, modes chosen and used each allow different knowledge to be gained. For instance, as a general comment, Ware (2000:319) notes that images are better for representing spatial structures and words are better for representing procedural information; that is, a mode can be considered to have a specific epistemic and semiotic reach, although this “reach” is not uniform cross-culturally (G. Kress, 2010).
As (natural) language has long been considered as a mode that can express all meaning, and deep structure of language was purported to be universal (Cook, 1988), reason and logic mediated through written discourse is hardly contested to be the sole means for attaining scientific knowledge, though increasingly the role of creativity in knowledge construction is being considered as equally valid (Hollingsworth, 2007; Ox & Elst, 2011; Sales et al., 2007), and initial findings indicate its importance in innovative research. The scientific method using empirical observation as a key component upon which many knowledge claims rest is primarily dependent on a single mode of representation. Even though well established and its method thoroughly understood, it is now faced with epistemologically related challenges, including:

1) Language is no longer believed to enable expression of all meaning

2) Languages can differ significantly, correlated with underlying conceptual frameworks and modal reach

3) Innovative research often is conducted by scholars who demonstrate well-developed cognitive capabilities beyond logic and reason

4) Current representation and communications technologies require other cognitive abilities and modal skills to express different meanings.

The emerging theory of multimodality (Kress and van Leeuwen as protagonists) as a social semiotic approach to representation and communication aims to provide a structural framework within which these issues can be addressed, because due to the poor understanding of 1) knowledge gained through other senses, 2) representation of that knowledge in other modes, and 3) the reflexive relationship
between these, a lack of appropriate terminology, for instance, inhibits understanding of cross-modal and cross-cultural communication and knowledge transfer (Figure 6).

5.1.1 Components of a multimodal framework

Within scientific discourse, language as a mode of meaning-making has long dominated and provided structure and certainty for knowledge validation. Due to the recent and continuous changes in means of communication that encompass social, economic, cultural, and technological domains, multimodality has quickly come to the forefront as a research interest constituting a complex phenomenon with profound consequences for learning, and shaping information and knowledge.

In a social semiotic approach the focus is on human sign making as cultural artifact, the aspects of which will be discussed first. Framing this within a biosemiotic context expands this frame to include signs perceived and sent by all organisms. Accepting the concept of semiosphere, the biosemiotic context allows the investigation of the differences in environmental perception as a source for evaluating socio-semiotic means of representation, as these are assumed to be intricately related (Kull, 2010).
As a social semiotic approach, language is no longer considered to cover all meaning. Different cultures employ different modes, and modal constellations to convey information meaningful within a cultural setting.

Figure 6 Linking Multimodality with spatial cognition
5.1.2 Multimodality as Social semiotic approach –

terminology

In academic settings the realization that language may not cover all meaning raises important questions about how and what kind of knowledge can be gained by engaging in other modes of meaning-making, in every day use as well as through restructuring scientific discourse. Knowledge and text are traditionally linked and the division between knowledge producers and consumers in that structure is clearly defined as a difference in competence; where those social structures were inequitable, though firm, new media technologies (where all technologies have embedded within them their specific assumptions of space and time (McLuhan, 1964) now allow consumers to become producers. In this changing distribution of power offered by digital technology, Critique of linguistic text as a means of opposing conventional knowledge structures now gives way to Design as a means for action, for participating in a communicational world with the intent of change (of knowledge) for the future. A theory of multimodality seeks to understand the affordances of different modes and modal ensembles for meaning making and knowledge production and to provide a framework within which this information and knowledge can be evaluated with a specific focus on cross-cultural differences, (meaning and arrangements as overarching labels in the theory) (G. Kress, 2010; G. Kress & VanLeeuwen, 1996).

For instance, what is covered semiotically by language differs from language to language and from culture to culture; language is but one mode of making meaning, and certain domains are considered beyond the reach of language. Moreover,
representations of meaning differ among cultures; semiotic resources, (modes) used for such representation thus comprise different “modal constellations”, where each mode can cover a culture-specific semiotic “region.” Therefore, as argued by Kress, “we have to begin looking at the field of meaning as a whole and see how meaning is handled modally across the range of modes in different societies” (G. Kress, 2010, p. 11).

Several scholars, but specifically Kress and van Leeuwen, have suggested and/or outlined new terminology for multimodal discourse, considering transcription, cross-modal and cross-cultural translation or any combination of these for which language analogs are not sufficient and/or are too restrictive (Forceville & Urios-Aparisi, 2009; G. Kress & VanLeeuwen, 1996; O’Halloran, 2008).

As each mode offers different potential for meaning-making, it uses mode-specific organizational rules. For instance, language consists of words organized through grammar and syntax. Writing and speech, both governed by these rules, are distinguished by their respective use of graphics and sound to express thought or message, each offering distinctive resources to shape its meaning. The spoken word, for instance, is shaped by the use of variations in loudness, rhythm, and pitch. Cross-modal translation of these specific resources is possible; for instance, “loudness” in written text is often visualized by using capital letters. (e.g., in phonetic notation, one cannot translate everything from sound to visual). Visualization, as a cross-modal translation or metaphorical mapping, thus employs specific visual resources, for another example, color to express “loudness,” can then be reversed as sonification (Forceville & Urios-Aparisi, 2009; Ox & Elst, 2011).
The “rules” for doing so, that is, for cross-modal translation, are not well understood and can be individual, in the absence of convention, or culture-specific, or potentially universal. However, as argued by Forceville and Urios-Aparisi, “one mode’s potential to render ‘meaning’ can never be completely ‘translated’ into that of another one and sometimes [translation is] impossible” (Forceville and Urios-Aparisi p4). The adoption of implied language-specific rules, for example, “visual grammar,” “space syntax,” may therefore inhibit a full understanding of the epistemic and semiotic qualities of specific modes (and cultures). Therefore, “We cannot afford to let older ‘language-based’ thinking to constrain how we see a mode, in a semiotic theory” (G. Kress, 2010, p. 92). The components of a multimodal framework described below are summarized primarily from the outline of a theory of multimodality as social semiotic approach by Kress.

Semiotics, as the study of signs, is intricately related with modality, where modes are semiotic resources beyond language to make meaning material and allow meaning to be transmitted through different carriers or media. This process of carrying meaning through the use of codes, including words, gestures, images, and performances, the meaning of which is agreed upon within a community, is therefore socially constructed in discourse. In a social-semiotic multimodal framework, *discourse, mode, and genre* provide the basic structural elements in a theory of representation and communication. Discourse functions as a resource for constructing epistemological coherence in texts and semiotic objects, and knowledge is shaped and produced by the specific
perspectives of a particular institution (e.g., science, law, education). Discourse is encountered in semiotic objects such as text, buildings, and ritual and answers the questions, “What is the world about? How is it organized as knowledge?” Within a social semiotic multimodality approach, a mode is a socially constructed and culturally given semiotic resources for making meaning, and in their varying affordances, make it possible to make meanings material with specific ontological effects, according to the intentions of rhetor and designer. “It [a mode] is shaped by and carries the ‘deep’ ontological and historical/societal orientations of a society and its cultures with it into every sign.”

“The term genre addresses the semiotic ‘emergence’ of social organization, practices and interactions. Genre answers the question: who is involved as a participant in this world, in what ways, what are the relations between the participants in this world” (G. Kress, 2010)? Therefore, according to Kress, meaning is fixed materially and ontologically/semiotically as mode; institutionally and epistemologically as discourse; and socially in terms of apt social relations, as genre.

Several other concepts are important in a multimodal framework. Framing refers to which modes are used to fix meaning; as each mode has its specific means for framing, a social-semiotic theory of multimodality is required to elaborate these means. Linking as a major resource for meaning-making refers to realizing relationships of various kinds, through action between entities: humans, objects, phenomena, or processes in any combination of these; the range and kind of such relations vary from culture to culture. Actions and processes happen in time and
they “take place” somewhere, in social, semiotic, and physical space; they have temporal and spatial location. A semiotic theory has to provide resources to indicate the locations of participants, actions and events; the terms “orientation” and “deixis” are suggested by Kress. Cultures and modes in cultures vary widely in their development and use of these features (G. Kress, 2010, p. 117), rooted in differences in spatial cognition, for example, different FoR and spatial categories (Hutchins & Hinton, 1984; Levinson, 2003; Majid et al., 2004; Pederson, 2003). Linking entails and rests on classification, where Classifications reflect the social organization, which has produced them and which is constantly reaffirmed, remade, and naturalized through them. In any one society and its cultures, classification and the forms of arrangements available are strongly related.

Metaphor structures thought and action and (as frame) is one of the major categories of a social-semiotic approach and initial studies of “multimodal metaphor” provide support for the idea that conceptual frameworks are consistent within modal constellations (Forceville & Urios-Aparisi, 2009; Lakoff & Johnson, 2003). Moreover, the choice of modes that are used to “fix” meaning, whether for science or everyday use, impacts our worldview significantly. That is, “once a particular means of ‘fixing framing’ has become habitual it is likely that the world represented through these modes and genres comes to be seen as “natural” (G. Kress, 2010, p. 95).

Transcription – Translation

Instead of using linguistic terminology, an overarching term for modes of representation suggested by Kress is to refer to them as “technologies of
transcription,” indicating the way thoughts are made material in modal design. The digital media of representation facilitate the use of many of such technologies (G. Kress, 2010, p. 97). Transcribing though, may be too close to “writing”, therefore another term adopted in this document is “technologies of encoding.” To understand the meaning effects – ontological, epistemological, social – of these different technologies of encoding beyond language is a major challenge in modern communication, but it can be considered equally applicable and challenging to cross-cultural understanding, past and present.

For example, “writing as mode and book as medium have shaped western imagination and forms of knowledge; the technology of writing has shaped the book, and the technology of the book has shaped how writing has developed.” (Cartwright, 1999; G. Kress, 2004). The current shift to the visual mode and the medium of the screen has “profound effects on human engagement with the world and forms and shapes of knowledge” (G. R. Kress, 2006, p. 1), and choices made during the development of these technologies have inherent and profound limitations for meaning making (McLuhan, 1964).

Even though writing is expressed visually, its underlying logic is considered more related to spoken word than to visual imagery. Within a framework in which (Euclidian) space and time serve as organizational axes, alphabetic writing and speech are governed by the logic of time, whereas image in contrast in governed by the logic of space (Ware, 2000). As Kress thoroughly discusses, choosing and employing different modes provides different affordances with significant epistemological consequences. Words, as described by Kress, (G. R. Kress, 2006, p.
3) are relatively empty of meaning, but are filled with meaning by our imagination, and even though images are full of meaning and less restricted in terms of sequence or reading path, “spatial rules” underlie an image and whether these rules are universally applicable, as is often assumed, can be questioned (G. Kress & VanLeeuwen, 1996). Regarding whether “layout” (spatial configuration) is a mode, it is stated that the disposition of elements in a framed space – a page, or a screen – does not “name” as words do, and it does not “depict” as images do. It does, however, arrange information in semiotic space; it positions semiotic elements and their relations; it orients viewers/readers to classifications of knowledge, to categories such as “centrality” or “marginality,” and to relationships that create categories (G. Kress & VanLeeuwen, 1996, p. 92).

Even more so, if organizational axes other than space and time can be anticipated (Thornton, 1997), as linguistic research suggests, these epistemological consequences likely take on different dimensions, and these basic categorizations of temporal-linear and spatial-hierarchical may be too simplistic and based on (an unfounded assumption of) Euclidian configuration of our mental space (Fernandez & Farell, 2009). In addition to imagination, speaking and listening to spoken words or stories requires memory, which involves not just memorization but also a command of a body of knowledge to permit improvisation (Blesser & Salter, 2007).

In addition to technologies of encoding, meaning can be moved between modes used, assuming overlap of modal reach. Translation (or “metaphorical mapping”) as an overarching term indicating a process in which meaning is moved, is subdivided
by Kress into *transduction* and *transformation* as two kinds or ways of moving meaning. Transduction moves across modes and changes entities, involving a change in ontological orientation (e.g., temporal to spatial). Transformation refers to translation within a mode and therefore stays within the same logic (G. Kress, 2010, p. 124). However, it is not clear how Kress understands the nature of cross-cultural differences, and based on significant differences in the spatial cognitive domain across language groups, it seems valid to add another term to indicate instances of simultaneous cross-cultural and cross-modal translation for the purpose of this research. The term I will provisionally use to indicate such instances is *transcoding*, encompassing orientation, deixis, and classification. The insight provided by psycholinguistic empirical studies can thus provide another level to the multimodal framework.

How meaning is realized in modes thus depends on history and culture, and given that most of our knowledge of meaning making is based on linguistic analysis, and to a lesser degree art historical studies, little is known about the diverse relationships among other modes of perception and representation. A biosemiotic context can provide a broader framework within which to consider these, and how the choice of modes of representation is linked to our modes of perception and sensory integration (Hoffmeyer, 1997; Neuhoff, 2004b; Stein & Meredith, 1993).
5.1.3 Aspects of biosemiotics that enhance a social semiotic approach

For this research it is paramount that a multimodal semiotic approach encompasses ecological aspects of the way signs are used: sent, emitted or reflected, perceived, and interpreted, that is, the relationship between percepts, concepts, and representation needs to be clarified, not only among humans in their social environments, but also dynamically between humans and their broader environment. The social semiotic approach is particularly focused on representation (sign making) in human communication and less on the source or objects perceived and conceptualized and subsequently encoded as new signs.

Studies conducted under the umbrella of biosemiotics provide ample information to provide a broader context for the social semiotic approach. It serves here to include the larger perceptual sphere (of humans), that is, the different ways people perceive their surroundings, including, but not exclusively, socially constructed signs that affect the mental and material representation in an ever-continuing cycle. These biosemiotic approaches seek to clarify and expand the notion of semiosphere (Kull, 2010); as a growing interdisciplinary field, but rooted in biology and ecology, biosemiotics seeks to answer questions regarding the biological emergence of meaning and intentionality that are difficult to address within traditional mechanist frameworks, studying the production, action, and interpretation of signs in the biological realm.

As discussed by Barbieri (Barbieri, 2009), the Peircean triadic model comprising representamen, object, and interpretant has proved to be applicable in the animal
world, as it was introduced by Thomas Sebeok (Kull, 2010), to extend the idea of semiosis to the larger biological realm (i.e., biosemiotics). To apply it to all organisms however, including cells, Barbieri introduces the code model, where codes provide a framework in which signs make sense through coding rules. Even though my research centers on human semiosis, environmental signs that can be part of the human perceptual focus include signs in the natural world (e.g., geosphere, biosphere, (B. C. Pijanowski et al., 2011), and sensory perception can therefore be considered a code, following the arguments that 1) interpretation cannot be separated from perception, 2) human perceptual systems differ from that or other organisms, and so presumably other species inhabit different perceptual worlds, and 3) even within the human species there are sociocultural and environmental differences in perception (Gibson, 1977; Norman, 2009). The latter idea is based on the premise that perceptual code is learned, and as a semiotic code, perception involves representation, but does not assume intentional communication.

To extend the model beyond social semiosis for this research allows for inclusion of signs in the larger geosphere and biosphere as knowledge sources for sense making, signs that are sent, emitted, or reflected. To indicate such surroundings, in many anthropological and human geographic studies “the landscape” serves as a container for human experience that encompasses such perceptual code (phenomenology). The landscape serves as a subsistence source but also is considered to be imbued with meaning, including messages of power (Bender, 1993; D. a. S. D. Cosgrove, 1988; Farina, 2006; Lindström, 2010; Thomas, 1993). Even though it is a valuable
concept, within this research the term landscape is considered too politically laden, as it is intertwined with specific representations of human-land relationships, implying a potential bias for this research. Land, and geosphere, and biosphere will be used instead as overarching terms, in addition to other appropriate terminology – environment, surrounding, Umwelt – that can serve to contextualize ecological relationships.

Perception is a necessary component within the reflexive relationship between cognition, epistemology, and representation, such that reality is always represented, but what we treat as direct experience is mediated by perceptual code, and perception involves mental representation. In an ecological approach to perception, humans are actors and not just spectators. The ecological approach is centered around the concept of “affordance,” which is identified as “action possibilities latent in the environment, objectively measurable and independent of the individual ability to recognize them, but always in relation to the actor and therefore dependent on their abilities.” This approach to visual perception set forth by Gibson (Greeno, 1994) during the 1970’s has radically changed the long-term ruling ideas of human perception as passive sensing (sensu Descartes). In a slightly different way, this concept was already described by von Uexkull during the 1920s, who called it functional coloring of objects, Uexkull was interested in how living beings subjectively perceive their environments, these subjective spatio-temporal worlds, called Umwelt (ambient world) and is reintroduced within biosmiotic approaches. The environment can be considered the sum of these subjectively perceived spaces (akin to Husserl’s intersubjectivity).
For instance, based on the notion of *Umwelt*, Farina et al. (Farina, Scozzafava, & Napoletano, 2007) have proposed the eco-field hypothesis in which “landscape” is considered as the sum of all eco-fields of a given species, (where an eco-field is defined as is a spatial configuration that, as a carrier of meaning, an organism perceives when performing a given function), and acts as an interface between needs and resources, where resources can be broadly defined to include means for human well-being. Within such a paradigm, the assumption of the primacy of the visual sense can be addressed. As stated by Lindstrom “the functioning of smells, light conditions, heat, sounds, seasonal changes, etc., as strong markers on which the memory of landscape and the events happening in that landscape are built, is further enhanced by the repetitive and rhythmical nature of all these stimuli” (Ingold, 2000; Lindström, 2010, p. 364). This idea of perceptual marker or code also extends the idea of natural object to other kinds of (physically based) objects (perspectival, parasitic), as discussed as part of spatial ontology research in a spatial information theory context (Casati & Varzi, 1999; Galton, 2000; Lindström, 2010; B. Smith, 1996).

In memory recall and spatial navigation (perception in motion), it is apparent that other senses besides visual stimuli are important, if not more important, in memory of a place, indicated by Lindstrom with the term “perceptual markers.” Besides sonic and visual cues these include, diurnal, seasonal, but also short-lived ephemera such as vegetation patterns, clouds (Krause, 2012; Lindström, 2010), (extending the *object* to include these rhythmic phenomena). In addition, mode of perception does not just indicate the kind of sensory information we prefer, but also refers to the
way sensory integration takes place in percepts, for instance, when sensoral information appears discordant.

5.1.4 Representational challenge:

Representational challenge is primarily discussed in the context of perceptual differences among species (Chittka & Brockmann, 2005), based on physiological differences in sense organs. Many animals have, for instance, sensory abilities for parts of the electromagnetic (EM) spectrum beyond those of human sense organs, for example sensing ultraviolet light. The representational challenge can then be understood as the potential to make different perceptual worlds understandable, that is, translate these into a mode within our perceptual or spectral range. One example given by Chittka and Brockmann refers to odor coding in bees. Odor is particularly hard to present on a physical continuum such as wavelength, as it is multidimensional, and this multidimensionality cannot be easily visualized in a low-dimensionality space, but as study has shown it can be quantitatively approximated. Moreover, as mentioned by Chittka and Brockman, future directions in research on perceptual spaces should explore, not only how such worlds are species-specific, but how they are in fact individual-specific.

Lacking certain perceptual abilities, humans have for instance created sensing instruments to enhance these abilities, such as satellite-carried sensors. However, understanding of culture-specific or individual-specific differences in perceptual space and the correlation with representation is sketchy. In addition to sense organs, and sensing instrument technology, humans also make use of sensing configurations. (Figure 7 —building on the idea of perceptual markers).
SENSING CONFIGURATION

Place of heightened/amplified perceptual or expressional quality based on knowledge of physical processes; considering the land surface – atmosphere dynamic as amplifying medium. Configuration, connecting of different perceptual and representational amplified places, including visual signaling or listening.

Figure 7 Sensing configuration
The latter can also be considered media of perception, ways of framing of space as an intervention that creates new objects as things or relationships, but do not need to be artifacts – they can consist of places for optimal perception of certain phenomena. (A sundial can serve as an example as artifactual sensing configuration (Casati, 2004).

The impetus leading to the development of a theory of multimodality as a social semiotic approach has also led to other innovate research in how people experience their surrounding and make use of different sensoral input. Differences among humans are individual, for instance the phenomenon of synesthesia (Ramachandran & Hubbard, 2001), or can be group- or culture-specific. An example of the latter is a study mentioned by Blesser and Salter (Blesser & Salter, 2007) of individuals who are well trained in musical/aural perception who demonstrate a better long-term memory than the average. In addition, differences also refer to global (context-dependent) or analytical (field-independent) modes of perception (see Nesbitt, for instance – western and Asian difference). Moreover, culturally preferred representational modes influence such (phenotypical) developmental direction, where modes of representation, including category making, allow humans to create sensing configurations to enhance their perceptual space in specific directions (sense organs; sense configuration; sense instruments; representational modes), affecting design principles and modes of representation, that is, modal constellation used.

Based on the above (and on the introduction to Part II), the following statement can be formulated: Different groups, (e.g., cultures, language groups), make use of different modes of representation and communication, presumably correlated with
varying perceptual spaces, the epistemological implication of which is that different knowledge is sought and obtained that may not be understood or whose meaning may be lost if it is translated into another mode or evaluated within a different cultural modal constellation that occupies a specific semiosphere. A related question, in turn related to the specific research question can be phrased as follows: Is it possible to access or identify issues underlying epistemological differences in relation to environmental knowledge/spatial cognition using current representation technologies? How should such an effort be structured, especially considering that technologies may have embedded within them their own assumptions of space and time?

The mixed methods research design outlined in the next section presents sub-questions and methods for exploring the representational challenge, based on the assumption that Ancestral Pueblo communities employed different modes of representation to communicate a significantly different conceptual framework, one that developed into the American Indian thinking of today.

5.2 Mixed Methods approach

The framework provisionally developed for this research combines several avenues of research that converge on the topic of human spatial cognition as a fundamental domain of thought and the emerging theory of multimodality; (G. Kress, 2010; G. R. Kress & Van Leeuwen, 2001) within the larger context of biosemiotics, fits within this framework to inform practical means and methods to explore several examples
that can demonstrate potential epistemological differences correlated to the
different cultural conceptual frameworks through material (multimodal)
representations. Representations as technologies of encoding have developed to
meet specific cultural needs to represent a specific conceptual world (O'Halloran,
2008).
Depending on worldview, which Creswell and Plano-Clark equate with research
paradigm, a mixed methods approach can be more or less suitable to address a
specific research problem. Creswell and Plano-Clark (Creswell, 2007), have
identified four major mixed method research approaches, each of which addresses a
specific type of research problem or objective. One of these approaches, the
Exploratory Sequential Design, is suitable for this research and consists of both a
qualitative and a quantitative phase, that are presented sequentially in this research,
but in fact reflects an iterative process, fitting within a design paradigm.
In general, an exploratory sequential model is selected based on the objective of
developing an instrument, a taxonomy, or an emergent theory that can be achieved
by quantitatively generalizing qualitative results. Given that the final objective of
this research is to identify epistemologically related factors that inhibit cross-
cultural communication and understanding with regard to the construction of
histories of the Pueblos, that the work will lead to different landscape taxonomies
and frameworks (or questioning of current categories and frameworks) for
archaeological research, is essential (Agrawal, 2002; Wautischer, 1998a), thereby
distinguishing between political and metaphysical (epistemological and ontological)
factors in an effort to clarify the methodological differences between indigenous and
western scientific knowledge requirements. The Exploratory Sequential Design is suited to address both the specific research question focused on representation, and the larger problem, and will aid in generating ideas and hypotheses that can inform future technological developments in the pursuit and the understanding of multimodal knowledge production.

Thus, an explicit qualitative component can serve to evaluate and suggest categories to be used in quantitative research efforts and, within a multimodal framework, epistemological implications of modal differences are assumed to be far reaching and this warrants a re-evaluation of the current dominance of the specific meaning-making modes in scientific practice and in GIScience in particular.

Therefore, in order to examine standard archaeological research methods, I use a mixed methods research design, employing both qualitative and quantitative research methods, to identify and explore the epistemological and ontological issues contributing to the problem as stated in the overall research objective and suggest new directions for research and technological development.

### 5.2.1 Case study specifics and justification

Given that different American Indian languages were and are spoken in the different Pueblo communities, the supporting thesis for the case study stipulates that spatial concepts underlying spatial organization and design are significantly different from western spatial concepts and design principles. With respect to the general problem and the case study used to address this problem, a mixed methods approach is not only applicable but essential.
The study of the histories of the Pueblos within the traditional academic disciplines of history and anthropology is compartmentalized, and rooted in the specific concept of Newtonian/Cartesian space-time (V. Evans, 2003; J van der Elst & Ox, 2006; Zerubavel, 2003). Pre-colonial history of American Indian groups is the subject of archaeological research and is based on scientific approaches that are mostly reductionist or mechanistic, whereas the subsequent time-periods, for which different data are available, are usually studied from a humanistic/historic perspective. This has resulted in an essentialist view of the history of the Pueblos, especially with respect to pre-colonial times. By this I mean that what is called prehistory is often seen as separated from later times in significant ways, preventing a consideration of the continuous development of Indigenous thinking underlying the worldview of modern American Indian groups.

An important component of this research (a prerequisite for validating the data used in the analytical approaches) represents a step in reconnecting the past with the present based on the notion that metaphysical and methodological aspects are a primary factor in human behavior and therefore need to be understood. This step is outlined in the case study chapter. Current American Indian philosophies or ways of thinking originated from a long history of thinking that, while it certainly has been affected by outside influences, it is based on concepts of its own. This is true for current western scientific thinking as well; ideas and principles do not develop in a vacuum or out of homogeneous components (Seznec, 1953).

The histories of the Pueblos and the ideas and/or explanations offered regarding human behavior that resulted in those histories have been written primarily within
academia by non-Native researchers (L. T. Smith, 1999). As these histories have been appropriated as part of the larger U.S. heritage, contributions of American Indian scholars are not considered necessary for justification and verification. In fact, it is often argued that American Indian lifeways have undergone such significant changes since first European Contact that contemporary behavioral patterns or insights into the underlying motives of past patterns offered by descendant individuals are not thought of as congruent with or considered analog to those of pre-colonial populations (Cordell, 1984; Lekson, 1999). This idea is contested here for the case study, and considered from a different perspective: that is, it is not the form of current communities, but the underlying conceptual systems that support a continuous development that is considered of prime importance for cultural understanding.

Justification of case study

In the next chapter (Chapter six) the discussion of archaeological studies and literature relevant for the Rio Grande region is focused on the time immediately prior to European colonization efforts. This discussion will be placed within a context of 1) a conceptual framework based on a review of American Indian methodological discourse, 2) a context of national and international attitudes toward cultural and natural heritage, and 3) a review of data and literature on American Indian history within a context of changing attitudes toward land. The focus will be on 19th and early 20th century intercultural developments and events, especially in relation to different data collecting methods, scientific changes, and changing government objectives and representations. I argue that ignoring
Philosophical and methodological differences between American Indian and western ways of thinking has led to biased interpretations and representations of American Indian histories.

5.2.2 Exploratory mixed methods design

In this specific research design, qualitative approaches will be employed as first steps to identify sources of differences in spatio-temporal categories/ontologies and the frameworks underlying spatial design/configuration for the case study as compared to those long used in conventional geography, but now subject to investigation in spatial sciences. The use of mode and medium within cultural settings (including western science) in which these are expressed is taken into consideration as an important epistemic factor. It is postulated here that the dominance of western modes of knowledge production have served as benchmarks to measure and evaluate all knowledge production, whereas based on the emerging theory of multimodality, it follows that such an evaluative framework fails to recognize knowledge outside the confines of the dominant perceptual and representational modal reach. It is paramount in this process to distinguish political motives from conceptual differences in the development of representational and analytical geotechnologies, and the discussion in Chapter six serves to clarify this. Within the subsequent exploratory analyses or interventions, selected categories and ideas will be explored within current geospatial systems and the possibilities these technologies provide to explore different spatial cognitive frameworks. Whereby intervention can be understood as an interface that mediates and
transforms (Matero 2007), these interventions are followed by *critical interventions* which discuss whether different spatio-temporal concepts suggested by qualitative research can be represented within and communicated through these systems, –in short, what are the epistemological *limitations* of these technologies? The rationale for this approach is that these explorations in total, qualitative and quantitative provide a general scope of the research problem and will lead to hypotheses and ideas for design and development of analytical and representational systems. Each of these approaches and exploratory analyses starts from a supporting question. The main objectives of the sum of these individual analyses are:

1. To explore ways in which different categories, concepts, or ontologies can be identified (from archival data).
2. To test and explore tentative categories that result from (1),
   - (a) using current geospatial technologies and analytical methods, to
   - (b) identify challenges in modes of representation.
3. The final objective is exploratory, that is hypothesis generating (IDEATION), rather than conclusive and explanatory for the case study. The goal is to indicate principles for the design of novel ways for communicating cultural knowledge, focused on understanding the translation mechanism in multimodal knowledge production and communication that can lead toward design of intersubjective spheres (IMPLEMENTATION) – conceptually and practically – for example, virtual environments (T. Brown & Wyatt, 2010) (Figure 8).
Secondary questions and hypotheses are formulated to guide the separate/specific analytical exercises, and the methods used in each of those are introduced and discussed under separate headings in the following sections.

**Figure 8 Design thinking and a mixed methods approach**

### 5.2.3 Qualitative Research component

The qualitative component that precedes the interventions and critical interventions serves to identify differences in spatial cognition that: 1) have developed historically, through tracing the development of cartography back to the Renaissance, the time of inception of large-scale colonial expansions that forced a restructuring of worldview at the same time that the search for new resources and
territory was deemed necessary to address political and demographic changes on the European continent; 2) are possible to communicate in different modes and media – specifically, how do non-visual forms/modes plus medium of geographic knowledge exchange define and make use of geographic categories as explored through ethnographic sources.

The first aspect more generally addresses the “cartographic encounter” between practices of European colonizers and indigenous traditions of the American continent of representing and communicating geographic knowledge in similar modes and medium, whereas the second aspect is more narrowly focused on the case study region, the Northern Rio Grande valley, investigating mode and medium characteristics and landscape category construction related to place names through a semiotic approach (Table 4).

Two main representational systems (modes) are integrated in cartography and geographic information systems (multimodal ensembles): image (graphic) and textual (graphic) representation of geo(graphic) information. In general, mapping traditions and current conventions integrate graphic/image and textual elements in a visual representation, however, from a multimodal perspective the standard representation of aspects related to the Earth’s surface is primarily visual, framed as a two-dimensional plane (MacEachren, 1995). Place names are often included in visual map representation, but they can also serve in a different mode(s) and medium of expression and communication, as oral /narrative systems that presumably have a different modal reach (Johnson, 2005; Louis, 2011; Williams, 2000). Therefore, other perceptual and representational aspects need to be
considered for their importance in conveying geo(graphic) knowledge. Two main sections make up this qualitative component, differing in scale, scope, and objective, but in both cases the framework for analysis is based on semiotic approaches focused on multimodal communication and critically evaluates cartography as the dominant representational mode/medium of geoknowledge, and its underlying spatial cognitive framework (MacEachren, 1995).

Within the first section –*Cartographic Encounter*– the investigation builds on several related strands of research: 1) on previous historic research comparing western and indigenous map making (cartography), 2) the field of geovisualization for analyzing geographic data, and 3) several recent research initiatives focused on the role of narrative in human spatial cognition. The second section, employing a published place names gazetteer, draws on recent findings and methods of analysis for investigating spatial categories. Research findings showing cross-linguistic and cross-cultural differences in spatial frameworks and spatial mappings across modalities affirm the underlying assumptions from which to begin this exploration.

Given that the (semantic?) boundaries between place names and landscape categories are often unclear, Tewa place names provide a starting point for exploring ontology of place/space and spatial frames of reference, but in addition, other categories related to Tewa cosmology recorded through ethnographic fieldwork are considered (Harrington 1916). The place names that are investigated, even though recorded in written medium, did/do not originally function in written form but in an oral mode, and as such have different *affordances* for representation and communication of knowledge (John P. Harrington, 1910; G. Kress, 2010; Wold,
A related but slightly different use of the concept of *affordance* (*sensu* Gibson) is employed by Levinson to investigate the relationship between place name/category and *referent (which defines the semiotic niche).* As motivation for creation of categories/names, *affordance* and use, as well as cultural ideas, are primary factors compared to perceptual salience; the latter would indicate universality in categories and names. The ontology, for instance, of Yeli Dnye, the language of Rossel Island, Papua New Guinea, is fundamentally different from that of Indo-European languages, containing a rich set of seascape terms (Levinson, 2008a)(Levinson 2008). Other ethnolinguistic studies, by Levinson and others, have indicated different frames of reference used in language that are evident in other modes (e.g., gestures) as well (Levinson, 2003; Levinson & Wilkins, 2006).

Cross-modal mapping differences, translating from music to language for instance, has also indicated different spatial frames of reference with associated categorical differences when different cultures were compared (Ashley, 2004). In the example given by Ashley, the geometrical pitch space in western music, when pitch is mapped onto, or conceptualized as, physical space, is different from that for African music in addition to different categories of pitch used within each framework. What is thus expressed in one mode in one culture can differ from what is expressed within that mode within another culture, and how this information is mapped or translated within a culture from one mode to another may involve a different meaning transfer than a similar cross-modal mapping in another culture. Research in multimodal literacy therefore cannot be extrapolated from studies resulting
solely from one specific cultural setting. The epistemological consequences of ignoring such differences imply loss of different kinds and dimensions of knowledge.

**Table 4 Overview qualitative component**

<table>
<thead>
<tr>
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<th>Data/ outcome</th>
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<td>Based on MacEachren Semiotic approach to enhance previous studies of cartographic comparison</td>
<td>Historic maps</td>
<td>Gain insight and understanding of concepts underlying different spatial representation and suggest possible modes in which this may differ across cultures</td>
</tr>
<tr>
<td>a) Underlying frameworks and objectives</td>
<td>What kind of spatial information is represented?</td>
<td>- Content -semiotics</td>
<td>Establish benchmarks that can be tested and provides guidelines to frame toponymic research</td>
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<tr>
<td>b) The theoretical basis for current geospatial technologies</td>
<td>How is the spatial information represented?</td>
<td>- semiotics - multimodality</td>
<td></td>
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</tr>
<tr>
<td><strong>Landscape Categories and Placenames</strong></td>
<td>Gain insight into the ontological basis for Tewa placenames</td>
<td>Beyond standard toponomic research methods - based on Ontology research in Spatial Information Theory MPI research approach and narrative methods.</td>
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<td></td>
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5.2.3.1 Maps and Mapmaking

Question: In what ways has the historic development of spatial (visual) representation influenced the way we understand the world? What are the sources of representation (technologically, conceptually; understanding multimodality; intercultural communication – international relationships – politically)?

a. What is the relationship between researcher and researched group in the case study discussed in a larger context of relationships between colonizer and colonized populations with respect to this question (What are ways in which this relationship can be characterized? Hierarchical, dependence

b. What are inherent limitations in technology (technology of mode) currently used and/or available for geographic representation; are technological developments driven by specific motives (conceptualizations) that can be traced historically?

Overall objective: To identify culture-specific templates underlying spatial representations in text and image (why are two-dimensional maps a dominant mode of representing space-time); to show that indigenous geo(graphic) knowledge is likely conceptualized and represented differently.

Overview of history of cartography

Current mapping technologies, often considered neutral or objective systems of representation of spatial relationships, have developed out of a long cartographic tradition rooted in a specific worldview and specific meaning attached to maps (Short, 2004). The history of mapping technology and its implications for current
representational systems of space-time has been discussed in the literature, notably by (D. Cosgrove, 1999; Duncan, 2006; MacEachren, 1995; Mack, 2004; Monmonier, 1996). Rhetorical aspects of mapping traditions are currently being reconsidered and concerted efforts toward standardization and objective mapping languages as research interest is based on presumed perceptual salience in human understanding of visual and spatial relationships (Izard, Pica, Spelke, & Dehaene, 2011; MacEachren, 1995).

Pursuing geo(graphic) knowledge can be driven by a number of motives and principles (affordances - *Umwelt*), such that knowledge necessary for practicing sustainable agriculture is different than knowledge needed for urban development or territorial expansion. This analysis is specifically focused on the Americas. The maps of the territory occupied and annexed by the Spanish during the 15th–17th centuries provide sources for this effort to understand differences in mapping objectives, skill, and conventions of mapmakers from European and Indigenous backgrounds, sometimes referred to as the Cartographic Encounter. (In the Study Area section this is placed within a broader European tradition and history).

Initially, Indigenous mapmakers were involved in the creation of maps for the Spanish Crown, as part of the *Relaciones Geográficas*. Certain elements and principles can therefore be identified as being of indigenous origin, but these eventually faded out of practice to conform to the requirements of the government of Spain (Mundy, 1996; Reinhartz & Saxon, 1998). Over the course of time, certain conventions have become standards of practice, informing recent guidelines or rules
for standardization in efforts toward developing a Geo Information Science (and that will appear to be “natural”). Decolonization processes that started on a large scale during the mid-20th century, however, forced the evaluation of the role of maps and mapping practices in initiating and maintaining power relationships (I. M. Wallerstein, 2006). MacEachren’s (MacEachren, 1995) semiotic approach for understanding maps is followed here in broad outlines, as he provides a thorough discussion of these developments and his approach fits within a multimodal framework of analysis, enabling the evaluation of cartographic elements and issues.

*Semiotic approach – image analysis and the meaning of maps – similar mode + medium*

The approach taken by MacEachren is specifically focused on knowledge construction through maps using a cognitive-semiotic framework. It aims to improve map design based on the understanding of how meaning is derived from maps (*interpretant*) and how maps are imbued with meaning (*object, referent*). It is adapted for this research as a framework for understanding, placed within a context of multimodal approach outlined by Kress. Similar to the idea that spatial cognition is universal, representation of space in the form of tow-dimensional maps is often considered as universally understood (*sensu* axioms formerly defined and described by (Egenhofer & Mark, 1995), which arguably is equally unfounded. Two broad avenues of research to address this issue are followed, focused on the meaning of maps.

1) Within the context of International relationships (background provided in Chapter six, sections 3 and 4)
2) Within the context of the development of geovisualization out of cartography (Chapter seven, section1)

The approach proposed by MacEachren attempts to merge the perceptual, cognitive, and semiotic issues of maps as functional devices for portraying space and the socio-cultural issues of how these portrayals might facilitate, guide, control, or stifle social interaction (MacEachren, 1995, p. 11). The map is viewed as one of many representations of phenomena in space that a user may draw upon as a source of information or an aid to decision-making and behavior in space. Within a larger framework of multimodality, it is also questionable whether cartographic maps are always the chosen/preferred mode for geo-representation (in a culture), and if not, whether or how these are understood cross-culturally (and what is missing).

The data used comprises published map studies, it is in essence a literature review or narrative analysis that makes use of both text and image (as published maps); the main purpose is not to discuss differences in the authors’ point of view but to explore the reproduced historic maps or details of those maps loosely based on the semiotic approach set forth by MacEachren, with the following objectives as guidance.

Objective 1: Discussion of historic cartographic maps, primarily maps that were created as part of the Relaciones Geográficas program of the Spanish Crown in order to gain insight into the different contributions to representations of the land by indigenous cartographers and the development thereof. In addition, maps created within non-western traditions will be considered/evaluated to identify different
modes of representation in which spatio-temporal relationships can be represented and communicated (as visual signs).

Objective 2: To explore whether current technological developments in geovisualization can enable/facilitate different ways of conceptualization and representation.

*Expected outcome*

- A better understanding of the underlying motives of geographic representation in historic context (purpose of knowledge).
- Insight into different frames of reference and categories that may be used within different cultural templates, even though modes and media appear similar.
- Identification of limitations resulting from specific technological developmental directions.

**5.2.3.2 Toponomy and Landscape Categories:**

*Question:* In what way has a western-based space-time conceptual framework determined metaphysical understanding, (such that inclusion as part of scientific practice became to be considered redundant and modes of representation universally valid).

With respect to the case study, is it possible to identify categories that are conceptually different from one's own: 1) given that it is shown that universal spatial categories do not exist, and 2) given that our
epistemological foundation is limited by the reach of employed modes and the technology (medium) of those modes (G. Kress, 2010).

**Objective:** This component uses the Tewa ethnogeographic names and categories recorded (and transcoded) by Harrington during the early 20th century as the main dataset to explore whether any indication of different kinds of categories exists to justify further research (John Peabody Harrington, 1916).

This investigation is supported by the triangulated theoretical framework:

1) Naïve spatial reasoning indicating different conceptual frameworks underlie category making, kinds of categories – ontologies (Galton, 2000)

2) Differences between language groups in the spatial domain in frameworks and spatial ontologies (Levinson, 2003)


**Overview of toponymic research**

Since the early 20th century, place names have been a topic of inquiry in anthropology and geography. Ethnotoponomy has long been recognized as providing important insight into indigenous cosmography, especially regarding the unique relationship to the land that is different from modern western ideas (Black, 2011; G. Cajete, 1999). The early investigations in North America, exemplified by ethnologists and linguists such as Harrington, Kroeber, Boas, and Sapir, stressed the value of toponymic research for providing clues on how the natural world is perceived and integrated into the social life of indigenous groups. According to Thornton, place names are of particular interest “because they intersect three
fundamental domains of cultural analysis: language, thought, and the environment.”

The study of place names therefore provides insight into the structure and content of the physical environment, but also about the conceptual world and social organization of a people (Thornton, 1997, p. 208). During the second half of the 20th century, renewed interest in place-based research in social geography, and a little later in anthropology, once again focused on the relationships between naming of the land and the importance of place (Basso, 1996; Casey, 2002; Feld & Basso, 1996; Fitzjohn, 2007; Hirsch & O'Hanlon, 1995; Hudson, 2006; Ingold, 2000; Tuan, 1977).

Due to the long-held dominant position of Chomsky’s universal grammar framework, linguistic interest in the relationship among language, thought, culture, and the environment, only recently gained momentum and is based on renewed interest in the Sapir-Whorf hypothesis of linguistic relativity that has led to several novel approaches to investigating place names (Burenhult & Levinson, 2008a; Hunn, 1996; Kari, 1996; Louis, 2011; Nagel, 2005; O’Meara & Bohnemeyer, 2008). Hunn, as discussed by Thornton, specifically has broken with the particularistic approach originating with Boas by focusing on “defining and examining place names as a lexical domain across cultures” (Thornton, 1997, p. 221). This, and other recent, and earlier described, cross-cultural or cross-linguistic approaches, have resulted in re-evaluation of models of human spatial cognition: variation in frames of reference used, ontology, and spatial templates.

Current developments within spatial information theory, focused on the human spatial experience, overlap with several linguistic and cognitive research approaches in efforts to understand the breadth, similarities and variation in human
spatial cognition (Burenhult & Levinson, 2008a; Duvall, 2011; Egenhofer & Golledge, 1998; Freska, Brauer, Habel, & Wender, 2003; Levinson, 2003; Zhang & Patel, 2006). As mentioned earlier, recent research indicates that stories are effective mnemonic devices in spatial navigation, questioning the dominance of visual representation, in modern geospatial technologies, in the communication of spatial (environment, and ambient) knowledge.

*Ontologies of space and place names*

In efforts toward understanding cognitive worlds, how the world is perceived, conceptualized and represented, and the differences between these worlds, a distinction needs to be made between *spatial categories* and *place names*, where spatial categories and objects can be distinguished as natural, perspectival, or parasitic (Galton, 2000) as an initial guide to investigating the ontological foundation.

Analysis of natural language has also provided insight into object-categorization, for instance topological notions and conceptual structuring can be illustrated through the use of prepositions (Carlson, 2005). In representations of geographic space, an additional problem is related to the nature of geographic entities that are currently used, many of which have no clear boundaries (B. Smith, 1996; Varzi, 2001). Natural language, however, is not the only source for investigating categorization and conceptualization. A general ontology, as argued by Smith, would draw from “other cognitive modes of access to reality, including perception, scientific theories, the map-making activities of the geographer, knowledge-sharing systems, and so on” (B.
Smith, 1996). Thus it opens up multimodal research, perception as well as representation, of ontological foundations.

It is within the discipline of linguistics, however, that most of the information regarding the diversity of human spatial cognition is generated that provides the starting assumptions for investigating the relationship between the Tewa ethnogeography and the physical landscape (John Peabody Harrington, 1916), thereby drawing from linguistic approaches. This research does not constitute proper linguistic analysis. Instead, it investigates the semiotic relationship between names, categories, and the physical land to identify a different conceptual connection to the environment.

The difference between proper names (including place names) and categories is generally understood as a difference in the referent. Proper names have reference but not sense (they are arbitrary, considered as a symbol, [icon, index]). In other words, the referent is not identified by describing it in terms of relevant properties, as is the case with categories. Landscape names and categories are a special case, however, where lines of distinction blur. For instance, it is argued that all languages distinguish between a “what” and a “where” category, termed “first-order entities” and “place/locations” by Lyons as discussed by Cablitz (Cablitz, 2008). The distinction between these two is generally understood as one based on perceptual boundedness.

As discussed by Cablitz, in her study of Marquesan landscape terms and place names, a clear distinction between place names and landscape terms in the traditional sense is difficult to make. Landscape terms are frequently combined with
other lexical components to form place names. Geographical entities hold an intermediate position between “first order entity” and “place” (Cablitz, 2008, p. 214) and are therefore ontologically ambiguous. On the one hand they constitute the landscape and therefore space itself, on the other hand, because of their distinctive features and boundaries, they often are categorized as first-order entities. In her study Cablitz investigated how Marquesans label the landscape and places in their environment and concludes that naming of places goes back to past events, expresses a relationship of possession, is connected with mythology, or depicts a very characteristic feature of that place (Cablitz, 2008, p. 224). Her study does not specifically address how these different names might function in specific distinct systems.

An important aspect of categories/objects are its boundaries. This is particularly true for geographic categories, for there are no clear boundaries for many of the geographic categories we take for granted (Casati & Varzi, 1999; Mark et al., 2007). The long-standing notion of universal geographic categories such as “mountain” and “river” is primarily based on research among Indo-European language speakers, but as more research is conducted in other speech communities, these categories prove to be specific and are suggested to be based on affordance and cultural aspects as main factors in category-making. Boundaries reflect the reification of worldview in representation.

Data and Methods—different mode + medium

The data used for this study are based on the Tewa Ethnogeography recorded by Harrington (John Peabody Harrington, 1916), one of the pioneer anthropologists in
this kind of ethnographic work. These early collections of place names, however, have later been read as an imposition of the colonial mode of representing space, and the interest in indigenous place names interpreted as a gateway to primitivism, a romantic idea of the pre-modern past and the treatment of indigenous peoples as “constants” unable to transform. The data and the translation of place names should therefore be considered as compromised, but can function for the purpose herein if these factors are taken into consideration (Heikkila, 2007). In addition to the recognized and discussed problems, several others have been identified. An important function of the qualitative exploration, therefore, is to identify the nature of these previously ignored issues and the epistemological consequences of cross-modal and cross-cultural translation (G. Kress, 2010).

The approach is based on several iterative steps of research defined as narrative methods, using archival documents to perform thematic analysis (space-time organization and representation), while questioning the underlying western framework (Riessman, 2008, p. 63), and explores ways in which indigenous ideas of space-time are encoded within the landscape categories and place names. General contextual knowledge is based on indigenous philosophical discourse, whereas possible different external representations – frameworks and categories – of different world percepts and concepts are drawn from linguistic research and spatial information theory for the construction of the methodological framework on multimodal semiotics as practice. The following steps are taken:

1. Relocating place name locations mapped by Harrington within current geographic information systems, addressing issues of
Transcoding and modes of representation. (Method – Kress; Traditional Ecological Knowledge TEK, Agrawal; Augusto – time/perception component of names and categories) What are the physical, spatio-temporal and perceptual boundaries that can be inferred?

2. Through narrative analysis explore the relationship between names, physical location, and socio-cultural factors. (Method – Riesmann, Cablitz)

3. How do the findings of steps 1, and 2 fit within current toponymic research models? (Content – Thornton, Kari, Hunn, Levinson)

4. What is the relationship between names and categories, employing a model of different kinds of spatial categories based on qualitative spatial reasoning? (Method – Galton – considering natural, parasitic and perspectival categories)

5. How do the results from step 1 to 4 fit within Tewa worldview models? (Content – Cajete, Ortiz, Dozier, Swentzell – discussed in Chapter 6)

**Expected outcome**

- Insight into problems in transcoding geo information from one cultural mode to another (cross-modal and cross-cultural – in relation to epistemological commitment of a mode)
- Insight into different conceptual categories and models of representing and communicating ecological knowledge
• Outline of issues that can be explored specifically within the quantitative component

5.2.4. Quantitative Research component

Depending on the outcomes of the qualitative component, testing current systems of spatial analysis and representation in general is based on exploration and evaluation of cultural models. Given that these systems have developed out of a long history of geospatial representation, issues identified and outlined within the qualitative component and the case study chapter within the context of multimodality are assumed to be inherent in these systems. This does not necessarily imply that these issues cannot be overcome; systems may have built-in flexibility allowing for different ways to explore geo-representation.(identifying latent possibilities as well as limitations).

As mentioned in earlier chapters, systems of representation, such as GIS, can be employed to analyze material objects and relationships and synthesize these within a larger spatial context. In order to do this, the existence of a physical reality, within which these things are placed and relate to other objects, and the fact that we can know and thus represent this reality, needs to be accepted, according to Raper (Raper, 2000; Unwin & Fisher, 2005). Theories of space, formalizing the nature of matter and void, underpin these representational systems. Representational systems, however, are abstractions at best, and choices are made in the design of these systems as to how and what is represented to provide a (conceptual) model that can help us understand the world around us.
An academic development that originated as Critical GIS questions representation and categories of space; essentially based on Critical Theory, it hypothesizes that these frameworks and categories support a dominant view that may not be applicable to all of human spatial experience. Especially true, but not exclusively, for sociocultural research (N. Chrisman, 2005; Kwan & Schwanen, 2009), this research has led to a broader investigative direction into ontologies of space (Ahlqvist et al., 2005; Schuurman, 2002, 2005a, 2006), notably, how spatial information systems can move beyond standard geometric representation to ones that are qualitative, in order to understand human spatial experience, movement, and navigation (Galton, 1995; Moratz et al., 2003; Tversky, 2003). The approach requires an investigation and understanding of how objects and their (spatial) relationships are conceptualized within a larger cosmology.

5.2.4.1 Geospatial methods and technologies

Geospatial methods and technologies include but are not limited to Geographic Information Systems and Remote Sensing technologies. A GIS in essence is a computer-based processing tool for geographic data. The investigation of geographic phenomena, traditionally conducted using paper maps, can now be performed at (geometric) scales and dimensions never before possible and can provide insight, for instance, in non-linear dynamic processes (Burrough, 1986; N. R. Chrisman, 1997). Remote sensing generally refers to instrument-based techniques employed in the acquisition and measurement of spatially organized data on some property of an array of target points (pixels) within a sensed scene that correspond to features, objects, and materials. Techniques involve amassing information
pertinent to the sensed scene (target) by utilizing electromagnetic radiation, force fields, or acoustic energy sensed by a variety of instruments (Jensen, 1996), (and therefore effectively enhancing human perception of the environment, as these can be understood mathematically). These data can be integrated within geographic information systems for further exploration and analysis.

As a geometric representation of the Earth’s surface or geographic space, basic components of GIS comprise space, time, and attributes (as tuples), enabling the analysis and representation of spatio-temporal distribution of physical properties of the Earth’s surface as well as other thematic information that has a spatial component (Michael F Goodchild, 1992). Originally developed as a data management system, these systems now provide ample means for multi-dimensional and multi-scalar data analysis for a variety of spatial, natural, and cultural phenomena, in other words, for data processing (acquiring; managing; analyzing; visualizing). A well-known early (prototypical) example of the kind of analysis now possible with GIS is the cholera map of 1854 by the English physician John Snow, who statistically (and geographically) correlated the location of cholera cases in London with water from a certain pump, and this example is often used to demonstrate the advantages of a GIS beyond land resource management, demonstrating its applicability in the health, social sciences, and humanities.

Knowledge of the Earth, however, is created within the confines of our conceptual systems. For instance, concepts such as containment and proximity are formalized within a GIS through data models. These concepts and data models together
constitute our ontologies (in a sense slightly different from philosophical meaning),
the frameworks we use for acquiring knowledge of the world (M.F Goodchild, 2005).

Maps (as geographic representations) are predominantly still two-dimensional
representations of the curved surface of a sphere. The transformation of this three-
dimensional space onto a two-dimensional plane is a projection and always distorts
one or more (geometric) properties: shape, area, distance, direction, and/or more.
Scale distortions are inherent, but not uniform across the map, related to the
projection and scale chosen, and dependent on the research question or other
purpose of the map. (Conventions however have become accepted as ‘natural’
(Mathur & Cunha, 2006)) Any variable that can be located spatially (and
increasingly, temporally) can be referenced in a GIS coded as $x, y (z)$ coordinate
pairs. Accuracy and precision of representation and analysis depend on the source
data: quality, acquisition, and how it is encoded to be referenced.

Data models

Currently two main data models are operative in GIS to represent spatial data:
vector and raster, each with its specific affordances and limitations for research and
management. (These can be considered as different modes or modal variations). A
raster representation is an explicit representation consisting of cells located by
coordinates, with each cell independently addressed with the value of an attribute.
The implicit or vector representation can consist of three different geometries,
point, line (networks), or polygon. Points are similar to cells, whereas lines and
polygons are sets of interconnected coordinates (topologically linked) that can be linked to given attributes (Burrough, 1986).

The simplest raster data structure consists of an array of grid cells (also called pixels), with each grid cell referenced by a row and column number and a number representing the value of the attribute being mapped, for instance, reflectance value in the case of a satellite image, or amount of rainfall at a given time. Depending on the resolution (and dimensionality) of attribute data, the object represented is more or less approximated.

A vector data structure, on the other hand is an attempt to represent the object as exactly as possible. Mathematical topology assumes that geographic features occur on a two-dimensional plane, and spatial features can be represented through nodes (zero-dimensional cells); edges, (one-dimensional cells) or polygons (two-dimensional cells), thereby assuming that two-dimensional representations are a naïve representation and intuitively understood; three-dimensional topology – curved spaces may be more appropriate (Worboys, Mason, & Lingham, 1998).

Topology in GIS is generally defined as the spatial relationships between adjacent or neighboring features. Topological data structures are advantageous because they enable spatial analyses such as adjacency, connectivity, and containment, among others (ESRI) “The coordinate space of a vector structure is assumed to be continuous, not quantized as with the raster space, allowing all positions, lengths, and dimensions to be defined precisely,” or as precisely as the limits of a computer world (Burrough, 1986, p. 25).
Not all types of data are equally suitable to be represented in either vector or raster structures. Geographical elements having clear boundaries (categorical, discrete objects) can be easily represented as vector data, for instance, administrative regions, that can contain numerous attributes in other data scale types. Continuous data, such as rainfall that varies spatially and temporally at different scales, are better represented using a raster data structure. The spatial predictability of such data can, for instance, also be used to generate or interpolate raster surfaces from discrete data measurement points. Classification methods (e.g., supervised or unsupervised) of raster satellite-imagery identifying, for instance, vegetation zones, can be used to transform raster into vector data models.

*Data sources*

Any attribute of the physical world that can be related to a spatial location (related to the earth’s surface as a coordinate pair) can be a data source for a GIS. A number of compatible methods are available for data entry, and the one selected depending largely on the purpose of analysis and representation. A broad distinction can be made between data that are collected in digital format, such as satellite imagery, and analog data that need to be converted to digital format. An example of the latter are scanned paper maps; the pixel values in this case are usually less meaningful than those of satellite imagery, and for analytical purposes these scanned maps are often used to digitize information in vector structure. Data sources include but are not limited to spatial location information obtained through Global Positioning Systems (GPS); and attribute data that is, or can be, linked with spatial location such as data
collected through satellite systems, (paper) maps; photographs, census information, and so forth (Foote & Huebner).

Information in a digital system is stored in different file types (flat, hierarchical, relational) that represent attributes of real-world phenomena (and has conceptual implications). The current trend in database organization is object oriented (group attributes), that is, in ways human recognize object in terms of their totality or wholeness. This organization implies a certain level of universality in object recognition among users (user group coherence).

Furthermore, data exploration in a GIS allows for understanding spatial relationships, such as containment, adjacency, overlap, but also enables statistical analysis between spatial and non-spatial data. Visual and statistical analyses make use of the overlay concept, a practice that has a long tradition in cartography but now has an added mathematical component (synthesis and analysis in more dimensions) (Burrough, 1986; De Smith, Goodchild, & Longley, 2007).

Finally, a GIS is used to represent and communicate geographic information in digital maps, a field that is known as geovisualization (Dykes, MacEachren, & Kraak, 2005), in which data are turned into information through multiple views or perspectives. Considerable efforts have been undertaken within the field of cartography/geovisualization to standardize methods of visualization within a communication paradigm (MacEachren, 1995), many of these developed standards are based on research in visual perception, such as color use in maps (Brewer, 2005). (As mentioned earlier, the focus on visual aspects has been criticized as a western preference across disciplines, whereas other sense information may be
equally important for our ability to understand our surrounding worlds, such as transient aspects of spatial experience as compared to [semi] permanent ones (e.g., time, sound, and smell).

To summarize, developments in geospatial methods and technologies have increased our ability to explore, analyze, and understand phenomena related to the Earth’s surface. As the world is infinitely complex, in mapping choices have to be made regarding the way to represent the world and everything in it. Some of these choices inhibit the potential for our understanding of differences in the way humans understand and know the world, by excluding certain experiential aspects. The epistemological consequences of the way systems of representation are designed can be investigated within a framework of multimodality.

5.2.4.2 Investigating – differences in human spatial cognition (frames of reference of GIS; ontology)

The objective of the quantitative component is to address several issues identified within the qualitative component, and the quantitative component is subdivided in interventions (potentials) and critical interventions (limitations). The following questions guide these explorations, which are made more explicit in Chapter 7 (Table 5-6).

Interventions

1) The dichotomous character of western thinking that underlies many scientific research efforts has thus far hindered research to investigate the role of humanistic aspects as important variables in ecological studies.
Indigenous and other nonwestern philosophies, on the other hand, have stressed a holistic approach. Recent research efforts have begun to explore more inclusive (mind-body) approaches. Typically, these variables have been investigated using different (qualitative) methods. In what way can these variables be included within a single framework?

a. How does our cognitive framework influence the way we represent space-time and can (do) these different frameworks intersect? (or are these mutually exclusive) (ecologically instead of from a physics, geometric perspective) What is the place of perceptual grounding- in the dynamic structure of cognition

b. Is all knowledge subjective and at best intersubjective? Considering the ecofield hypothesis by Farina (Farina, 2006)

2) Many Southwest archaeological studies have focused on the environmental constraints of the semi-arid landscape and the adaptive and response strategies of its human inhabitants. Site distribution maps correlated with environmental factors and certain sociopolitical factors have been used in support of those studies to investigate change detection of specific settlement patterns.

a. What are the issues that can be identified regarding the use of standard mapping technologies for understanding settlement choices, and can different ways be explored to enhance current understanding
using standard technologies, i.e. incorporating cognitive elements in addition to subsistence factors?

b. As an example, should architectural elements be considered as discrete, isolated, cultural material objects or as part of the larger surroundings – as part of the cognitive landscape? What is the consequence for current heritage practice?

Humanistic (social sciences, history) approaches in GIS have been applied in archaeological research, for instance for viewshed and Least Cost Path analysis (Lee & Stucky, 1998; Llobera, 2000, 2007), but the applications are derived from models of physical characteristics and phenomena of the Earth's surface. As stated by Okabe (Okabe, 2006), studies in the humanities and social sciences can be enhanced by the use of GIS, as all phenomena studied within those disciplines occur in geographical space. Employing GIS, however, is not straightforward, but several examples serve to illustrate the applicability when researchers devote the necessary time and effort to adapt geospatial capabilities for their specific research interests (Michael F Goodchild & Janelle, 2004; Gregory & Ell, 2007; Lock & Stancic, 1995).

A widespread analytical capability available in many GIS is visibility or viewshed analysis. As the term implies, this use of GIS indicates the area of land that can be seen with the human eye from a specific vantage point, and is used in many archaeology and planning studies. Calculation of a viewshed (a binary raster surface) is a geometrical calculation of visible cells using a digital elevation model as base data. Although observer height can usually be set, it is not based on human perception specifically, that is, what the human eye can clearly distinguish at
specific distances, and several studies have addressed the usability of viewshed or line-of-sight analysis in humanistic approaches. Viewshed analysis does take geographic analysis into vertical realm, but limits itself to the earth’s surface (topographic prominence) (Farina, 2006). Several approaches have been developed to formalize the structure of human experience in the land and are often based on Higuchi viewshed indices (perceptual characteristics) (Higuchi, 1983).

Critical Interventions – exploring different aspects of the world beyond assumed universalities

The findings that created the theoretical framework are used within this section to contextualize the findings of the qualitative component and interventions, to explore limitations of current information systems.

1) Considering that objects may represent relationships, observing land/atmosphere relationships; wind, clouds – what can these represent in terms of sensing configuration?

2) Considering philosophy of remote sensing – how can spatial variability of rainfall; wind, cloud knowledge in relationship to land characteristics – greenness (perceptual range -classification) understood differently within a multimodal framework?

3) Considering the relationship between the earth’s surface and atmosphere/sky, what is the potential in current GIS for integrating different perceptual information and concepts?
Table 5 Interventions

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Objectives</th>
<th>Methods/Procedures</th>
<th>Data/Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Landscapes</td>
<td>Cognitive landscapes is a working term to explore the intimate - ecological- knowledge serving multiple functions in a cultural system</td>
<td>Creating a spreadsheet of different attributes of placenames, based on insight gained in qualitative research</td>
<td>Placenames recorded by Harrington and selected during qualitative component</td>
</tr>
<tr>
<td>Raster analysis</td>
<td>Locating and placing the names within a geographic information system to explore the relationship with physical features and attributes: vector to raster analysis</td>
<td>Exploring the different attributes and the restrictions of current geospatial systems to represent these, such as shape, dimension, cultural affiliation.</td>
<td>Show the opportunities and difficulties in using geospatial technologies in cultural studies</td>
</tr>
<tr>
<td>Location analysis</td>
<td>Compare locations of habitation sites as related to Harrington by Tewa informants with those recorded through archaeological research</td>
<td>Perception - multimodality Viewshed analysis 2D - 3D - multidimensionality Location of habitation sites and the relationship to the larger landscape through modeling the architecture within a larger landscape setting and anticipate temporal/cyclical changes of natural phenomena</td>
<td>Site location information from archaeological literature and databases through time</td>
</tr>
<tr>
<td></td>
<td>Explore variables that influence choice of location of habitation sites beyond those used in standard archaeological analyses</td>
<td>Cultural, intangible aspects in relation to these phenomena as facilitated through architecture</td>
<td>Showing that, in addition to standard archaeological models and explanations, other aspects can be explored, especially with respect to ecological relationships</td>
</tr>
<tr>
<td></td>
<td>Perspectival objects, Explore what can be seen or observed from a specific vantage point</td>
<td></td>
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</table>
Table 6 Critical Interventions

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Objectives</th>
<th>Methods/Procedures</th>
<th>Data/ Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are objects? (parasitic objects) Sunpath analysis</td>
<td>Based on the three different kinds of object discussed by Gallon, investigate the different relationships that are represented by certain place names and categories. Explore how these can function to observe natural phenomena and build knowledge focused on Pueblo locations.</td>
<td>Creating simple 3D models of architectural structures and create yearly shadow cycles, showing the sunpath at that specific location. Using 3D modeling software and Geographic Information System analytical capabilities. Integrate these in the larger landscape and evaluate the connections between land and atmospheric processes and cultural cyclical aspects related to subsistence practices.</td>
<td>Published plans views of Pueblo architecture. Geospatial data layers. Show that architecture, considered a man-made artifact, cannot be analyzed separate from its natural context, but is an integral part. Conventional architectural analysis is therefore not sufficient and culturally biased.</td>
</tr>
<tr>
<td>Shadows</td>
<td>Explore whether spatial rainfall variability, a cyclical phenomenon, is a factor in selecting specific site for observing land and sky. Connecting remote sensing technologies with cultural components</td>
<td>Select certain locations of architectural components. Compare data-ranges of occupation of these sites to current reintroductions/revivals of rainfall and moisture availability. Compare past modeled conditions with modern records and use current spatial moisture availability patterns from vegetation indices as proxy for past conditions.</td>
<td>Site locations from published archaeological reports and databases; rainfall data tables and analysis based on prior published research; satellite imagery used to create vegetation indices. Show that remote sensing technologies can be employed in different ways to explore cyclical patterns as well as the relationships and integration between natural and cultural aspects in different worldviews.</td>
</tr>
<tr>
<td>What are objects? Holes (different perception - vision, sound, modes, visualization, sonification and movement)</td>
<td>Explore names and categories referred to as gaps. It is hypothesized that these represent relationships through which certain phenomena can be observed and mediated. Proper names and categories Sempitane (tools for intercultural dialogue)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Expected outcomes:

1) Better insight in regions of meaning-making (*sensu* Kress)

2) Recommendations regarding needs of future technologies to understand differences in meaning making

Insight into how these (1 and 2) may contribute to addressing ecological problems in novel ways.

5.2.4.3 Sustainable digital environments

A still often heard comment or desire in academic research efforts is that more data are needed to answer the posed question satisfactorily. This research is based on the premise that our current era is data-rich and in comparison methodologically poor (BlueRibbonTaskForce, 2010). The logical approach to take is to use or reuse available data, much of which can be integrated and compiled, and to focus on developing novel questions and design methods that can take advantage of this restructuring and (continuous) supply of large amounts of digital data.

A standard practice in archaeology, including cultural resource management is to collect as much material as possible and preserve it for future research when new methods and techniques become available that will permit researchers to extract more or different information. Even though there are clear advantages to this strategy, and increasing digitization efforts to make material more widely available prove this point, there are also downsides. A negative aspect is that the impetus is still to gather and collect more, instead of reusing old material before collecting more (more is better). Exciting new (visual) data-capture technologies let us gather
data at an increasing rate with ever-improving accuracy, and the neutrality or objectivity of these data is often assumed. Organization and processing of the data is complex and time-consuming, a component of research that does not always receive proper attention. Often even less attention is paid to storage (physical and conceptual) and maintenance issues, making many of these data-collecting efforts useless in the near future (Judith van der Elst et al., 2010).

The bulk of the data used in this research is publicly accessible or freely available for research; the focus, that is, the original contribution is in the use of the data to make different connections, while the working, methodological, framework provides new ways to explore these data.
CHAPTER 6  THE PUEBLO WORLD FROM MULTIPLE PERSPECTIVES: HOW HISTORIES ARE MADE AND THE ROLE OF MULTIMODAL REPRESENTATION

The objective of this chapter is to provide an overview of archaeological research and its interpretations contributing to the histories of Northern Rio Grande Pueblos, in the broad context of cultural heritage policies and practices. Based on the discussion in previous chapters, I assume that conceptual frameworks in which modern Pueblo life is rooted have developed from a long intellectual history and as such are closely related to design principles underlying archaeological material in the region. Within this chapter I assess if and how these principles are considered in archaeological research design and practice.

Linguistic continuity within Indigenous communities in the Northern Rio Grande region provides a strong argument for independent conceptual development that may be difficult to understand from a western perspective, an idea that has also been indirectly supported through archaeological research interpretations by referring to differences in worldview for unexplained aspects of culture (Schaafsma, 2000; Snead, 2008). As the emerging theory of multimodality suggests, modes and media of communication can take on different “constellations” within different cultures, resulting in, and allowing for, variations of knowledge gained and expressed through different tangible and intangible modes of perception and representation.

In this chapter several factors are distinguished that impede the recognition of the importance of different conceptual frameworks and of multimodal communication
in pursuing ecological knowledge and understanding, broadly categorized as methodological, political, or technological factors. Based on the necessity of intersubjective spheres for knowledge exchange, the recognition and definition of these impedances and challenges can lead to different ideas and hypotheses toward reaching broader ecological understanding (A. Verhagen, 2010).

The guiding hypothesis for this chapter is that the acceptance of cultural and intellectual continuity, from so-called prehistoric up to modern times, for the case study is hindered by three facts: 1) the time period of Spanish political domination is mostly written based on Spanish documents (Kessel, 1987). 2) Since inclusion of New Mexico into American territory, U.S. acts and policies have served to incorporate culture-specific histories into a general American history, as manifested in cultural heritage management practices (Haake, 2007; Rosen, 2007). As a consequence, archaeological research has often been conducted in relative historic and conceptual isolation, disconnected intellectually from modern Pueblo communities. 3) Written (“permanent”) records, as a western scientific modal preference, and archaeological material analyses have been the preferred sources of knowledge of the past in heritage research and management. Therefore within the context of the general research problem, several questions need to be addressed:

- What are the historic precedents that have resulted in this isolationistic or compartmentalized approach? Different disciplinary approaches; political motives/land tenure issues; issues of identity and sovereignty. (political)
- What are the main research questions posed in archaeological studies of the Northern Rio Grande region, in what way are explanatory models used
relevant for longitudinal histories of the Pueblos, and what are its limitations based on Indigenous discourse and critique? (methodological)

- What is the role of analytical and representational systems in affirming or dismissing specific aspects of a culture, specifically regarding the histories of the Rio Grande Pueblos? (technological)

Addressing these questions will show that archaeological research in general provides important information regarding socioeconomic patterns and subsistence practices of past societies, but only marginally considers Indigenous methodologies in research design (Table 7). More importantly, framing this overview within a larger context of Indigenous critique and later historic developments of intercultural relations, will provide a justification for the validity of use of data of more recent historic and ethnographic times/sources to provide the context for the exploratory analyses in Chapter 7, the methodological foundation of which was laid out in the previous chapter (5).

Moreover, by placing this discussion in the context of post-conquest political changes in the region, archaeological research is linked with the practices of cultural heritage management, demonstrating that archaeological research is not an isolated, purely objective, scientific endeavor.

Finally, as this research pivots around spatial knowledge and spatial cognition, this discussion will encompass the role of spatial analytical and representational methods and technologies used in the making of history through archaeological research. Even though the improvements offered by current geospatial representational and analytical tools can enhance transparency in archaeological
research and dissemination, the limitations of these technologies need to be identified and are addressed in more detail in the next chapter.

Thus, in arguing for cultural continuity the overall need and objective is to differentiate between political and philosophical/methodological factors (Agrawal, 2002; Wautischer, 1998a) that hinder intellectual self-determination, addressed through the following secondary objectives:

- Identify methodological (epistemological/ontological) differences between American Indian research and worldview and the majority of archaeological research relevant to the case study
- Provide a general overview of archaeological research in the context of 1) general (longitudinal) American Indian histories, 2) objectives and methods used for reconstructing histories within academic parameters, and 3) the use and development of geospatial technologies in pursuing these objectives.

At least three lines of development during the 19th and 20th centuries have prevented a widespread acceptance of a distinct continuous Indigenous tradition for the case study region. First, the positivist paradigm as the foundation of modern science rested on the framework of progressive stages of (human) development, culminating in modernity and assumed to be universal. This resulted in such anthropological models as “social evolution” and specific scientific and management practices (Morgan). Second, examples of management practices that are related to the preservation of cultural and natural resources, such as the American Antiquities Act (1906) and more recently the Archaeological Resources Protection Act (ARPA date), focused on material remains, identified and categorized as a Western
Authorized Heritage Discourse (AHD) within critical discourse (see Smith and Akagawa ed. 2009). Archaeological practices following the rules established in these and other acts and on attitudes focused on physical remains were only recently impacted by the need to consult with descendant communities and consider intangible cultural aspects. Third, preceding, but related to the heritage focused acts are the U.S. policies that affected and still affect indigenous populations, such as removal, relocation, and assimilation measures undertaken in an effort to integrate or dissolve American Indian populations and their histories into mainstream American culture (Haake, 2007). Moreover, changes in land and water management dramatically impacted traditional subsistence systems.

Finally, map representations, which function as a reification of world order and establishment of histories, have been used as a standard tool for communicating knowledge in archaeological research since its inception, from plan-views of buildings and monuments, to site layouts, to showing the spatial relationship between archaeological sites and the larger geographical context. Being powerful tools to reify world order, the use of maps has been subject to extensive discussion and criticism (Harley, 1992; Monmonier, 1996), though many of us tend to take information presented as/in maps to represent uncontested, objective reality. Notably, in the United States systematic mapping efforts have been undertaken through the United States Geological Survey (USGS) since the mid 1800’s, based on the objective of land and mineral resources inventory, primarily for political/economic and only secondarily for scientific purposes. The salient point to make is that the development of technology always serves a specific purpose or
interest, and it is important to make this purpose explicit. A multimodal framework serves to investigate the kinds of knowledge gained through such representations, as well as its limitations, based on the discussion in this paper of different epistemological needs driven by different worldviews (Rabbit).

**Table 7 Chapter overview**

| Identified domains in which differences in human spatial cognition exist: |
| Spatial frameworks of reference: absolute; intrinsic; relative |
| Space-time concepts: ontologies |
| Systems of representation: multi-modality |

**Case study: History of the Rio Grande Pueblos**

| I Tewa concepts; design principles | • Relationships |
| • Interstices |
| • Cycles |
| • Flow |
| • Integrations of natural and cultural elements |
| • Pueblo as center |

| II Archaeological research - comparative evaluation of frameworks of understanding | • Epistemological differences among archaeological research approaches. |
| • Commonalities among archaeological research approaches (space-time universals) (view from nowhere) |
| • Differences between archaeological interpretive frameworks and Tewa design principles |

| III History of the Pueblos as represented in official documents and maps | • Political motives |
| • Interpretation and representation based on western principles |
| • Essentialists historic framework |
| • Denied linguistic and cultural continuity |
6.1 Case Study Introduction

Differences in academic historic research approaches are influenced by several factors, ranging from the use of different sources of information to different methodologies. Whereas the discipline of history employs “historic document” or written documents, “prehistoric” is defined as times for which no written documents exist and therefore is studied within the confines of other disciplines. Archaeological research, not necessarily considered a historical discipline, but more often a material or behavioral science, has provided important insights in times and components of societal histories and processes for which no specific, alphabetically written documents exist, and can provide a voice for underserved groups in general (Wolf, 1982). However, the term “prehistoric” can be offensive, as it implies a time or part devoid of history or stories.

The emerging theory of multimodality serves here to correct this misunderstanding in practice. It is essential to keep in mind the close reflexive-relationship between the elements of the multimodal framework, the perceptual and conceptual, the epistemological and ontological basis and its associated representation and communication technologies (modes – media) in the following discussion. The acceptance of multimodal communication is a prerequisite for developing successful intercultural communication and negotiation strategies, and for demonstrating the importance of other modes and cognitive affordances in knowledge pursuit and that communication forms an important pillar in this research. The recognition of differences in spatial cognition serves to expand prior models of information
exchange that were rooted in the notion of a universal language structure supporting human thinking.

6.1.1. Case study delimitation and suitability

The case study is concerned with archaeological research, its objectives and its contributions in establishing the histories of the Pueblos located in the Northern Rio Grande River valley in the state of New Mexico, also known archaeologically and ethnographically as part of the Eastern Pueblos. With a specific temporal focus on the time during and immediately prior to the Spanish Entrada and Conquest, a question is how results of these research efforts are integrated within longitudinal histories that are constructed across disciplines (Wilcox, 2001) (Preucel, 2002). Geographically the study is centered on the Galisteo Basin (or Galisteo district) within the larger Northern Rio Grande region.

Placed within a context of Indigenous Critique and broader historic developments, several shortcomings and limitations of current archaeological research methodologies can be identified, focused on cross-cultural differences in perception, knowledge representation, and communication that are argued to have epistemological roots and implications (G. Kress, 2010). The approach taken here is directed toward proposing different ways of understanding meaning as part of ecological dynamics between people and their environment, explored at the intersection of spatial technologies and human spatial cognition and the diversity thereof (further explored and proposed in the next chapter).
The justification for the case study selection is based on: 1) active Indigenous scholarly research addressing intellectual differences; 2) knowledge differences often attributed to other than intellectual differences, for example, political and socioeconomic, development is complicated by the fact that archaeologists are mostly from a non-indigenous background.

6.1.1.1 archaeology overview – [state of interpretation – current consensus]

Within the current dominant archaeological interpretive framework, the Northern Rio Grande region comprises a number of different districts (Huntley et al., 2007) or regions (Adams & Duff, 2004), and in general the region at large, including the central and southern districts, gained cultural prominence during what is categorized as the Pueblo IV period (P IV, ca. A.D. 1275–1600 in Kidder’s Pecos Classification), a time currently characterized by migration and community re-organization, but initially thought of as a period of decline following the regional systems of the Pueblo III period, notably centered in Chaco Canyon and Mesa Verde (Cordell, 1984; Kidder, 1927; Ortmann, 1998; Spielmann, 1998a). Archaeological research has since shown, however, that during the P IV period overall population increased in the Rio Grande region, and changes in village size, layout, and location, in addition to changes in ceramic complexes, are well documented (Adams & Duff, 2004; Spielmann, 1998b). Significant changes occurred during the early 14th century, marking an archaeological classificatory distinction between the Coalition (A.D. 1200–1325; earlier) and Classic (A.D. 1325–1600; and
later) periods, based on Wendorf and Reed’s classification, although the exact time of these changes may vary across the region (Crown, 1998; Wendorf, 1954).

Within the Northern Rio Grande region the Classic period is characterized by an increase in village size and spatial clustering of these larger settlements, which often contained enclosed plazas as part of their village layout, and is interpreted as population increase in the region at large. Several models of social and regional organization have been proposed for this kind pattern, ranging in focus from autonomy, alliances, and warfare to centralization, and for the Northern Rio Grande region specifically, variations of a model based on loose alliances of trade and exchange between clusters of sites to address patterns of resource stress and abundance is most common ((Anschuetz, 1998; Crown & A., 1994; Duff, 1998; Graves & Eckert, 1998; Haas & Creamer, 1997; Hena & Anschuetz, 2000; Herhahn & Hill, 1998; Hill, 1998; Jett, 1964; Snead, 2008; Spielmann, 1994)

A current research trend continues to focus on regional models that are generally considered landscape archaeology approaches (David & Thomas, 2008a), integrating and/or synthesizing multiple datasets, for instance conducting site cluster-analyses and (ceramic) sourcing studies. Several long-term and in-depth research projects, such as the Pajarito and Arroyo Hondo research projects, demonstrate the importance and benefit of multi-disciplinary research approaches (Dickson, 1979; Kelley, 1980; Kohler, 2004; Rose et al., 1981; Shapiro, 2005; Wetterstrom, 1986) for enhancing these current regional models (Crown, 1998).
Characterized by several large aggregated Pueblos occupied at the time of Spanish conquest, the Galisteo Basin/district became an important center of ceramic production during the Classic period, specifically for Rio Grande Glaze Ware (Fig. 9).

Figure 9 Location of archaeological sites in the Galisteo Basin

Rio Grande Glaze Ware ceramics, a decorated ware distinguished by its black lead-ore–based paint with a widespread distribution throughout the region, was produced primarily in a few settlements that had access to lead sources (Habicht-Mauche, Glenn, Milford, & Flegal, 2000). The tradition of Rio Grande Glaze Ware lasted from around A.D. 1315 to 1700 and is divided into arbitrary types of shorter
time-spans (Mera, 1940). As an important archaeological research focus, glaze ware ceramics research has provided a basis for chronology (Kidder, 1927; Mera, 1940; Society for American, 2005) and is currently often investigated from a technological and/or sourcing perspective, employing models of organization of production, exchange, and communities of practice, an approach advocated and employed by Shepard earlier (Shepard, 1956) (Habicht-Mauche et al., 2000; Huntley et al., 2007).

Within the Galisteo Basin/district, Pueblo San Marcos was a center of production, likely due to its physical proximity to what is now called the Cerillos Hills, a prime source of lead ore (Eddy, Lightfoot, Welker, Wright, & Torres, 1996; Ramenofsky, Neiman, & Pierce, 2009). The rise to prominence of other settlements in the Galisteo cluster is less clear (C. D. Allen, 2004; Ni, Cavazos, Hughes, Comrie, & Funkhouser, 2002), but several factors mentioned, among them favorable environmental conditions in the area during this time, likely contributed.

The Indigenous population was forced out of the Galisteo region early on, around A.D. 1700, by European immigrant groups for economic reasons, such as the presence of geologic/mineral resources valuable to Spanish and later Anglo immigrants (Kessel, 1987; Stearns, 1953), relocating to diverse locations including Hopi and Santo Domingo Pueblo. Even though this region has not been physically reoccupied by descendant American Indian communities since then, conceptual connections to the land exist and can be demonstrated ethnographically, for instance through knowledge and associated stories of this region, recorded as the *Tewa Ethnogeography* (John Peabody Harrington, 1916) during the early 20th century. More recently, land claims cases have also elucidated the historic and
continuing ties of descendant Pueblo communities to the land beyond present reservation boundaries, including the Galisteo Basin (Ellis & Dunham, 1974).

Although I am aware of this recent information, and its importance for knowledge regarding land concepts and land use areas of the different tribes, I will not pursue it in this research.

Renewed interest and opportunity for studying the Galisteo Basin is due to land tenure changes and passing of the Galisteo Basin Archaeological Sites Protection Act (GBASPA, Public Law 108-208-Mar. 19, 2004), facilitating archaeological fieldwork, and other efforts that employ a number of novel research approaches in this region to contribute to a broader understanding of the histories of the Pueblos. This particular case study is one such effort and is suited to address the general research problem for (at least four) reasons:

- Linguistic continuity between [late Pre-Colonial -Ancestral] Pueblo communities and modern Pueblo communities can be demonstrated, therefore conceptual continuity can be assumed (Dozier, 1951, 1983)

- The sovereign position of modern Pueblo communities allows continuance of cultural practices, therefore knowledge of history of practice can be assumed (G. Cajete, 1999; Jojola, 2004; Swentzell, 1990)

- Indigenous scholars have addressed methodological differences between indigenous and western research generally, and specifically for the case study region, providing information for alternative models of history (P. R. Schmidt & Patterson, 1995).
• Archaeological research and cultural heritage management for the case-study region has been conducted and/or directed primarily by non-indigenous scholars. The objectives of these research efforts are subject to investigation, for example, whether or not, or to what degree this research serves Indigenous interests; does “universal” interest take precedence over specific interest in cultural heritage, with specific attention as to how ‘universal’ is qualified or quantified, nationally and internationally?

6.1.1.2 Problem of history after the Pueblo Revolt of 1680

Although many questions remain to be addressed for pre-Colonial times through research of archaeological material, as stated by Snead (Snead, 2008), the period of Colonial dominance prior to and after the Pueblo Revolt of 1680 appears more contentious, due to the competing economic and ideological interests of multiple parties/interest groups (Liebmann & Murphy, 2011; Preucel, 2002) that have influenced research efforts in the creation of histories. Even though the time of Spanish conquest was violent and also accompanied by a biological factor of disease that resulted in a significant decrease of Native populations across the Americas, the time period following the Pueblo Revolt in the Rio Grande region is often also characterized in the literature as one of collaboration instead of confrontation and conflict between Indigenous and immigrant agricultural communities from the south. The latter model often attributes the most adverse effects on indigenous population and life ways starting later with Euro-American dominance (Kessel, 1987; Zubrow, 1974).
The ability of Indigenous populations to adapt to, adopt, and integrate changes (be it sociopolitical, or climatological) within cultural complexes has been shown archaeologically and ethnographically for the region, including changes incorporated during the so-called Contact period (Spanish conquest) (Dyer, 2010; Preucel, 2002; Schleher, 2010), and there is little or no indication to believe that this ability—often characterized as resilience—changed significantly or disappeared in later times. Efforts and strategies to control and/or manage Indigenous populations differ(ed) widely between subsequent Spanish, Mexican, and Anglo-American immigration and domination. The way these strategies—directly and indirectly—influence(d) archaeological research methodologies and the sociopolitical organization of the Pueblos, are discussed in this chapter (section 3, below) (Haake, 2007; Liebmann & Murphy, 2011; B. Schmidt, 2001).

Moreover, there is no doubt that Indigenous communities were and are affected by subsequent migration waves; however, different ideas, sentiments, and rhetoric characterize the relationship between Indigenous populations and immigrant populations of Spanish, mixed, and Anglo descent resulting in different, potentially competing, histories of this time, the sensitivity about which appears to produce some sort of selective amnesia with respect to the status of the Indian populations (Haake, 2007; Rosen, 2007; B. Schmidt, 2001). These histories are intertwined with changing attitudes toward land and land management and are therefore politically charged. In order to demonstrate continuity of Indian cultural and metaphysical foundations, however, certain aspects of those histories need to be clarified and are discussed and summarized in section 4, below.
6.1.1.3 Physical characteristics of the region

There are several ways to describe the physical geography of the Northern Rio Grande region, and in general within an academic setting the purpose to do so is “to explain the spatial characteristics of the various natural phenomena associated with the Earth’s hydrosphere, biosphere, atmosphere, and lithosphere” (Pidwirny & Jones, 1999-2010). A physiographic province, for instance, defines a particular pattern of landform (topography and geology) that differs significantly from that of adjacent regions, and within the Northern Rio Grande region the Southern Rocky Mountain Province and the Basin and Range Province dominate, characterized by mountain ranges, and deep structural and broad dry basins. The varied natural landscapes of New Mexico are the result of geomorphic processes that include deep-seated (hypogene) forces, such as volcanism and tectonism, to surficial (epigene) processes, such as erosion and sedimentation by water and wind.

In addition, a distinction can be made based on lifezones, determined by altitude (+latitude?) and the viability of plant and animal life as a result of that altitude. Six lifezones can be distinguished in present day New Mexico: Lower Sonoran – 2,817–5,000 feet (above sea level); Upper Sonoran – 5,000–7,000 feet; Transition – 7,000–9,000; Canadian – 8,500–11,500; Hudsonian – 11,500-12,500; and Arctic-Alpine – above 12,000 (Figure 10).

Besides the mountain ranges that characterize this region, including the Sangre de Cristo, Jemez, and Sandia ranges, the dominant physiographic feature is the chain of valleys and canyons occupied by the Rio Grande that result from geologic rift
processes. The predominant components of the rift valley are the Española Valley; White Rock Canyon, separating the Pajarito Plateau on the northwest from the Caja del Rio Plateau on the southeast; “White Rock Canyon is formed where the Rio Grande dissects the volcanic highland that separates the Española Valley from the Santo Domingo Valley….The La Bajada escarpment east of Cochiti Pueblo from the traditional northeastern boundary of the Lower Rio Grande Valley and also represents part of the eastern boundary of the Santo Domingo structural basin….The Cerillos Hills, north of the Galisteo River, and Caja del Rio Plateau from uplands separating the Santo Domingo Basin from the Espanola Basin to the northeast” (Sawyer & Minor, 2006). The Galisteo area is largely east of the Santo Domingo Basin and includes, in addition to the Cerillos Hills, the Cerros del Rio volcanic field and the Galisteo monocline (Stearns, 1953).

Within the semi-arid region of the Northern Rio Grande, moisture availability is a critical factor in ecology, and as argued by Whitney (1999), the study of spatial and temporal patterns across landscapes is central for understanding and managing ecosystems, however, the crucial relationship of stream course to its forming watersheds is often overlooked. Furthermore, identifying the factors contributing to the natural variability across different spatiotemporal scales in hydrology and river morphology is essential to understanding the changes in biological integrity. The concept of biological integrity differs from biodiversity in important ways and is better suited, according to Whitney, in support of water management approaches. Whereas diversity only describes the elements, integrity is reflected in both the biotic elements and the processes that generate and maintain those elements across
many spatiotemporal scales regulating the flow of energy and materials (Whitney, 1999).

The waters of the Rio Grande are strongly influenced by regional climate; the upper portions are fed primarily by snowmelt from winter storms, whereas the lower portions of the river accumulate runoff from thunderstorms of the summer monsoon (Costigan, Bossert, & Langley, 2000, p. 83). The physical process and cycles impacting the climate of the Rio Grande basin at various spatial and temporal scales were simulated by Costigan et al. based on recent (1990s) data that included an extremely wet (1993) and extremely dry (1996) year, in order to gain insight into current and future water resources in the basin.

Figure 10 Location of Galisteo Basin - subbasin
Precipitation variability in New Mexico, according to several recent climate studies, is due, among other things, to the interplay (or teleconnection) of two known phenomena, the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO), enhanced by the orographic effects of topographic variability. ENSO and PDO affect weather and climate at different time scales; the ENSO cycle, consisting of an El Niño and La Niña phase, averages about 4 years and ranges from 2 to 7 years, while the PDO cycle, positive and negative phase, averages about 50 years. A positive PDO phase and an El Niño phase enhance precipitation, whereas the negative PDO and La Niña both are characterized by diminishing precipitation (Liles, 2003; Ni et al., 2002).

The interplay between these two phenomena therefore can have great impact on rainfall variability; however, not all climate regions are affected equally (Liles, 2003). Ni et al. published a tree-ring–based reconstruction of cool-season precipitation based on the principle of uniformity, implying that physical and biological processes in the past are the same as today. The tree-ring record for this region is well established and is widely used for correlation with archaeological patterns (Rose et al., 1981; Stallings, 1933). Dendrochronology is a method of using tree-rings as a measurement of time, and through dendroclimatology, a subdiscipline, past climatic conditions can be inferred, reflecting past moisture or temperature conditions. Contour maps of decadal dendroclimatic variability show that at certain times conditions varied greatly spatially, whereas at other times conditions were relatively homogeneous. The relationship between spatial
variability and tree-growth is positive, meaning that favorable climatic conditions allow greater variability in tree growth, than do limiting conditions (Dean, 1988, p. 141).

Ni et al. (2002) employ and test two different methods that can be used to highlight the spatial variability through time among climate zones; New Mexico is currently divided into eight climate zones, and two of these roughly cover the northern Rio Grande region. The test data show, for instance, that severe dry and wet periods (>5 years) generally occurred simultaneously in most climate divisions in both models; however, the amplitude shown for these events differed between models. Periods of drought (sustained dry periods) were shown for the mid AD 1100s, 1570–97, 1664–70, the 1740s, the 1770s and the late 1800s.(Ni et al., 2002, p. 1657). “From 1370 to 1600 there were very few persistent wet periods, especially in New Mexico, which may have exacerbated the impact of the late 16th century mega drought over the study area” (Ni et al., 2002, p. 1658).”Wet conditions occurred during A.D. 1108–20, 1195–1204, 1330–45, the 1610s, and the early 1800s, of which the interval of 1330–1345 was the most persistent and extreme.

Geospatial technologies have been employed to gain insight into the relationship between moisture variability and vegetation health, suggesting that by observing (and communicating) vegetation changes, knowledge can be obtained regarding its complex spatial patterning. Based on these studies, indicating the importance of linkages for understanding the spatiotemporal (cyclical) complexity of the northern Rio Grande landscape, the geographic framework for my study will be organized by hydrological basins/watersheds and further delimited based on descriptions of the
Tewa world in the following section. Place name studies in other regions have indicated water and watersheds as important organizational axes for indigenous land use (Kari, 1996).

The terms basin and watershed are often used interchangeably with “catchment.” All three terms are used in hydrologic models of drainage systems in which they represent different levels in drainage hierarchy, or scales of representation (Maidment, 1993). A catchment can be defined as “an area of land, bounded by a divide [typically topographic highs or ridges], in which water flowing across the surface will drain into a stream or river and flow out of the area through a specified point on that stream or river” (Hornberger, 1998, p. 278). In other words, flow is the organizing principle.

6.2 Pueblo World(s) – aspects of American Indian thinking

Since incorporation of the case-study region into U.S. territory in 1848, official integration and assimilation policies, for instance the already existing Indian Removal Act of 1830, only partly met the objectives set forth by U.S. government agencies early in the 20th century. During the later years of social protest and change, the inception of the American Indian Movement and the Civil Rights Act (1964) set in motion a series of events challenging the way American Indian interests were represented in government and the number of treaties that were not upheld (Haake, 2007) (Rosen, 2007).
Moreover, a growing number of Indigenous scholars voiced critiques of standard scientific, and other practices in heritage research that are negatively affecting Indigenous peoples and interests, most recently focused largely on research methodologies. Many of these efforts are rooted in Critical Theory (Burkhart, 2004; Denzin et al., 2008; L. Smith & Akagawa, 2009a; L. T. Smith, 1999).

These critiques, as part of a growing global movement addressing cognitive imperialism, have led, for instance, to new policies being proposed—and partly-implemented—nationally and internationally, such as the Native American Graves Protection and Repatriation Act (NAGPRA) and the UNESCO recognition of intangible heritage and landscape as universal heritage; these developments demonstrate how closely political and intellectual self-determination are intertwined (L. Smith & Akagawa, 2009a).

The fact that western thinking is often equated with western scientific thinking, based solely on reason and objectivity, implies that deviating ways of thinking are then easily classified as subjective; however, this perception can be largely considered a remnant of the positivist paradigm. Objectivity, as discussed in Chapter three, is in my research thought of as the sum of subjective ideas and experiences, that is, intersubjectivity, building upon Husserl’s phenomenological and more recent cognitive scientific approaches as laid out in Chapter two (A. Verhagen, 2010; Zhang & Patel, 2006).

It is posited that: a) Indigenous or nonwestern philosophies are not necessarily opposed to scientific principles, but, similar to western science models, are often based on culturally specific metaphors and values; and b) any scientific paradigm is
necessarily biased by its individual researchers and their cultural backgrounds.
Indigenous methodologies therefore are here considered as (a) distinct research paradigm(s) underlying a worldview and epistemology within a larger overarching knowledge framework (Creswell, 2007).

6.2.1 Linguistic diversity and continuity

A major assumption on which this research rests is related to the fact that many indigenous worldviews are rooted in a deep historic (and conceptual) connection to the land as source of knowledge and jurisprudence, and therefore encompasses a large body of knowledge of the land/place that people inhabit in order to live sustainably within the parameters of given laws (Black, 2011). For instance, the strong positive correlation between patterns of linguistic diversity and biodiversity can be considered an indicator of this knowledge (Maffi, 2005).

This knowledge, and the underlying organizational and behavioral principles, is likely communicated by diverse means and media (modes). The complexity of the system may not be easily understood from a western scientific perspective, due to the different language groups represented and the possible different modal constellations used. Cultures that do not use written natural language (as is also increasingly the case in the western world) as their dominant means of communication likely employ different and/or multiple ways of communicating knowledge based on the same underlying conceptual framework that underlies their natural/spoken language. To begin to understand this complexity, it is useful
to provide a brief overview of indigenous languages spoken in the Rio Grande region and their known characteristics.

In the 19 New Mexico Pueblos existing today, five different Indian languages are spoken (as categorized in traditional linguistics way. They are listed below (Mithun, 1999):

1. Keres: six distinct dialects, spoken in seven Pueblos (Acoma, Laguna, Zia, Santa Ana, San Felipe, Kewa [formerly known as Santo Domingo], Cochiti)

2. Tewa: spoken in six Pueblos (Santa Clara, Ohkay Owingeh [formerly known as San Juan], San Ildefonso, Nambe, Pojaque, Tesuque)

3. Tiwa: spoken in four Pueblos (Taos, Picuris, Sandia, Isleta)

4. Towa: spoken in Jemez Pueblo

5. Zuni: spoken in the Pueblo of Zuni (not part of the Rio Grande region and therefore not part this study)

Of the Native American languages that are described by Mithun as language families, isolates and branches within language families, the Kiowa-Tanoan family and Keres encompass the languages that are spoken today in the Rio Grande region.

Historically, the Galisteo Basin was inhabited by Keresan as well as Tanoan speaking peoples.

The Kiowa-Tanoan family ((Mithun, 1999, pp. 441-447) consists of four branches: Kiowa, Tiwa, Tewa, and Towa. The Kiowa have been (has been spoken) on the southern Plains since at least 1700, while the Tiwa, Tewa, and Towa, known collectively as Tanoan, have been (and Tanoan has been spoken) in the Southwest for a long time (Dozier, 1983). As discussed by Mithun, the relationship between
these languages was firmly established with Hale’s construction of Proto-Kiowa-
Tanoan phonology in 1967. “The Tiwa branch of the family consists of a subbranch
Northern Tiwa, with two languages Taos and Picuris, and the Southern Tiwa
language” (Mithun, 1999, p. 442) (Sandia, Isleta), and considered mutually
unintelligible.

Tewa is spoken in a number of pueblos along the Rio Grande in New Mexico and in
one village, Hano, at Hopi, Arizona. Rio Grande communities include Santa Clara,
Ohkay Owingeh (San Juan), San Ildefonso, Nambe, Tesuque, and Pojaque. Extensive
research has been done, for instance by Dozier and Harrington (Dozier, 1983; John
P. Harrington, 1910; Mithun, 1999, p. 443; Speirs, 1975). Jemez Pueblo represents a
consolidation of perhaps a dozen smaller settlements, including Pecos, the last
residents of which moved to Jemez in 1838. Nearly everybody who lives there
knows the language (Towa). The Piro language has not been classified definitively
due to lack of speakers and limited documentation. The Spanish first described over
20 Piro pueblos south of the Southern Tiwa along the middle Rio Grande. It has been
suggested that Piro can be considered a branch of the Tanoan language; however
Leap suggested it may have been a different language. The speech of several other
groups in the Rio Grande region, the Tompiros, Jumanos, Mansos, and Sumas,
remains unclassified due to lack of attestation. That of the Tompiro, originally living
to the northeast of the Piro and southeast of the Southern Tiwa, is thought to be a
dialect of Piro.
The Keres language is spoken today at Acoma, Laguna, Zia, Santa Ana, San Felipe, Kewa (Santo Domingo), and Cochiti. It comprises of dialects that are mutually intelligible, but is not demonstrably related to any other languages (Mithun, 1999). As was discussed by Dozier (Santa Clara), these languages (or more correctly, the speakers of these languages) have been resistant to change, as exemplified by the effect of Spanish on three of the Pueblo languages, Tewa, Taos, and Keresan, and supported by the assumption that the way the languages are presently spoken also preserve spatial conceptualization. Early Spanish and subsequent immigrants may have disrupted former Native spatial configuration/formalization, however, spatial conceptualization should have remained similar- or at least developed within the confines of indigenous conceptual parameters. “Tewa morphology and syntax seem not to have been affected strongly by Spanish. The influence of phonology also appears to be minimal. Loanwords have undergone phonetic changes, but for the most part they are still incompatible with Tewa phonological structure. The number of outright loans in Tewa is less than 10 percent; for Keresan and Taos it is only about 5 percent (Dozier, 1983, p. 181).

The strong emphasis on the Tewa language in this research is an effect of research sources available. Discussion of some of its characteristics is not meant to be representative of all languages spoken in the region, but to serve as an example of difference from Indo-European languages and related conceptualizations.

Harrington (John P. Harrington, 1910) described the characteristics of the Tewa language in a short paper, and from his brief outline it is clear that it differs significantly from Indo-European languages. As noted by Harrington, the Tewa
language has been recorded by means of a scientific alphabet, however, the language is characterized by its use of “tones” of which 45 distinct sounds were identified in Harrington’s study (twelve of them are vowels), and therefore it is difficult to express in available written notation. Five classes of sounds are distinguished: orinasal; oral vowels; “semivowels”; larynx consonants; and oral consonants. The “tones” contain elements of “pitch,” “leap,” and “duration,” and many common words are distinguished by tone only. For instance, the word p’o can mean “water,” “trail,” or “moon,” depending on applied tone.

In addition, Harrington states that there are many parts of speech for which no satisfactory nomenclature exists in English, and that descriptions of these are approximations at best. “The governing ‘part of speech’ is the pronoun, which expresses personality, and together with the verb forms a complete sentence expressing several or all of the following categories: 1) self or non-self; 2) position or direction; 3) state of being an animal, vegetable of made thing, or mineral; 4) oneness, duality, or state of being three or more; 5) exister in position or mover in direction, actor upon, acted upon, actor upon self, exister of mover in relation exister exists or mover moves, exister or mover in relation to which actor acts upon acted upon” (Harrington 1910: 499). Moreover, the Tewa language is rich in sentence-words or interjections and has an immense vocabulary, and it remains difficult to record in current scientific notation.

Several new directions in ecological research draw on semiotics and communication models to gain a deeper understanding of and relationship between human behavior and experience, and concurring efforts to maintain biodiversity. The close
relationship between language and thinking, discussed in previous chapters as an important component of the spatial cognitive framework, can enhance these models, however, it is necessary to recognize the importance of linguistic diversity and complexity of representation and communication as (part of) living systems, that is, cultures/ecologies.

### 6.2.2 Structural and general ecological concepts

Even though, as explained by Cajete (Santa Clara), there is not a word for epistemology in any American Indian language, there is a body of understanding to explore the origins, nature, and methods of coming to know a way of life, similar to what this branch of Western philosophy represents. To better understand American Indian epistemologies Cajete (G. A. Cajete, 2005, p. 70) discusses this body of understanding and translates this understanding within the context of development of American Indian education unfolded through reciprocal relationships between one’s social group and the natural world. Based on the metaphor of environmental orientation that is widely shared among indigenous groups across the Americas, Cajete describes and discusses seven foundations of tribal education: the Environmental, the Mythic, the Artistic, the Visionary, the Affective, the Communal, and the Spiritual, all of which are closely interrelated and are briefly summarized below.

Environmental foundation forms a context of learning based on direct interaction with the natural world. Within the context of Mythic foundation guiding thoughts, dreams, explanations, and orientations to the world are explored and rest on stories
described in language and cultural metaphors of a tribe. The Visionary foundation allows individuals and groups to teach and learn through exploring their inner psychology and the collective unconscious. The Artistic foundation forms a natural triad with the Mythic and Visionary, representing the inward aspect of indigenous education, it contains practices, mediums, and forms through which meanings and understandings can be expressed. The Affective foundation provides a bridge between the Environmental and Communal foundation, forming the second, external directed triad; it mediates feelings for place and community. The Communal foundation forms the context containing responses and experiences reflecting the social and communal dimension, which affect all aspects of human life, teaching, and learning. The Spiritual orientation can be considered the foundational process of education, the parameters of which are formed by Nature and all it contains (G. A. Cajete, 2005, pp. 74-76). With respect to the physical manifestations of different histories of the Pueblos, several scholars have published underlying indigenous ideas/concepts (G. Cajete, 1999; Jojola, 2004; Ortiz, 1972a, 1972b; Swentzell, 1990; 1997. In a generalized Pueblo worldview, the emphasis is on place and the concept of time is thought of differently than what is customarily focused on Native American culture in academic studies, and is different from the western worldview at large (Ortiz, 1972 #93).

Even though it is here acknowledged that each Pueblo is considered autonomous, shared principles (such as those explained by Cajete) allow for some generalizations, and based on the current availability of data and information for addressing the posed thesis problem, the dominant resources and support for such
generalizations consist mostly of research focused on the Tewa and research by Tewa scholars. As described by Swentzell (Swentzell, 1990), 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/structure, where cyclical time is chosen, and movements are inward and spiral, instead of outward and dispersed (Swentzell, 1990, p. 29). The following quotation by Swentzell exemplifies the main organizing principles outlined by Cajete that were introduced above:

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, p. 23).

The reference to flow and movement as organizational principles in the Pueblo world is shared more widely across indigenous thinking (Waters, 2004b), and can be considered significantly different from the fundamental organizational axes of space and time expressed geometrically (is abstract) within a western worldview. To understand the structural principles underlying the physical manifestation and ecological relationships, it is important to take this into consideration.
The outline of the spatial conceptual framework related to physical configuration is described by Dozier and at length by Ortiz, as its relation to the land as its foundation is mediated through subsistence and ritual practices (Dozier, 1983; Ortiz, 1972a).

As described by Ortiz and Dozier, each Tewa village has concentric ecological zones emanating outwards from the center of the pueblo to the peripheries of the Tewa world. Each zone has four shrines located in approximately the cardinal directions, but in prominent physical locations –mounds, hills, cliffs, and the like. First is a zone encircling the pueblo, second, a zone extending to the edge of the cultivated fields, third, a zone including the uncultivated plains and foothills, and finally a fourth zone of the encircling mountains. In the last zone are the directional mountains or peaks bounding the Tewa world, each containing a spring and a shrine” (Dozier 1970:208). This description can easily be used as a geometric “template” to overlay onto a cartographic representation of spatial locations of physical remains, however, doing so may not do justice to the complexity of this conceptualization, which is not based on geometric relationships per se. Especially Ortiz’s study, as a structuralist approach, has been consulted by a number of non-indigenous scholars to provide a context for their own study of physical archaeological remains from the Northern Rio Grande region {Anschuetz, 1998 #144}(Snead, 2008) that can be categorized as landscape approaches and will be discussed in the next section. The relationship between human thinking, perception, and the environment is, however, mostly studied within the disciplines of psychology and biology, and only in a limited way within archaeological landscape approaches (Llobera, 2007).
Recent efforts in ecology/biology study the dynamic relationship between human perception and what is traditionally considered the natural landscape. The ecosystem not only “offers” air, water, and food to humans, but also aesthetics and sounds for instance, that contribute to a sense of wellbeing, that is, meaning embedded in the cognitive landscape (Farina et al., 2007) formulated as the eco-field hypothesis. “An eco-field is defined as a spatial configuration, that as a carrier of meaning, an organism perceives when performing a given function....The organism’s ‘landscape’ is the entire collection of eco-fields that it perceives in order to fulfill all its functions and locate all its resources (Farina et al., 2007, p. 10). This concept is closely related to von Uexküll’s concept of Umwelt, but also to Gibson’s theory of affordances, discussed earlier especially in relationship to place names and spatial ontology (Gibson, 1977; Levinson, 2008b).

Placing these ideas within a larger knowledge context that includes Indigenous methodologies, this (suggested) connection to the land has long been manifested in indigenous jurisprudence “in which individuals are characterized by their rights and responsibilities to the land [see also Black 2011] that underpins many indigenous traditions” (Munjeri, 2009) (Figure 11).
6.2.2.1  *Mulitmodality, ontological effects and epistemological implications*

Considering the land as a source of knowledge ruled by dynamic interrelationships between different elements classified as objects and processes, modes of perception and representation in an ecological framework, are likely different from western science models and systems of classification and notation. Rather than presenting this as a dichotomous relationship between western and nonwestern/indigenous ways of knowing, as is often done, I start from the position that these seemingly opposing avenues can be complementary. However, I believe that the emphasis on synthesis in many nonwestern ways of knowing has been downplayed in western scientific practice, and as a consequence the connection between source of
knowledge as part of an integrated system and the research results is not well understood.

Signs in the natural world as indicators of health, stress, and so forth are numerous, and can be interpreted and communicated in many different ways. The way people organize or frame the world within which object classifications make sense can then be based on different feature priorities. For instance, if sounds or color in nature are indicative of changing conditions, the mode of representation may be related. Rather than describing or visualizing a sound or sound composite, the changing conditions can be expressed in tonal differences in speech or music, resulting in modal expressions (or languages) that are not understood if the relationship between source of knowledge and implication of change is not understood when such a language is not learned. In other words, ecological literacy can consist of many modes of perception interrelated with modes of representation, transcoding the information in the process. Land, the atmo-, geo-, and biospheric processes, becomes both source and medium, as changing signs and layout.

Therefore, cultural material expressions that are found in the archaeological record have to be carefully evaluated, as western design principles are likely inappropriate models. As a hypothetical example, if a language allows for identifying plant health and changes in plant health, for instance through color or texture at a primary level, instead of species identification only, or subtle shifts or fluctuations in habitat boundaries, then a more complex meaning is communicated that may be difficult to translate into western scientific notation.
6.2.3 conflicting views of land and land management

The territory that became the State of New Mexico in 1912 was ceded to the United States by Mexico under the Treaty of Guadalupe Hidalgo in 1848. Land property rights granted under Spanish rule and adopted by Mexico, as aboriginal title have been contested since the beginning of U.S. rule through the implementation of federal acts and state regulations and continues to this day. Even earlier, at a national level, the Indian Appropriations Act (1851, 1871) served to move western tribes onto reservations that were protected and enclosed by the U.S. government, setting a precedent for modern-day Native American reservations, which were officially created to protect the tribes from the growing encroachment of white settlers (Haake, 2007; Rosen, 2007) also affected by Pueblo Lands act 1924 locally). The Pueblo Lands Act of 1924 served to settle land claims in New Mexico involving titles that were granted under Spanish rule, but either never affirmed or complicated by land use by non-Indian settlers.

An early sign of the impending status of land as commodity was the adoption of the Land Ordinance of 1785 by the U.S. Congress in order to raise money through the sale of land of the unmapped territory acquired by the U.S. government. This legislation established the basis for the Public Land Survey System (PLSS), dividing the land into one–square-mile sections that could be further subdivided for resale to settlers and land speculators. The earliest surveys were made in support of agriculture, but the recognition of mineral resources that could serve economic
purposes soon led to the employment of scientists for geologic research to be integrated into these efforts.

To manage public land and resources the USGS was established in 1879 with the responsibility for classifying (and mapping) public lands and examining geological structure, mineral products, and products in the national domain (pubs.usgs.gov). Land was thus commodified by this process, as an integral part of a developing capitalist economy. “Nearly all the public lands were within the arid region as defined by John Wesley Powell in his 1878 'Report on the Lands of the Arid Region of the United States.' Water was the region’s most precious resource, but Powell had pointed out that very little of the remaining public land was suitable for conventional farming and that only a small fraction of the arid land was irrigable. He then proposed radical changes in the land system, including organization of irrigation and pasturage districts, which suggested that water was more of a sociopolitical than a scientific problem” (Rabbit). His recommendations for development of the West, for land use other than agriculture, were, however, largely ignored by politicians, resulting in a perpetual problem of water availability and water rights.

Powell, who became director of the USGS in 1881, saw geology and topographic mapping as separate but interrelated components of geography, and topographic mapping soon became a dominant focus. These efforts also served his function as the director of the Bureau of Ethnology. For his ideas as an anthropologist he was indebted to Morgan, dividing human societies into developmental stages, in which all societies eventually progress toward “civilization.”
What can be inferred from the description of the Tewa world is that the conception of land in Pueblo histories is not defined by agricultural needs only, but encompasses a wide range of resources providing far more than a western concept of subsistence needs. As bounded by the outer sacred mountains, (cyclical) processes that affect the subsistence base can be understood through observation and experiential learning in the land, a conceptualization very different from a socioeconomic one. A recent shift in focus of USGS research practices in New Mexico is a response to the growing demand for water, directed toward better understanding the geological structure and hydrological processes for models of water availability (Leopold, 1951; Sawyer & Minor, 2006). Even though water continues to be part of an economic system of supply and demand, these studies will likely elucidate the interconnectedness of the Northern Rio Grande contributing basins and their biodiversity (Whitley & Hicks, 2001). The spatial configuration of the Tewa world can easily be considered a prototype of such models, however, the strategies to manage (sustain or exploit) these resources are completely different. These conflicting views provide a context for evaluating the dominant framework of archaeological research in the region.

### 6.3 Archaeological research within a broad context of cultural heritage

This section provides an overview of archaeological research conducted in the region and the methodologies used, organized chronologically in separate sections as early and late research. The rationale for this organization is based on a hiatus in
research in the Galisteo Basin and the Rio Grande Pueblos in general, due to several factors: 1) physical access: many of the ancestral Pueblos are located on private land, where research is not federally regulated; 2) research focus: the period in which the ancestral pueblos of the Rio Grande rose to prominence was initially regarded as a period of decline and therefore not of prime research interest; 3) research dissemination: research conducted at several sites as part of university field school programs is not well reported (Kidder, 1927; Spielmann, 1998a).

In general, the history of archaeological research is characterized by a change in focus from the development of culture histories during the early 20th century to understanding of processes and universal traits in human behavior, known as processual archaeology, and subsequent research based on critiques of prior research, collectively known as post-processual approaches. Throughout, however, establishing a linear timeline employing increasingly sophisticated dating techniques forms the backbone of all archaeological analyses.

The different research methodologies employed are discussed within a context of changing national and international attitudes and regulations relevant and applicable to cultural heritage. Set within a general policy of integration and land appropriation, ancestral North American Indian cultural material remains became part of the American heritage and protected on public land under U.S. law as of 1906 with the passing of the American Antiquities Act. The need for protection of monuments and objects of cultural significance, recognized in many regions in the world, became a globally united effort shortly after World War II (WWII) organized under the United Nations Educational, Scientific and Cultural Organization.
The first World Heritage Convention (WHC), held in 1972, “embodied [these many developing ideas as] a particular understanding and conceptualization of the nature of both cultural and natural heritage as universal value,” which has since had a significant impact on national and international heritage policies. Even though issues of self-determination and human rights were addressed in response to the adverse effects of WWII, the central concept of “universal value” of heritage, on which the WHC agreed, is contested. Particularly, “it was criticized for legitimizing a particular Western perception of heritage in both policy and practice” (L. Smith & Akagawa, 2009b). The underlying discourse, indicated as Western Authorized Heritage Discourse (AHD), not only defines what “heritage” is, but also dictates how it should be managed, focusing strongly on a definition of the universal value of heritage as material, monumental, grand, aesthetic notion that is reflected in archaeological research as a material science.

To counter this focus on tangible aspects of culture, the concept of intangible cultural heritage emerged during the 1990s: in 1992 the WHC adopted guidelines to protect cultural landscapes, a term that embraces a diversity of manifestations of the interaction between humankind and the natural environment (UNESCO). Taking this further, the Intangible Cultural Heritage Convention was adopted in 2003 and enforced in 2006 by UNESCO for the protection of intangible heritage. Spurred by postmodern thinking, archaeological research, as a result, is characterized by more paradigmatic diversity to encompass different variables, for example, ideology.

The following section will focus on early archaeological research in the Northern Rio Grande region in the context of regional and national acts and policies dominated by
the focus on material remains, whereas the subsequent subsections are placed within a broader context of heritage attitudes and regulations that shape and are shaped by archaeological research during the late 20th and early 21st centuries, evaluated at different scales of government.

6.3.1 Early research in context of the development of Cultural Resource Management

The passing of the American Antiquities Act of 1906 was a response and a solution to the increasing problem of pothunting and looting of American Indian sites/material. In section 3 of the Act, a permit system was established that would ensure that only qualified researchers perform excavation and investigation of objects, and as such it helped to establish the practice of archaeology as a scientific discipline, in which Edgar Lee Hewett played a crucial role. In providing measures to protect and preserve American heritage, it also prescribed the conditions under which research could be conducted, rooted in a strong material focus: “Provided, that the examinations, excavations, and gatherings are undertaken for the benefit of reputable museums, universities, colleges, or other recognized scientific or educational institutions, with a view to increasing the knowledge of such objects, and that the gatherings shall be made for permanent preservation in public museums” (NPS). Fieldwork with the objective of identifying and investigating archaeological sites and materials thus became well
regulated on federal and Indian lands, but remained uncontrolled on privately owned land.

6.3.1.1  Early research objectives, strategies, and findings

The purpose of early explorations and research efforts during the 19th and early 20th centuries in the American Southwest was to inventory Indian cultural material remains, sites, and ruins, especially those mentioned in historic (Spanish) documents, and to establish a cultural historical timeline as part of national heritage. Early researchers working in the Rio Grande region notably included Adolph Bandelier, whose secondary objective it was to demonstrate that myths surrounding American Indians were projecting a false picture of Pueblo life. In his documentation on the Rio Grande Pueblos he cautions the reader regarding several issues in reconstructing history of the region: 1) the view in the written historic documents represent only a specific perspective (that of the conquering Spanish); 2) the historic documents that could be accessed by Bandelier present not only different perspectives but also are based on variable degrees of accuracy of observations and measurements, resulting in discrepancies between these documents regarding events and locations; and 3) information obtained from inhabitants in native languages could have been recorded incorrectly for several reasons, such as the interpreter not being well-versed in the phonetic complexity of the languages spoken in the region, and the information given by speakers of different languages or dialects may contain different words for the same geographic feature (Bandelier, 1910). These reasons provide a strong argument for
archaeological and ethnographic research as independent evidence in the creation of histories.

Archaeological and ethnographic research was in large part commissioned and/or supported by governmental/national institutions, such as the work conducted by Bandelier under the auspices of the Archaeological Institute of America, 1880. Both Bandelier and John Wesley Powell were students of Lewis Henry Morgan; therefore, Morgan's theory of social evolution formed the dominant research paradigm for conducting research in the Southwest, such as that conducted by Nels Nelson (supported by the American Museum of Natural History) and J.P. Harrington (as part of the Bureau of Ethnology) (John Peabody Harrington, 1916). The Bureau of American Ethnology (BAE, originally Bureau of Ethnology) was established in 1879 by an act of Congress. In addition to its objective of transferring records and materials related to Indians of North America from the Department of the Interior to the Smithsonian Institution, the broader mission promoted by its founding director, John Wesley Powell – who also served as second director of the USGS until 1894 – was to sponsor broad-based field research projects related to North American Indians, well documented through diverse publications series. Since 1968 the BAE has been merged within the National Anthropological Archives. The general attitude, supported by Morgan’s ideas and the positivist paradigm, was that progress toward civilization was inevitable. Thus, the accepted fact that Indian life was disappearing, as supported by policy, resulted in large-scale efforts undertaken to document all aspects of Indian life, material and immaterial, to be preserved as part of the American heritage.
Nels Nelson was one of the first researchers to conduct archaeological studies of the ancestral Rio Grande Pueblos after Bandelier. His 1914 research paper is a report based on field investigations carried out in New Mexico mainly during the summer of 1912 (Nelson, 1914). The choice of the Galisteo Basin as a desirable locality for research was made only after the completion of a cursory survey of the 300-mile stretch of the Rio Grande drainage lying between El Paso and Santa Fe. Several groups of more or less well-known pueblo ruins were examined in the vicinities of Magdalena, Bernalillo and Cochiti, on the west side of the Rio Grande, but the most extensive and best preserved remains were found at a considerable distance east of the river, which Nelson divides into four main groups (Figure 12).

The eight Galisteo pueblos that are the subject of Nelson’s report form the northernmost group. Four and possibly five of these pueblos were known to have been seats or visitas of Franciscan missions during the seventeenth century, while the actual foundation of each one of the eight settlements could safely be referred to a time prior to a the arrival of the Spanish explorers. Seven of the eight pueblos were excavated by Nelson, to the extent of determining their chronological order (Nelson, 1916). The stratigraphic method and ceramic seriation pioneered by Nelson in the Galisteo Basin formed the foundation upon which the Pecos classification (Kidder, 1927; Shepard, 1956; Woodbury, 1960a, 1960b) devised by Kidder (1927) was built. Control of (linear) time was, and still is, a prime objective upon which all inferences are based, and stratigraphy and ceramic mean- and probability-dating provided the cornerstone for archaeological research. Cross-
dating with tree-ring chronologies (Stallings, 1933) proved that ceramic dating was a robust method for providing a temporal framework (Powell & Benedict, 2002).

Within the Pecos classification, dividing Pueblo occupation into four main periods (P I – P IV), the P IV period was generally considered as a period of decline compared to the P III time of large regional systems, such as the one centered in Chaco Canyon. Revisions of the Pecos classification proposed by Wendorf and Reed (Wendorf, 1954) resulted in the currently preferred chronological framework for studies in the Rio Grande region, based on specific history different from the larger Southwest context (Mera, 1940). The Wendorf/Reed chronology identifies five major periods, based on temporal changes in settlement patterns, architecture, and artifacts in the Rio Grande region specifically. In general, the Rio Grande Coalition period is characterized by population influx and especially toward the end of the period as a time of demographic upheaval, the subsequent Classic period is characterized as a time of population aggregation and the establishment of large-scale residential communities (Powell & Benedict, 2002)
Incorporating Nelson's Maps - Using Aerial Imagery

Nelson (1914) published a report of his fieldwork that included detailed maps of seven of the 8 large pueblos that are here shown on the map. In the above map Nelson's map of Pueblo Galisteo is scanned, georeferenced, vectorized and saved as a shapefile. Aerial imagery is used as a reference layer in the georeferencing procedure in ArcGIS.

Figure 12 Digitizing Nelson's maps
Earlier, H. P. Mera published an important synthetic study of the Northern Rio Grande region (Mera, 1940) that has been widely criticized, but still provides an important foundation for present archaeological studies. The objective of Mera’s study was to give a general overview of population shifts and changes based on ceramic data, using a well-established ceramic sequence. The Rio Grande Glaze Paint ceramic sequence is named after its spatial distribution and technology of decoration, centered in the Rio Grande valley of central New Mexico, with extensions to the east. The time period in which this specific ceramic paint technology occurred is roughly from the middle of the 14th to the beginning of the 18th century. (But see others for earlier evidence about glaze paint originating in the Zuni region (Bower, Faciszewski, Renwick, & Peckham, 1986)) The glaze paint ceramics are subdivided into six groups, from A to F, classified mainly based on rim differences. Based on characteristics and frequencies of occurrence of these groups, Mera came up with a division into five time periods for his population study (Mera, 1940, p. 5), and he used an areal division based on linguistic groups: the Piro division, the Tompiro division, the Jumano division, the West-Tewa division, the
East-Tewa division, the Keres division, the Tano-Towa division, and the North Tiwa district (Figure 13).

Mera worked back in time, using the distribution of modern Pueblos to classify groups in earlier times. This direct historical approach has been criticized and discredited, based on the fact that disruption and change took place due to the Spanish conquest, and many archaeologists favor the categorization of groups based on archaeological remains, not on ethnographic information, as it is considered more objective. Since Mera’s study very few refinements have been made to his ceramic-based chronology (Wolfman, 1994), but recent renewed interest in the glaze ware ceramics produced in the Galisteo Basin has spurred numerous sourcing-studies employing petrographic and chemical analytical methods (Dyer, 2010; Habicht-Mauche et al., 2000; Huntley et al., 2007; Schleher, 2010), refining models of migration and interaction of the ancestral inhabitants of this region. (Linguistic evidence is also reconsidered for use in archaeological models.)
6.3.1.2 The socio-political context within which early research was conducted

The importance of cultural material and natural features in building a national identity through heritage was recognized early in U.S. history and measures were undertaken to support the protection of this heritage. Notably, Edgar Lee Hewett was instrumental in the process of withdrawing land sections for the protection of Bandelier and Chaco Canyon as national monuments, which led to the Antiquities Act. The way the material was/is valued can be thought of as a “landscape archive,”
and the remains are to be protected and preserved “as is.” (Forte, 2004). With its establishment in 1916, the National Park Service became the dominant institution for overseeing historic sites through the Historic Sites Act (1935) as a government responsibility.

Research regulated by these laws was to establish the history of the U.S. and, in absence of written records, innovative scientific methods were developed to do so. The stratigraphic methods, dendrochronology, and ceramic cross-dating pioneered in archaeological research in the case-study region, helped establish archaeology as a scientific discipline. The attitude toward the Indigenous population, however, was strongly based on theories of cultural and social evolution, concurrent with government policies supporting acculturation, assimilation, elimination of Indian lifeways, with the goal of merging with mainstream America. This led to in-depth ethnographic research programs ("salvage ethnography") in an effort to record as much intangible (language, customs) information of a “vanishing” culture as possible (John Peabody Harrington, 1916). Ontologically, within such a view, Indigenous people, customs, and traditions can then be considered as an obsolete earlier stage of human development that should be archived and preserved.

For instance, the main objective of the Indian Removal Act of 1830 was to relocate tribes living east of the Mississippi to lands to the west, through “land exchange” made possible through either treaties or coercion, to clear the land for white settlement. Though not directly applicable to the Pueblo communities living in the Rio Grande region, the underlying objectives of this Act, of assimilation or eradication depending on Indian willingness to become “civilized,” persisted in
subsequent government policies (Haake, 2007). Even though inhabitants of the Pueblos were considered “civilized” based on their agricultural life style (and also were citizens of Mexico before it was ceded to the U.S), continuing expansion of white settlements led to reduced landholdings of many tribes after the Indian Appropriation Act was signed into effect in 1851. As policies designed to keep white and Indian communities segregated were not very successful and/or too expensive, different strategies were implemented.

Although the implementation of the Civil Rights Act (1866) prohibited individual states from discrimination against any citizen on the grounds of race and color, due to the fact that many American Indians lived on tribal lands and did not pay taxes, they were not considered under this Act and were, for instance, not citizens and not counted as part of the population census. Subsequently, several policies were signed into effect to “Americanize” the Indian population beginning during the 1880s, through education and land reform. This would “solve” two persistent problems: the need to protect Indian land reserves against white encroachment was no longer necessary, and Indians would become productive, self-sufficient members of mainstream society (Haake, 2007, p. 19). The Land Allotment Act (1887), for instance, allowed the allotment of Indian lands without Native consent.

Even though the allotment policy was considered a failed effort, the Indian Citizenship Act of 1924 bestowed citizenship without infringement of rights to tribal properties, but still excluded American Indians from many benefits of U.S. citizenship (voting restrictions, for instance). The recognition of unfavorable economic and educational circumstances among American Indians led to the
proposal of the Indian Reorganization Act of 1934, which was supposed to move power from the Bureau of Indian Affairs (BIA) to tribal governments that were recognized through this act. However, compromises made in order to pass the act diminished the original intent; tribal constitutions were to be modeled after the U.S. constitution and therefore countered many traditional ideas.

In summary, the late 19th and early 20th centuries saw two opposing developments: to remove “Indianness” for Indian in the future, while at the same time preserving historic Indianness in perpetuity as part of American heritage. It can be questioned whether this attitude continues to underpin heritage research and management, as a result of, or in concurrence with, sociopolitical developments at national and international scales.

6.3.2 Changing attitudes in archaeology, heritage research and management – national and international trends

It can be argued that the myth of modernity and universalism is still underpinning research and management efforts in cultural heritage. As laid out by Wallerstein (I. M. Wallerstein, 2006), modernity is the core of Euro-American rhetoric as the reincarnation of “true universalism,” associated with a capitalist economy. This claim of modernity, asserted to be inherently progressive, was necessary to face the challenges other civilizations posed that were encountered in their colonial quests, especially in the Orient. Modernity, then, when argued as historic necessity, could
only have grown out of the Greco-Roman world of antiquity, and the scholars who studied it, known as Orientalists (I. M. Wallerstein, 2006, p. 33). The belief in modernity guided much of their research during the early 20th century. As described in Chapter three, Said (Said, 1979) was a vocal critic of Orientalism during a time when the global political landscape had changed dramatically as a response to the atrocities of World War II. Said criticized the detached and reductionist view of the Orientalists, but equally rejected postmodernism, for its absence of grand narratives; instead, he identified himself with post-colonialism.

It was this climate that provided the breeding ground for new attitudes and policies toward Indigenous peoples, but still today, cultures, languages, and heritages of Indigenous peoples are threatened globally at multiple levels. A number of standard-setting international instruments and processes are currently available to mitigate such situations and are discussed by Marrie (Marrie, 2009). The relatively recently signed Convention for Safeguarding of the Intangible Cultural Heritage (2003) is most relevant for evaluating the role of archaeological research, but other instruments that can impact research focused on Indigenous peoples notably include the UN Declaration on the Rights of Indigenous Peoples, Convention of Biological Diversity, and the UN Convention to Combat Desertification in Those Countries Experiencing Drought and/or Desertification, Particularly Africa (1994).

As these conventions provide guidance for policy making, the implementation and success of these conventions ultimately are dependent on the number of members ratifying the conventions and the quality of domestic legislation that follows ratification, such as the Native American Graves Protection and Repatriation Act
(NAGPRA, passed 1990) in the U.S. Although the wording is often vague, collectively the content of these conventions provides a tool or framework for discussing and negotiating current heritage standards at the different governing and academic levels (Marrie, 2009, p. 188).

Intangible heritage in UN context is defined as (ICH Article 2(i): “practices, representations, expressions, knowledge skills – as well as the instruments, objects, artefacts and cultural spaces associated therewith- that communities, groups and, in some cases individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity” (UNESCO).

This specific wording not only makes reference to the interconnectedness between the tangible and intangible aspects of a culture, but also emphasizes the strategies and procedures to maintain that heritage. As argued by Kreps (Kreps, 2009), approaches to cultural protection are products of specific cultural context. The established modernist paradigm of cultural heritage preservation is, however, seldom questioned, as we have grown accustomed to the associated museum practices. The thesis posed by Kreps is that Indigenous and other nonwestern curation of cultural material can be considered an integral part of intangible heritage that already has an effect of museological thinking regarding the changing role and function of the museum as institution focused on what is curated and how it is curated.
It is within the context of these international heritage conventions that the current archaeological research in the Rio Grande region is discussed. The question is whether it still is driven by early 20th century ideas of archiving and preserving a (history of a) culture, or if and how ideas that underlie these conventions have been integrated in research design, enabling not only intellectual but also political changes to face current challenges to humanity.

6.3.2.1 Archaeological research development: human behavior, proxy measurements, and models of human development

In general it still holds that cultural material curated in museums/repositories is mostly, and continues to be, collected through institutional research programs in accordance with federal and state regulations (Figure 14). Archaeological field research traditionally results in large collections of cultural material that are systematically catalogued and preserved, and in principle remain available for future study. In addition to the collection of physical material (out of original context) resulting from these projects, other information is collected rooted in a theoretical understanding of a studied culture, such as records of geometric measurement of architectural remains. These records, usually paper but increasingly digital, also become part of collections; however, they represent, and thereby reify, a specific framework within which the cultural materials (e.g., lithics, ceramics) were collected and re-contextualized. The histories created are thus perpetuated and reified by the tangible records (maps, lists of measurements, etc.) that become associated with these material remains through research paradigms (T. S. Kuhn, 1970). In this section the central question is how archaeological research
methodologies changed over the years, either in accordance with or despite political changes. In general, it will be shown that the strong connection to the land and the structure of space-time characteristic of, and providing the foundation for many Indigenous methodologies is not well translated (only marginally considered, in accordance with current state and federal regulations) within current archaeological research design for the Northern Rio Grande region.

Over the years, research in the Rio Grande region has been impacted by land tenure; land ownership and use make up a complex mosaic of Native American lands, U.S. Government lands, Spanish land grants, and minor state and private jurisdictions (Sawyer & Minor, 2006). As certain sites were marked for federal and state protection (e.g., Bandelier, Chaco Canyon) others, such as the Pueblos in the Galisteo Basin, were not. Many research projects in the Galisteo Basin, for instance, were/are conducted as a consequence of economic land development that requires compliance with section 106 of the National Historic Preservation Act (NHPA; 1966).

A map of surveyed regions and research shows this discrepancy in research in the larger river basin, between the Pajarito Plateau on the west of the Rio Grande and the Galisteo basin on the east for instance. (also mentioned by Crown 1998; (Crown, 1998)). As a result, the models that have developed over the years are often site specific, and as it becomes clear that changes and developments are not uniform across the region that is reflected in the categorization of districts, extrapolation of these models to explain the larger region is not necessarily applicable or appropriate.
Surveyed Area

Figure 14 Surveyed region of the Galisteo Basin (data source (ARMS & Section))
Archaeological research in the Southwest has long been characterized by the early adoption of innovative applications of scientific methods and technologies, such as stratigraphy and dendrochronology, mentioned in the previous section, and more recently, material chemical-sourcing and selected geospatial technologies. Following a general trend in science, the turn from culture history approaches of the early 20th century toward scientifically based research as embodied by the New Archaeology program, or processual archaeology, during the 1960s, also spurred a number of long-term regionally focused research programs that fostered interdisciplinary collaboration, defined by the parameters of processual archaeology. Examples include the Pajarito and Arroyo Hondo projects in the Rio Grande region (numerous studies (Dickson, 1979; Kelley, 1980; Kohler, 2004; Rose et al., 1981; Shapiro, 2005; Wetterstrom, 1986). Changes in research focus are reflected in these projects as a result of their duration.

The focus of processual archaeology on explaining general patterns of human behavior grew out of criticisms of previous archaeological research as being primarily interested in specific events rather than processes. It was suggested that archaeological data should be conceived within a systemic frame of reference within which processual change in one variable can be shown to be related in a predictable and quantifiable way to changes in other variables, the latter changing in turn relative to changes in the structure of the system as a whole (Binford, 1962, p. 217).

In many of these studies/models, environmental factors functioned as independent variables in what can be generally characterized as Stimulus-Response models of
human behavior, leading to the dominant critique that many of these studies were environmentally deterministic.

Subsequent research has been largely influenced by economic models based on a dominant trend to consider human behavior as motivated by optimization of economic return (profit), driven by technological change and innovation and market expansion. As a result, current approaches, many of which can be labeled as landscape archaeology approaches (David & Thomas, 2008b), carefully reintroduce environmental variables, but often as supporting evidence. In addition, long-ignored aspects of human behavior that are difficult to quantify (e.g., ideology, perception) (re)entered academic discourse, underpinning/supporting various research models since 1980s. As general trends and in accordance with international cultural heritage discourse, these changes are reflected to a greater or lesser degree in archaeological research in the Northern Rio region (Anschuetz, 2005; Anschuetz, Wilshusen, & Scheick, 2001; Graves & Eckert, 1998; Preucel, 2002; Snead, 2008).

Landscape archaeology refers to a wide variety of approaches grown out of different schools of thought, processual as well as post-processual in origin (David & Thomas, 2008b) Studies focused on the Coalition and Classic periods of the Northern Rio Grande notably include sourcing studies, building upon a material science–oriented analysis integrated within economic models of production and consumption at a landscape scale (Habicht-Mauche et al., 2000; Hill, 1998). Phenomenological approaches, being interpretive rather than analytical, are increasingly employed, mostly to address the Classic–Contact period transition (Preucel, 2002; Wilcox,
2001). The latter, with their focus on human experience, are in general more attentive to Indigenous worldviews.

With their potential as part of an integrative (landscape-approach) methodology, geospatial technologies were pioneered in the Southwest during the 1970s and 1980s; however, their current use is predominantly in CRM context and only to a limited degree addressed and employed within an academic/research setting. In other words, theoretical (and philosophical) issues of spatial/spatio-temporal models, methods, and technologies explored for other regions are lacking in Southwest archaeology (but see, (Eddy et al., 1996; Hill, 1998)). These are mostly regional approaches, comparing differences and similarities between districts using established practices to address population, socio-political organization, and subsistence.

Maps representing geographic (Euclidean) space and distribution of loci of human activities are, however, an important tool in archaeological practice. The space-time framework supporting these maps is rooted in the established geometric frame in which space is considered the neutral backdrop for human activity. The representation of time is, however, complicated, but the geometric division of time or periodization derives from the conceptualization of space (V. Evans, 2003; Zerubavel, 2003). Developed from a long cartographic tradition, current geospatial technologies offer new ways to analyze and represent space-time changes within this conceptual framework (for instance, space-time cubes (Kraak, 2003, 2005; Kwan, 2004) that can represent landscape processes). Figure 15-16 show how available data can be integrated within a GIS.
Figure 15 Sample map and Table – digitizing sites investigated in previous studies for exploration
Figure 16 Digitizing published maps using the overlay capability in ArcGIS for comparative exploration (displayed data source: Habicht-Mauche; Mera)

Although research in the Northern Rio Grande is spatially oriented in regional and community approaches, the main focus of archeological research is on time. Establishing chronologies based on a specific concept of time, in which blocks of sequential time (periods) are identified in ways similar to the way that space is subdivided according to geometry (distance), is its main goal, and knowledge of change in behavior is its objective. Mapping technologies are predominantly employed to represent site locations in a Euclidean frame of reference, but several studies have shown the potential of these technologies beyond this dominant function (Herhahn & Hill, 1998; Hill, 1998; Lightfoot & Eddy, 1995).

Movement

Migration and transformation (across space and time) continue to be dominant themes in research in the region (Snead 2008). And even though environmental deterministic models no longer are popular, due to the importance of moisture availability, the relatively well established climatological record (C. D. Allen, 2004;
Dean, 1988; Orcutt, 1991; Rose et al., 1981), as a linear series of drier and wetter
events or periods, provides an important frame of reference for suggested models of
changing sociopolitical organization. Even though it has been pointed out that
movement and migration is an integral part of Pueblo worldview (Naranjo, 1992),
due to the scale of the migration occurring at the beginning of the P IV period, it is
considered different from earlier and subsequent migration events in archaeological
research (Spielmann, 1998a, p. 16).
Changes in settlement pattern as a reflection of migration and transformation are
addressed, among other things, in models of population fluctuation, predominantly
using architectural measurements, such as site areal extent, number of structures,
room counts, floor area, and settlement pattern studies, focused on clusters as an
indication of community (Crown, 1991; Spielmann, 1994).
Whereas the early, Developmental, period is characterized by sparse population in
mostly in well-watered valleys along the Rio Grande, the subsequent Coalition
period is defined in terms of rapid population increase (migration) in already
occupied sites and previously unoccupied upland areas, as evidenced by the
presence of surface roomblocks. Population is characterized, however, as relatively
unstable, based on the fact that residences were occupied only briefly, a pattern
argued by some as part of a cycling pattern. Toward the end of the 14th century,
generally considered the start of the Classic period, population aggregation is
inferred from increasing site size, consisting of multiple roomblocks surrounding a
plaza area, although the total population is thought to have decreased, and sites are
considered clustered. This pattern is notably present in the Galisteo Basin (Nelson,
The Arroyo Hondo study is particularly important because the Coalition and Classic period occupation is clearly distinguished by an occupation hiatus, often correlated with environmental degradation (Habicht-Mauche, Lang, Thibodeau, & Phagan, 1993), from which models of change are extrapolated. Sociopolitical organization changes within and between regions (and/or clusters) are addressed using building style, layout or configuration and technology changes in production, including architecture, ceramic, and lithic technologies (Crown and Kohler, Crown, 1991) showed, for instance, building changes based in abutment and used specific calculations to estimate room use-life for Pot-Creek (T’aitōna) that has been accepted as patterns throughout (S. M. Fowles, 2004).

More recently, space-syntax–based models were used to evaluate accessibility in Arroyo Hondo compared to other P IV sites in the region (Shapiro, 2005). Space syntax is a spatial analysis method developed to assess social organization based on the idea of differential access in organized space, primarily built environment. The underlying principles of this method have been criticized, similar to critiques of universal language (see Shapiro). Such community–social organization approaches are often based on geometric proxies/indices(straight line distance in cluster/community models) – not taken into consideration other spatial factors – topography, visibility for instance – that can be problematic. (Figure 17).

Economic models serve the study of trade and exchange of goods (e.g, study of agricultural goods such as cotton, and more commonly, ceramic goods through spatio-temporal changes in presence of iconographic elements on pottery and more recently evaluating the (chain of) production and consumption of ceramic goods
employing sourcing analyses) (S. M. Fowles, Leah Minc, Samuel Duwe, David V. Hill, 2007; Habicht-Mauche et al., 2000). These studies have contributed valuable insight into the access to and use of resources, even though the exact organization of trade and exchange between and among sites is still difficult to infer and ensure. Based on the unique resource for lead-based paints used in ceramic production (glaze ware), a ‘chemical fingerprint’ can be established based on which a geographic location can be indicated, although it has become clear that not each resource location can be uniquely differentiated from all others, diminishing the use as a proxy measurement of this method for economic models of exchange. Several centers of production are identified correlated with access to lead as a resource. The Galisteo Basin, is considered a center of production, specifically San Marcos Pueblo, due partly to its closeness to the Cerillos Hills (Schleher, 2010).

Figure 17 Mera’s sites- shapefile overlaid onto a Digital Elevation Model in ArcScene (ESRI) – looking North
In general, economic models imply standardization of production with market expansion or sphere of influence, but a recent study of San Marcos glaze ware ceramics indicates otherwise (Schleher, 2010), and studies in agricultural practices throughout the region also show the high degree of variation through local adaptation, that is, unique solutions to local conditions. The models based on a notion of universalism, may thus be inappropriate.

Subsistence, conventionally assessed using carrying capacity models based on technological expertise and changes in subsistence practices, is complicated by the diversity shown across the region (Anschuetz, 1998; Maxwell, 2000; Zubrow, 1974); therefore, as these studies show, the identification of different adaptive strategies should be given priority before such models can be meaningful, for instance studies done in Galisteo by Eddy and Lightfoot (Lightfoot & Eddy, 1995), identifying and categorizing different field types. Although subsistence studies have always focused on the changing carrying capacity of the surrounding lands that can support the estimated populations, where aggregation and dispersal are considered as response strategies to fluctuating moisture availability to grow sufficient amounts of food, conflict and warfare has been a recurring research focus to explain site location, location changes, and aggregation, primarily arguing defensibility (Kolb & Snead, 1997; LeBlanc, 1999; Snead, 2002).

Crown (Crown, 1998) has previously argued the limited research scope, that is, focus primarily on subsistence and economics, to be problematic, but has indicated that recent and current studies, such as community studies and the integration of conflict and ideology as important conceptual components, are enhancing our
understanding of Pueblo histories. However, the focus on space in absence of fine chronological control, such as exemplified by the Pajarito and Arroyo Hondo projects, remains archaeology’s main objective as well as problem. Even though considered a spatial science (Wheatley & Gillings, 2002), innovative spatial analytical technologies are employed or explored in this region only to gain insight into conceptual underpinnings of the archaeological material in landscape context (Herhahn & Hill, 1998; Maples). Maples conducted a visibility analysis based on indices developed by Higuchi (Higuchi, 1983), whose research is rooted in changes in Japanese landscape organization, but also in perception and conceptualization. Maples employed primarily the geometric components of Higuchi’s paradigm, The different facets of Higuchi’s research, however, provide a more holistic landscape framework than the indices alone (Higuchi, 1983).

Ideology is for instance studied in the Northern Rio Grande region from changes in architectural construction and iconography, primarily of rock art and ceramic decoration. Differences in iconographic elements present in different settings and exposures is used to support or contrast, enabling categorization of districts or ethnic boundaries otherwise based on settlement patterns (Olsen, 2004; Schaafsma, 2000); whereas ceramic differences in style and decoration are used in exchange models (both economic and ideological), rock art of the Rio Grande region is not a dominant archaeological research focus, because it is difficult to date. Despite its apparent ubiquity in the region, other than assumed territorial/ideological boundary markers, the function, for example, discursive or other communication significance
on a landscape scale, is seldom addressed ((Olsen, 2004) but see (Bernardini, 2005; Williams, 2000)).

Appreciative of landscape archaeology to study meaning, but critical of early (20th century) research in the region, Snead seeks to integrate the different themes — migration, conflict, subsistence, ideology — in a contextualized landscape approach, defined as “deep mapping.” He does not employ novel methods and technologies in his landscape community study; archaeological data and interpretations of those data are not much different from those in earlier studies. His approach, however, seeks to integrate a phenomenological view and historical ethnography to present an alternative context for these interpretations to enrich the understanding of significance of place. It does not specifically question archaeological theories and methods and their underlying space-time framework, but is critical of early research in the region as static and documentary in approach (Snead, 2008, p. 20). His criticisms lose some credibility, though, when he suggests, for instance, that the (scientifically notated) terms for water, moon, and trail in Tewa are the same and therefore conceptually related, ignoring the fact that the written form does not adequately represent the spoken form. Nonetheless, research to connect the land through the investigation of trails is a promising development and deserves continued support. Ultimately, a landscape approach has to address space and time and the different conceptualizations that underlie the archaeological material that is sought to be understood (Franchetti, 2006; Nash & Chippendale, 2002).
6.3.3 The structure of space and time – and the creation of histories

As expressed in Indigenous discourse, the concept of time is thought of differently than in the general western concept of time (Ortiz, 1972a; L. T. Smith, 1999). Temporal frames of reference and their conceptual and representational content in language and other modalities are considered closely connected to, and derived from, the spatial domain (V. Evans, 2003). The space and time axis as organizational principles in a western scientific, geometric conceptualization and representation of space, and space as metaphor for time are reflected in language (Lakoff & Johnson, 2003). The development of a conceptual structure of space and time, its exclusive innateness no longer supported by research, is argued by Evans to be at least partially based on experience (Evans 2003). This experiential correlation, supported by the psycholinguistic research discussed earlier, allow the idea that speakers of different languages express different (fundamental) concepts and structures of reality (or worldview) in language as well as other modalities (Forceville & Urios-Aparisi, 2009). The lack of an abstract concept of time has been argued to be the case for a number of languages, including Hopi, but this issue is debated and questionable if no effort to identify different concepts accompanies the research (Carroll, 1956; Malotki, 1983). Moreover, it is not inconceivable that, similar to the identification of use of an absolute frame of reference, an associated frame of reference of (other) fundamental concepts exists; also, the mapping of time using spatial structure as metaphor may be different.

*Time and motion (history as a thing of the past? And the past is behind us)*
The basic metaphoric mapping of time as either Moving Time or Moving Ego is shown by Evans to be flawed, and he suggests that time is related to a distinct set of lexical concepts, including a Moment sense, a Duration sense, an Event sense, and a Matrix sense. (Examples are for the English language.) The Measurement-system sense of time, for instance, arises from a correlation between periodic behavior in the external world and our experience of duration (V. Evans, 2003, p. 169). Although examples to demonstrate these concepts are all expressed in English, a discussion on the notion of past, present, and future addresses language differences that influence models of time. For instance, the Moving Time and Moving Ego mapping are projected on a horizontal movement trajectory, that is, straight lines (one-dimensional), and suggested to be dominant in a western worldview. A cyclical view of time is associated with the motion of heavenly bodies, instead of movement of humans along a path (ancient Greece). Following these research models, to analyze the archaeological material as representation of Pueblo histories within a western space-time framework will result in specific (linear) histories, but will fail to recognize possible different ways of understanding, organizing, and mediating the world, as expressed in different modes. What is important to understand is the motive behind history construction and the worldview(s) within which these histories function.

*Knowledge and intangible heritage*

Our knowledge is structured by our frame of reference, within which this knowledge makes sense. What we know and how we know varies among cultures, societies, academic disciplines, and individuals, and based on the reconsideration of
the Sapir-Whorf hypothesis, these differences can be argued to be closely related to differences in language in addition to the method used to justify beliefs. Knowledge “that” (usually discussed as propositional knowledge — epistemology) differs from other forms of knowledge. Knowledge “how” (procedural knowledge) and knowing of (knowledge by acquaintance) can all be considered intangible aspects of a culture. For instance, knowledge of how to make a basket is different from knowing that certain soils provide better plant nutrition or knowledge derived from a logical statement.

Intangible heritage refers to those aspects of a culture that are immaterial and in general not studied from archaeological remains, but can be inferred by analogy for instance, as ethno-archaeological approaches that broaden our understanding of, and creating a context for archaeological material. The recognition of intangible heritage as of “universal value,” integral to cultural identity, cultural diversity, human creativity, human rights, and sustainable development (Munjeri, 2009, p. 131), has led the international community to adopt the Convention for the Safeguarding of the Intangible Cultural Heritage (2003). However, not only have the followed practices been criticized as being based in a western-oriented discourse, as mentioned earlier, the choice of what to protect is selective (Marrie, 2009). Whereas certain components, such as biodiversity-related knowledge for instance, is actively promoted, languages, according to Marrie, even though considered the fundamental vehicle for knowledge and creativity, are almost totally neglected (Marrie, 2009, p. 175). Selection can be driven by several factors: cost (including maintenance), ease of dissemination, and “universal value,” to name a few. The example provided by
Marrie highlights the difference between knowledge “that” and knowledge “how”; the visual digital recording of how to make a basket can be made once and maintained and disseminated with relative ease, whereas the effort to maintain a language requires more resources and long-term commitment.

Yet, it is through language that knowledge is communicated and current insights in spatial theory, psycholinguistics, and multimodality demonstrate the value of language diversity, and through language communities (including Indigenous communities) that cultures can safeguard their intellectual property and maintain cultural practices. Therefore, the criticisms and problems outlined by Marrie of the effectiveness of the adopted UN conventions and related practices regarding intangible heritage and Indigenous Knowledge (IK, also known as Traditional Knowledge, TK) are helpful for understanding and acknowledging the impact of epistemological differences in natural and cultural research and heritage management (Agrawal, 2004; Marrie, 2009; Watkins, 2000).

6.4 *Pueblo histories: global factors influencing its integration into mainstream American history*

Threats to natural and cultural resources are omnipresent. Global, regional, and local efforts to protect these valuable resources are diverse in scope and focus. The role of archaeological research has always been debated in terms of its methodological underpinnings, but also for its political motives. Global efforts to safeguard cultural and natural heritage and the accompanying discourse reflecting
global political dynamics since the second half of the 20\textsuperscript{th} century may appear as a change in thinking and practice; however, it can be argued that this is a continuation of a long rhetorical history in which the “Indian” has always played a marginal role. Ever since the “discovery of the New World” by the Spanish, the representation of the Americas and the Spanish in its conquest has been crafted specifically by the Dutch to blacken the Spanish reputation and thereby resist Spanish tyranny from which they themselves suffered as well. A colonial discourse not unfamiliar today that was inspired by the writings of Bartolomé de Las Casas was printed in the Netherlands, where the vibrant printing establishment during that time (16\textsuperscript{th} – 17\textsuperscript{th} century) allowed a diversity of representations (pamphlets, maps, etc.) to be disseminated widely across the European continent to a broad audience. As the Reformation was taking place at the same time the print shops in the Netherlands served well as propaganda and resistance.

The ensuing cultural geography was phrased in terms of tyranny (Spanish) and innocence (Indigenous peoples of Americas; Indian as metaphor), in which the Indians were considered or imagined as allies/kin against the Spanish. The objective of the Dutch, however, were twofold, one was to address the physical and cultural brutality of the Spanish, for instance the enforcement of Spanish as the only language to be used was a fate that could await the Dutch as well, and secondly, the dominance and missionary activities of Spain hindered possible future trade relationships with the “New World.” This second objective was not explicit in the rhetoric of innocence, as it reveals (would reveal) the Dutch more as competitors of the Spanish than as victims. All in all, this carefully created image, widely exposed
through diverse modal representations (landscape painting, maps, pamphlets, histories), was instrumental in the success of the Dutch revolt and the operations of the Dutch West India Company and subsequent European expansion into the Americas (B. Schmidt, 2001).

Even though the players in this rhetoric shift roles as the Dutch and English engage in their own tyranny overseas, the structure of discourse remains effective as an instrument in political relationships between European nations and management of all their colonial possessions. The term “Black Legend” (Juderías, 1914) coined more recently refers to a style of historic writing that has its roots in this early colonial discourse, perpetuated in Enlightenment polemic, that was introduced to address and correct the negative image of Spanish history, also affecting the history of colonization of the Americas that resulted from this shift in roles.

Within certain histories of the Pueblos, discussing the impact of Contact for instance, the “Black Legend” is employed in argument to present a more nuanced picture (ameliorating circumstances) of the Spanish-Indian relationships (Wilcox, 2001).

There are, however, two distinct ways in which the idea of the Black Legend can be used in histories, one absolute and the other relative. In an absolute sense the role of the Spanish can be re-evaluated in a way that results in the perception of a an overall less violent role. In a relative sense, the role of the Spanish can be seen as equally violent as in prior interpretations, but in comparison to other European colonization efforts, was not necessarily worse than any other (B. Schmidt, 2001).

Extrapolating the argument, well laid out by Schmidt, describing “the cultural geography in early modern Europe…. in which other place and peoples were
imagined, appropriated, and manipulated in a period of ‘encounter’” (B. Schmidt, 2001, p. viii) a relative view of the “Black Legend” in Pueblo histories provides a broader context for evaluating motives of cultural heritage practice. In doing so, the rhetoric of alternating tyranny and innocence takes on a different meaning but is still in effect. Within such a framework, European settlers in New Mexico are part of the same continuing polemic, illustrated by Haacke by a quote from a Hollywood movie (Haake, 2007, p. 1):

“...you mean he took it [the land] away from whoever was here before, Indians....Well, I'm taking it way from him” (Thomas Dunson ,portrayed by John Wayne, in “Red River” 1945), showing how this idea is also perpetuated in popular culture (Singer, 1996).

The disappearing Indian – or the continuation of the metaphoric Indian

The Enlightenment in Europe provided the foundation for modern science. The early, positivist paradigm provided the model of progressive but distinct developmental stages of humanity that underlay the anthropological research in the Rio Grande region. According to science, the disappearance of the Indian population (ontologically and physically) was inevitable (John Peabody Harrington, 1916), thereby justifying any political measures of assimilation, removal, and appropriation (of natural and cultural resources) as benevolent acts. The model of social evolution also perpetuated the idea of universality in human cognition.

The radically reduced population of Indian individuals was not only a physical reality of the belief in the inevitability of this disappearance, but maybe more importantly a political and administrative decision. The difficulty of estimating pre-
colonial population in the region based on architectural remains and carrying capacity models discussed above is supposed to have improved with administrative written records in colonial and post-colonial times. Several factors, however, complicate the objectiveness of these counts: the lack of systematic record keeping during Spanish domination resulted in less reliable numbers, and even though methods may have improved under the American government, the status and definition of “Indian,” that is, Indian identity and rights, was reflected, for instance, in the absence of Indian individuals in the early United States population census. A rare study that evaluates population changes from pre-colonial to recent times was conducted by Zubrow (Zubrow, 1974) employing a variety of methods continuously through time, in order to cross traditional academic (methodological and temporal) boundaries. Evaluating climate, room counts, historical records, and agricultural potential (ecological, demographic, and spatial aspects), even though often working with incomplete data sets, Zubrow reached some surprising conclusions: first, Pueblo population is correlated with climate after 1800 rather than before due to acute strain on limited resources by Spanish and Anglo immigrants; second, Anglo immigration (even though nonviolent) was more disruptive than the Spanish; and third changes in recent times show a decrease in agricultural dependence by an increasing population in the Pueblos (Zubrow, 1974, p. 79). This brief overview of global and local developments provides a context for evaluating archaeological research and heritage management from a methodological and political perspective that further prepares the framework for the exploratory analyses of the next chapter.
Within this chapter the following questions were addressed:

- What are the historic precedents that have resulted in this isolationistic or compartmentalized approach? (Different disciplinary approaches; political motives/land tenure issues; issues of identity and sovereignty.) (political)

- What are the main research questions posed in archaeological studies of the Northern Rio Grande region, in what way are explanatory models used relevant for longitudinal histories of the Pueblos, and what are its limitations based on Indigenous discourse and critique? (methodological)

- What is the role of analytical and representational systems in affirming or obliterating specific aspects of a culture, specifically regarding the histories of the Rio Grande Pueblos? (technological)

In summary, this section is a refinement and focus of the previous sections. Politically, current heritage laws and tools provide ways to protect cultural and natural heritage, however, these efforts are criticized by Indigenous and local communities as being biased toward western values. Their attitude has deep roots and a specific history in New Mexico. By linking several disciplinary findings, this section presents a different way to view these historical relationships.
CHAPTER 7 GEO(GRAPHIC) REPRESENTATION AND COMMUNICATION:

EXPLORATORY ANALYSES OF MULTIMODALITY AND ITS

EPISTEMOLOGICAL IMPLICATIONS

Accepting a reflexive relationship between epistemology, cognition, and representation, I contend that cultures exhibit epistemological and ontological differences in the spatial domain expressed across modes of representation and communication (Figure 18). Where “a mode makes it possible to make meaning with specific ontological effects” (G. Kress, 2010), configurations of perceptual structure and conceptual framework are assumed to be interrelated with material manifestations of information in a variety of modal expressions. The diagram below shows the relationship among components of a knowledge system.

![Diagram showing the relationship among components of a knowledge system.]

Figure 18 sense – percept – concept ➔ representation
Case study incentive

The overview and discussion in the previous chapter outlined the differences in methodologies used for clarifying and/or reifying Pueblo histories, between archaeological research and Indigenous objectives, and specifically the limitations of current archaeological analytic research models for grasping ecological underpinnings of Indigenous understanding that is based on synthesis, that is, experiential knowledge (G. A. Cajete, 2005). Furthermore, several Indigenous scholars have argued that organizational principles different from a Euclidean-based geometric model of space and time support such a knowledge system; flow, movement and relationships provide the fundamental axes (G. Cajete, 1999; Ortiz, 1972a; Waters, 2004a). Employing a Euclidean geometric space-time framework exclusively in research is expected to lead to incorrect interpretations of certain aspects of material culture expressions of ancestral Pueblo communities, specifically and potentially limiting in broad ecological research (Ascher, 1991; Burenhult & Levinson, 2008b; Neuhoff, 2004b; Seuront, 2010). Especially since recent studies have demonstrated that a Euclidean framework is not innate in human thinking, but a culturally constructed conceptual framework, recognition of experiential learning and its perceptual grounding can show its unique contribution to ecological knowledge, where

A sign stands for something to the idea which it produces, or modifies. Or, it is a vehicle conveying into the mind something from without. That for which it stands is called its object; that which it conveys, its meaning; and the idea to which it gives rise, its interpretant. The object of representation can be nothing but a representation of which the first representation is the interpretant. But an endless series of representations, each representing the one behind it, may be conceived to
have an absolute object at its limit. (A Fragment, CP 1.339, not dated) (Bergman & Paavola, 2003)

No longer explained by stimulus-response models of the senses, experience and experiential knowledge is currently validated in psychological and cognitive research, referring to the interactions of humans with their environments (Storkerson, 2009).

In general, geospatial representation is characterized by its long development as multimodal representation; however, the development of geo-representation as current practice within academic boundaries has taken place largely within the confines of the visual-graphic domain and Euclidean geometry (Ascher, 1991; Raper, 2000; Schafer, 1994; Short, 2004). The explorations presented in this chapter therefore start from the premise that current scientific models of geo-representation organized according to Euclidean geometric space – time axes impede representation and communication of ecological information that functions, and knowledge that originates, within a different framework. The objectives of this chapter are to: 1) demonstrate the nature of these limitations; and 2) explore the boundaries of current systems, drawing from innovative ecological approaches originating in several disciplines and preliminary testing of these ideas, employing standard available technologies for their potential epistemological implications (and ontological effects). Based on these identified shortcomings, in the following, concluding chapter, I will 3) outline new directions of research methodologies and technological developments as hypotheses for future research that fit within an immersive epistemology.
Two main questions guide the initial evaluations for defining differences between western scientific and Tewa epistemology for the purpose of this exploratory research: 1) what kind of knowledge is pursued (conceptual framework), and 2) which modes (sense/percept and representation) and media are, or potentially are, used to pursue, represent, and communicate that knowledge, with a strong focus on the object, within a worldview ontology. The outcome provides the basis for further exploration presented in the second part of this chapter and in the next chapter, that more specifically studies perceptual grounding as the ontological foundation of an immersive epistemology, the foundation or source of experiential knowledge.

The theoretical discussion and methodology outlined in earlier chapters frames this effort, whereby the importance of diversity in human spatial cognition cannot be overstated; it warrants questioning of prior assumed universality in (the evolution of) human cognition and perception that underpins many previous and current studies across disciplines, including archaeological research of material expression and technological development of representational systems.

Through qualitative evaluations, methodological differences described in the previous chapter between western archaeological and American Indian thinking are identified as formalized in representations of 1) similar mode and medium (maps and mapmaking) and 2) as cross-modal representations of geo-information, in this case, toponyms. These results further justify the specific spatial categories and phenomena selected for investigation within the second part of this chapter, which addresses spatial organization of the Ancestral Pueblo communities of the Northern Rio Grande region in the physical environment. This second, quantitative evaluation,
consists of several *interventions* (this chapter) and *critical interventions* (Chapter eight), where “intervention” is defined as “an interface that mediates and transforms” (Matero, 2010) and ‘critical’ denotes the need for emancipation (following Critical Theory/Critical GIS, (Kwan & Schwanen, 2009)), that is, shows the potential and limitations of current systems of analysis/representation, and explores new or re-directions in the latter.

For my exploratory analyses the principle of *flow*, and related principles of *movement* and *relationships*, are used as a springboard to generate ideas for how sensoral information is perceptually structured to support a nonwestern epistemology, whereby the ontological foundation of knowledge is investigated from a broad perceptual perspective, including, but not limited to, the visual (Bregman, 1990; Galton, 2000; Kubovy & Van Valkenburg, 2001; Neuhoff, 2004b).

As the case study, this is true for the Tewa, for whom visual information may carry a different weight in perceptual grounding, than it does in western understanding.

*Multimodality and the potential of immersive environments – (immersive epistemology)*

As argued by Kress (G. Kress, 2010), no mode of representation alone can cover all meaning. Similarly, different modes of perception allow different information to be gained; each mode has a specific modal reach that can overlap with others, but not match, resulting in loss of information when translating between modes. Even though human perception is often studied from a physiological perspective, and insights in sensory integration provide a basis for this study, the main concern
within this research is the different *meaning* (and ontological weight) attached to percepts. It starts from the idea of active perception set forth within affordance theory and related ecological approaches to perception (Gibson, 1977; Neuhoff, 2004b), and further builds on emerging semiotic approaches across disciplines (biology, ecology, sociology, and design). Efforts to bridge the methodological division in studies of perception between researchers studying the physical sources and those focused on cognitive aspects are evident from more recent, ecologically oriented approaches (Farina, 2006; Kull, 2010; B. Pijanowski et al., 2011), stressing the interrelatedness of these processes. In addition, I propose that differences in perceptual skill/acuity among human individuals/groups are also associated with different uses of modes of representation that function as mnemonic devices and intervention tools (see for instance, (Schafer, 1994)).

To reiterate, a visual mode of representation has long since dominated research and technological development within a western worldview, and is based on the *assumption* of vision as the most important of the human senses. This assumption has been challenged recently as being a result of historical development rather than an innate human characteristic. Asher, for instance, argues that the mathematic formalization of visual representation useful in scientific analysis has contributed to this idea, but recognition of this limitation has spurred research toward understanding the role of other sense information, specifically auditory, in (human) spatial cognition (Bregman, 1990; Schafer, 1994; Stein & Meredith, 1993). Even so, the intended meaning of visual representation that originates from different organizational principles is not always understood either, for example, two
different kinds of ocean wave representation, better known as stick charts, used by
indigenous populations of the Marshall Islands. These navigation aids are based on a
different mathematical principle than western maps, as discussed by Asher,
demonstrating a profound knowledge of physical wave processes. This
misunderstanding is not surprising if we accept the research results from
psycholinguistic studies regarding significant differences between language groups
in spatial cognition, and the purported consistent use of frame of reference across
modes within a language group (Levinson, 2003; Levinson & Wilkins, 2006). That is,
the frame(s) of reference used within a culture underpin a modal constellation
within a specific worldview (G. Kress, 2010). The qualitative component outlines
specific aspects that can be addressed for the case study, exploring the possibility of
different organizational principles, whereby it is acknowledged that grounding of
perception as dominantly visual is not universal either, and this diversity needs to
be addressed as part of a larger perceptual structure within a specific knowledge
system.

Indigenous epistemology, or a way of knowing that can be indicated with this term,
in addition to its experiential foundation, is also characterized by the integration of
creative/artistic aspects (G. A. Cajete, 2005). Within a western worldview, organized
according to a separation of scientific disciplines to study the surrounding world,
art, as creative mode of representation and communication, is categorized entirely
separately from the sciences, and therefore not considered in ecological models due
to its presumed lack of practical use. New research in neurososcience challenges this
long-held western view of aesthetics, arguing instead for a revised conception of aesthetic processing and creative thinking that is more biological and adaptive in scope, based on demonstrated similarities in brain processing across modalities in the appraisal of (so-called) art and non-art objects (S. Brown, Gao, Tisdelle, Eickhoff, & Liotti, 2011). Krause (Krause, 2012) posits a similar hypothesis in his investigation of the origins of musical expression in relation to habitat health, suggestive of the ecological grounding of artistic (creative) expression, and the information gained from the environment similar to aesthetic qualities. The importance of (multi-sensory) signs in nature brought to the fore by recent biosemiotic and acoustic approaches in landscape ecology attest to this notion (Farina, 2006; B. C. Pijanowski et al., 2011).

The challenge before us is to recognize different modes of expression, or *de-sign*, as (extended) sensing or representational instruments that are part of a broad ecological knowledge framework, that is, immersive epistemology (its ontological effect and epistemological consequence that can integrate experiential and formal knowledge). The objective of the exploratory analyses below is to generate hypotheses within an immersive framework to be tested or further developed in follow-up research. Based on the interrelationship between percept–concept, representation as interface can be studied for the semiotic relationship and perceptual grounding of spatial cognition. The implication for archaeological research is that different interpretive models for cultural material expression can be conceived.
7.1 Qualitative Research – Comparing and evaluating geographic concepts and modes of representation and communication

The qualitative component evaluates the differences in modes of representation and communication of geo(graphic) knowledge within the historic context of cartographic development that has led to current scientific ideas of geo(graphic) understanding and the dominant conventions of representation. It is driven by the objective of 1) identifying indigenous, specifically Amerindian, traditions of geo(graphic) representation and the possible underlying conceptualizations (+ontology), and 2) exploring the possibility of different (and multimodal) representations, such as geo-narratives, geo-performance (e.g., dance, perambulation). These kinds of representations are less (or not) limited by two-dimensional (visual) representational space, addressing the epistemological and ontological implications of representation and problems of transcoding (G. Kress, 2010; Louis, 2011).

Geovisualization, the current field of study of the representation of geographic reality, is rooted in a long developmental history of mapmaking, but is influenced largely by ideological, intellectual, and technological innovations for mapmaking and landscape representations since the Renaissance discussed in the previous chapters (Dykes et al., 2005). This dominant and primarily visual tradition has as one of its main goals to represent measurable reality; even though all maps are made for a specific purpose or several purposes and are abstractions (e.g., based on
specific projections), they introduce distortions of that reality. Yet, we have come to accept those distortions as representing realities (Ascher, 1991; Mathur & Cunha, 2006). Our perception of reality, in other words, is heavily influenced by our representations of it — the circularity and reflexivity of this relationship become clear.

Besides representing physical “reality,” maps can in addition represent statistical, mythical, metaphorical, and imaginary worlds, providing supplemental information about the nature of the relationship of humans to their surrounding worlds (indicative of its conceptual structure). In any case, reading maps is a learned skill; within a cultural setting we learn to interpret a reduced dimensional representation of a multidimensional world as mnemonic device to extract the message and/or needed cultural knowledge, grounding our experience (Ascher, 1991; MacEachren, 1995; Monmonier, 1996).

Perceptual and conceptual structure: categorizing and understanding our environment

According to Smith and Heise (L. B. Smith & Heise, 1992), the distinction between the perceptual and conceptual grounding of our categories and experiences as primitive or more developed, respectively, is false; they argue based on several experimental studies in psychology that perception is the grounding force of conceptual structure, where conceptual structure does not replace or override perceptual categories but contributes continuously as part of an ongoing interrelated process. In this view, percepts and concepts are not “things” as building blocks for knowledge (in which percepts become subordinate as conceptual
knowledge develops) but an ongoing restructuring process of perceptual and conceptual structure (Smith and Heise 1992). This idea of dynamic relationship started when Wittgenstein challenged Aristotle’s “natural kinds” during the early twentieth century, but has gained momentum over the last decade. As Storkerson puts it: “knowledge is the content of the human representation of experiences, thinking is the process by which knowledge is constructed and knowing is the act of achievement, which is phenomenologically marked by the sense of knowing” (Storkerson, 2009, p. 2).

In review of previous literature regarding this subject, a number of studies referenced in Smith and Heise’s paper support their notion of perceptual similarity as basis of categorization, a few aspects of which are repeated here in support of my research. Perceptual similarity embodies and reflects implicit knowledge, and in this Smith and Heise differ from many other theorists who believe that perceptual similarity is given in the stimulus, which Smith and Heise adequately argue against. In other words, for long the dominant view was that perceived similarity between two objects was constant and unchanging (as natural kinds) (L. B. Smith & Heise, 1992). As described by Smith and Heise, perceptual similarity is dynamic and based on the “weight” given to features of the “object” by the observer; there is no assumption of the existence of natural kinds. For instance, as shown in experiments basic classifications can differ if a feature is added or extracted. Many of these experiments, however, focus on classification based on formal characteristics, not on function or process. Focus on the latter may add additional support to Smith and Heise’s argument (Lucy, 2000; Wilkins, 2000).
Classification methods

Testing perceptual similarity in human cognition is often conducted by showing, for instance, images of objects or animals. This is very much in tune with a traditional academic learning style, but different from experiential learning. In addition to features well represented in visual images, such as form and color, other features may be given much more weight when observing objects or animals in their natural habitat, as is done in MPI's research of cross-cultural landscape categories (Burenhult & Levinson, 2008b).

The statistical procedure known as principal component analysis (PCA), often employed in classification of remotely sensed data, provides insight into how different variables or features can be weighted in such settings. Simply put, if we consider for instance an analysis of the distinguishing features of different birds using a multivariate approach, by changing axes in data space, different aspects of known features may be combined as causal variables (principal components), for which no obvious term in the English language is readily available, such as “wingness” or “flyness.” “Jerkiness,” “greenness,” and so forth.

One other aspect discussed by Smith and Heise is important to mention in the context of this research, namely, the fact that children are able to distinguish between natural and man-made objects based on surface gradient alone. Although rarely investigated, possibly due to representational limitations, Smith and Heise speculate, “following Mandelbrot, that the complex and seemingly irregular surface gradient of natural objects stems from the fact that they grow and are caused by a multiple of converging forces whose effects accrue in time (Seuront, 2010). In
contrast, the scale-specific structure of manufactured objects presumably derives from the fact that they were made at a particular scale level and at a particular point in time” (L. B. Smith & Heise, 1992, p. 258). The fractal nature of the natural environment may therefore trigger a classification using a different weight distribution of features in a perceptual structure than that in an environment dominated by manufactured objects, or if objects are classified based on artificial representations (translations).

In a theory of knowledge that is based on experiential learning, integration of sensory information and the ability to translate into thought and expression (Stein & Meredith, 1993; Yu, Rowland, & Stein, 2010) as mnemonic devices in a supportive spatial structure is considered central. In scientific theory this ability underpins a synthetic statement; however, analytic statements are much more common in current scientific practice for knowledge justification (known as propositional/inferential learning and formal knowledge). This preference, though, is potentially cultural, and the idea of “process” in categorization as put forth by Smith and Heise (and supported by others) supports this diversity in/as concurrent knowledge systems.

*Representation of the environment: Mapping conventions*

According to MacEachren (MacEachren, 1995), (cartographic) maps provide a means to represent and communicate three fundamentally different categories of meaning: about space, time, and attributes of space-time. It is argued that maps use five kinds of codes to do so, three of these, “tectonic” (where), “temporal” (when),
and “iconic” (what), are associated with the denotative meaning. Two other systems of codes, “linguistic” and “presentational” make denotation possible (i.e., mediate through mode) and limit the percipient’s options in determining the intended denotation (MacEachren, 1995, p. 312).

MacEachren states that time and place are currently often taken for granted in maps (the Euclidean-based geometric axes of organization). The “what” of map sign denotation, on the other hand, has been the major concern of those pursuing the cognitive approach to cartographic research, often focusing on the denotative-connotative distinction (MacEachren, 1995, p. 317). A map is assumed to be a geometric (Euclidean) representation of space, following certain developed standards of single projection and orientation. Given the multimodal framework employed for the evaluation here it is necessary to accept that these five codes are not mutually exclusive and that modes of representation can be differently configured in different cultural settings. Following Kress, a map as representation of geographic reality is limited by its modal reach and in addition by its cultural conventions. An example from the early Spanish maps of the Americas is the clear but subtle difference between the use of image elements that are depictive in Spanish tradition, but both descriptive and depictive, indicating multidimensional meaning, in Indigenous representations, in what is known as a logographic writing system (Mundy, 1996).

In short, environmental information, in a western-science tradition is mostly communicated as two-dimensional visual (text and graph/image, 2.5D) cartographic representations of physical and thematical or conceptual elements of the world
within a spatial, gridded framework of reference, and analyzed from different disciplinary perspectives (Short, 2004).

I have argued (Chapter six) that the dominance of mode and medium of representation are a function of, or at least significantly correlated with, technological development and cultural and disciplinary preferences and conventions (e.g., USGS), influencing such development. Visual reproduction allows access to and dissemination of specific information rapidly and has become the standard of scientific knowing, but other information and knowledge is excluded in the process (G. Kress, 2010; B. Schmidt, 2001), but see also (McLuhan, 1964; Pallasmaa, 2005; Schafer, 1994). The qualitative component, consisting of evaluative sections, starts with visual two-dimensional representations because of these historic facts.

Upon encounter, indigenous skills of geographic representation in the Americas were recognized in case modes and media of geographic representation were considered as similar. Indigenous-authored maps, that became known through maps as part the Relaciones Geográficas primarily, provide a starting point for exploring differences in conceptualization and representation of the surrounding world and the categories and relationships that support/underlie such frameworks. The rationale for starting this evaluation with these Mesoamerican maps is based on the notion of pan-Amerindian similarities in spatial cognition and spatial organization (purported to exist by several indigenous scholars) and the general framework this can provide for further explorations presented in this chapter.
Focused on the case-study region, the subsequent evaluation presented in this section investigates toponyms related to the Northern Rio Grande valley, that were recorded as part of an ethnographic study by J. P. Harrington during the early 20th century and published as the *The Ethnogeography of the Tewa Indians*. It is recognized that these toponyms may not be representative for all languages spoken in the region, however, they are considered to be based on certain shared underlying concepts. Toponyms, following Levinson, are considered representational for a spatial subdomain and informative regarding spatial ontology, where spatial ontology is considered to be a relation between the physical and cognitive (see Figure 4). It is acknowledged that the data used for this effort are problematic due to the fact that within Harrington’s study these names and categories are represented in a mode and medium within which they never functioned culturally: that is, they are transcoded (sign > sign, to a different mode and medium and sociocultural context). The challenge here is to identify different perceptual-based and conceptual categories within this gazetteer despite these limitations. The insights gained from the evaluation of the *Relaciones Geográficas* maps and recent advances in toponymic research provide a foundation for this effort.

The outcome of these evaluations provides specific aspects to be addressed within the quantitative component and preliminary testing of the usability of current geospatial technologies to represent, understand, and communicate information associated with a different way of knowing.
7.1.1 Maps and Mapmaking: the Cartographic Encounter

General interest question: How has the historic development of spatial (visual) representation influenced our frames of reference and spatial perception? Based on the assumption of pan-Amerindian similarities in spatial cognition as a distinct tradition, early Encounter maps can be evaluated regarding the roots of this development and the epistemological differences between European Renaissance and pan-Amerindian traditions that followed and led to separate developmental trajectories.

Specific questions: In comparing Spanish and Indigenous map traditions during the Encounter (Mesoamerica), which elements of cartographic representation can be distinguished that are different or similar in these two traditions and how? Which elements, technologically, conceptually, modally, have developed into modern scientific map-making standards? And can preliminary conclusions be drawn regarding differences in spatial cognition and epistemology?

Based on the fact that modern cartography and geovisualization have their roots in the Renaissance, underpins current scientific practices, it can be postulated that the specific western pursuit of knowledge is linked to the development of a specific mode and media constellation for representing and communicating geographic knowledge since that time (Short, 2004). The early mapping efforts of the Americas, as discussed by Mundy, are evaluated for distinguishing differences in kinds of knowledge pursued, how it is used, and the modes and media used to do so, among
both colonizers and indigenous populations given that many indigenous mapmakers participated in this effort. The purported pan-Amerindian similarities in spatial understanding justify this approach for providing a basic historic context for exploring the epistemological implications of geo-representational differences in the Northern Rio Grande region (Mundy, 1996).

7.1.1.1 Relaciones Geograficas and the changing worldview

Short argues that in 16th century Europe, “space as a social construction was re-imagined. It was re-envisioned and re-conceptualized from a locus of religious wonder to an instrumentalized sphere marked for exploration, conquest, and appropriation” (Short, 2004, p. 150). Moreover, colonial explorations triggered a needed revision of the conceptualization from a three-part to a four-part worldview (Virga & Library of, 2007), and in general encompassed a changing idea of what constitutes knowledge (Short, 2004; I. Wallerstein, 2004). This process resulted in a fragmentation of a coherent cosmography into different fields of knowledge that was spurred by the need for new spatial practices, notably land survey, and served as a bridge between an understanding of the world and the transformation of the world toward the appropriation of space for material ends (B. Schmidt, 2001; Short, 2004, p. 153).

Philip II, who reigned over the Spanish empire from A.D. 1556 to 1598, was particularly interested in making “his territory” visible; however, the Spanish Empire was so extensive that personal visits were not easily accomplished. Visualizing the empire through maps provided a way to know and have knowledge
of the territory under his reign, and as a powerful ruler, he was able to commission cartographers to map and describe his world through the program known as the *Relaciones Geográficas* (RG) (Mundy, 1996).

The knowledge sought by Philip II was obtained through questionnaires requiring written responses by local respondents, or drawn, in the case of requested maps (akin to modern day “crowd-sourcing”). In other words, the needed information was provided by functionaries representing the Crown in New Spain, or commissioned by them. As noted by Mundy (Mundy, 1996, p. 57), these functionaries did not hold images in great esteem, consequently negating native logographic writing, and saw little need for visual documentation. The response to question number ten (translated below by Mundy) was therefore often delegated to Indigenous artists, with varying results for intended purposes, constituting a mix of colonial semiosis, a mixture of graphic and print sign systems drawn from both Spanish and Indigenous traditions.

Describe the sites upon which each town is established. Is each upon a height, or low-lying, or on a plain? [topography] Make a map of the layout of the town, its streets, plazas and other features, noting the monasteries, as well as can be sketched easily on paper [scale, projection, thematic]. On it show which part of the town faces south or north [orientation] (Mundy, 1996)

Whereas maps in Spain were often used to consecrate property, there was no need to do so in the “New World,” as the local functionaries were more concerned with fulfilling labor needs to work the land. However, this changed, as is evidenced by the landgrant or *Merced* maps focused on the demarcation of land for the purpose of
assigning property rights to immigrants, representing “the transformation of the world toward the appropriation of space for material ends” (Mundy, 1996, p. 195; Short, 2004). Some of the Merced maps were also created by Indigenous artists and could be identified by their distinctive style (Mundy, 1996).

7.1.1.2 Types of maps and their purpose: Indigenous and Spanish

Two mapmaking methods were in use in Europe/Spain during the time of colonization, chorography and cartography; whereas a chorographic map provided an oblique view of a geographic detail, such as a city and its surrounding topography, cartography indicated, and developed into, the science of making maps (representing geometric space) and mostly refers to planimetric maps. Both of these were appropriate methods to be used in response to Question 10. The rationale for engaging indigenous artists in mapping efforts was based on the fact that 1) recognizable geographic representations were part of the Indigenous tradition and known to the Spanish, and 2) local knowledge would benefit the quality of the maps. The reason pre-Colonial maps have survived and are known today is due to the fact that these visual representations were considered non-sacred/non-religious and therefore were not (all) destroyed by the Spanish (Anders & Jansen, 1988; Mundy, 1996). Included in the RG map-making efforts, indigenous artists were then able to continue their tradition.

In general, communities across Mesoamerica established a powerful sense of community that is represented within these maps and is strongly related to the
space they occupied (Mundy, 1996, pp. 105-106). Partly based on these maps, two ways of representing community have been distinguished in scholarly research as Indigenous tradition, 1) the cartographic history concerned with the establishment of the community, and 2) the social settlement map showing the spatial and social organization of the community (Mundy, 1996, p. 107).

According to Mundy, the single most defining characteristic, then, of Indigenous cartography is its focus on community, its lands, its peoples, and their histories. The two above-mentioned Indigenous types of maps can often be distinguished as individual maps, although elements of each are not mutually exclusive and occur within a single representation. Within the RG corpus the clearest examples of influence of each were created in different regions and centers of mapmaking within those regions. However, it should be noted that Aztec rule in neighboring regions has also influenced mapmaking, mixing local and Nahuatl text, image, and logograph/glyph elements (Figure 19; Table 8).

![Figure 19](image_url)

**Figure 19** Locations of map making centers (Google Earth) discussed by Mundy
<table>
<thead>
<tr>
<th>Name of Relation</th>
<th>In main toponym</th>
<th>In subsidiary toponym</th>
<th>To depict people</th>
<th>To name boundaries</th>
<th>To show topography</th>
<th>To depict architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amatepec</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Composados</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
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<tr>
<td>Cuicatlan 8</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
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<td>Misquiahuala</td>
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<td>x</td>
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<td>Muchitlan</td>
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<td>x</td>
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<td>Tezozoccoico</td>
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<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>Toluca</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Table 8 Indigenous map elements (adapted from Mundy 1996, table 5, p100)

7.1.1.3 Similar mode and medium – epistemological implications

Even though mode and medium of Spanish and Indigenous mapping traditions appear similar, they are semiotically different, for instance images are depictive in European tradition and not held in high esteem, whereas images are a component of a logographic writing system and are depictive and descriptive in Indigenous tradition. Not only are the frame and projection different for the two traditions, indicated by Mundy for example as a difference between geometric and humanistic projection, indigenous map symbols/elements differ from Spanish ones in significant ways as to what they refer to. Because of mixing of modes apparent in maps in the RG corpus, logo-syllabic graphic writing and alphabetic writing for instance, in certain cases these maps could not be totally understood by any single individual.
Despite these issues, the prior research on and evaluation of the RG maps provides several insights in differences in spatial representation. First, the community oriented framework or projection is different from modern cartographic standards that grew out of the need to quantify and appropriate land and identify and locate resources. This need, associated with European colonization efforts, also supported the development toward the more geometrically accurate survey methods of land surface of the USGS, for instance. Second, the community orientation represents different societal and ecological dimensions/relationships within a single map, facilitated by specific modes of representation (logographic writing; different layout, scale, projection) as visually mimetic (Mundy, 1996, p. 104) and likely in association with other modes, notably perambulation (geo-performance; geo-narrative), that are more transient and dynamic (as modal set). Thus, as mentioned by McEachren (MacEachren, 1995), even though space and time (where and when) are usually unquestioned in modern maps, it can be argued that this is a foundational difference between Spanish and Indigenous mapping conventions that resulted in different developmental trajectories of representing the surrounding world based on different cultural needs, and developed into specific multimodal constellations. Furthermore, Mundy refers to the communicentric mapping tradition as widespread, by mentioning as specific example “the circular convention” as an “Amerindian concept of the local landscape, expressed by the Pueblo Indians, who saw their surroundings arranged in a great circle around the central town”, referencing Ortiz (Mundy, 1996, p. 117).
Both the social settlement and the cartographic history map appear to maintain topological relationships, projected on the horizontal and/or vertical plane. As an example, the RG maps of both Amoltepec and Teozacoalco represent the associated, surrounding communities in a perfect circle, interpreted by Mundy as creating a geometrically perfect frame and are specifically compared to the Tewa spatial configuration, indicating a pan-Amerindian characteristic. However, as mentioned earlier, this can also be thought of as a projection on the vertical plane, namely (direction on) the horizon. From the social settlement map, such as that of Cempoala, the social and territorial relationships can be read, representing non-contiguous and interlaced territorial spaces integrated within social hierarchies. In addition, ethnic and linguistic differences exist among the different parts of the Cempoala community (Figure 20, see for Indigenous map Mundy 1996)

![Google Earth Map](image)

**Figure 20** – Using Google Earth – the physical landscape is compared to the map elements, exploring the kinds of relationships that are represented on the maps
7.1.2 Landscape categories and Place names

*General Interest Question:* In what way has a western-based space-time conceptual framework determined and restricted the metaphysical foundation of scientific research, and how can this issue be addressed within a multimodal framework for archaeological research?

*Specific question:* With respect to the case study, interest is focused on means to identify categories that are conceptually different from standard western scientific categories, 1) given that it is shown that universal spatial categories do not exist, 2) given that the (standard scientific) epistemological foundation is limited by the reach of employed modes and the technology (medium) of those modes (G. Kress, 2010) (and vice versa), and 3) based on the assumption that (cross-modal) perception, cognition, and representation are dynamically integrated (supported by cross-disciplinary research).

If pan-Amerindian similarities can be assumed for the conceptualization of space, then the differences between European and Indigenous map making discussed in the previous section are appropriate for providing a broad context for the exploration of manifestation of spatial concepts that differ both in mode and medium for the Tewa case study. The objective is to identify (some of) these spatial concepts based on perceptual grounding that can be studied from available data, and suggest a model within which these concepts can function as an integrated whole, within a semiosphere model.
To begin the exploration of this problem, the evaluation will be divided into its ontological and epistemological aspects, both of which are addressed using Harrington’s (1916) previously collected data set. This publication is primarily a gazetteer of place names recorded and phonetically and etymologically transcribed by Harrington. The epistemological issues focus on the fact that the names and categories originally function within a specific mode and medium (orally based), but are published within the confines of another (visually based). That is, we don’t know from this publication how the knowledge framework within which these names functioned was organized, and this evaluation needs a heuristic approach.

Within a multimodal research framework these issues can be addressed, or at least identified, but due to the epistemological implications, the use of these data to investigate ontological aspects is limited and therefore only exploratory, using selected samples. However, the nature of these data, supplemented with literature describing the Tewa language, provides ample means to explore the problem. (Figure 21)

Considerations for evaluation; dataset specifics

Comparing the Harrington toponymic dataset with data used for a recent ethnographic study conducted by Kari and Tuttle (Kari & Tuttle, 2005) provides insight into the value of this data and at the same time creates a broader context for the interpretation of some of my findings. This particular research by Kari and Tuttle was conducted on the Copper River Basin in Alaska, which covers overlapping territories of groups speaking several languages and dialects (comparable to the linguistic situation in the Tewa Basin). Landscape knowledge is
demonstrated through “career place name maps” of selected experts. These maps represent personal travels and the extensive knowledge base of each one, covering a specific region that can overlap with that of other individuals and vary in reach and density, representing both expert and common knowledge. Organized by watersheds, the names of which were collected through participation of more than 100 individuals, the area is subdivided by streams that convey the way in which these names, which are connected through a physical trail network are memorized, (and indicated as hydronyms). This information is then compared with data from an archaeological reconnaissance survey, showing that a high density of names per area does not necessarily correspond with a higher concentration of archaeological sites. The underlying assumption/principle in Kari and Tuttle is that the distribution of place names represents the territory occupied and the level of use of that area by individuals or groups speaking the Ahtna, Eyak, and Tlingit languages and dialects, and is not necessarily mirrored in physical cultural material manifestations as investigated by archaeologists.

Standard computer mapping methods and software were employed for representation of the Copper River Basin names and trails, a modal translation through which part of the dimensionality is lost. For instance, memorization occurs through walking the physical trail, not by looking at the map on which the names become fixed as symbols that no longer have a necessary sign, index, or otherwise dynamic relationship to the land. Even though no current computer mapping technologies were used, the Tewa place names’ gazetteer offers a similar dataset, where for each name recorded in the different languages and dialects in which it is
known, a dot symbol situating the name is fixed at an approximate geographic location on a series of geographic map(s), but information regarding how these names are interrelated is lost. Some of the advantages and limitations of using GIS approaches for indigenous place names have been addressed elsewhere; the primary advantage is that intangible heritage can be recognized and cultural knowledge partly, if not optimally, preserved or maintained (Johnson, 2005; Louis, 2011).

In addition to the toponyms, categories in the geographic domain beyond the Earth’s surface are also listed by Harrington, providing valuable context regarding landscape ontology. In both Harrington and the recent study, the problem of representing a primarily oral system in a visual mode and the epistemological implications of that chosen representation are not addressed. This important for these studies, considering that tonal language structures may differ, a dimension of representation and communication that cannot be represented or easily translated in visual mode. Following Kress (see also (Ware, 2000)), not only is the modal reach of a visual mode and medium of representation insufficient to cover modal reaches based on a theory of multimodality, but the sources of (sense and perception) information underpinning these names and categories (ontology) is potentially obscured (G. Kress, 2010; Kubovy & Van Valkenburg, 2001).
PLACE NAMES AND LANDSCAPE CATEGORIES

Based on the data generated by the study of place names and landscape categories. In order to investigate the semiotic relationship of names and referents, and the issues surrounding transmodal mapping.

Mapping place names using current geospatial information systems; database potential

gereference

on-screen digitizing

Edit the data table

<table>
<thead>
<tr>
<th>no</th>
<th>harr_no</th>
<th>tewa</th>
<th>sanlIdef</th>
<th>cochiti</th>
</tr>
</thead>
<tbody>
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<td>y</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>217:2</td>
<td>0</td>
<td>y</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>317:3</td>
<td>0</td>
<td>y</td>
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<td>y</td>
<td>n</td>
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<td>n</td>
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<td>n</td>
<td></td>
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<td>n</td>
<td></td>
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<td>n</td>
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<tr>
<td>1017:10</td>
<td>0</td>
<td>y</td>
<td>n</td>
<td></td>
</tr>
</tbody>
</table>

Creating tables

Narrative analysis of semiotic relationships

Ground-truthing perceptual grounding
Modal and ontological issues

Figure 21 procedures followed for digitizing place names – sample table and map
7.1.2.1 Relocating place names employing Geographic Information Systems

Toponyms can be thought of as a system of signs representing landscape knowledge, and it is the system of representation that provides the means of relating that knowledge in a way that can be interpreted by its users, for example, as visual maps and oral stories. The first step in this analysis is to relocate the names recorded by Harrington (1916) on modern topographic maps within a GIS, in order to gain insight into the semiotic relationship (name > referent object) expressed by these names (Figure 21).

In addition to the scanned topographic maps available for download from digital repositories, a 10-meter Digital Elevation Model (DEM) was added as a data layer within a GIS to better understand the local and regional topography (Table 9).

This exercise provides the foundation from which the complexity of, and issues with, the data and toponyms in general can be assessed. As not all names are indigenous or exclusively indigenous, the dataset enables the evaluation of the differences in semiotic relationship between indigenous and western names. Specifically for indigenous names, several aspects were selected to be evaluated: a) the different geometries represented, that is, not all names refer to point locations even though they are symbolized as such; b) the different relationships represented between physical place and percept/concept (referent), or the variation in level of arbitrariness (i.e., name–category distinction); and c) deviation of types of relations that can be identified from traditional place name categorization schemes (Cablitz, 2008).
### Table 9 Data sources and methods used

<table>
<thead>
<tr>
<th>DATA</th>
<th>DATA SOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Elevation Model (DEM) – raster</td>
<td>RGIS <a href="http://rgis.unm.edu/">http://rgis.unm.edu/</a></td>
</tr>
<tr>
<td>Digital USGS 7’5 topo quads – raster</td>
<td>RGIS</td>
</tr>
<tr>
<td>Hydrologic features – shapefile; vector</td>
<td>National Hydrography Data set</td>
</tr>
<tr>
<td>(line)</td>
<td></td>
</tr>
<tr>
<td>Scanned georeferenced maps</td>
<td>Harrington 1916</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>METHODS</th>
<th>OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georeferencing</td>
<td>General location of the mapsheets can be estimated providing a guide for locating place names and insight into accuracy of original map locations.</td>
</tr>
<tr>
<td>On-screen digitizing</td>
<td>Creating new shapefiles (vector-point) for each map sheet, showing approximate locations for listed place-names. Spatial and non-spatial attribute data can be added to these files. Data can be queried and integrated in spatial analytic approaches within GIS.</td>
</tr>
<tr>
<td>Ground-truthing</td>
<td>Digitized locations can be field-checked using spatial coordinate information (GIS; GPS) and creating photographic records. This will provide insight in difficulties of digitizing from old field maps and the characteristics of the place names, especially the importance of ‘point of view’.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAP CHARACTERISTICS</th>
<th>ADVANTAGES AND ISSUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place name locations are digitized as vector points</td>
<td>Advantage: as part of one data layer it facilitates certain analytical capabilities. Issues: Not all names have similar scale (spatial extent) and geometries, invalidating certain analytical approaches.</td>
</tr>
<tr>
<td>Shows spatial correlation to other place-name locations and other geographic (cultural and natural) features</td>
<td>Advantages: x.y. and z provides insight into spatial relationships between place-names and between place names and other features such as water features, enabling the evaluation and understanding of the referent relationship. Issues: Place-names never functioned in a 2D map representation, but as ‘in the landscape’ perspective.</td>
</tr>
</tbody>
</table>
Some issues became clear during this preliminary exercise, notably the cases in which names referred to a specific landform/configuration that can be observed from a specific place in the land, but not from topographic maps. Reference to the presence of specific vegetation and/or colored minerals was also impossible to locate on a modern map. Landmarks, as conceived within current studies of spatial navigation, possibly function or are grounded differently. Limited field visits were part of this exercise.

7.1.2.2 Narrative analysis, exploring the relationship between names, physical location, and sociocultural factors

The place names gazetteer is a specific dataset that offers advantages but also presents challenges compared to other, for instance primary ethnographic, data. Narrative analysis of this dataset, in which narrative is often considered synonymous with "story," specifically refers here to the investigation of spatio-temporal discourse in a landscape setting (mode), employing archival documentation (where, when, what) (Riessman, 2008).

A first reading of all names in the gazetteer provides the general context, supported by the insight gained from relocating the names in geographic context, as described in the previous section. Three broad categories are distinguished: 1) names that are exclusively indigenous, known either in single or multiple languages and dialects; 2) names that are known in indigenous language and dialect and Spanish and/or English; variations are present within this category regarding origin and adaptations; and 3) names in Spanish and/or English only, or is identified by
researchers as consisting of indigenous cultural material ("ruins") for which no indigenous name was obtained. Names in this last category were often integrated into modern topographic maps.

Of primary interest for further analysis are locations/places that have an indigenous name or name only, or are considered indigenous in origin. Whereas locations that also have a Spanish and/or English name are ambiguous, the exclusively indigenous names are assumed to represent, or be part of, an Indigenous spatial conceptual framework, as well as to represent physical territory (following Kari and Tuttle). Place names are unique, as discussed within toponymic and spatial ontology research, in that these are often ontologically situated between names and categories. Naming places is often related to labels of geographic or landscape features (Cablitz, 2008) as classifiers (Wilkins, 2000).

To explore the Tewa place-names, I generally follow Cablitz’s method of identifying lexical components and the different combinatorial patterns present in the sample. The sample is selected based on a general reading of all names and then of re-locating the names within a GIS. This reconnaissance led to the selection of the areas (sample: Table 10), loosely based on 1) density and diversity of place names, potentially related to the knowledge of Harrington’s informants; 2) the discussion of spatial configuration in Tewa cosmology; and 3) the assumed relationship (physical, historical) to the Galisteo Basin.
Table 10 Exploring the place names, sample of tables adopting a method used in Cablitz

<table>
<thead>
<tr>
<th>H_mapNo</th>
<th>Indigenous only (yn)</th>
<th>Geospatial referent_main</th>
<th>Geospatial referent_other</th>
<th>Non-spatial component</th>
<th>Type of Non-spatial component</th>
<th>Type of spatial component/indicator</th>
<th>Place-name - phonetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:1</td>
<td>y</td>
<td>Small low roundish place</td>
<td>Firefly</td>
<td>Insect</td>
<td>Form</td>
<td>See 13:17</td>
<td></td>
</tr>
<tr>
<td>11:2</td>
<td>y</td>
<td>Height</td>
<td>Firefly</td>
<td>Insect</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:3</td>
<td>y</td>
<td>Arroyo</td>
<td>Firefly</td>
<td>Insect</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:4</td>
<td>y</td>
<td>Arroyo; [wide] galeh arroyo</td>
<td>Beyond; beyond</td>
<td>wide</td>
<td>Form</td>
<td>Spatial relational; topological</td>
<td></td>
</tr>
<tr>
<td>11:5</td>
<td>y</td>
<td>Low corner</td>
<td>Beyond; beyond; arroyo</td>
<td>spatial relation;</td>
<td></td>
<td>Spatial relational; topological</td>
<td></td>
</tr>
<tr>
<td>11:6</td>
<td>y</td>
<td>Arroyo</td>
<td>broad</td>
<td>Form</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Method based on Cablitz 2008; Data from Harrington 1916
Evaluation – some issues identified that can be further studied in spatial research

The main objective of Harrington’s original study was to provide an exhaustive list of known place names, but no specific effort to understand underlying organizational principles that link these names in a larger framework guided this study or is made explicit in the published work. Even though a substantial effort is directed to a listing of cosmological categories and associated linguistic information, specific conceptual information, such as the potential complexity represented through hydronyms (Kari & Tuttle, 2005), may be underrepresented or absent. Most indigenous names that were provided by Harrington’s informants semantically relate to physical characteristics of the land, implying a strong ecological conceptual framework.

Evaluation of the perceptual grounding of these names, even though speculative at this point, provides several ideas for further exploration of frame of reference and ontology. Already mentioned were names that refer to a specific form as seen from an on-the-ground position, or specific land-sky (dynamic) relationships, indicated as “gap,” for instance. Within a classification of objects as outlined by Galton, these can be considered as perspectival or parasitic objects (Galton 2000). This may indicate grounding beyond the Earth’s surface.

Other clusters of names are nested, whereby a specific nominal is nested in a series of classifiers, indicating their physical spatial-topological relationship (Wilkins, 2000). For other places that were deemed important by Harrington, no name could be obtained; several reasons can account for such situation. For instance, if knowledge is distributed not everyone may have access to the same knowledge, or
perhaps the knowledge cannot be shared with all individuals, such as shrine locations, which are increasingly integrated into archaeological studies (Anschuetz, 1998; Snead, 2008). An alternative suggestion, discussed by Wilkins (Wilkins, 2000, p. 180), for instance, is based on the idea ontological commitment as a worldview theme known as “the logic of eternity.” This notion is described as the reflection of the persistence of entities through transformation, for instance, the use of a single lexeme to refer both to some cultural object and also the natural source from which it is obtained.

The reference to “wind” as (translated as) “wind gap” raises several ontological questions. In this context, gap is not an empty space but a medium, and changing wind at that place provides important environmental information and possibly a heightened (aural and other) sense experience, connecting the physical with the metaphysical. As it is also indicated that this represents the voice of the ancestors, the integration of different knowledge domains is apparent, and different metaphors support such domains.

The narrative analysis hints to the complexity of names and provides some entry points for further exploration, not as a linguistic study but as the study of the perceptual grounding of human experience providing the foundation for the explorations in Chapter eight that outline the importance of perceptual grounding, and its role in underpinning concepts of space and time, and ways of knowing.
7.1.2.3 How do 1 and 2 fit within current models of toponymic research?

According to Levinson (Levinson, 2008b), new directions in toponymic research have provided different insights into the broader field of human spatial cognition, in approaches ranging from linguistic and ethnographic fieldwork to spatial analytical approaches, discussed in Chapter five (Burenhult, 2008; Louis, 2011; Mark et al., 2011; Thornton, 1997). The close relation to the land, the spatiality of which underpins many indigenous conceptual frameworks, warrants a careful consideration of spatial components, and current geospatial technologies (as a new paradigm, (Burrough, 1986)) potentially offer novel ways of integrating this as part of cultural research, even though certain limitations were already identified; Interventions I and II serve to further outline the potential and limitations of these technologies.

My research is unusual in that the data that are used are considered archival, that is, secondary, and have already been linguistically analyzed. The advantage of this dataset is that territorial restrictions were fewer at the time the date were recorded during the early 20th century, and a larger active land knowledge-base can be assumed than exists, or is shared at present, given current Indian Reservation boundaries and surrounding land ownership. The disadvantage is that some recent and new ethnographic research methods that have provided new insights into spatial cognition are not applied. For instance, density analysis, although conducted as part of this research, is not included. I concluded that it did not provide
meaningful results in this case, due to the fact that origin, provenance, and nature of use cannot be assumed or ascertained.

Several recent findings, however, provide a different framework for interpreting toponymic data and have raised new questions. Two of these can be addressed with the current dataset. First, what is the extent of the spatial domain beyond the land surface as conceptual framework in different ecological settings? The second involves relating the cognitive landscape with the physical landscape through investigation of the perceptual structure (nodes and navigation) (Higuchi, 1983; Lynch, 1960). While the first cannot easily be explored with current surface data models and will be addressed in the following chapter, the latter will be investigated primarily through exploratory spatial analyses in the following component, representing two perspectives of western science (from above, and first-person).

7.1.2.4 What is the relationship between names and categories?

The ambiguity of a place name centers on its referent/object. Cablitz (Cablitz, 2008) describes linguistic boundaries between place names and landscape categories as being vague, and it was shown in 7.1.2.2 that many of the place names in the gazetteer are related to geographic or landscape features and are not arbitrary, but descriptive of certain physical features (icon-index) at least. Based on Cablitz’s method, I suggest the possibility that this is similar to other domains for which terms are listed in the Tewa Ethnogeography, especially since recent spatial ontological research has indicated that in addition to “landscape,” (Earth’s surface), other domains are demonstrated to be equally important parts of the same
conceptual framework in a number of case studies, identifying other parts of the perceptual and conceptual Umwelt (in human spatial cognition). This also reveals an important shortcoming of current geospatial systems for representation and analysis in humanistic approaches focused on understanding human experience. Particularly when considering flow as organizing principle connecting objects in these different domains through process, such as wind and water. Given that moisture (precipitation) availability is an essential and a limiting factor for living in the Rio Grande region, the assumption can be made that observation of atmospheric patterns and processes, for example cloud patterns, in general constitute an important cultural component of Tewa life and cosmology, supported by current interpretations of iconography (cloud symbols, etc.). Comparing the lexical components of place names with those of cloud categories and other categories related to the Earth’s atmosphere, I believe that information and knowledge are sought equally in horizontal and vertical realms, that is, immersive. The comparison also questions the ontological basis; phenomena considered transient within a western space-time framework can be considered objects within a different conception of time (Galton, 2000) and potentially based on multi-sensory input, not necessarily visual.

7.1.2.5 How do 1 – 4 fit in with Tewa worldview models discussed in Chapter six?

Information regarding the Tewa worldview used in this study is primarily based on Ortiz (1969), supplemented by publications of other Tewa scholars, as discussed
within the previous chapter. Given the complexity of the Tewa worldview described by Ortiz, it is not my intent to translate that worldview into a representation within a geographic information system, but merely to outline limitations of such systems, through spatial correspondence between the place name gazetteer and the described characteristics of the Tewa worldview and organizational principles.

First, the communicentric aspect of the Pueblo, that is often stressed and is likely common across the Americas (Mundy, 1996), connects the Pueblo, meaning more than its architecture, to the outer zones in the horizontal realm, and to earth and sky in the vertical realm, as frame of reference. Place names can be thought of as creating integrated content (mediating signs and knowledge) in this seemingly abstract configuration, also expressed by Ortiz in visual diagrams. The two-dimensional representations published by Ortiz fit within a western epistemology; however, the representation of the Tewa world using such a diagram is possibly a translation of this configuration in the visual two-dimensional realm. Namely, the different zones are delineated and discussed by Ortiz (Ortiz, 1972a, p. 18) as a series of tetrads or groups of four: at the outerzone by four sacred mountains that are associated with certain physical and symbolic characteristics; the next by the flat-topped hills or Tsin; at the third the principle shrines of the directions at the edge of the village; and finally the dance plazas within the village (Ortiz, 1972a, p. 20). The physical spatial reference points serve to anchor the social and supernatural organization of the Tewa.

Staying in the physical realm for the purpose of this research, the terminology expressed as relationships (light-shadow), recorded in Harrington, indicates the
integration of the Pueblo with the larger cosmos. Considering the importance of flow and relationships, mentioned in the previous chapter as being fundamental Tewa organizational principles, also metaphorized as breath, suggests different organizational principles based on the evaluation of place names as mode of representation and communication, functioning within a space-time geometry different from that of the western worldview.

7.1.3 Summary: mode and medium and its epistemological implications informing the quantitative exploration

As a general guiding question for investigating perceptual grounding, we can ask first how sensoral information available to us is shaped perceptually into “objects” that fit in our conceptual framework (Galton, 1995; Van Valkenburg & Kubovy, 2004), and second how these objects function in an ontology, that is, how they are categorically interconnected between thought and being, and how are our spatial topologies are shaped through these different objects that can cross (sense and representational) modalities.

Given that multimodal representation and communication are not restricted to two dimensions, choice and use of modes vary cross-culturally and are potentially related to differences in human spatial cognition and sensory integration. The qualitative explorations described above brought to the fore several factors that can be further investigated for outlining epistemological differences.
The main issues that potentially have epistemological implications can be summarized as follows:

• Names, whether visually represented on a map or as oral narrative, often represent multiple dimensions other than representing geometric space (Kari & Tuttle, 2005; Mundy, 1996; Wyeld, 2008) —what if the semiotic relationship is non-arbitrary, possibly transformative, and/or temporally cyclical?

• Spatial representations in a specific mode can function in, be part of, a multimodal system (G. Kress, 2010) (mode makes it possible to make meaning with a specific ontological effect).

• If it is possible that earth surface and atmospheric categories are ontologically the same, then spatial ontology is not restricted to a two-dimensional plane, that is, the Earth’s surface. (Levinson, 2003) and modes of representation should reflect that.

• Spatial ontology includes objects, transient phenomena, and relationships between them, the hierarchy of which can vary among cultures/language groups. These are based primarily on affordance and cultural ideas (Levinson, 2008b).

• If it is possible that these objects and relationships are based on different sensing sources, then perceptual structure may constitute a different geometry (non-Euclidean), related to different concepts of space and time.

The following component will test current spatial representation systems that are rooted in western theories of knowledge for their ability to facilitate these
multimodal representations that are different from western scientific methods and conventions. The idea of a perceptual structure of multidimensional space as an immersive epistemology underlies this effort. Two scenarios or Interventions are designed to demonstrate current possibilities offered to understand such a structure visually, while three other scenarios or Critical Interventions serve to show the limitations of current systems of geo-representation for understanding space-time and landscape experience that are based on a different worldview.

7.2 Quantitative component- Interventions: affordances/potential of current geo-technologies

Based on the ideas that no universal landscape categories exist (Mark et al., 2007); that perceptual and conceptual structure are interrelated (L. B. Smith & Heise, 1992); and that affordance and cultural ideas provide the ontological foundation of place names and landscape categories (Levinson, 2008b), in addition to the above-listed characteristics of Amerindian mapping conventions and Tewa place names, the following sections discuss and test the possibilities and limitations of current geographic information systems and tools for representing perceptual and conceptual frameworks different from a western scientific one within which these systems developed. Instead of assuming that these systems are uncontested or neutral, the following interventions and critical interventions explore how differences in human experience and knowledge systems, supported by configurations of perceptual and conceptual structures, clarify the limitations of
current representational modes and analytical systems for ecological understanding, given their modal reach. The outcome of these explorations points to different directions for system development in order to augment rather than substitute the breadth of human perceptual acuity (the human sensing potential and its role in an intersubjective sphere of knowledge exchange).

The quantitative component is divided into two main sections. The first, *Interventions* (this chapter), employs current available technologies, such as geovisualization, for exploring 1) the means for understanding how humans experience and gain knowledge of their surroundings as allowed by these technologies, and 2) the importance of this experiential knowledge for ecological understanding (Storkerson, 2009). This humanistic approach focuses on the relationship between concept and percept in human spatial experience, primarily in the visual domain, and takes its cue from an ecological approach to perception (Gibson, 1977, 1979; Higuchi, 1983) and recent landscape ecological approaches (Farina, 2006; B. C. Pijanowski et al., 2011) and outlines some of the limitations of current approaches.

Based on these explorations and the remaining outcome of the qualitative section, in the following chapter *Critical Interventions* become part of a proposal for further research, focused on defining research directions to address the limitations that impede the development of an ecological model that can integrate experiential knowledge as an important parameter. It thus explores the limitations of current representational and analytical systems for studying differences in space conceptualization and experience among humans, with the intent to understand
how the principle of flow structures (intermodal) percepts and concepts, and outlines future research challenges (see also (Worboys et al., 1998)).

Specifically, Chapter 8 focuses on the modal reach of visual representation based on insight from recent research into physical, philosophical, psychological, and cognitive approaches to sensory integration and perception (cf. (Neuhoff, 2004b; Stein & Meredith, 1993).). Given that much of this innovative research is focused on auditory aspects of perception, these explorations will be largely limited to visual and aural perception and representation, and will not venture into other, somatosensory experiences. Even though the limitation of this choice is acknowledged, comparing visual and aural perception provides an example of the importance of experiential multisensory information in ecology (i.e., beyond visual) and clarifies the remaining research gaps for future research.

Modes of representation: Visual-spatial

New digital information technologies (Information Systems) offer different ways of learning and communication of new information and knowledge (G. R. Kress & Van Leeuwen, 2001; Tergan, 2005; Urry, 2007). Recognizing this potential, several scholars have directed research efforts to expand, formalize, and integrate multimodality into a theory of knowledge, notably as a social semiotic approach, in which modal constellations are assumed to differ across cultures (Chapter 5; (Forceville & Urios-Aparisi, 2009; G. Kress, 2010). Furthermore, it has been argued that geospatial technologies (Geographic Information Systems) as components of these technologies provide a new paradigm for spatial approaches research (analytical, phenomenological) (Burrough, 1986; Corbett & Keller, 2005; Curry,
1998; Michael F Goodchild & Janelle, 2004; Schuurman, 2005b) and others. Whereas standard mapping technologies — paper maps; flat media — reify worldviews with a specific ontological foundation, new spatial technologies have stretched beyond the limitations of those representations, technologically and metaphysically, and will be shown as examples in the following explorations.

Of the new spatial information technologies, Virtual Reality (VR) and Virtual Environment (VE) systems are immersive and offer the possibility of experimentally testing human perception using multi-sensoral cues that approximate real-world (spatial) experiences and responses in new ways (as discussed in Chapter four and five, (Baltsavias et al., 2006; Forte, 2010; International Conference on Remote Sensing in, Forte, Campana, & Liuzza) in which one-, or multi-person applications can provide an immersive experience in a different space and time, whereby most attention is given to accurate representation of the visual domain. However, other sense experiences are often considered as supportive of the visual (Amedi et al., 2005; Larsson, Västfjäll, & Kleiner, 2001).

Geographic information systems, on the other hand, have been developed to model and analyze (quantify) earth surface characteristics, processes, and change, including aspects resulting from human behavior (examples include studies of land use change, habitat analysis, assessment of agricultural potential, and predictive site modeling in archaeology; (Evans, 2006; Franchetti, 2006; P. Verhagen, 2007). More recently, several humanistic approaches, employing certain analytical capabilities these systems offer, show the ability to model, or approximate, human experience in the landscape. The focus in my research is on the latter system as it is suited to
model and analyze ecological problems, described in Chapter 5. These systems offer two main data models to be used in analysis, vector and raster; the latter is most suitable for this study, as it offers ontological flexibility that is necessary to explore ontological foundations of different spatial frameworks.

Proposition

Despite these innovative technologies and applications that have revolutionized our view and understanding of multiscalar processes related to the Earth’s surface and atmosphere, I contend that human sensing/intermodal integration provides a unique perspective as perceptual and conceptual structure, and expect that human sensing skills are differentially developed across human populations based on affordance and cultural ideas among cultures or linguistic groups—the breadth and potential for knowledge acquisition of which is not readily recognized in scientific undertakings. Integration of these different perspectives as cognitive landscapes within current systems therefore can be expected to enhance/broaden current ideas of environmental change and health (i.e., sustainability) and ways to mediate it. Several recent studies in landscape ecology concur with this idea, and the theoretical discussion and practical applications that have been conducted in support of an emerging landscape ecology paradigm provide a context for the following explorations that contribute to further understanding of the role of experiential knowledge, in support of immersive epistemology.
7.2.1 Intervention I: Cognitive Landscapes

The term “cognitive landscape” was conceived for this study to indicate human knowledge fields before I found that is was an ecological term defined by Farina et al. (Farina, 2006) However, as a landscape ecology term it covers all species, whereas the term used in my study (J van der Elst, 2010a, 2010b) refers to human cognitive landscapes, with the added complexity of percept, concept and representational dynamics to study inter-human cognitive diversity. Incorporated in the larger semiosphere, it draws from social semiotic and biosemiotic theoretical developments, as discussed in Chapter 5.

If place names, as representational systems, are perceptually grounded as non-arbitrary semiotic relationships, in addition to their geographic location \((x,y,z)\), places can potentially be compared to environmental features, and particular states of these features, to which they refer, be they static or dynamic. As such, this exploration presents a method that can provide insight into the kind of ecological knowledge that is sought in using these names, and provides the foundation for a hypothesis regarding the structure of the underlying knowledge system/worldview, and is elaborated upon in Critical Intervention 2, Chapter 8.

7.2.1.1 Cognitive landscape and its role in ecological science

The new emerging direction in landscape ecology, as advocated by Farina and others, seeks to integrate information as an essential component, complementing energy and matter, that is, connecting the material and “un-material” in the nature
of landscape, including urban landscapes, in which waves/energy act as carriers of information (Farina, 2006; Pretor-Pinney, Rooney, & White, 2010). In doing so, the new idea builds on the concept of Umwelt for representing the subjective ecofields of different organisms. Within the ecofield hypothesis, as set forth by Farina and others (Farina et al., 2007), “information landscape represents the mosaic built by information that an individual can (potentially) perceive. [akin to sensory integration and affordance] Information landscape and cognitive landscape, when fitted, are the expression of the ecofield.” (Farina, 2006, p. 31). An organism’s cognitive landscape, as described by Farina, encompasses three different types of surroundings, the neutrality-based, the individual-based, and the observer-based. The first can be considered noise that is not perceived as signs; the second incorporates signs decoded by cognitive mechanisms driven by genetic processes, and the third provides a cultural filter gained by experience ((Farina, 2006, p. 16). My research does not distinguish specifically between those components, but is focused on how current representational systems can be used to explore cross-cultural differences in all of them (Figure 22).
Even though the eco-field hypothesis does not specifically address possible perceptual and cognitive differences between human groups, it does not deny it either, and the observer-based landscape provides a means to address it and emphasizes the importance of other aspects the landscape has to offer in addition to material components, related to spirituality, philosophy, and metaphysics (Farina, 2006, p. 9). These ideas dovetail with the concept of semplate, as proposed by Levinson and Burenhult (Levinson & Burenhult, 2009) to investigate and understand the differences in human spatial cognition. The semplate concept is a blending of “semantic” and “template” and is based on the identification of distinct linguistic patterns, lexical sets, and causative verbs. It can be defined as “a configuration consisting of distinct sets of layers of lexemes, drawn from different semantic subdomains or different word classes, mapped onto the same abstract semantic template” (Levinson & Burenhult, 2009, p. 154). Such semplates were first
observed in the spatial domain, while investigating cross-linguistic difference in frames of reference and landscape notion. Given the emergent character of these theories, the ideas indicated by these terms are still in development, but mostly they seek to define aspects of ecological knowledge that have long been neglected in western science, notably “intent” and “creativity.” My research is comparable in intent.

“Cognitive landscapes,” then, building on previous research, is used here to indicate the importance of what is generally considered as nonmaterial aspects of ecological relationships, and specifically how the dynamic relationship between cognition and perception and design/representation as developed differences in human spatial cognition can inform us regarding potential difficulties for cross-cultural communication). Moreover, perception is not limited to visual information; other aspects that are more transient, such as acoustics/aural/sound and sense of smell/olfactory information, need to be considered as vital in the perceptual grounding of cognition.

Biosemiotic approaches elucidate the kind of information that is available in nature, much of which cannot be readily perceived by the human sensory organs, either because it is outside the human physiological range, requires training of the senses, or depends on technological augmentation (Blesser & Salter, 2007; Chittka & Brockmann, 2005; Pallasmaa, 2005). I presume that the spatial structure in which an organism operates can differ — if the “frame” is dominated by the visual, a different worldview results than if other senses are more or equally important, but
this requires a better understanding of perceptual structures underpinning sensory information.

*Traditional Knowledge and the land (territory)*

The importance of place and closeness to the land has been discussed as fundamental in Indigenous methodologies and is considered fundamentally different from a western conceptualization (Burkhart, 2004; G. Cajete, 2004; Cordova, 2004; Hester Jr., 2004; Jojola, 2004; Waters, 2004a) (Denzin et al., 2008; Mihesuah & Wilson, 2004). Even though this is acknowledged in many anthropological and archaeological studies of Indigenous cultures, how it affects understanding of human behavior and cultural material is poorly understood and rarely addressed in depth for its epistemological cause and implications, especially when research efforts are based on the notion of universal spatial cognition as the underlying assumption and therefore employ models based on western concepts and categories (economic exchange models, ecosystems models). The following exploration investigates whether raster data models can be used to integrate perceptual and cognitive aspects from different worldviews into geospatial models of environmental monitoring.

### 7.2.1.2 Data models – raster data (flexible boundaries and multidimensionality)

*Human Sensing + Remote Sensing of the environment (knowledge integration)*

To gain information regarding changes in the environment through observing the Earth’s surface, technological innovations of airborne and satellite systems have
been further developed to collect information of physical characteristics and processes by means of remote-sensing instruments. These instruments are carried either in targeted flights or platforms in orbital paths to collect surface reflectance data of electromagnetic (EM) wave energy. The specific “windows” in the EM spectrum in which this data can be collected includes not only the human visual range, but also reflectance values outside the human sensing range. The numeric data, however, can be analyzed and represented (translated) visually as raster (data) surfaces within a GIS. In the case of orbiting platforms, data are collected at regular intervals and thus provide information on cyclical changes, encompassing human-induced changes and natural processes. The resulting surfaces represent spatial distribution and coverage of landsurface characteristics, providing information on vegetation health (vegetation *indices*) and landcover, among other things, that can be statistically analyzed to extract further information as single or multivariate analyses at multiple scales. Data collected at different time intervals can be used in change-detection analysis, providing insight into temporal dynamics. The raster data model (discussed in Chapter 5 and below) can provide sufficient flexibility to study periodic, cyclical, and long-term changes in the Earth’s surface, canopy, and increasingly of the atmosphere, depending on the spatial resolution at which the data is collected. The different bands in which data are collected can be displayed and analyzed simultaneously, resulting in proxies or indices based on EM energy patterns (spatial multivariate statistics). Figure 23 shows the procedure followed in this exploration and is described in detail in van der Elst 2010a, 2010b.
COGNITIVE LANDSCAPES

Based on the data generated by the study of place names and landscape categories

the physical land surface

Example of what can be detected as remotely sensed

Integrating different knowledge

Place name shapefile – pointfile > changing geometry to polygon to represent area

Selecting polygons representing different languages and dialects

Changing data model: from vector to raster, creating a file of known places for each language /dialect (1.0), viewed as single or cumulative raster

Potential to compare knowledge fields with environmental data (if temporally congruent)

Figure 23 Procedure cognitive landscape – (van der Elst 2010, a,b)
Human sensing of the environment – building on Umwelt/Ecofield

This ability to observe changing conditions has provided new insights in ecological processes, interpretation of the data however still depends on calibrating the remotely sensed data with on the ground information and context. These efforts have resulted in a database of spectral signatures of specific materials and variable (e.g. cyclical) conditions of those materials, facilitating future analyses of an ongoing data collection.

Many of the analyses are based on a “from above” (detached observer) perspective of the Earth’s surface and employing “groundtruthing” as a strategy of calibration (index to icon/sign relationship) to link the information gained remotely (far range) to what can be experienced at close range on the ground,(as was shown in the previous section — image of ‘perspectival object’). Even though this strategy provides a means to extrapolate or infer an “on-the-ground” perspective at scales not previously possible, and we often rely on technology to approximate this knowledge, this component serves to demonstrate that currently such technology is not a substitute for knowledge that results from experiential learning, based on human sensing, sensory integration, and perception. The research can support a proposition that experiential knowledge is unique and provides an important/necessary component for understanding and navigating the environment, as part of an immersive epistemology as it draws on different sensory information simultaneously as integrated perceptual grounding; different landscape categories based on different configurations of sensory integration and perception then result.
Moreover, the flexibility of the raster data model to study changes in the Earth’s surface characteristics also allows the exploration of landscape ontology using results of insights from the Tewa ethnogeography evaluation to start these explorations, and how “intent” as a recently recognized critical variable in landscape ecology (Farina, 2006) can be integrated into analyses. It will demonstrate how different landscape categorization and conceptualization can support a different worldview and style of environmental management.

This idea builds on the practice of image analyses to classify landscape characteristics according to prior knowledge (supervised classification) or data-driven (unsupervised classification), employing diverse statistical procedures to allow for novel categories to emerge that are more informative of environmental processes and temporal cycles (e.g., greenness) (Jensen, 1996). This research attitude can also be applied to investigating differences in human spatial cognition and the relationship to environmental features as objects in a semiosphere or specific knowledge field (Kull, 2010).

If information from the EM spectrum obtained through current geospatial technologies is an accurate indicator of environmental conditions, or representative for all of the semiosphere, current remote sensing information and proxies may suffice; however, I contend that the resulting information is not a substitute for the human perceptual/conceptual potential. Indices of environmental condition may not be representative for the whole, as more processes are involved in different ways that can be perceived in an immersive setting (Figure 24).
Cognitive fields

Distributed knowledge

Interspersed communities

Temporality

Semiotic relationship to the land

Not necessarily correlated to ‘sites’

Issues .......

Figure 24 principle of image processing, map algebra – integrating tangible and intangible landscape aspects. (image derived from (Huber, 2000))
7.2.1.3 Exploratory Method – integrating physical and cognitive processes

As mentioned earlier, the gazetteer of Tewa place names that was collected during the early 20th century provides, despite its limitations, insight into the landscape knowledge of Pueblo inhabitants at a time when access and movement were less restricted than in present times. Places are also listed in a variety of languages and dialects by which each is known, including Spanish and English. Limitations are many; therefore, the interpretations derived from the analysis are informative for generating hypotheses rather than conclusive. Examples of limitations include the fact that the dynamic aspect of the place names and categories may be lost, as these names are represented as static and fixed. (See for instance the description by Harrington of Tewa language as more flexible than the structure of most Indo-European languages (John P. Harrington, 1910)) The research method to obtain these names may have been driven by prior knowledge and not sensitive to native linguistic nuances. In addition, the categories may have been “mapped” onto a western template (as transmodal mapping). For instance, current examples indicate that names may differ in certain languages depending on the position (geographically) of the observer (Ascher, 1991; Mark et al., 2007). Also, the physical configuration of places indicated may differ spatially and temporally, though they are currently represented as point locations on a cartographic map. Some of these limitations became clear during the qualitative analysis while mapping the place names employing current geospatial technologies.
Based on the qualitative evaluation, a sample from the place names gazetteer was selected for exploring cognitive landscapes. Several things were noted during that phase: 1) core regions were known only by one group; 2) other areas were known by several or many groups, as indicated by the different names for a specific place; 3) other names were known as Tewa, without reference to a specific group. In addition, certain names were known in Spanish and English as well, or had Spanish or English names only. These places could often be identified as non-native and referred to cultural elements such as Spanish homes. Even though these places could have functioned as navigational aids, they are mostly excluded from the sample.

The names that were already digitized as point shapefiles were assessed for the geometry they referred to. For instance, a river or river section indicated as a point is spatially better represented as a linear feature, whereas other points/names refer to larger areas/fields. They were also assessed for the number of different languages or dialects in which places are known, inferring the level of shared knowledge. First the geometries were digitized, resulting in a new polygon shapefile, covering the land surface. Within the associated table the languages and dialects in which each polygon field was known were entered, allowing queries of the database. Subsequently, a unique field of knowledge (converting vector to raster as a binary file of 1-0) for each language or dialect was generated, resulting in several raster files. A cumulative raster file was then generated by employing a
raster calculator in ArcGIS that showed which places were known in one of more languages.

Potentially, knowledge fields as raster files can be integrated into GIS applications within ecological models that use a variety of environmental data, such as land cover, vegetation indices, and hydrological data, which are standard in current practice. In this way the signs as referents can be compared to the different sources of perceptual grounding indicating, for instance, whether places represent, ecotone, watershed, or animal habitat boundaries (Figure 23) (van der Elst, 2010a, 2010b).

7.2.1.4 Outcome of cognitive landscape exploration

In general, the way in which the land is classified says something about how the land is used. What this exploration shows is that a wide variety of tangible and intangible (physical, physically transient, and conceptual) aspects related to the land can be represented and explored using a raster data model. Traditionally used to represent physical objects, where the boundaries of objecthood are not fixed, intangible and transient objects and phenomena can also be explored and integrated within current systems of representation; however, they do have to conform to the space-time structure of current systems.

The place name data used for this exploration were recorded at a specific point in time, during the early twentieth century, and this presents a major limitation for the potential of how the data files generated in this exploratory analysis can be used.

Potentially, visualization of semiotic relationships comparing names/categories as part of a specific ontology with other data layers can demonstrate kind and extent of
environmental knowledge. For instance, in the case study, where names mostly refer to natural features, the knowledge fields can be linked to landcover files. However, in this case discrepancies are expected, as currently no valid proxy landcover datalayer is available representing the time at which the place names were recorded and current landcover data were used. But potentially, habitat boundaries assessed through spatial analysis can be expected to link to knowledge of animal movement.

The results of the exploration show 1) the possibilities that current spatial technologies offer for integrating cognitive aspects, such as linking specific perceptual/cultural categories with physical landscape data, and the ability to perform certain types of analysis allowed by the datatype whereby new hypotheses can be generated using this method for understanding the perceptual grounding of human cognition; and 2) the limitations of current technologies for representing and analyzing aspects that have come to the fore as part of the evaluations of toponyms: if names refer to a perceptual quality other than visual; if names refer to an object or phenomenon other than part of the Earth’s surface (atmosphere); if names refer to a process; if names refer to a specific temporal event/sequence; if names originate from a specific point in the land.

The key limiting factor related to this specific case study, however, it the fact that modern remotely sensed data and place names were recorded in different times; this aspect is further addressed in the next chapter. It is suspected that the place names have an inherent dimensionality that cannot be investigated easily, due to their having been recorded at one specific point in time and represented as a fixed
system, different from the oral mode they functioned in. Despite these issues, integrating human thinking into systems for environmental analysis offers means for understanding differences in human cognition that can indicate different attitudes toward the land or land management-strategies.

### 7.2.2 Intervention II: Location Analysis

Over the last decade interest in how humans experience their environment has grown, and geospatial technologies have facilitated integration of this information, for instance in environmental and urban planning projects, recognizing human experience as an important or key variable. Given the technological development, as well as a focus on psychology and cognitive science, visual perception takes precedence in such approaches that have also been used, and further developed successfully, in archaeological studies for understanding historic spatial organization. These approaches predominantly employ and customize the analytical capability known as *viewshed* analysis, a surface calculation resulting in a binary raster field of what can be seen and not seen from a specific vantage point. As was discussed in Chapter six, several scholars have begun to contextualize their archaeological data and analyses based on the Tewa world structure described by Ortiz (Anschuetz, 1998; Ortiz, 1972a; Snead, 2008) to explain changing site locations, providing an alternative explanation for site prediction models that are often environmentally deterministic. The geometric reality of that structure, as represented in several diagrams in Ortiz, can, however, have different manifestations *in* the landscape, where strict linearity on a plane (i.e., Euclidean
geometry) is not necessarily the dominant relation between the different elements of the multidimensional world—as can be inferred from the evaluation of place names.

As an example, alignment to north may be an important factor in spatial organization but may carry a different ecological significance than in western paradigms of spatial organization, where North as an index has become a symbol or convention in mapping practice. As mentioned by Ortiz, alignment to cardinal directions is an important factor, but not the only one. To assume its dominance and determining character, for testing visibility only, does not seem valid.

Established cartographic representation technologies/methods are conducive to “overlay” of such diagrammatic outlines over planviews of architectural building footprints and topographic maps. To do so exclusively, however, conforms to a mode in which land and nature can be observed, represented, and communicated based on the rationale of sight transformed into mathematical space (Lima, 2003). The axiom of “seeing is knowing” prevalent in western science has established visual observation as an objective endeavor.

Even though viewshed is increasingly used to explain and/or justify certain built environments, there is surprisingly little research on how humans experience the environment, the role of visual perception in wellbeing, and the interplay of vision with other sense experiences. Such research is particularly lacking for natural environments, and for cultural differences in perception of natural environments (Casas, 1993; Cheng, 2005; Kaupinnen, Henriksson, & Vaatainen, 2006). It is expected for this section, then, that even though visual aspects can be suggested to
be of importance in site location, given the absence of research supporting such assumptions, the absence of data, and the inability of current systems to integrate other sense experiences, these efforts are only the beginning of exploring the importance of human experience in experiential knowledge, even though theoretical support of the existence of these issues has long been in development (Storkerson, 2009).

The preliminary thesis for this Intervention can then be stated as: Given that the focus within a Tewa worldview is on flow, relations, and movement, it is expected that the structural outline presented by Ortiz is a translation of those concepts into a geometric visualization for the purpose of communication within a western scientific framework. To explore these concepts and the limitations of a planimetric/geometric representation as abstraction of “psychophysiological” space (Lima, 2003, p. 25), the explorations underpinning this section employ current methods and tools available within geospatial systems adapted for a humanistic approach (Higuchi, 1983; Llobera, 2007; Okabe, 2006). As defined by Panofsky, psychophysiological space indicates the product of processes that determine our understanding of space, that is, our sensual experiences that necessarily go through psychological interpretation to give those experiences meaning (Lima, 2003, p. 25) and is at the heart of the discussion of validating experiential knowledge (Storkerson, 2009).

According to Lima, within western science the concept of horizon provides the bridge between the optical and the epistemological, between seeing and knowing.
The vanishing point on the horizon in pictorial space, that is, the technique of perspective as the mathematical work that underwrites the artistic achievement of the Renaissance painters, also grounds the claim of science to objectivity, as it transforms psychophysiological space into mathematical space. Even though the objectivity of experience was later called into question from a phenomenological perspective, the rationalization of sight, or the visual dominance of source of knowledge, was accepted, or not contested. This “rationalization of sight produced a conceptual frame in which sight has become the principal avenue of the sensuous awareness upon which systematic thought about nature is based” (Lima, 2003, p. 21).

Given this integrative aspect of experience and “objective” representation of visual space historically, current geovisualization methods and technologies that grew out of this development can be employed to examine human visual experience. This Intervention starts from the proposition that more different knowledge requirements underlie location choice and land use than most current archaeological models suggest, as these models are often based on socioeconomic variables instead of parameters of nature. Intervention II explores the Pueblo as center place/node (communicentric) within current geospatial representation systems. Based on the assumed dominance of the visual/spatial structure of physiological sense experience, this understanding functions as a first step toward examining “the epistemological dilemma of synthetic knowledge” (Lima, 2003, p. 20). The intent is to identify missing elements in current systems that are
potentially part of an immersive epistemology, integrating the findings of previous explorations and evaluations.

7.2.2.1 Perception from the perspective of being in the land: places and trails

Visual-spatial structure of the land, where land surface defines perceptual structure, can be examined within current GIS viewshed analysis, calculating visible and non-visible locations of the land surface from an origin point in a 360 degree field-of-view. This analysis is based on the use of a Digital Elevation Model (DEM) as data source, which is a raster surface representing elevation values with a specific (but variable) spatial resolution. That the resulting “visibility surface” only approximates human vision is widely recognized in archaeological studies, and derived measurements and adjusted applications have been designed to represent human visual experience that is better suited to explain human behavior and design, such as cumulative viewshed, total viewshed, topographic prominence and visualscape (Farina, 2006; Llobera, 2007; Ogburn, 2006). These approaches are indebted to Gibson’s ‘theory of affordance’, and Higuchi’s (Higuchi, 1983) Visual and Spatial Structure of Landscapes. Higuchi specifically created a number of indices of visual spatial structure useful in spatial systems based on aspects of human visual perception (Figure 25).

Notable are Llobera’s efforts to model human movement along a path (sense and direction) as a series of samples along that path; however, a number of limitations in current applications, most importantly atmospheric attenuation and the effect of light on perception [EM energy] have not been addressed in geospatial technologies,
as is pointed out by Llobera (Llobera, 2005). Furthermore, even though technological advancement of cartographic-based systems has resulted in tools and applications to simulate an egocentric perspective/frame of reference (e.g., Arcscene®, Google Earth®), analytical capabilities are mainly restricted to surface statistics, not volumetric approaches. These capabilities, however, can be useful as foundation (Figure 26). Indices of the visual perceptual structure developed by Higuchi highlight the importance of aspects beyond the horizontal plane for perception, and serves as a starting point for this and following explorations that anticipate the importance of other sense experiences in ecology.

To investigate perceptual space — in this case limited to visual perception — in experiential learning that is dependent on and influenced by physical factors (field-of-view, light, etc.), the question of salience of landscape features, often indicated as landmarks, is essential. The difficulty of identifying such features from land surface models was already made explicit in section 7.1.2. Place names, specifically as dominance of perceptual salience may not be a universal aspect. Physical features are not equally meaningful or weighted across cultures, resulting in different landscape/environment ontologies and related systems of navigation and spatial design (Levinson, 2008b; Norman, 1999). Simply put, if ontological foundation and frame of reference differ across language groups, the spatial perceptual structure that grounds spatial cognition can be expected to differ in similar or the same ways, in other words, landmarks are different and not necessarily limited to visual aspects (Ascher, 1991; Louis, 2011; Schafer, 1994; Williams, 2000).
PERCEPTUAL STRUCTURE

This term is a derivative of the term used by Higuchi, visual and spatial structure of the landscape that describes the visual indices in an ecological approach to visual perception. Perceptual structure is used as a conceptual outline to investigate perceptual configurations of other sense experiences in the land.

Visual /spatial structure – Higuchi indices

Higuchi developed eight indices for studying human visual perception of the environment. The assumed dominance of vision in human perception has recently been challenged and the development of systems of representation focused on the visual has been attributed to the ease of translation of visual aspects in geometric based systems. Even so, the indices developed by Higuchi provide a starting point to think about the perceptual structure of other human sense experiences.

<table>
<thead>
<tr>
<th>Index 1</th>
<th>Visibility - invisibility</th>
<th>Which point on the surface are visible from a specific vantage point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index 2</td>
<td>distance</td>
<td>What kind of objects can be distinguished at what distance from a vantage point</td>
</tr>
<tr>
<td>Index 3</td>
<td>Angle of incidence</td>
<td>This index is used by Llobera, known as topographic prominence</td>
</tr>
<tr>
<td>Index 4</td>
<td>Depth of visibility</td>
<td>“places that...afford good views...” [Higuchi 1983, p36]</td>
</tr>
<tr>
<td>Index 5</td>
<td>Angle of depression</td>
<td>“depth is an effect of a continuous change in the terrain surface...and of atmospheric perspective or the overlapping of objects viewed” [62]</td>
</tr>
<tr>
<td>Index 6</td>
<td>Angle of elevation</td>
<td>Shadow; texture gradient; cyclical changes; affect how objects are recognized</td>
</tr>
</tbody>
</table>

Figure 25 Visibility analysis – integrating Higuchi’s indices, - viewshed in ArcGIS
7.2.2.2 Pueblo as center: zones (movement and communication)

as explored through the visual spatial structure based on Higuchi

At the outset of my research, this particular section was considered central in the research design, based on the argued importance of and connection between visual and spatial thinking in the literature, which has become prominent with the widespread acceptance of locative and visual media (P. Shah & Miyake, 2005). During my research it became apparent that theoretical and empirical support for the dominance of visual experience is lacking, and instead, it became clear that research into the importance of other sense experiences, recently on the rise, indicates that this assumption is based in large part on cultural preference (Blesser & Salter, 2007; Bregman, 1990). The initial intent to demonstrate how visual perception underpins spatial design now becomes a mere step in developing a model that can integrate multimodal aspects of the semiosphere within an immersive epistemology.

To place this idea in context, it is useful to recall several case studies, even though not specifically from a Tewa perspective, that have different spatial organizational principles and representational modes. The navigation maps or stick charts of the Marshall Islanders, representing wave characteristics and processes, were never taken to sea as navigation aids, but were memorized (Ascher, 1991). Asher discusses the different worldview of the Navajo, for whom the focus is on processes instead of objects and situations. The different perception of boundaries that is part of this view results in a world that is not subdivided into discrete units, but of dynamic interfaces in an interrelated system of parts that are in motion and in
process of change (mountain ridge; earth-sky) (Ascher, 1991, p. 129). As oral cartography, Williams described a multimodal approach in the Navajo spatial cognitive framework that serves to integrate and communicate these concepts as oral stories and that makes use of a visual perceptual structure as well, as landmarks as one moves along with the remembered story (Frake, 1985; Gluck, 1991; Williams, 2000). Thus, visual perception and visual structure are important, however, their role in a multimodal constellation should be carefully considered as one in a unique perceptual-conceptual framework.

Figure 26 Using the shapefiles created based on published research and data from the New Mexico Cultural Resources Information System (ARMS & Section). Non-spatial data are integrated in the spatial data files. Places that were occupied simultaneously can be queried and displaced; visibility analysis can be performed using the selected sites.
In many archaeological studies a move to prominent landscape locations for which the total area of visibility (i.e., landsurface) is increased is often attributed to defensibility, assumed to be enhanced by its visual advantage, following models applied in other geographical locations. I propose that such locations and their change in visibility provide other, ecological and observational qualities that can be considered, based on the following premises:

- Movement is an integral part of Pueblo life (statements)
- Movement between upstream and downstream locations is motivated by availability of rainfall/moisture for agricultural practices (anecdotal information in Harrington 1916).
- Spatial variability in moisture availability under different environmental conditions is shown for the modern day and can be observed visually (and can potentially can be tested using Higuchi indices); and suggested for past conditions (climatological analyses)

Employing current tools in GIS, the observational qualities/affordances and the function they may have served are explored at different locations, such as Pueblo as center and other suggested “nodes.” Over the course of my research I have conducted several pilot studies to explore elements of perceptual structure, but not all are presented here (J van der Elst & Ox, 2006; J van der Elst, Richards, & Arias, 2006).

To build on previous efforts, the diagram by Ortiz is compared to landscape features to which it refers, to explore the geometric relationship and modal use of such visual diagrams. My initial hypothesis was that spatial configuration of the built
environment, in this case Pueblo architecture, was designed to create a connection to the larger Tewa world and that this was manifested through the visual (Figure 27). This can be thought of as a mode of representation and framing and linking as important components of that mode. *Framing*, then, indicates the vistas created through the open corners in architectural design, that *link* the center of the Pueblo to important nodes in the larger environment. Even though this link can be demonstrated on a planimetric map and through a “line of sight” procedure that takes into account the topography employing current GIS software, the visual indices in visual perception developed by Higuchi point to different aspects, and the multidimensionality of perceptual structure as a whole that can be integrated into ecological models (Higuchi, 1983).

Given that not all Pueblos are situated in similar topographic settings, other visual aspects, other perceptual aspects, different ecological aspects, or a combination of these can be explored as alternatives to socioeconomic reasons put forth in archaeological models.

An initial baseline exercise is based on Ortiz’ structural diagram and his description of the landmarks framing the different zones of the Tewa world (see Ortiz, 1972, Figure 2,10,11). Using the ‘overlay’ in ArcGIS onto the Ohkay Owingeh (San Juan) location, on which these diagrams are modeled, it is clear that the diagrams are an abstraction of relationships in the land and not the Euclidean geometric reality/accuracy desirable in western cartography. This exercise shows that on a geometric plane, the cardinal points that frame the Tewa world are within the general directional quadrant from the Pueblo perspective, but the relationship is not
geometrical as is standard in western cartography. The different zones may be related to a distance index, as what can be distinguished as the salient object in the different zones, but can also be distinguished as separate horizons. The example used by Higuchi concerns the distance at which an individual tree can be distinguished by the human eye. This can be further explored, but needs to be based on a salient object in Tewa ontology, as well as attention to different atmospheric conditions and vegetation and climatic conditions in the past that influenced such distances (spatio-temporally) for the Rio Grande valley environment (Higuchi, 1983, p. 16).

Seven of the eight Higuchi indices can, potentially, be modeled within current systems, as they can be considered as geometric relationships in assumed static situations; however, only aspects of the Earth’s surface (horizontal) can be modeled directly or as an indicator of other, atmospheric, aspects in the vertical realm. The indices in themselves are not limited to the Earth’s surface. It was also already indicated (Llobera, 2007) that the last index is difficult to model within current systems of analyses, even though light is the source of visual perception, such that different light conditions change dynamically how things appear and as such influence all indices. Light waves (EM spectrum), however, are of interest because of their dynamic aspect and changing relationship between things occurring in the horizontal and vertical plane, but this will be further explored in the next chapter.
Figure 27 exploring the view from being in the land (1) and the view from above (3), employing capabilities of Google Earth, ESRI shapefiles and a plug-in (HeyWhatsThat), line of sight and visibility surfaces can be interactively explored. For each point on the landscape a visibility surface can be created and simultaneously displayed and compared; and outline of the horizon can be explored in Google Earth and graphically as diagram from HeyWhatsThat (Kosowsky)
The mountains indicated by Ortiz as cardinal mountains of the outer zone frame the watershed model introduced earlier. In general, most viewsheds that were generated from specific Pueblo locations are encompassed by this model (see Figure 11).

Using a cumulative viewshed approach, it can be assessed, for instance, from which location one, two, three, or four of the sacred mountains, or other specific locations, can be seen. This kind of exercise can lead to hypotheses on navigation strategies, connecting the different places in the land through different modal perceptions and representations. Although it must be noted that other signaling systems used may not be dependent on visibility of the land surface, smoke or sound signals for instance, or even specific cloud patterns. The cognitive landscape approach in this case can be helpful for modeling corridors and animal habitats, for instance, whereas other locations, such as rock art sites, can be tested for their perceptual affordance, that is, what can be seen or heard, in terms of navigational affordance, but also as indicators of resources or processes and changes (Johnson, 2005; Louis, 2011). The points generated by this effort did not result in “known” locations in the archaeological landscape, that is, these locations may be or may have been important culturally for the Tewa, akin to “career maps” documented by Kari and Tuttle (Kari & Tuttle, 2005). To make such claims, however, is over-speculative and unsupported by any recent perceptual research on landmarks.

Initially, I explored framing of vistas through spatial configuration of architectural elements of Pueblo Galisteo (J van der Elst & Richards- Risssetto, 2007). Even
though viewshed and line of sight procedures were available, modeling of the horizon was not standard practice (Higuchi indices on the vertical plane). This initial exploration made use of the operation of extrusion of polygon features within ESRI’s ArcScene® environment, but did not result in distinctive outcomes of specific landmarks. Certain reference points in the land, mentioned by Ortiz are not based on a geometric relationship.

Pueblo Galisteo in the archaeological literature is considered as part of a cluster of sites in the Galisteo Basin, discussed in Chapter six (Nelson, 1914). To better understand its connection to other sites, I performed, in collaboration with Heather Richards (J van der Elst et al., 2006) a least-cost-path analysis, a measure used to test accessibility often conducted in concert with visibility analysis. Similar to the viewshed procedure, this measurement is based on topography and specifically modeled after waterfall models to generate a path of least resistance or cost, and similar to viewshed models they have been adjusted to account for human movement (Tobler, 1993). Even though the outcome shows a link between the different sites in the cluster, closely relating Pueblo Galisteo to other sites in the basin, review of the place names and other ethnographic sources that link Pueblo Galisteo to the Tewa, but the other Pueblos as ancestral to Kewa (Santa Domingo), may prevent quick conclusions to be drawn from this outcome (Ellis & Dunham, 1974)). In any case, it shows that measurements such as visibility and access need to be supported by additional research in human spatial perception and cognition that is currently inadequate.
In addition to Pueblo Galisteo, I selected Tsankawi, located on the Pajarito Plateau, to further explore visual aspects, which included photographs of the horizon. As most geospatial analytical software is focused on the land surface, the vertical domain is usually modeled as topography against an empty sky (space as empty backdrop). The 360-degree panorama photographs from the Tsankawi location show the importance of the atmosphere (Figure 28 shows a section of that panorama). Not only does it determine what and how things are perceived on the Earth’s surface, atmospheric processes (wind and cloud formation and movement) can be observed, as well as the interaction between atmosphere and land surface, that is, moisture patterns (akin to description of Navajo concept of space; Asher). Connections understood between these different phenomena and processes provide important signs and indices. Current geospatial models cannot integrate these dynamic factors — energy and matter — as aspects of experience and perception.
Land – atmosphere relationship

Field-of-View: photo camera (above), ArcScene (ESRI) (below)

Figure 28 View from a site: the dynamics of the atmosphere and absence thereof
7.2.2.3 Sites, sources and communication using visual cues (flow, movement, and relationships) - limitations

Current spatial technologies provide means for understanding spatial relationships and increasingly the ability to model human experience. The above explorations served to outline some of these means and, at the same time, to point out limitations that need to be addressed to further develop ecological approaches to perception. Features of the landscape such as other habitation sites, potential near and distant fields, and mountain peaks can be compared in a binary listing and weight can be assigned based on their assumed importance within an interpretive model. For instance, potential fields can be calculated in GIS based on slope, aspect, parent material of soil, and distance to water, as described in Chapter six. Even though the horizon is hard to model in current GIS packages, other plug-ins have been developed that create the boundary between earth and sky, indicating the location and outline of topography from a specific viewpoint, providing some insight into the view from “being in” the land and comparisons what can be seen from different settings. Different environmental conditions, for instance, may require tending to fields further away and differently distributed, a need to observe signs and indices. Dispersed rainfall may factor in a choice of location that can be modeled using these applications.

Using Ortiz’s diagrams and descriptions as a conceptual guide, supplemented by ideas from the place names evaluation and Higuchi’s indices, the landscape configuration surrounding different habitation sites can be compared, for instance,
as to landscape type, affordances, and how these differences can impact the subsistence activities described by Ortiz or the way ecological processes can be observed and perceived.

However, Ortiz pointed out that though location and orientation of sites is based on anchoring toward the places in the different zones, it is likely influenced by other factors than geometric relationships. In addition, the evaluation of place names showed the complexity and dimensionality of knowledge that may influence such decisions. Furthermore, little research is available to support the assumption of importance of visibility and the role of visibility in different societies. It is therefore difficult to investigate a specific model of visibility as a factor in location choice.

That said, several suggestions for further research are made depending on what is being observed Higuchi's indices are more or less influential in different settings and situations. The fact that the index of light is difficult to integrate is suggested as highly influential in what can be continuously sensed and perceived.

Even though light (flow) is the energy source of information in remote-sensing studies, the ability to investigate atmospheric changes, especially light in visual perception, as part of humanistic approaches still proves to be difficult. From a position of “being” in the land, however, sensoral data can be perceived that are unique: to specific locations; as specific event, providing information of changing conditions at multiple scales/aspects.

The table (11) below shows salient aspects of Tewa ontology that were identified as possibly different from a current western worldview. In the next chapter, these aspects are initially explored for defining novel future research directions.
### EXPLORING SPATIAL ONTOLOGY

<table>
<thead>
<tr>
<th><strong>Possible differences in ontology, explored through “groundtruthing” sample place names</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Names indicating a relationship, shadows indicative of temporality</strong></td>
</tr>
<tr>
<td><strong>Places recognized for its characteristic (form or other quality) observed from a specific position in the land</strong></td>
</tr>
<tr>
<td><strong>Land – atmosphere relationship</strong></td>
</tr>
</tbody>
</table>

Table 11
The following sections focus on flow and the perceptual grounding of landscape (+atmospheric) categories that indicate a different perceptual-conceptual process, potentially underpinning an indigenous way of knowing.

Certain qualities/affordances are suggested that can be visually observed; however, current systems offer only limited ways to do so: observe atmospheric changes/processes (short-term – long-term) to understand rainfall patterns; observe land surface as indicator of moisture content, distribution of rainfall, and movement of water (distance index for instance important, color and texture as dominantly weighted visual cues); observe fields; subsistence practice/organizational aid, depending on where these are most suitably located based on knowledge of moisture availability; visual communication systems (e.g., rock art; signaling as active signs) (event and node/markers); navigation, movement along a path (supporting oral stories, perceiving passive signs), supported by a system of triangulation for instance; observe atmospheric processes.

Given the indication of the multidimensional and dynamic character of experiential knowledge suggested by the place names exploration and discussion of Indigenous scholars, it is not expected that spatial organization/cognition can be reduced to a single mode, and further explorations are necessary to generate thoroughly grounded hypotheses for and an ecological approach to perception and cognition.
CHAPTER 8  HUMAN DESIGN PRINCIPLES AS PART OF THE LARGER SEMIOSPHERE

The consequence of assigning a more prominent position to experiential knowledge in environmental understanding is a shift in how ecological problems and challenges are, and can be, approached. The environment as a complex source of information (semiosphere), linked to energy and matter, is difficult to reduce in current formal knowledge practice. Some of the significant limitations were outlined in the previous chapter, related to the mode of representation and systems of analysis used to do so. Therefore, perceptual grounding is restored as an important part of a dynamic flow of knowing.

Within this chapter the important limitations are explored in more detail, regarding the implications for further research leading into preliminary conclusions on how these limitations affect archaeological research, specifically for the Northern Rio Grande Pueblo histories. The limitations that are addressed are underpinned by prior research. Most of the ideas and proposals for change presented are not (or not entirely) new, but are combined in a larger framework, and incorporate the preliminary conclusions as a foundation for future research.

In my effort to demonstrate that epistemological differences are at the root of the fraught relationship between the Indigenous and archaeological research communities regarding Pueblo histories, two major limitations have been identified that hinder such an effort. These limitations, related to current geospatial systems, geometry, and spatial ontology, were long considered to represent universal aspects
of human spatial thinking. This is no longer believed to be true, and the previous explorations showed the impact on practical applications that these shortcomings present for understanding a non-western worldview (see (Sieber & Wellen, 2011), who refer to this as “epistemic violence”). In addition, there is only limited scientific support for long-held assumptions regarding how humans use sensing and perception in knowledge systems that are based on an integration of analysis and synthesis, especially of environmental knowledge (but see (Neuhoff, 2004c; Schafer, 1994)). Recognizing these limitations allows the design of different strategies to pursue this effort. In fact, a renewed, even if only limited, interest in earlier research on aural perception conducted during the 1960s and 1970s has brought to the fore the importance of experiential knowledge (an immersive epistemology incorporating multimodal knowledge sources). This literature provides support for the explorations below.

To further our ability to recognize whether contention between Indigenous and archaeological research communities can be attributed to epistemological differences, the following explorations are guided by current ideas of the relationship between different perceptual grounding and conceptual frameworks and their spatial structure/geometry.

The following questions generated by the previous explorations support this effort:

• Is it possible that features/processes related to the Earth’s surface are ontologically the same as those of the atmosphere in a Tewa worldview?
• Is it possible that spatial ontology is based on different sense sources?
  (different signs and indices underpinning experiential knowledge, time and
  space effects)
• Is it possible to distinguish different weights given to features in Tewa
  ontology (mereotopology)? (using a principle of flow)
• If so, what are the consequences for modes of representation used, kinds, and
  structure? (ontological and epistemological consequences)

Focus on visual aspects and visual representational systems has inherent
epistemological implications (nature of knowledge that is derived), and different
cultural foci may elucidate different knowledge to be gained through other
sense/perceptual sources and gained and expressed through different modes of
representation (G. Kress, 2010). Even so, a major limitation of current systems
discussed in the literature (Cheng, 2005; Llobera, 2007) is the difficulty in
integrating (the index of) light and other atmospheric processes interacting with
surface features and dynamics, even though it influences and constitutes the source
of what can be visually perceived. It is the flow of energy (the source of sensing and
perception) that is central in this chapter for exploring and generating new
hypotheses.

In a worldview in which even boundaries have a dynamic component and process
and interrelationship are paramount, the constraints of a Euclidean-based system
thus present a number of challenges for representing and understanding models
and ontologies of space (in science applications). The following sections identify and
explore some of these, where the focus is theoretically on the perceptual grounding of concepts, and methodologically on current advances in representation and modeling of processes and relationships (as its spatial structure).

Based on the description provided by Cajete of an Indigenous way of knowing, I gather that the Tewa employ, and/or likely have done so in the past, a model for spatial reasoning different from the western scientific approach. Since flow, movement, and change, as well as interstitial spaces, are mentioned as fundamental underlying concepts, compared to space and time as fundamental axes in western philosophy, indicating a complex, but diverging, worldview (G. Cajete, 2004, 1999; Cordova, 2004; Jojola, 2004; Swentzell, 1990; Waters, 2004a), implications for design and underlying design principles can then be expected. Associated ontological differences are here explored to define hypotheses that can further elaborate the hypothesis of epistemological differences, supported by the questions resulting from the qualitative component within the methodology outlined in Chapter five. Perceptual structure as ontological foundation, is therefore considered, based on 1) different spatial domains beyond the Earth’s surface, 2) different sense experiences, and 3) possible different sensory integrative processes, in which visual sense is not necessarily dominant, explored in three separate sections in this chapter. Based on the outcome of exploring these ideas, what kind of knowledge can be assumed to have been pursued, and what other representational systems could possibly serve to gain such knowledge given the ontological insights of the following
explorations, thereby leading to new hypotheses to investigate human experience as a source of knowledge.

### 8.1 Critical Interventions: What are objects?

*Perceptual grounding*

The study of “what constitutes an object” (as ontological reality in our shared world — if a physical reality is accepted) crosses several disciplines and for reasons already made explicit previously, is often focused on the visual. A large number of these studies exclusively investigate the physiological aspects of perception and category making, that is, how the human sensorium functions within this process. Through the groundbreaking study by Gibson (Gibson, 1977, 1979), the need to consider the environment in which these experiences take place, constituting a dynamic process, came to the fore. Affordance, as the pillar of this ecological approach, is also considered to be the main component of the ontological basis of placenames (Levinson, 2008a), and currently supports a number of other studies integrating the importance of sensory integration (Stein & Meredith, 1993; Van Valkenburg & Kubovy, 2004).

Given this (nonuniversal) research foundation, it is justified to use the specific findings of the qualitative evaluation of the Tewa place names to explore what specific affordances these may provide for the physical and conceptual reality of the Tewa world. Several aspects of that worldview are highlighted in the following explorations, but they are not meant to be exhaustive, only exploratory, toward further developing an immersive epistemological framework.
That the available scientific knowledge of sense and perception is primarily in the visual realm, however, has led to the (possibly false) assumption that the visual sense and visual representation are the most important or dominant in human beings. As mentioned earlier, this assumption has begun to be questioned as perhaps the result of historic research development rather than of physical actuality (Bregman, 1990; Schafer, 1994), but even so, it has reified a specific framework for spatial and the associated temporal experience, the limitation of which has already been noted and will be further clarified below. Aural perception is used to exemplify differences in perceptual structure and how representing (i.e., translating) this information into a visually oriented system results in loss of information and knowledge. This example is focused on the case study, originating from a worldview structured by flow and relationships. The implication for the notion of TIME, and what is considered tangible or intangible, will be discussed.

*Flow – its physical manifestation and its role as organizational principle in an epistemology*

Although it is beyond the scope and interest of this study to discuss the physics of waves in detail, a brief introduction is necessary to provide the context for several types of waves that are central to human sensory integration and perception of the surrounding world (as well as the function of remote sensing technologies) and how these can be studied as part of a dynamic flow process (other flows: epidemic flow, migration flow; (Tobler, 1993; Worboys et al., 1998)).
In physics, a wave can be defined as a disturbance or oscillation that travels through space-time, accompanied by the transfer of energy. In previous chapters, electromagnetic energy was introduced as the phenomenon on which the theory and practice of remote sensing and image processing is based, collecting reflectance values of Earth and canopy surface(s) for monitoring change (reflectance translated into numbers) in surface features. Visible light is part of this spectrum, the transfer of which allows us to see when it interacts with matter, for example, when it is absorbed, reflected or diffracted. A change in wave characteristics can be picked up by our sensorium (sense organs) or external instruments (Jensen, 1996).

The main distinguishing feature of EM energy is that it can travel through vacuum (although we “see things” because it interacts with matter in and on the Earth’s atmosphere and surface), whereas another type of waves, mechanical waves, needs a medium for wave propagation. Examples of those, relevant for this study, are acoustic waves, wind, and water waves (fluid dynamics). Waves can be expressed in terms of frequency and wavelength and share basic characteristics that will be discussed in more detail for their perceptual/ecological importance within the following sections (Pretor-Pinney et al., 2010).

In the literature, water and wind (currents) are recurrently mentioned as important/central in Indigenous life and thinking. Reiterating, Asher (Ascher, 1991) discusses the Navajo belief in a dynamic universe made up of processes, rather than consisting of objects and situations. Change in this paradigm is, as interrelationship and motion, of prime significance. Asher gives an example of the difference of the conceptualization of wind, a phenomenon that is not essential in western-based
descriptions of space, but in a Navajo worldview it is of central importance. It is around us and within us, and the source of animation of all that was created (Ascher, 1991, p. 132). Breath or breathing can then provide both the metaphor and physical process to model such a view of space, as is also expressed by Swentzell (in writing and visualization). Quoting Asher, as a cyclical view, “processes emanate from a center, spread out from the center, and return back along the same path” (Ascher, 1991, p. 130). (It is interesting to note that spiritus in Latin means 'breath'; the transformation of a physical quality to an immaterial concept in western thinking can be argued to perpetuate the mind-body dichotomy.)

Novel ideas that consider information as a component equal to matter and energy in physical sciences are not very different from using speech of ancestors as metaphor for listening to wind, that is, identifying specific sound objects for the information they provide in a specific knowledge system (epistemology) (Farina, 2006; John Peabody Harrington, 1916; Krause, 2012; Schafer, 1994). Murray Schafer particularly has made the argument regarding the importance of tuning in to the environment, the basis of the emerging science of soundscape ecology.

The critical interventions (CI’s) serve to explore the boundaries for a different, immersive epistemology through inclusion of the processes and phenomena of the land/geosphere in a multimodal framework, connecting the social semiotic approach with a biosemiotic one, indicated by the term “ecosemiotics,” introduced in Chapter 5 (Figure 29). Although what this term covers has been discussed in the literature for over a decade, ecosmiotics is still ill-defined and open for exploration
and refinement. The integration of a social semiotic approach within this framework serves to include human modes of perception and expression that are technologically based. Even though it is difficult to integrate dynamic environmental processes in archaeological studies, the Critical Interventions serve to show methods that can be employed to gain insight into such processes, which affect and inform human design and modes of representation.

![Figure 29 Semiotic ecology: different natures in the semiosphere. - image based on Kull Kalevi 1998. - (Kull, 1998)](image)

*When is a sign?*

A sign in traditional semiotics stands in for something else. Hence a sign and its referents or object, for example the sign 🍎 can be interpreted as ‘apple’ (non-arbitrary, icon), or, more likely, as a brand of computer (arbitrary, symbol), depending on cultural context (or for an apple, as an index of the availability of moisture during its growth). Whereas some signs have apparently universal appeal, others are ambiguous, can be interpreted for their denotative and connotative meaning, or only recognized and interpreted as intended by a small population.
A sign stands for something to the idea which it produces, or modifies. Or, it is a vehicle conveying into the mind something from without. That for which it stands is called its object; that which it conveys, its meaning; and the idea to which it gives rise, its interpretant. The object of representation can be nothing but a representation of which the first representation is the interpretant. But an endless series of representations, each representing the one behind it, may be conceived to have an absolute object at its limit." (A Fragment, CP 1.339, not dated; Peirce) (Bergman & Paavola, 2003)

In social semiotics, the sender of the sign is generally thought to play an active (though not necessarily conscious) role in the semiotic relationship (outlined by Kress, through mode and medium of representation), but integrated into bio- and ecosemiotics, signs can also be thought of as “indicators” (icon, index, proxy, symbol), on a continuum of intentionality and relatedness to the object. The role of the interpretant (as the idea to which it gives rise) thereby comes to the fore, as that which results from a process of interpretation (Kull, 2010).

Signs in the environment (and how their flow/transmission is structured) that are interpreted by humans (given meaning), vary in level of intent of the source (source/sender and intended receiver), and level of dynamics (static-dynamic continuum). For instance, “greenness” as a sign of vegetation health can be considered a dynamic sign (changing icon of vegetation health or indicator of moisture availability, for instance). Where non-organic (e.g., geophonic) signs can be considered unintentional (e.g., lightning, although can be metaphorized, i.e., become a symbol for a specific meaning), signs expressed by animals and humans are often considered as communicating a message intended for a specific receiver. From the total field of information (semiosphere —mediated by energy/matter), species
select the needed information (perceptual structure) in order to perform a specific function (Figure 30).

THE SEMIOSPHERE AND THE PERCEPTUAL RANGE OF ORGANISMS

The flow of energy carries information, vibrations, or signs that can be sensed and perceived by organisms. No organism can sense all signs, and perception of the signs used by any particular organism can be understood as encompassed in the organism’s Umwelt. A brief comparison of the range of frequencies that can be sensed by different organisms gives an idea of how different the world is experienced.

The sensing system of each organism consists of a number of different organs that will not all be covered by this diagram, and may not have an equivalent in the human sensorium. The standard organs used in studies of human perception are also debated, but will here be focused on visual and aural perception.

<table>
<thead>
<tr>
<th>Species</th>
<th>Range Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>human</td>
<td>64-23,000</td>
</tr>
<tr>
<td>dog</td>
<td>67-45,000</td>
</tr>
<tr>
<td>cow</td>
<td>23-35,000</td>
</tr>
<tr>
<td>bat</td>
<td>2,000-110,000</td>
</tr>
<tr>
<td>whale</td>
<td>1,000-123,000</td>
</tr>
<tr>
<td>elephant</td>
<td>16-12,000</td>
</tr>
</tbody>
</table>

Within the human population, diversity in perceptual acuity exists among individuals and cultures and what kind of sound objects are recognized (Murray Schafer, Levilatan)

* Humans detect certain parts of the EM spectrum as color, sensed with our eyes. Other parts of the spectrum are sensed with other parts of the body, heat for instance.

Figure 30 description of semiosphere and the implications of physiological and environmental (including cultural) differences on perception (EM image: (Wikimedia)
Perception as active process (according to affordance theory, we are not blank receivers) is the means through which this selection occurs. In addition to somatic means, humans also employ extrasomatic means, such as technologies and designed instruments, as modes to receive and represent information and concepts that can be integrated as part of an ecosemiotic approach and immersive epistemology (sensu Peirce). These extrasomatic means can be evaluated for the nature of the semiotic relationship (arbitrary–non-arbitrary continuum) and the level of intention, as well as the level of dependence on the environment (or context) in which they are expressed. For instance, an autobiography in book form can be considered non arbitrary, with a high level of intention but a low level of dependency on the environment, that is, it doesn’t need to be read in the same or a similar environment within which it was written. On the other hand, in a built environment in which architectural elements are configured in the natural environment to mediate and produce certain sounds or sound effects (e.g., a designed perceptual configuration to heighten or diminish intensity), the level of environmental dependency (symbiosis) is high and knowledge of sound waves/signal behavior is paramount. This allows us to consider different modes of perception and representation within a culturally constructed modal constellation and their epistemological affordances and underlying different principles of organization.

Building on the previous Intervention, the first CI starts with the importance of the location of the Pueblo, as the center of the conceptual and physical world and its
communicative relationship with the surrounding world through energy processes, resulting in different categories of design, where relationships are not geometrically imposed, but are considered more complex, based on ideas resulting from Interventions I and II.

The second CI explores what can be observed from these and other strategic locations within a larger sensing configuration, and specifically focuses on the ability to gain information on moisture availability through ontological alternatives as it is assumed that this knowledge is of key importance. It also builds on the findings of Interventions I and II.

The third CI is the most speculative; it draws on research that indicates the importance of the different senses and sensory integration in human perception of the environment and its spatial structure, specifically focused aural perception, as the ecological implications are supported in scientific literature. In other words, it explores perceptual cues other than the visual for understanding the world around us (Blesser & Salter, 2007; Larsson et al., 2001; Milekic, 2007; Ox & Elst, 2011), and can be encompassed within a multimodal ecosemiotic framework or ecofield hypothesis, distinguishing among sense organs (physiology); sensing configurations (perception and cognition); and sensing instruments (technological development and design).

8.1.1 Critical Intervention I: Shadows and Holes

*Different kinds of objects*
In previous publications, Galton outlined different kinds of objects that support a spatial ontology, different from an assumed universal ontology of natural kinds. The distinction between three different kinds of objects, natural, parasitic, and perspectival, and their perceptual grounding, can be explored in practice, employing a variety of geospatial systems and tools to show the effectiveness of flow as an organizational principle in landscape experience when different objects are perceived and conceptualized. This was discussed in Chapters two and five, and within this section, these differences are explored through practice-oriented exercises.

The previous section (Intervention II) focused on the position of the Pueblo within the landscape, but did not specifically address the building as a focal part of that exploration. Within this component, the integrative character of the building within the larger landscape, its matter, and its configuration are central. Architectural analyses in Southwest archaeological studies in general follow current architectural theories and employ applications that are based on assumed universal rules of spatial experience and expression, such as space syntax (Shapiro, 2005). Within such a view, architecture can be assessed for its aesthetic value and/or its social implication of space configuration, employing access and visibility measures for instance ((Hillier, 1996). Based on the idea that architectural design is a mode of expression, in line with an ecosemiotic approach of multimodality, within the parameters of a particular worldview, I suggest that Tewa architectural design needs to be understood using different principles.
Architecture is concerned with the design, arrangement, and manipulation of the physical properties of space, communicating worldview with a vocabulary of spatial elements (Blesser & Salter, 2007, p. 1; Brusasco, 2007; Kanekar, 2001). In modern architecture the focus is almost exclusively on visual aspects of a structure at the expense of other sense experiences (Pallasmaa, 2005). This tendency fits well with the use of other modes of expression in western science and culture, but may not be the most common for human spatial experience, and some archaeological studies have been conducted to explore other aspects of experience, such as archaeoacoustics, using sound mapping (Watson, 1999), and light, often important in defining space. An essay by Tanizaki (Tanizaki, 1977) focuses on the importance of shadows in experience of space.

This exploration is guided by statements concerning the role of the Pueblo from a physical and conceptual standpoint discussed in the previous study area chapter, as well as ontological differences that have become important in clarifying this position. The terminology for Pueblo components listed within the Tewa Ethnogeography refers to the integrative character of Pueblo architecture in the larger landscape and the ontological basis for these terms, expressing relationships, in this case cardinal position and sunlight, and provides an entry point to explore the role of spatial design within an immersive framework and practice. It is acknowledged that this represents a way, but not necessarily the only way, of representing ecological relationships within which cultural expressions form an integral part.
Assessment of visual aspects of architecture and its integration in the larger landscape is related to placement, configuration of architectural elements and changes in light (index 8 of Higuchi; visual range of electromagnetic spectrum). In this case, sunlight is attenuated by atmospheric elements, whereas waves from other parts of the EM spectrum and mechanical waves cause different, desirable effects that can be sensed, such as temperature, wind, and sound. These flows of energy, fluctuations in which can be sensed and observed/perceived, constitute an important source of knowledge of the environment, and in this way architecture can be thought of as mode and/or medium of environmental signs, in an experiential, immersive way of knowing. This Critical Intervention takes the terminology related to San Ildefonso Pueblo, recorded by Harrington as broad categories of shady side and sunny side, as a starting point for exploring the potential different metaphysical position of architectural material and configuration in a Pueblo worldview.

(See table 11)

8.1.1.1 Physics of Shadows and Holes –relationship as objects

Instead of thinking of architecture as an independent object and the spaces created within the boundaries of this object as open or empty space, the terminology of Pueblo components expressed as shadows suggests a different frame of reference. From a physical perspective the design and configuration of architectural elements has distinct implications for human experience that are not addressed in space syntax applications. Other modes of cultural representation and communication, such as dance, are interrelated to the configuration of architectural elements mediating the connection with the larger environment.
Knowledge of, and knowledge that can be gained from observing, atmospheric and climatological processes is suggested to underlie and/or support specific design choices in Pueblo architecture, in addition to those related to its habitation function as indicated by this terminology and descriptions given by Indigenous scholars (G. Cajete, 1999; Jojola, 2004; Ortiz, 1972a; Swentzell, 1990).

Systems of spatial information and representation currently used in academic spatial analysis enable the study and understanding of spatial change. The objects defined and analyzed in such systems contain attributes susceptible to spatial change, which we tend to categorize as discrete objects, but bare matter simply is the stuff of which the material/physical world is made, including atmospheric elements (western ontology of physical objects — Intervention I already made the distinction between raster and vector models to account for differences in boundaries). What constitutes an object has been and is widely discussed from a philosophical standpoint, whether “it reflects the inherent organization of the matter itself and to what extent it rather stems purely from the systematizing propensities of the human mind” (Galton, 2000, p. 104); see also (Casati & Varzi, 1999; B. Smith, 1996). Several examples, given by Galton, show the ambiguity of definition and categorization of objects, given the continuous state of flux of matter that constitutes those objects, some of which were already introduced. “A flow can [also] be characterized as an object, usually rather homogeneous and unstructured, whose constituent matter is being constantly and continuously replaced.” A cloud is an example of an object “which may occupy various positions on the continuum between pieces of matter and flow” (Galton, 2000, p. 109), discussed in a previous
section as a boundary within a western system, in contrast to the indigenous meaning. Shadows and Holes, explored as part of this Intervention, are examples of relations/flow as objects that are also indicated as parasitic objects in earlier work by Galton.

Shadows can be expressed as four-part relations: $x$ is a shadow cast by $y$ on a surface $z$ in the light coming from $w$. In the case of Pueblo architecture, $w$ is always the sun (energy-light source). Holes (including interstices), identified as three types, tunnel, pit, and cavity, can be said to be dependent on a host; however, a hole is not a vacuum as it consists of matter and has volume (Galton, 2000). Spaces created by architectural elements (in plan or volume, open or closed) are not “empty,” that is, they are not vacuums, the attenuate or amplify atmospheric elements with specific effects that can be perceived by human sense organs. Epistemologically, holes and shadows potentially have different roles within a Tewa worldview (and its ontological inventory) as prominent knowledge sources.

Figure 31 Shows a mapview and a 2.5D view of the study area. It shows the topography, visibility layer (viewshed) of Tsankawi. The specific sun path for Tsankawi is displayed. Within ArcGIS shadow patterns can be generated for a specific time. Even though these can be visualized in current 2D and 2.5D representational systems, the connection to other changes in the environment that are related are difficult, as are other atmospheric processes – such as mediated through holes and interstices
Figure 31 exploring solar cycles, light, visibility, and changing shadow patterns
8.1.1.2 Meaning (perception and philosophy) of Shadows and Holes

The discussion of the meaning of objects such as shadows and holes can be framed within an ecological approach to perception, as ecosemiotics. Shadows, for instance, “afford” the perception of change in cyclical aspects, daily and yearly cycles, dynamics that are important in structuring of cultural practices (Ortiz, 1972a, 1984), signaling (denoting) time and informing subsistence and ritual practice as rhythmic pulses (see Schafer, 1994). Shadows, however, often have a negative connotation in western thought, given how shadow is used as metaphor. Casati (Casati, 2004), in his treatise on the physicality of shadows and its history in thought, argues that shadows are in fact a valuable aid to knowledge, and that this negative connotation is undeserved. Without shadows, we would not be able to perceive depth and the shape of our environment, for instance. A striking example is the moon. Lit by the sun, it is perceived as illuminating (light emitting) object and only through the shadow cast by the Earth do we see it as a rock sphere (and can thereby understand their interrelationship). Also, texture gradient in land surface features are sensed through shadows.

Modern artificial light can render objects flat and insubstantial. In his essay on architecture entitled In Praise of Shadows, Tanizaki explains the Japanese sense of beauty and the central role of light and shadows in the creation of interior and exterior space. As a result of modern lighting, this experience of space has changed dramatically, even if other architectural elements remain the same. His essay highlights the importance of light in the sense of the aesthetics of spatial experience;
from a broader perspective, it describes the relationship of built space and its surrounding elements. Given the terminology of Pueblo configuration as recorded by Harrington, which is expressed partly in shadow terms, I suggest that a different conceptualization of space and time underpins architectural design than is common in western design and science. Elements of design are explored that can lead to insights into how architecture is integrated within the larger environment of a Tewa worldview, thereby considering shadows as indicators of natural rhythm, open corners as holes, interstices, and plazas as performance space, all facilitating/mediating ecological communication.

8.3.1.3 Exploring shadows – ontologically and physically –

time/cycle

Because the focus of digital representational systems is on (visual) space and the reification of certain spatial relationships, transient aspects are underrepresented or ignored, although a current interest in sustainable practices in architectural and landscape design have spurred development of procedures and tools to represent and/or analyze such aspects for software applications in design and environmental studies and management (for instance Ekotekt®, enhanced interoperability between GIS and CAD software).

Sunlight and sunpath can be modeled within currently available geospatial packages. Three-dimensional models of buildings can also be created within geospatial or architectural modeling software and can be integrated within a landscape setting for visual assessment, outward, for instance the effect of a highrise
on surrounding buildings and streets in an urban setting, and inward, the effect of light in different interior spaces. A interoperability increases between these different packages, it is possible to combine these efforts within a single application to observe changing lighting conditions as they are affected by the built environment. Considering the role of the Pueblo as inwardly and outwardly dynamic in its integration in the larger landscape, it is possible to explore how the architectural elements structure the landscape elements, as well as how these elements are affected by and mediate environmental processes, in order to generate new hypotheses regarding perceptual grounding of an immersive epistemology. For example, are specific perceptual abilities or physical qualities enhanced or stressed as part of an ecological paradigm? At present it is difficult to model the architecture within the broader environment needed for such and exploration, beyond visual assessment. (table 11)

8.1.1.4 Integrating architecture within the “ecofield”

Through exploration of the terminology of architectural elements recorded by Harrington, characteristics discussed by Indigenous scholars, and the explorations described above, I argue that the ontological position of built space reflects the relationship within what Farina indicates as the larger ecofield. According to the ecofield paradigm, “every function that a species activates needs a specific spatial configuration recognized by innate cognitive mechanism” (Farina, 2006, p. 32). In such a paradigm, a species’ habitat is the summation of the different ecofields, and
habitats are selected for the highest score in terms of each ecofield, with every species perceiving land mosaics differently (Farina, 2006, p. 35). Even though human cognition and design can be integrated within such a paradigm, precautions should be taken to not consider this an optimization theoretical approach, because the perceptual field is key and is ever-changing, that is, dynamic. Given the theoretical underpinning of my study, perception of the surroundings differs among human groups, suggesting that design/representation is affected in similar significant ways. The role of architecture in mediating perceptual cues in an immersive knowledge system is suggestive of the importance of the perceptual grounding through which these differences can emerge. It is expected that Pueblo architecture is based on design principles rooted in ecology, similar to those described by Pallasmaa (Pallasmaa, 2005, p. 41).

Architecture is essentially an extension of nature into the man-made realm, providing the ground for perception and the horizon of experiencing and understanding the world. It is not an isolated and self-sufficient artifact; it directs our attention and existential experience to wider horizons. Architecture also gives a conceptual and material structure to societal institutions, as well as to the conditions of daily life. It concretizes the cycle of the year, the course of the sun and the passing of hours of the day .... Every touching experience of architecture is multi-sensory

Taking this idea from Pallasmaa, architecture can also function as sense-enhancing configuration and medium, not only for observing shadows, but also for other energy and information flows.
Considering holes and shadows and the possible ontological position of those concepts within a Tewa worldview, the ecofield can encompass human design and design process, where material elements flow at different rates to constitute different perceptual and physical qualities. In this respect, the open corners in a pueblo can function as holes or gaps to facilitate energy flow as wind and sound, in addition to framing vistas, and it can be informative to consider wind patterns in relationship to architectural configuration within the larger topographic setting, where wind and sound can mediate either physical or metaphorical desired characteristics. Wind, often described as animating force in nonwestern societies (Ascher, 1991; Schafer, 1994), and sound effects may be more difficult to model, but the latter especially, have been investigated as part of recent archaeological studies, as mentioned above, for both their beneficial and their detrimental effects. Such efforts are a step toward development of perceptual analysis and recognizing the importance of different percepts (as ontology) and defining spatio-temporal frameworks for environmental health and sustainable practices. Also, it is a step toward recognizing different cultural (configured and integrated) modes of perception and representation for interpreting environmental signs and indices.

8.1.2 Critical Intervention II: Cyclical phenomena – monitoring moisture – water flow

In archaeological studies, understanding of climatological conditions is an important factor in contextualizing cultural material, even though criticism of such analyses as environmentally deterministic over the last decades have resulted in a shift of focus
to other factors of change, such as sociopolitical factors, as discussed in Chapter six.

Still, environmental fluctuations, for instance in moisture availability in the semi-arid climate of the Rio Grande region, require knowledge of these mosaics to devise carefully planned strategies and practices to mediate these conditions, and this knowledge presumably underpins spatial configuration (including but not limited to tangible places, e.g., architecture).

For this exploration I start from the premise that historically, knowledge of meteorological dynamics and their environmental effects was obtained through empirical/experiential multisensory observation and integration, even though methods for interpreting these observations as signs and indicators were different from current scientific practices. The working framework of immersive epistemology serves to contextualize the discussion of what kind of environmental processes and phenomena could have been observed and how synthesis rather than analysis would underpin cultural practices to mediate changing conditions.

*Retrodiciting past conditions*

Scientific methods used in studies for climate reconstruction in the Rio Grande region rely on a variety of sources and analytical techniques, notably dendro-climatology/chronology, packrat-midden studies, and channel erosion aggregation/degredation, as described briefly in Chapter six (C. D. Allen, 2004; Dean, 1988; Orcutt, 1991). These studies have provided insight into long-term and short-term climate patterns in the region, and how these may have affected carrying capacity for human occupation. Several limitations are inherent in these
applications: for instance 1) the fact that climatic conditions are extrapolated over large areas (homogeneously), and 2) these types of analyses do not necessarily consider how these conditions were culturally mitigated (on a day-to-day basis) and what (kind of) knowledge underpinned these mitigations (often assuming simple stimulus-response relationships). Recent innovative approaches address either one of these limitations, but not both simultaneously. Spatial variability of moisture is addressed through vegetation indices resulting from analysis of remotely sensed data for recent times (Weiss, Gutzler, Coonrod, & Dahm, 2004), and agent-based models have been employed to study human decision-making in the past (Gimblett, 2002; Jordan, 2007; Kohler & van der Leeuw, 2007).

This intervention proposes, first, an approach to gaining insight into past conditions, sensitive to spatial variability based on understanding of atmospheric processes and landscape dynamics of current conditions. Second, based on that proposal, I discuss how experiential knowledge serves to perceive these conditions from an on immersive position, that is, from presence in the land and through human sensing. Third, I will argue that even though technological advances in extrasomatic instruments to collect earth/atmospheric data have also resulted in innovative methods of interpreting that data, the epistemically unique knowledge resulting from experiential knowledge and its perceptual grounding (sign and indices) is not/can not be replaced/usurped by these methods.
8.1.2.1 Understanding water/moisture as spatio-temporal flow

1) How can we gain insight into past conditions?

If moisture conditions fluctuate only through time and behave more or less homogeneously across space, current analytic methods used in archaeological studies are appropriate for inferring past environmental conditions (numerically expressed and reduced) and modeling cultural strategies. The fact that predictive models are often unsuccessful can indicate that factors other than environmental changes are important, but also that strategies for mitigation of variable conditions are not considered.

Unlike localized climate records that are used to spatially extrapolate conditions over larger areas, as part of the study by Ni et al. (Ni et al., 2002) a 1000-year reconstruction of cool-season precipitation for each climate zone in Arizona and New Mexico was developed, based on a network of 19 tree-ring chronologies. In this study the authors compared two statistical techniques, in which the connecting method relies on cross-validation with more recent records, in this case instrument records from A.D. 1896 to 1930, for retrodicting past conditions. Even though this method provides insight into spatial variability between climate zones, the spatial resolution is not fine enough for addressing land management questions for past conditions. Cross-validation in this case indicates a method for interpreting tree-ring signals by comparing these records with partly temporally overlapping instrument records of precipitation and stream-flow gauge data that have finer spatio-temporal resolution. As discussed earlier, remotely sensed data are used to
monitor processes and change on, and affecting the Earth’s surface (Jensen, 1996). Innovative methods and analytical techniques have been developed to understand, monitor, and manage environmental conditions and changes at multiple scales. An example is the observation of melting glaciers, the full impact of which can now be understood because the scale at which it is being monitored is unprecedented.

Similarly, changing vegetation and associated moisture conditions can be monitored at spatio-temporal scales and resolutions not possible using more traditional, on-the-ground instrument records (rain- and streamflow gauges); cross-validation, however, provides a means to gain insight into conditions in the past.

A study conducted in the semi-arid environment in central New Mexico employed remotely sensed data and image analysis to construct a time-series of a normalized difference vegetation index (NDVI) (Weiss et al., 2004). This index represents a ratio of different bands, reflectance values in the EM spectrum that indicate moisture conditions of vegetation present. Each type of vegetation can be recognized by its spectral signature, that is, the unique composition of reflectance values in the different bands, its different moisture conditions over time or cyclically, can be monitored through “greenness” indices, notably NDVI, based on and analyzed using those reflectance values, and can potentially be used for cross-validating long-term but spatially coarse data records. Interpretation of these data, however, is still dependent on “groundtruthing,” spectral signatures (collected in the spectral library http://speclib.jpl.nasa.gov ; (Baldridge, Hook, Grove, & Rivera, 2009)) that are based on identification on the ground. It is this aspect that I will return to in the following
section to argue for the importance and unique contribution of experiential knowledge.

Result of these studies – potential insight into Rio Grande region

To briefly repeat the results of these studies which are discussed in Chapter six, variability in the moisture availability in the Rio Grande Basin is the result of teleconnection between several global climatological phenomena, primarily the El Niño Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO) particularly, and the North American monsoon and the interaction of those with local and regional topography. In short, for the 1000-year reconstruction based on cross-validation, Ni et al argue that with minor differences both statistical methods can be used to simulate precipitation, and that sudden reversals from dry to wet were not uncommon throughout the millennium. The instrumental records indicate that such reversals in the 20th century are associated with strong shifts from cold to warm ENSO events and from a negative to a positive PDO, suggesting that similar processes affected climate in the past.

The study conducted by Weiss et al. demonstrated the positive correspondence between variability in NDVI and precipitation, which indicates that these indices can be used to increase spatial resolution through cross-validation (Figure 32). In the future, these data can be used to provide insight into past conditions, such as spatial variability, that are relevant to understanding the landscape knowledge of Pueblo communities.
Figure 32 Potential for retrodicting spatial moisture distribution in the past, using remote sensing data and cross-referencing

The complexity of these relationships can result in highly variable (spatial and/or temporal) local conditions for sustaining subsistence practices. Periods of change therefore, are not limited to significant changes in archaeological material that mark period transitions in archaeological models, but are hypothesized to be continuous and observable through the many signs and indices.

8.1.2.2 The effects of hydrologic processes that can be sensed – ontological alternatives

2) In what ways did/do people gain knowledge of these processes from an on-the-ground perspective?
This section describes which aspects of the environment can be (or currently are) detected by the human sensorium, or by extrasomatic sensing instruments, to provide insight into moisture conditions. Starting from the results of innovative applications afforded by geospatial technologies, the changing perspectives serve as a guide to exploring differences in human perception of the environment. Instruments recording reflectance values as EM energy include those within the human visual range, but also those outside that range. These data, recorded as numerical values, can be analyzed in mathematical/statistical models and also visually represented as raster data surfaces to gain insights into changing conditions.

Within the Earth’s atmosphere, forms of energy, other than EM waves play a role in environmental processes that are interconnected with/dependent on EM energy, but not measured by remote-sensing instruments orbiting the Earth. Considering the semiosphere, visual signs do not make up the only sense information that underpins knowledge of the environment, but includes other signs that are the result of (movement of) other energy patterns, notably mechanical waves. (Cloud shadow) Atmospheric processes and air pressure changes, result in wind and cloud formation that, affected by the Earth’s surface topography, forms part of the hydrologic cycle. Cloud patterns can be visually observed from a position in the land, but wind in particular is not directly visually observable, though it can be felt, seen, and heard as it interacts with other features, as indices. Human sensing, through sensory integration, constitutes a complex system to perceive environmental change.
Alternative landscape ontology (as categories derived from sensing EM energy and remote sensing image/data analysis) can be thought of as providing a stepping-stone for broadening the idea of human spatial cognition. As these alternative categories are not limited to the view from above, they can also inform (human) perception (and ontology) from an immersive position. In other words, “greenness” can be observed from a position in the land, and the ontological foundation also can apply to other atmospheric processes in the vertical or multidimensional realm, for instance, defining object-processes in the cloud field.

Guiding questions can then be formulated to further explore spatial (but related to temporal) ontologies: What is culturally important to know? How can this knowledge be obtained from an immersive position? What sources are available? This effort can be framed by the indices developed by Higuchi and described in the previous chapter. For instance, different kinds of objects can be recognized as part of the different zones in the Tewa world, integrated in a larger whole of semiosis. (For example, color as indicating dryness-vegetation health (using Higuchi’s indices: Perhaps certain light conditions are more optimal for distinguishing color variations especially from large distances; but more importantly, atmospheric phenomena and changes can be observed and related to such changing conditions and patterns on the surface.)
8.1.2.3 The ontology of image processing and how we can “see” things differently

3) How does experiential knowledge still play a vital role in environmental knowledge that cannot be replaced by either reductionist approaches or innovative spatial technology applications? Ontological alternatives in the framework of flow.

What is important to know? How can it be sensed from an immersive position? And what sources are available?

The scientific approaches described in the previous section provide important environmental information for current management practices. In addition, they also

1) show how landscape features can be differently categorized, for example ‘greenness’; however, 2) they provide a land surface perspective primarily from above and on-the-ground perspective needs to be inferred. In contrast, in an immersive epistemology, the objective is the understanding of the relationships between the different elements and processes observed from a position in the land. Even though the areal view is limited, the spatial resolution and multidimensionality this position (or multiple positions in a sensing configuration) offers can result in unique knowledge, depending on the epistemological and ontological foundation and perceptual acuity of the observer/receiver, as a more fluid understanding of changing conditions.

In addition to observing different color and texture gradients of the land at different distances (J. G. Evans, 2003; Higuchi, 1983), the relationship to other, atmospheric processes can be understood through a) multiple senses and b) knowing from which
locations these can be best observed. Therefore, I argue that even though we currently use landscape categories such as “greenness” only as a result of novel image analyses, observation of these features and processes can also be part of an experiential approach to understanding landscape changes that affect subsistence practices. Furthermore, observing atmospheric processes and phenomena, such as cloud and wind patterns, closely relates to such changes on the land surface, and observing one can serve as proxy or indicator for the other from an immersive position. Moreover, where certain aspects are best observed with a broad areal view, other signs and indices may be observed at specific locations, such as subtle shifts in habitat boundaries, and intermittent streams, to understand the relationship between the objects and processes that can be related in stories. Knowledge of such locations that collectively provide information on changing conditions can be indicated by the term “sensing configurations.” Although the idea is speculative, I contend that by understanding the relationships between these phenomena and processes multidimensionally, experientially based knowledge of short-term and long-term patterns is possible. Therefore, a better understanding of how perceptual grounding can be based on multi-sensory integration can generate different models for addressing change in archaeological patterns.
8.1.3 Critical Intervention III: Transient objects –
multisensoral information and multimodal based
knowledge

Recent and current research indicates that information regarding environmental
health obtained within the visual realm is not necessarily congruent with
information gained in the auditory realm (Bhanoo, 2012; Krause, 2012). So that the
visualscape can indicate a healthy habitat while the soundscape indicates a
deteriorating state. These insights, although supported by few empirical studies,
provide a strong/further impetus for multimodal research relating to the problem of
relying too much on visual information in inferential knowledge, already discussed
earlier, and the case for experiential knowledge as prerequisite and support for
formal knowledge.

What we perceive is the result of movement of energy in waves. The different kinds
of waves are all interrelated within the Earth’s atmosphere to move matter, such
that air pressure changes, caused by solar energy, form the wind that moves ocean
waves, and so on (Pretor-Pinney et al., 2010). Understanding these processes and
knowledge of different ocean wave patterns allows the indigenous population of the
Marshall Islands, for instance, to navigate using both familiar routes and unfamiliar

Spatial analysis is increasingly considered synonymous with the primarily visually
oriented geographic information systems, but, as stated by Neuhoff (Neuhoff, 2004a,
p. 89), “by almost any measure, determining the spatial location and path of
movement of objects in the environment is a primary task of most perceptual systems. Thus, the auditory system as well as other sense organs, are involved in spatial experience, orientation, albeit differently than the visual system.”

In the previous Critical Interventions the importance of other sense experiences was already proposed, as part of the perceptual grounding of ontology associated with different organizing and design principles. In this section the starting point is a place name that is listed in Harrington as ‘wind-gap’ (John Peabody Harrington, 1916, p. 281). Visiting this place led to the suggestion that not all objects are visually grounded. From a western perspective this name is ontologically problematic, when gap is considered synonymous with hole (Casati & Varzi, 1999), and wind is elusive (Ascher, 1991; Casati, 2006; Galton & Mizoguchi, 2009; Krause, 2012).

The results of Critical Intervention I suggested that architectural configuration could also serve as medium (framing, linking) for other sensory information, as a mode of representation or sensing configuration. In addition to the built configuration, land surface and atmospheric characteristics also serve to mediate this information, for instance as “wind instruments” (see also (Schafer, 1994)). Together with cultural elements, such as architecture, this becomes an ecological mode of representation — ecological discourse. Critical Intervention II focused on ontological alternatives, opening up a way of thinking that considers physical processes as an important component of object recognition. Defining categories based on different, temporally variable features of the environment, perceptual structure can be thought of as more dynamic and able to integrate different perceptual sources within a single ontology.
The study of sound and sound perception of the environment has only recently gained momentum, even though some of the groundbreaking research in this field is several decades old (Bregman, 1990; Schafer, 1994). There are several reasons for this, most prominently related to doubts about the assumption of visual dominance in spatial thinking, but increasingly auditory (and other sensory) qualities of the environment are considered for their adverse effects, commonly expressed as noise pollution levels that negatively affect human wellbeing. This has, however, generated general interest in the importance of, or at least in the processes involved in, other perceptual sources for human spatial experience and environmental health. Perception can be studied as the interconnection of source and sensor, as transfer of information, and meaning-making (interpretation of sign).

In (this case visual and auditory) perception, wave processes are important to understand for what we can see or hear. Perceptual structure is different for different sense experiences, given the different source, medium, and sensor characteristics; how, can be understood from an ecological approach, but the terminology needs to be adjusted. Adopting terminology used in visual perception studies can be problematic in the same way described for multimodal studies (Forceville & Urios-Aparisi, 2009; Iedema, 2003; G. Kress, 2010; O’Halloran, 2008). Several studies in acoustic-related fields will be discussed below that demonstrate the importance of differences in perceptual grounding in ecological literacy, and highlight the limitation of current representational systems for understanding different underlying principles.
Brief overview of research:

A landmark study was conducted by Bregman (1990), who began the study of perceptual organization of sound during the late 1960s, and later published his work as *Auditory Scene Analysis*, focused on auditory stream segregation. In other words, he investigated how our perceptual system recognizes and classifies sound objects, and his work is considered a fundamental source for studies in aural perception. Another, major development in the study of sound was a project headed by Murray Schafer (1977); better known as the World Soundscape Project, this research group studied the multiple aspects of soundscapes, a concept formalized through this project. Motivated by the realization of noise pollution, the importance of acoustic design was brought to the fore and was the source for later development of studies of acoustic communication (Truax & Barrett, 2011) and acoustic ecology (Westerkamp, 2002).

Recent developments in landscape ecology and ecological psychoacoustics are indebted to these earlier developments that crossed scientific and creative practice. Even though studies of noise pollution are a major driver in development of methods and technology for the study of sound, these recent approaches in landscape ecology and psychoacoustics more and more focus on the beneficial aspects of the natural soundscape (environmental sounds) and how understanding of this information constitutes an important source for environmental knowledge and studies of habitat health. The niche hypothesis proposed by Krause, integrates music, a mode of cultural expression in ecology. Presented as a new area of research, soundscape ecology is “based on an understanding of how sound, from
Various sources—biological, geophysical, and anthropogenic—can be used to understand coupled natural-human dynamics across different spatial and temporal scales” (Krause, 2012; B. Pijanowski et al., 2011; B. C. Pijanowski et al., 2011). The methodology used for this field of research employs advanced audio field recording and spectral analysis of generated spectrograms. Software packages have become more available to process large datasets, and research efforts have been directed to automating species recognition in such datasets (spectral signatures). The implication of representing this information visually (as modal translation) is discussed below.

However, human-generated sounds (anthrophony) are set apart from other bio generated sounds, and often defined as disturbances of the natural environment; sounds are classified as anthrophony, biophony and geophony for non-organic natural sounds. Given the framework of immersive epistemology, my research assumes the position that humans are part of the larger semiosphere, incorporated within the biosphere, and that our technological means of communication loop within the larger multimodal communication sphere (thinking about the natural environment as pristine seems essentialist), (see Figure 22).

Within the multimodal semiotic framework, how our understanding of different sense information is epistemologically implicated through the representation and analyses of sound objects in visual frameworks is also addressed. Even though these ideas appear new and innovative, much of the groundwork was laid by the World Soundscape Project, including ethnographic/empirical studies of differences in recognition and perception of sounds. Drawing on research methods from what
have become separate strands of sound research,—acoustic analysis, psychoacoustics, and music—, he proposes a new interdiscipline: acoustic design. It is therefore the work of Murray Schafer that serves as a reference and calibration for these recent research developments. “From acoustics and psychoacoustics we learn about the physical properties of sound and the way sound in interpreted by the human brain. From society we learn how man behaves with sounds and how sounds affect and change his behavior. From the arts, particularly music, we learn how man creates ideal soundscapes for that other life, the life of the imagination and psychic reflection” (Schafer, 1994, p. 4).

Perceptual spatial structure – adding senses

Van Valkenburg and Kubovy (Van Valkenburg & Kubovy, 2004, p. 113) propose a theory of perceptual objecthood to address what they identify as a main, two-pronged problem in perceptual research: first, modality specific communities are divided theoretically, and second, theoretical communities are divided along modal lines. Their approach focuses on capturing perceptual commonalities between modalities for creating a modality-neutral theory and assessing its ecological validity. In doing so they build on previous approaches, Gestalt theory, computational models, and ecological perspectives. The latter is the least prominent in their emerging theory, which is more focused on how the human perceptual system classifies objects than on the different geo- and biospheric elements in the perceptual structure addressed in current soundscape ecology.
Spatial structure of other sense and perceptual sources is different, and at some point was considered not even spatially important (as space was expressed visually-geometrically). Based on the ecological approach to visual perception, Higuchi’s work provides a springboard for how, in this case, auditory perception is different. To do so, different components that are related to the spatial auditory structure need to be defined, because “detecting and recognizing a sound are the result of a complex interaction of physics, physiology, sensation, perception, and cognition” (Neuhoff, 2004c). Bridging diverse and diverging lines of research in sound, the volume entitled Ecological Psychoacoustics integrates these different components while integrating prior research, providing a background and starting point for this section to outline the perceptual grounding of ontological foundations.

Material and/or objects can be identified (and given meaning) visually by the reflectance value of light waves, or electromagnetic energy of different wavelength. Recording these values at different time intervals and under different environmental conditions results in unique spectral signatures of different materials or organisms—as was discussed earlier regarding visual perception. As stated by Neuhoff (Neuhoff, 2004a, p. 87), in the human visual perceptual system there is a relatively isomorphic correspondence between spatial positions and equivalent points on the retina, which also accounts for the relative ease with which we can study visual experience mathematically. Other, mechanical wave propagation patterns are often considered ephemeral or transient and difficult to understand, and their perceptual importance in western knowledge systems is considered marginal, even though certain places exhibit distinct perceptual patterns (Krause,
It is those kinds of nodes/configurations that are of interest in this section, references to which can be found in innovative studies across scientific disciplines, for instance, when changes in animal habitat are difficult to observe visually, but can be observed using sound patterns at specific locations (Bhanoo, 2012; Dunn & Crutchfield, 2009; Krause, 2012). Our ability to sense and perceive this information, however, is impeded by rising ambient noise levels, affecting natural sounds and rhythms in detrimental ways.

### 8.1.3.1 Atmospheric processes – affecting waves

*Physics of Sound*

In the previous section and earlier in this document, the physical characteristics that make it possible to gain environmental information through remote sensing technologies and image processing methods was discussed. The electromagnetic spectrum of energy carrying waves interacts with matter within the Earth’s atmosphere, resulting in different signatures that can be measured by these instruments and can be further analyzed through image processing. Sound is different; it depends on mechanical waves within the Earth’s atmosphere. “The propagation of sound waves in the atmosphere is largely determined by refraction, absorption and scattering depending on the actual state of the atmosphere. Refractions at the topography (vegetation, buildings, hills, etc.) cause further modifications. Since the topography again influences the atmosphere the complete system of atmosphere, topography and sound field has to be considered” (DLR). Sound waves are small pressure oscillations (sound pressure) in an elastic medium
(air, liquids, solid bodies). In the lower atmosphere sound waves propagate with a phase speed of approximately 340 m/s or 1220 km/h. The speed of sound depends on the temperature, the colder the air, the slower the speed, and vice versa. Sound cannot be inferred from land surface data alone; it is “animated” by atmospheric processes. In addition, sound as part of the semiosphere is more than sound perceived by the human ear. These aspects of sound are addressed in soundscape ecology.

Ecology of Sound

Even though perceptual research has focused predominantly on the visual, it has always been recognized in Gestalt research and ecological approaches that other sense information is important in human perception.

Sounds that originate in the environment, produced by physical processes and organisms, vary spatially and temporally, and the integration of all these sounds is what is indicated by the term "soundscape" within the field of soundscape ecology, a term that was formalized by Schafer (Schafer, 1994). Soundscapes (defined as such) reflect many ecological processes, and to analyze these processes from an acoustic perspective, different ways of recording natural soundscapes are employed.

However, the basic method for analysis is still to visualize the spectral information through spectrograms.

A spectrogram is a time-varying spectral representation (forming an image) that shows how the spectral density of a signal varies with time. The most common format is a graph with two geometric dimensions: the horizontal axis represents time, the vertical axis is frequency; a third dimension indicating the amplitude of a
particular frequency at a particular time is represented by the intensity or color of each point in the image (Wikipedia).

As already argued by Murray Schafer however, “all visual projection of sounds are arbitrary and fictitious”[italics in original][Schafer, 1994, p. 127], Indicating that acousticians are the best sightreaders, he states that many specialists in sonic studies have no proficiency with sound other than the visual (Figure 33) (Schafer, 1994, p. 128). This situation has not really changed since the 1970s, as the development of information systems since then has occurred mainly in the visual realm.

Until recently the focus in acoustic ecology was primarily at the individual species level, but the niche hypothesis set forth by Krause has drawn attention to the communicative aspect of soundscapes, understanding of which is an important factor in addressing habitat health. Based on his extensive experience of natural sound recording, Krause argues for a more symbiotic approach, as his analyses have shown that each creature “appears to have its own sonic niche in the frequency spectrum and/or time slot occupied by no other at that particular moment” (Krause, 1993). In this symphony of sounds, both Krause and Murray Schafer propose, lies the roots of music (mode of sonic representation). Empirical research conducted by the WSP and by Krause forms the foundation of the field of soundscape ecology, the conceptual framework of which consists of the following components: the human system; the built environment; the atmosphere; the natural environment; and interactions among these elements. This field of study investigates the human
impact on natural dynamics; for instance, how does an increase in the level of anthrophonic noise influence or change animal behavior and habitat? In addition to anthrophony, the terms biophony and geophony indicate biologically and geophysically generated sounds. Examples of the latter include land atmosphere dynamics such as thunder, rainfall, and wind. Considering the soundscape as an important variable in ecological models, as spatio-temporal differences understood as disturbance gradients, differences in richness and diversity have shown that sounds are crucial in communication, as indices of changing conditions, and that they are not always congruent with visual cues. This implies that sound is a unique source of perception, from which different meanings can be derived (Dunn & Crutchfield, 2009; B. C. Pijanowski et al., 2011; Schafer, 1994). This difference between auditory and visual also suggests that other sensoral information can provide unique information, not represented by visual signs, as part of a total semiopshere (sensu Kress). The ambient niche is important or even crucial in species’ health and wellbeing, and music as a representational mode intends the same. Even though, as discussed earlier, human physiology is the same across the human population, in terms of range, how we develop our sense acuity, and how we recognize sounds in percepts, varies across various dimensions (across and within cultures; see Murray Schafer for changing ideas of music performance, similar to how Higuchi discusses the changing perception of views/vistas in visual perception).
8.1.3.2 Expanding the perceptual spatial structure: seeing and hearing

Human Perception of Sound

The psychology of aural perception has been largely neglected in academic research compared to the attention given to visual perception. The way humans hear, listen to, and classify sounds in their environment varies widely, although whether the effects of certain sounds are beneficial or detrimental is valid across the human population. For instance, rhythmic sounds of nature, such as waves on the shore, are experienced as relaxing, whereas industrial sounds are shown to cause stressful responses in the human brain.

In the study of aural perception several attributes or variables of sound are important, comparable to light, brightness, contrast, color, and texture in visual perception. Pitch, amplitude, timbre, and envelope influence how organisms recognize sound objects. "Sounds may be classified in several ways: according to their physical characteristics (acoustics), or in the way they are perceived (psychoacoustics), according to their function and meaning (semiotics and semantics), or according to their emotional or affective qualities (aesthetics) (Schafer, 1994, p. 133). Although studying these characteristics separately has provided important insights (Bregman, 1990), the way humans recognize and give meaning to sounds is interrelated in our perceptual field.

The way the human sensorium identifies sounds from a field of acoustic stimuli has been studied in controlled laboratory settings, where for instance pitch, timbre, and spatial origin can be manipulated. Recognition of certain sounds as sound objects
constitutes a dynamic process of sense, percept, and conceptual frame (Van Valkenburg & Kubovy, 2004).

Furthermore, in controlled laboratory experiments, the source of the sound is known, as is its path, the way it reverberates through the lab space. Understanding the different configurations of acoustic and visual information in a landscape setting is more challenging, particularly for transient sources such as sound and olfactory cues. Drawing on theories of visual perception, notably auditory streaming and segregation (Bregman, 1990), Gestalt theory concepts of Figure and Ground have been used to better understand “objecthood” in studies of sound in an ecological approach (Gibson, 1979; Higuchi, 1983; Van Valkenburg & Kubovy, 2004). Van Valkenburg and Kubovy (2004) have outlined the accomplishments and challenges in sound research, notably the investigation of the normal variation in perceptual and cognitive abilities and strategies in the human population, and in their study mention that substantial questions that remain in the area of multimodal perception. This is specifically the realm of immersive learning and epistemology.

Perceptual spatial structure

As stated by Neuhoff (Neuhoff, 2004a, p. 87) the primary task of most perceptual systems is to determine the spatial location and path of movement of objects in the environment, and the ability to localize acoustic sources specific to the auditory system. It is generally accepted that the spatial resolution of the visual system is much better than that of the auditory system and that the temporal resolution of the auditory system exceeds that of the visual, and this may be due to different means of
coding spatial information (Neuhoff, 2004:88), although this simple distinction probably does not do justice to the complexity human sensing. According to Neuhoff, spatial position is calculated by the human auditory system using a number of different sources of information, including differences in the characteristics of a sound as it arrives at each ear, both spectral and temporal. As research on sound perception is conducted almost exclusively using stationary static sounds, and environmental approaches, as advocated by Neuhoff, have only recently attracted interest, considerable research remains to be done, even though these issues were already outlined by Schafer and earlier by Bregman. The approach proposed by Neuhoff distinguishes between stationary localization and motion perception. Studies of the former, focusing on the ability to localize sound, origin/source, direction, distance and elevation have been conducted since the 1930s. Studies of perception of sound in motion, within a natural environmental setting, generally follow one of two competing theoretical approaches. One is the so-called “snap-shot” theory, based on the idea that the human ear samples the auditory sources at different points in time and makes a comparison in order to detect motion. The other theory is based on direct perception of auditory motion, and this research has been advanced with the use of brain-imaging techniques (Neuhoff 2004:96). The use of echolocation, traditionally defined as determining the location of objects in the environment on the basis of sound produced by the listener, now often includes the use of ambient reflected sounds. In other words, the ability of the listener to interpret sounds based on his/her knowledge of the physics of sound, is part of the perceptual structure.
Research to bridge ecological and cognitive approaches in auditory perception is still in its infancy. Based on my discussion, which has drawn from many different strands of research in spatial perception and cognition, it is anticipated that diversity in auditory perception can be expected based on spatial cognitive differences. In fact, empirical studies have indicated that this is the case, in the recognition of natural sounds and human produced non-natural sounds, and also in the development of musical representation (Ashley, 2004; Hudson, 2006; Krause, 1993; Schafer, 1994)( Krause for instance mentions his fieldwork with aboriginal peoples, whom could interpret sounds as navigational aid, therefore ‘dead-reckoning’ identified by Levinson is may be based on a broad perceptual foundation of local/nearby and distant sources (Krause, 2012).

This research urges us (again) to consider a perceptual grounding of multimodal constellations, not just one based on visual objects, to understand differences in design and underlying principles of knowledge systems, a goal that is essential for cross-cultural communication and ecological understanding.

Similar to the case with visual perception, knowledge of auditory perception is mostly based on experimental studies in which little or nothing is said about the cultural background of the subjects participating in the study. The many different studies conducted as part of the World Soundscape Projects still are an important, or if not, the most elaborate resources to inform us about cultural differences and changing attitudes toward sound. Prominently mentioned are water and wind as natural rhythms and breath and walking as guiding frames of reference, aspects that
have also been associated with a different spatial structure and mathematical support than the Euclidean framework underpinning much of western research. (non-Euclidean and based on topological flow) Many aspects of acoustic studies initiated by the WSP have not been further developed, or are still unresolved, especially the in which way sound is recorded and represented. The methods designed to observe and classify sounds, in terms of pitch, tone, rhythm, and localizing their origin is still considered more an artistic skill than a component in ecological studies.

The importance of observing atmospheric phenomena and processes was already alluded to in the previous critical explorations and earlier chapters. Exactly how one does this becomes a question if visual perception and visual mode of representation are shown to be of limited use. Current ecological approaches are experimenting with how to record, represent, and analyze environmental sounds, whereas psychoacoustics is specifically focused on how sounds are perceived (by humans, predominantly), often in controlled environments for which research integrity can be assured. The problem of analysis of sound in the visual domain remains problematic. The analytical approach proposed and used by the WSP in becoming listeners, in other words to train perceptual acuity, has not been noticeably further developed within and academic setting.
8.1.4 Wind, Water, and Clouds, experiencing complex physical processes

Recording of environmental processes and change through time has been done by instrument measurements at least over the last century. Examples include placing temperature and stream gauges at specific locations and recording values at set times. The development of remote sensing technology has increased the resolution and dimensions at which data on the condition of the earth’s surface can be recorded. Even though these technologies provide a wealth of information, as already mentioned, the visual representation is not necessarily congruent with information gained through sound analysis. This raises new questions about how other kinds of information are perceived, processed, and represented in a multimodal framework: 1) how can human sensing function as an integrated knowledge system, providing resolution and dimensionality that cannot be achieved by (current) technologies, and 2) how do current technologies enhance or diminish part of this information?

To focus on wind (though this discussion is applicable to other transient information as well) several scholars have indicated the difficulty of recording wind (Krause, 2012; B. C. Pijanowski et al., 2011). The sounds generated by wind flow create a complex spatial pattern that is difficult to record with current microphones. The effect of wind can also be observed visually, as moving bio- and atmospheric matter. In scientific studies, wind is generally expressed as cardinal direction; the resolution of this pattern spatially is dependent on the number and distribution of
wind gauge instruments, but is also influenced at finer spatial resolutions by surface topography.

Wind influences sound wave propagation, just as other atmospheric conditions do. To understand these sounds as part of a spatial ontology in a multimodal framework, it can be expected that such sound objects can be expressed and communicated in multiple ways: as music, in which the semiotic relationship as percept and representation is close; as music notation; as natural language, in which cultural concepts become more dominant. Expressed as pitch and tone for instance, a sound description is based on attributes of sound, but when using an analog or metaphor, such as ancestral voice, it may be more easily understood and communicated for its ecological meaning, considering the land as (part of) the instrument.

Modes of perception, modal transcoding, and transmodal mapping

This overview of sound research and sound perception, however brief, shows the importance of perception beyond the visual sense. Instead of the visual sense and perception providing an index of all perceptual information, it is more likely the case that different perceptual information is partial but complementary in a larger whole and can even be significantly different from visual information. Within a knowledge structure, as diagrammed in Chapter seven, systems of representation used in human communication influence the way this information is integrated in ways of knowing. The argument by Kress, that a visual mode of representation cannot convey all meaning, therefore has serious implications for the way we understand the world if we are willing to ignore other sense and perceptual sources.
To transcode a percept, for instance a geophone or biophone, humans can use voice or a musical instrument to code similar frequency and amplitude. To code color we can use pigments or light to recreate the same hue and intensity in a visual medium. In the process of transmodal mapping we can perceive and/or record a sound and represent it in a different mode, for instance visually. Spectograms are an example of visualized sound, and such representations can be very helpful in, for instance, assessing the impact of human-produced sound (causing biophony subsidence). When colors are described in language, such as “red,” “blue,” this also is an example of transmodal mapping. Affordance and cultural ideas influence the way people categorize objects as part of their ontology, and are not necessarily restricted to linguistic use. The fact that certain percepts are not named in language does not therefore mean that these are not important ontological components, but that they may be expressed in a different mode. The dominant focus on language and vision in a western worldview and its epistemological implications, limiting the meaning that can be expressed, as argued by Kress and supported by others, delimits perceived affordances in specific ways.

To gain insight into the complexity of differences in modes of perception and representation that results in different ways the world can be known, the phenomenon known as synesthesia can be a starting point. Synesthesia “is a neurological condition in which stimulation of one sensory or cognitive pathway leads to automatic, involuntary experiences in a second sensory or cognitive pathway” (Cytowic & Eagleman, 2009). For instance, numbers are correlated with specific colors, but these correlations are not uniform. In other words, the number 3 may be “yellow” for one
person, but “green” for someone else (Bowen, Ramachandran, Muday, & Schirillo, 2011; Ramachandran & Hubbard, 2001).

Although not the same phenomenon, the notion of this effect can be used to understand the correlation between modes of perception and how focus in one mode may influence perception in another due to focus on specific features and attributes of that mode. I have argued that an approach of multimodality organized according to the principle of flow, that is, wave characteristics, as a source of sense and perception can be used to investigate epistemological differences between knowledge systems. The idea of an immersive epistemology in which human multi sense and perception is an essential component in ecology, derives from this argument.

8.2 Toward the integration of physical-conceptual frameworks

This research was designed to investigate whether epistemological differences, as purported to exist between western and indigenous knowledge systems, could be investigated using current systems of geographic information and representation, specifically focused on the spatial domain. To do so, required the identification of the nature of these differences. Based on converging research in spatial information theory, psycholinguistics, and Indigenous philosophy, several aspects were identified related to spatial ontology and spatial framework.

The methodological framework developed for this research, integrating social and biosemiotic approaches, served to explore these aspects in practice. These
explorations are not conclusive, but hint at different directions for research and ways of understanding differences in human experiences of their surroundings.

What is culturally important to know?

The classifications of land/atmosphere characteristics that are used in image processing applications show that different landscape categories can inform our understanding of changing environmental conditions. Similar to the perspective from remotely positioned instruments, an “on-the-ground” position can employ different means and classification schemes to obtain environmental information.

Extending this idea further, different ontologies, related to difference in language in culturally specific epistemologies, provide a means of perceiving the environment in multiple ways, within a non-Euclidean frame of space.

Intervention I, cognitive landscapes, provided some insight into the different conceptualization of landscape and land use, through “mapping” Tewa place names onto an image analytical data model. To understand moisture availability and changes in this resource at different time scales, observing vegetation health (color/texture) and memorizing patterns over time is essential, and also tracking animal movement and habitat. (Names and/or stories can serve as mnemonic devices for doing so). In addition, the understanding of changing cloud and wind patterns beyond the Earth’s surface processes, and the relationship of these patterns with Earth’s surface phenomena, would appear to be important information for sustaining subsistence practices.

Furthermore, the idea of distributed knowledge, within and between cultural groups was something that was suggested by this exploration and also shown
through other toponymic studies (Kari & Tuttle, 2005). In addition to spatially variable knowledge fields, other dimensions of knowledge distribution can be important but could not be tested with the available data, as such a study would require a better understanding of perceptual grounding of ontologies.

*How can the world be sensed from an immersive perspective? What sources are available?*

Starting from the philosophical underpinnings of remote sensing, what organisms sense and/or perceive and how meaningful “objects are detected and recognized is based on a complex interaction of physics, physiology, sensation, perception, and cognition” (Neuhoff, 2004c, p. 1). Signs that can be observed are the result of interrelationships between energy and matter, for example vision is dependent on EM waves, and auditory experiences are related to mechanical waves. If we accept current ideas that objects constituting an ontology are based on a dynamic of percept and concept, and, an object-process continuum (Galton & Mizoguchi, 2009; L. B. Smith & Heise, 1992), where an ontology containing objects recognized as “greenness” indicates a specific spatio-temporal frame of reference. Such a framework can then also include “clouds” according to the same meaning making principle, and are driven more by interrelated physical processes than static material manifestations. Sensory acuity is possibly differently developed (as perfect color sense, perfect pitch, etc.) for the different sensing organs for any given knowledge system. Through the vertical and oblique observation angle of immersive human presence, unique information can be obtained, depending on the ontology and framework used, where sensory integration can rely on visual, aural, olfactory,
haptic, and such less commonly mentioned senses as proprioception (sense of space). This integrative process of experiential learning is what sets human sensing apart from technologically derived information, but within an immersive framework these knowledge sources can be complementary.

Current systems of information and representation, however, are limited in the way different ontologies and frameworks of knowledge systems can be represented. This limitation was explained using an ecosemiotic approach of multimodality, by focusing on the diversity of perceptual grounding of ontology.

8.2.1 Toward intersubjectivity in a multimodal context

**Outcome – evaluating steps**

This thesis set out to investigate the claim that epistemological differences are at the root of the contentious relationship between American Indian and archaeological research communities regarding the interpretation of histories of the Pueblos in the American Southwest. The histories of the Rio Grande Pueblos served as the case study, employing a mixed methods approach. The different chapters are the product of that exploratory process which has led this research in directions not anticipated at the outset. As such, this thesis is part of a work in progress.

*Immersive position, immersive systems, toward intersubjectivity*

In western research we generally distinguish between two observer *perspectives*. A third-person perspective, or a detached-observer, is generally associated with
objective research, whereas a first-person observer perspective is mostly thought of as subjective. Phenomenological approaches are considered to be an example of the latter. In discussing experiential knowledge, where the dynamic between percepts and concepts is primary, the position of presence is associated. To rely on perspective only can be attributed to the development of science within a western, visually dominated framework. Given the perceptual structure for the different sensing sources, a position of immersive presence is a necessary and unique complement in ecology. The way we translate between different modes and modal representations in western scientific practice needs to be reassessed for its restricting framework, some of the limitations were outlined in this thesis, as well as a methodology to further this research.

The thesis assumption that was tested focused on the ability of current systems of representation used in western science practice to represent and analyze different ideas of space and time, ideas generally thought of as the subjective product of “The Other,” but argued here as being part of the breadth of human spatial cognition. From this the following argument was constructed; if these systems are not designed to, or do not allow different spatio-temporal structures to be integrated, the claim of epistemological differences is hard or impossible to ascertain within a western scientific framework.

Given the apparent circularity of this problem, the theoretical framework is composed from different disciplinary perspectives and insights in order to circumvent the issue. The methodology designed for this research, integrating emerging social and bio-semiotic methodologies, allows the evaluation of
knowledge systems from a physical landscape and a system perspective, bringing the perception and conceptualization of signs and indices within a single framework. Instead of thinking of technology as a substitute for human experience, the idea is that technology enhances human experience. In a way, this is similar to the notion of a percept and concept dynamic instead of concept replacing perceptual grounding.

The mixed method approach, combining qualitative and quantitative components, served to identify possible differences in space-time percepts and concepts for the case study that were preliminarily tested within the quantitative component. The important insight resulting from these explorations are related to potential differences in perceptual source in an ontology and the related spatio-temporal/topological structure within which such an ontology operates, including objects based on, for instance, sound and atmospheric processes and earth-atmosphere dynamics.

Immersive epistemology can be defined as a knowledge system in which sensory sources and perceptual information and integration comprise a prominent role. The historic development of systems of representation, however, has resulted in the assumption of visual dominance in human cognition. Through investigation of that history and evaluating recent cognitive research, that assumption can be successfully challenged. It is therefore argued that human sensory and perceptual systems as sources of environmental knowledge are underused and that epistemologies should integrate such information as part of education, as well as system development.
**DESIGN for future research**

Digital technologies have been heralded as tools and network opportunities that enable democratization processes at a global scale. Levy (LÈvy, 1997) refers to the digital network as the collective intelligence, an opportunity to increase our knowledge but also to promote and achieve freedom. In light of recent research on the effect of using digital technologies and social networks, his ideas and his prediction of an increase in intelligence as a result of these technologies may be premature. In addition, in earlier publications much has been written about the digital divide; even if digital technologies and networks provide opportunities, not all are necessarily positive (Agrawal, 2002). This has led me to think of tangible and intangible heritage differently, where intangible can often be replaced with transient.

Intersubjective spheres, based on the discussion in Chapter three, can be thought of as communication facilitators, whether this space is an actual or conceptual. If the concept of Umwelt or ecofield is considered as the subjective world an organism occupies, overlap in such worlds can act as points of departure in intersubjective communication and understanding. Given that, physiologically, all humans have similar or the same abilities for obtaining environmental information, different conceptual frameworks based on environmental information (or perceptual grounding) can potentially be understood across the human range. The problem identified within this research focused on the limitations of modes of perception and representation used to cover all meaning. I suggest that in order to
broaden our knowledge base, sources of knowledge should include different perceptual sources, such as sound, and smell, but also different visual aspects, components of human experience that are often associated with the arts. A better understanding of such knowledge as necessary for environmental knowledge was indicated by research into soundscape ecology.

The way to think about this may be to use learning of a new language as an analogous process. As has been argued by several scholars, some of the intricacies of a native language are hard to fully understand by non-native speakers, and the same may be true or assumed for other modes of expression and communication, albeit possibly in different gradations. Intercultural understanding should then be focused not just on natural language but equally on other modes of representation and communication, and the multidimensional relationship within and among cultures and modes (and intra and inter modal understanding) and immersive, and a different direction in the development of virtual, immersive systems can potentially facilitate such an outcome.
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