Landscape Categories in Yindjibarndi: Ontology, Environment, and Language

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Abstract.
This paper describes categories for landscape elements in the language of the Yindjibarndi people, a community of Indigenous Australians. Yindjibarndi terms for topographic features were obtained from dictionaries, and augmented and refined through discussions with local language experts in the Yindjibarndi community. In this paper, the Yindjibarndi terms for convex landforms and for water bodies are compared to English-language terms used to describe the Australian landscape, both in general terms and in the AUSLIG Gazetteer. The investigation found fundamental differences between the two conceptual systems at the basic level, supporting the notion that people from different places and cultures may use different categories for geographic features.
Keywords. Geographic categories, geographic ontology, landscape terms, natural language, cultural differences, Yindjibarndi, Indigenous Australians, spatial cognition, geographic information systems, GIS.

Introduction

Do all people, and all peoples, think about the landscapes and its elements in more or less the same way? Or are there significant cross-cultural and cross-linguistic differences in the ways human beings perceive and cognize their environments at geographic or landscape scales? These are important scientific questions, and also important challenges to designers of geographic information systems (GIS) and compilers of geographic databases and spatial data infrastructures. For the past several years, we and our colleagues have been approaching these questions from a variety of research perspectives, most recently the perspective of ontology.

In this paper, we attempt to gain perspective on such questions by examining landscape categories in Yindjibarndi[1], an Australian language spoken in the Pilbara

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[1] The name of this language and group has been spelled in various ways. Recently, local groups in the community have preferred "Indjibarndi". Von Brandenstein (1970) spelled the name as "Jindjiparndi", and Tindale (1974) used "Indjibandi". For conformance with current scholarly work on Aboriginal languages, In this paper we have spelled the language name as "Yindjibarndi", following the current spelling standard from AIATSIS, the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS, 1994).

region of northwestern Australia, approximately 1,600 km north of Perth. Yindjibarndi is a language that is very distant linguistically from English and other Indo-European languages, and is that spoken by people from an environment that is very different from northwestern Europe. Thus, if the comparison does not reveal significant differences, such a result would support the proposition that there are universal landscape concepts for the domains examined. Such universality can be regarded as the null hypothesis for the study.

Theoretical Background

Ontology

Ontology, in its long-established philosophical sense, seeks to identify the constituents of reality. In its more recent information systems sense, an ontology is "a logical theory which gives an explicit, partial account of a conceptualization" (Guarino and Giaretta, 1995, p. 32). The ontology stipulates the taxonomy that forms the basis of a data dictionary used in building an information system. At a relatively abstract level, ontology determines the kinds of entities that can exist—objects, fields, parts, solids, fluids, etc. Ontology also identifies observable properties or attributes, such as size, shape, or curvature. Another important aspect of the ontology of a domain is the categories to which entities can belong, and the relations among those categories. Recently, the geographic information science research community has devoted considerable attention to the ontology of the geospatial domain (Winter, 2001; Smith and Mark, 2001).

Categories

Categories are central to cognition (Rosch, 1973a, 1973b, 1978; Smith and Medin, 1981; Lakoff, 1987; Mark, 1993b). Some categories reflect groups of similar entities in the real world—natural kinds, if they exist, would be an example of this. Other categories exist by design—most artifacts belong to the categories that their manufacturers intended them to belong to. In contrast, there is more room for different people or groups to come up with different categorization schemes for natural inorganic domains—and geographic entities fall into this subdomain. For geographic entities, categories may in part reflect similarities and discontinuities in the landscape, but to some extent are projected onto the landscape by human cognition and language. This study explores the relative balance of such factors in the case of landforms and waterbodies.

Standards

Theoretical aspects of cognitive categories meet practical issues of geographic information systems and spatial databases in the area of standards (Mark, 1993a). Geospatial data exchange and data infrastructures depend on the use of standards for data formats. Semantics of spatial information often are expressed through some system of feature codes or entity types that indicate a real-world geographic category to which a feature on a map or in a database belongs. Feature codes also play a key role in gazetteers, which are important in digital map and image libraries. Government-endorsed feature categories also provide a baseline description of landscape categories according to the dominant culture in a society, against which category systems by other groups such as indigenous peoples may be compared.

Ontology of the Geographic Domain

As Smith and Mark (1998) noted, both geographic entities and their categories may differ in kind from entities and categories in other domains. Geographic entities are not simply large versions of their counterparts at smaller scales: "geographic objects are not merely located in space, but are tied intrinsically to space in a manner that implies that they inherit from space many of its structural (mereological, topological, geometrical) properties" (Smith and Mark, 1998, p. 592).

Smith and Mark (1998) speculated that categories of geographic entities might be organized differently than other categories studied by psychologists and cognitive scientists. However, subsequent empirical evidence appears to show that geographic categories have the same sorts of structures and internal organizations as do categories in other domains (Mark et al., 1999; Smith and Mark, 2001; Mark et al., 2001). In contrast, the distinctive nature of individual geographic entities, compared to entities in most other domains, remains apparent, especially in terms of their boundaries. For example, graded or transitional boundaries are common for geographic entities (Turk, 2000) but extremely rare in other domains. The existence of individual objects is a brute fact in the cases of organisms, fruits, or tools, but geographic entities such as mountains do not quite exist as objects to the same degree (Smith and Mark, 2003). Rather, most geographic entities are parts of the Earth's surface that are delimited from neighboring parts in a variety of ways, some of which may be contingent on the conceptual system of the delimiters. For example, believing that some region is a marsh may give it a different boundary than it would have if it were thought to be a lake. Such contingency provides more opportunity for cultural, linguistic, or individual differences in the delimitation of individual geographic entities. Even in the propensity to transform a continuous landscape into objects at all may vary across cultures.

A key issue then, is how do individual people, or the people in a speech community, divide the landscape into entities such as mountains or valleys? In addition, how are those entities categorized, and is there an interaction between the classification and delimitation processes? How important is the nature of the particular landscape that provides the environment for a speech community, and especially the range of forms in that landscape? How influential is the culture and lifestyle of the people, that is, the nature of human interaction with the landscape? How influential is the nature of the language itself, its grammar and lexicon?

Cross-linguistic comparisons might help tease apart these and other effects. In order to attempt this, we examined the terms for landscape entities in the Yindjibarndi language of northwestern Australia. We decided to study an Aboriginal Australian language because the Australian languages are only very distantly related to the Indo-European languages. We chose Yindjibarndi because one of us (AT) has worked with the Yindjibarndi-speaking community in Roebourne for several years, together with his collaborator, Dr. Kathryn Trees (Australian Indigenous Studies, Murdoch University) (Turk, 2000, 2002; Turk and Trees, 1998, 1999, 2000).

The Yindjibarndi People, Country, and Language

Before European colonization of Australia, the Yindjibarndi people lived mostly along the middle part of the valley of the Yarnda-Nyirra-na (Fortescue River) in northwestern Australia, and on adjacent uplands. To the south, their traditional country is bounded by the higher mountains of the Hammersley Range, occupied by the Banjima and Gurrama peoples, and to the north, their country ends approximately at the escarpment

leading down to the coastal plain occupied by Ngarluma speakers (Tindale, 1974). Yindjibarndi, Ngarluma and Gurrama belong to the Coastal Ngayarda language group, and Banjima isclassified among Inland Ngayarda languages; all of these languages are in the South-West group of Pama-Nyungan languages (SIL, 2001).

Figure 1: The **yinda** called "Jindawarrina", located at the place of the same name (Jindawarrina) also known as "Millstream".

There are no permanent or even seasonal rivers or creeks in Yindjibarndi country. Larger watercourses have running water in them only after major precipitation events, usually associated with cyclones (hurricanes). Between such major rain events, rivers continue to 'run', however, the water is underground, beneath the (usually sandy) surface. Permanent pools occur where the lie of the land and the geology cause the water table to break the surface of the ground. Permanent sources of water include permanent pools along the channels of the Yarnda-Nyirra-na (Fortescue) and other larger rivers, as well as some permanent small springs, and soaks where water can be obtained by digging. Unlike many areas of inland Australia, there are no significant intermittent or seasonal lakes in Yindjibarndi country. Local relief (elevation differences) within most of the traditional country of the Yindjibarndi is relatively low, with rolling hills and extensive flats.

As part of the European colonialization process, Yindjibarndi country was taken over by sheep and cattle stations (ranches) from the 1860s. The Yindjibarndi people were moved off their traditional territory into camps and settlements (Ieramugadu Group, 1995; Rijavec et al., 1995). Today, most of the Yindjibarndi speakers live in and around Roebourne, in what traditionally was Ngarluma country. Most of the

surviving Ngarluma people now speak Yindjibarndi and English in addition to their own language. The Roebourne community is mostly Indigenous and people use their own languages and English to differing degrees, depending on the context, sometimes with terms from both languages occurring in the same sentence.

Several linguists have studied the Yindjibarndi language. Von Brandenstein (1970, 1992) studied Yindjibarndi and Ngarluma and collected stories. Wordick (1982) also collected stories and produced both a grammar and a Yindjibarndi-English dictionary. Anderson revised Wordick's system of phonetic spelling for Yindjibarndi, and produced both Yindjibarndi-English and English-Yindjibarndi versions (Anderson, 1986). Anderson also coded the words according to topic. A digital version of Anderson's compilation is available from the Aboriginal Studies Electronic Data Archive (ASEDA) of the Australian Institute of Aboriginal and Torres Strait Islander Studies (Anderson and Thieberger, no date); this electronic source with thematic coding was extremely useful in this study. In this paper, we will sometimes refer to Anderson and Thieberger's reworking of the Wordick (1982) and Anderson (1986) dictionaries, and the 1992 word lists from von Brandenstein (1970) collectively as "the dictionaries".

Landscape Categories in Yindjibarndi

Research Methods

Before our November 2002 visit to Yindjibarndi country, we compiled lists of all geographic terms that we could find in the dictionaries. Anderson (1986) coded 55 terms as "geographical features". These included all but one or two of the Yindjibarndi landscape terms that we could find in the dictionary, plus several terms for geologic and earth materials. We then classified the geographic terms into semantic groups according to the usual meanings of their English equivalents, using groups such as water features, land forms, land cover types, etc., to assist in organizing fieldwork.

In November 2002, the authors visited the Roebourne area for a week. We met with local language experts Allery Sandy, Trevor Soloman, and Nita Fishhook, and also toured the area to take photographs of landform examples. During these meetings, we asked our Yindjibarndi collaborators whether they agreed with the meanings of Yindjibarndi words given in the dictionaries that appeared to refer to kinds of geographical features. We also asked them to suggest additional words for kinds of features in the landscape. The elicitation aspects of these meetings were assisted by the use of color prints of photographs of parts of Yindjibarndi country and neighboring areas taken (by AT) on previous fieldtrips. At least initially, the discussion was structured in terms of particular superordinate classes of feature (e.g. water features; hills), and we asked questions seeking to clarify issues identified from analysis of the dictionaries. We also asked about entity types in English for which the dictionaries did not include Yindjibarndi equivalents, such as "island" or "waterfall". Terms were both written on a whiteboard and discussed verbally, and most of the sessions were recorded on digital audio tape. One of us (AT) returned to Roebourne for a week in late January 2003 and had further consultations with Trevor Soloman and with Marion Cheedy, using word lists and color photographic images from the November 2002 fieldtrip. This assisted in clarifying the meanings of some of the terms and established arrangements for more detailed and extensive assistance from Yindjibarndi elders, to be conducted during the first half of 2003. Both authors spent another week in Roebourne in May 2003, taking more photographs and measurements and discussing terms with Marion Cheedy, Jane Cheedy, and Trevor Soloman.

Spelling is somewhat of an issue in this research, since the Yindjibarndi had no written language before European contact, and since some of the phonemes used in Yindjibarndi are not used in English. In this paper, we have used Anderson's spelling for any word that he included in his dictionary, although these sometimes disagreed with the preferred spelling according to our Yindjibarndi colleagues. Inadequacies of the process of compilation of the dictionaries, differing linguistic approaches used, variation in usage of terms over space and time, and the influence of English, all make it impossible to be completely definitive regarding either the exact meaning or the most appropriate spelling for Yindjibarndi words. Our intention is not to make judgments regarding proper spelling, but merely to try to obtain an understanding of the Yindjibarndi landscape terms sufficient for the research project. Compilations of terms and photographs resulting from the research project will be provided to the community to assist our collaborators with teaching of Yindjibarndi language in schools, and at that time the standards for phonetic spelling must be re-visited.

Yindjibarndi Categories for Water in the Landscape

The Yindjibarndi language has several terms that refer to water bodies or watercourses. In Table 1, we compare these terms to the relevant set of water terms and categories from the Australian Gazetteer standard (AUSLIG, 2002).

Figure 2: Part of the **yinda** called "Nangarnyungu" by the Yindjibarndi people, which is referred to in English as "Deepreach Pool". The pool is located at Jindawarrina .

One of the most important Yindjibarndi landscape concepts is **yinda**, a permanent pool. A **yinda** may be either large or small, but a body of water must be permanent to be a **yinda**. As noted above, in Yindjibarndi country, all rivers are dry at the surface almost all the time—thus the small number of **yinda** along the river beds take on great ecological and cultural significance. Every **yinda** has its own proper name. Most **yinda** are in the beds of the major rivers in Yindjibarndi country. Yindjibarndi believe that the river channels were formed "when the world was soft" by the river spirit (**warlu**) and that the **warlu** currently occupies and protects the **yinda**

(Ieramugadu Group Inc., 1995; Rijavec et al., 1995). Hence, proper behavior at a **yinda** incorporates respect for the **warlu**. Our collaborators said that during extended dry periods, a **yinda** may be reduced to a small pool, termed a **thula**. Anderson spells it *thurla* and says it means, among other things, "eye". Hence, a **thula** may be thought of as the eye of the **warlu**. Intermittent or temporary pools are not given a water body term at all, but are simply referred to by the general term for water as a substance, **bawa**.

Figure 3: A **wundu**, referred to in English as "Dawson Creek", in Yindjibarndi country north of Jindawarrina.

Yindjibarndi has two terms that appear to refer to fluvial channels. **Wundu** is usually translated as "river", and refers to riverbed and channels. All the examples of **wundu** that we confirmed through photographs were broad, low-gradient channels at least several meters wide. Anderson (1986) states that **wundu** can also mean "gorge". The other term for channels was **garga**, which seems roughly equivalent to "gully" in English; it appears to refer both to the concave topographic feature and to the channel in it.

Yindjibarndi also has two words for water flow in nature. **Manggurdu** is the term for flood, or for other strong, deep water flow. **Yijirdi** is the Yindjibarndi word for a shallow, narrow flow or trickle of water. It appears that, unlike in English, the Yindjibandi treat the water flow and the channel as *different things*. If this is confirmed by further research, it would be a sharp difference from the conceptualization of watercourses in English.

In English and most other European languages water features are first divided into standing or flowing ones, and then the standing water bodies are divided into larger ones (such as lakes) and smaller ones (such as ponds and pools). Additional terms in English refer to water bodies with distinct origins, such as lagoons. Mark (1993b) discussed minor differences in water body categorization between French and English, as an example of the linguistic phenomenon that is the focus of this paper—French appears to distinguish *étangs* from *lacs* based on water quality and a lack of a surface outlet, rather than giving priority to the size difference that usually separates ponds

from lakes in English. In contrast, the Yindjibarndi appear to give primary empasis to permanence, a factor which is not encoded in the basic level water categories of English. Clearly, the conceptual organization of water body terms in Yindjibarndi contrasts sharply with the organization of terms and concepts in English.

Figure 4: This flowing water near Jindawarrina would probably be referred to in Yindjibarndi by the term **yijirdi**.

Figure 5: Another **yijirdi** (small stream) flowing into a **yinda** (permanent pool) at the place known in English as "Fortescue Falls" in Karijini National Park, which is in Banjima country.

Table 1: Comparison of Water Terms and Categories

AUSLIG category	Language	Terms
LAKE	English:	lake, tarn, loch, lough
	Yindjibarndi:	(some **yinda** are large enough to be considered to be lakes in English)
SOAK	English:	native well, soak, soakage
	Yindjibarndi:	**yurrama**
SPRG	English:	spring, pool spring, hotsprings, mineral spring
	Yindjibarndi:	**jinbi** (permanent spring)
STRM	English:	stream, brook, watercourse, anabranch, backwash, backwater, run, creek, river, gully, rivulet, beck, backwater, burn
	Yindjibarndi:	**Wundu** (riverbed), **yijirdi** (small stream of water), **garga** (gully)
WRFL	English:	waterfall, cascade, cataract, falls, rapids
	Yindjibarndi:	(no Yindjibarndi term for waterfall, however **yijirdi** is used for a small running stream of water over rocks)
WTRH	English:	waterhole, lagoon, hole, pool, washpool, billabong, oxbow
	Yindjibarndi:	**yinda**

Yindjibarndi Categories for Hills

Marnda is the common Yindjibarndi term for most hills and mountains. Even though most **marnda** would be called hills in English, Wordick and Anderson do not list "hill" as a possible translation of **marnda**, which according to those authors translates to "rock, mountain, metal, hard material, money" (Anderson, 1986). The word **marnda** was very familiar to our collaborators. There are several other Yindjibarndi terms for small hills or mounds, but **marnda** appears to include most things that would be called hills in English, as well as mountains or mountain ranges such as the Hammersley Range (at the Southern end of Yindjibarndi country). **Marnda** is also used for ridges. **Marnda** has other meanings—rock, metal, any hard material, and money (coins). **Marnda** is almost certainly a basic level term, and is one of the most common geographic terms in Yindjibarndi.

Figure 6: The tablelands between the northern edge of Yindjibarndi country and the Yarnda-Nyirra-na (Fortescue River) have scattered **marnda**, of which this is one of the larger ones near the road to Jindawarrina.

Figure 7: This small feature in the Jindawarrina area, with a top about 2 meters above its base, would almost certainly be a **bargu** in Yindjibarndi.

Although many features that would be hills to an English speaker would be **marnda** in Yindjibarndi, there are at least three other terms in Yindjibarndi that refer to smaller hills or mounds. A **bargu** is a small hill or a sand hill—the key distinction between a **bargu** and a **marnda** appears to be size, rather than shape, steepness of slope, or material. A **burbaa** is a steep slope along a road, the sort of thing that is referred to as a "hill" in English. But **burbaa** also can refer to a mound, a small sandy hill, an incline, a slope on the side of any hill, or a vegetated sand ridge. Yet another term for a convex topographic feature is **bantha,** a mound or pile, banks, or a hump. At one point our collaborators suggested that a typical **bantha** is very

small (e.g., a mound of earth covering a grave), but later it seemed that the main thing that distinguishes a **bantha** from a **bargu** or **marnda** is artificiality.

Again, we compared these terms to the convex topographic terms and categories from the Australian Gazetteer standard (Table 2).

Table 2: Comparison of Terms for Convex Topographic Features

AUSLIG category	Language	Terms
HILL	English:	Hill, Knoll, Knob, Mesa, Sugarloaf, Lookout, Butte, Hillock, Kopje
	Yindjibarndi:	**marnda, bargu, burbaa**
MT	English:	Mountain, Peak
	Yindjibarndi:	**marnda**
PEAK	English:	Mountain Peak, Summit, Point (inland), Rock Column, Butte
	Yindjibarndi:	**marnda, gankala (*)**
RDGE	English:	Ridge, Saddle, Spur
	Yindjibarndi:	**marnda**
RNGE	English:	Range, Mountain Range, Hills, Mountains, Rock, Boulder, Pinnacle, Crag, Needle, Pillar,
	Yindjibarndi:	**marnda**
ROCK	English:	Rock Formation, Tor, Rocks (on land), Rocks (offshore)
	Yindjibarndi:	**marnda, jurrun** (D*), **thalungarn** (F*)
(Other)	Yindjibarndi:	**bantha**
	English:	pile, mound

(* = term not discussed in this paper; D = term only from dictionary, not recognized by our Yindjibarndi colleagues; F = term only from our fieldwork, not in the dictionaries)

Note that **marnda** appears under six of the seven English terms. A single basic-level term in Yindjibarndi appears to cover a range of topographic convexities described by several terms in English: mountain, hill, ridge, range, and others, while the meaning of the basic-level term "hill" in English is expressed by several terms in Yindjibarndi. For convex topographic features, it appears that the relation between Yindjibarndi terms and English terms is many-to-many. Thus, one would need reference to the exact form of the real-world referent in order to translate these terms correctly. This

closely parallels the situation for the water body terms *pond* in English and *étang* in French (Mark, 1993b).

Discussion

In one sense, the conceptual systems for water features and for convex topographic features in English and in Yindjibarndi are very similar. The meanings of the Yindjibarndi terms for such features can easily be expressed in English, and we had no problem communicating in English with our bilingual Yindjibarndi colleagues regarding the meanings of Yindjibarndi landscape terms. Of course, it is possible that there are subtleties of Yindjibarndi landscape concepts that cannot be expressed in English. On the other hand, at the basic level of category terms, the Yindjibarndi landscape vocabulary is completely different from the terms covering the equivalent domain in English. None of the Yindjibarndi terms discussed in this paper is exactly equivalent to one single term in English. Yindjibarndi terms divide up subdomains of geographic reality quite differently than do English terms. For example, permanent and temporary water features that otherwise are similar are considered to be different kinds of features in Yindjibarndi; English, in contrast, treats permanence of water bodies and water courses as only an attribute or property, and expresses it through adjectives such as "temporary", "seasonal", "intermittent", or "ephemeral". In addition, there are several kinds of small hills in Yindjibarndi, but this is not simply a refinement of terminology for convex terrain features, since, from the Yindjibarndi perspective, there are several kinds of **marnda** in English--the basic level terms simply do not match.

Indeed, this is exactly what we should have expected. The basic level categories in a language *must* be tuned to the variations in the particular environment in which a speech community lives, and to the ways in which that environment affords various activities essential to life, if it is to provide the common terms needed in every-day speech. The popular myth of the large number of Eskimo words for snow (Pullum, 1991) appears to be an exaggeration of a real tendency of environmental variation to influence vocabulary. The basic-level category system for environmental features *should* vary across environments. Of course, such a relation between categories and environment would not be deterministic, but would be probabilistic. Also, different cultures occupying the same landscape could have developed different concepts because of differences in lifestyle. For example, Indigenous Australians in their traditional lifestyle did not have the technology to store large quantities of water, and thus it is not surprising that permanent sources of water take on a vital significance.

Some Significant Issues for Further Research

There are many unresolved matters regarding the true nature of the Yindjibarndi landscape ontology (as revealed through their language), which require further research. Some of the more significant are as follows:

1. The Role of Compound Words and Phrases

A language might have a large number of words to refer to different kinds of geographic entities. Alternatively, speakers of a language might use a small number of general terms, and combine them with adjectives describing attributes, forming either phrases or compound words. However, in a language without a written tradition, the difference between a compound noun and a noun phrase is not always obvious. For hills of different size, it appears that in Yindjibarndi different terms are often used (**marnda; bargu**), however, at times our collaborators used the expression "**gubija**

marnda" to mean a small hill. There does not seem to be a simple term for a flat-topped hill (mesa, butte) with the compound word **marndamarlirri** (literally: hill + flattened) used. Similarly, a type of hill in Yindjibarndi country and adjacent areas has a surface composed of slabs of loose iron-rich rock, which weathers to a very dark brown color. These are called **marndawarrura** (literally: hill + black, brown, dark). A similar, though somewhat different, etymology applies to the term for "mountain country" - **marndamirdayi** (mountain + place of, place where the … is). Cognitive linguists often assume that the encoding of some concepts in monolexemic words, rather than as noun phrases, indicates that those concepts have in some sense a deeper importance to the speakers of the language in question. According to Berlin and Kay's classic work on color terms (Berlin and Kay, 1969), one characteristic of terms for basic level concepts is that they are monolexemic, and Wierzbicka (1996) also promotes this criterion, calling it "Morphological Structure" (Wierzbicka, 1996, p. 356). It would be very interesting to understand more clearly why some kinds of geographic features are denoted by monolexemic terms and why others are dealt with by compound words and phrases, and to try to establish whether this reflects some underlying cognitive salience or environmental importance, whether it is largely linguistic or historical effect, or whether it is due to chance.

2. The Role of Proper Names

During discussions with our Yindjibarndi collaborators, they frequently mentioned that significant geographic features are usually referred to by their individual (proper) names, rather than by generic terms. For instance, one of the authors (AT) was present (during an earlier fieldtrip) when a Ngarluma elder listed in order the first twenty **yinda** (permanent pools) that one would encounter when traveling inland from Roebourne along the Ngurin (Harding River). Knowing the names for pools, mountains, etc is an important part of Indigenous Australian culture, often passed on by 'singing' lists of names. In these cultures, one is expected to know the limits of one's own country and the cultural significance of places, and be able to demonstrate this by knowing the proper names of its features (Ieramugadu Group Inc., 1995). Malpass (1999, p. 3) notes that this is a key component of relationship to the land for Indigenous Australians: "So important is this tie of person to place that for Aboriginal peoples the land around them everywhere is filled with marks of individual and ancestral origins and is dense with story and myth".

The authors have not yet been able to establish the full extent of use of proper names for geographic features for Yindjibarndi, although it is clearly extensive. One of our collaborators said that all permanent features (of significant size) in the landscape had names - rivers and creeks, pools, hills, rocky outcrops, flat areas, etc - but that many of the names were not recorded and may now be lost. More fieldwork is needed before the way that this influences the form of geographic terms could be reasonably inferred.

3. Object vs. Field Conceptualizations of Landscape

Western conceptualizations of space, and the categories and data structures of GIS which arise from them, tend to treat geographic features in the landscape as objects. However, there is at least anecdotal evidence that Indigenous Australians (including the Yindjibarndi) tend to view landscape more as a continuous field. Parallel ideas have been suggested by Atran and Medin (1997), who claimed that "Westerners make much more use of categories for purposes of inductive inference than do members of other

societies," and that members of other cultures are "more likely to organize on the basis of relationships and similarities". We have not yet been able to design and implement an experimental method to adequately explore this issue with respect to Yindjibarndi landscape categories. However, if the anecdotal evidence noted above is well founded, it would be of considerable significance to the design and usability of GIS.

4. The Role of Spirituality

For Indigenous Australians, including the Yindjibarndi people, spirituality and topography are inseparable (e.g. all **yinda** have **warlu**) (Ieramugadu Group Inc., 1995; Rijavec and Harrison, 1992; Turnbull, 1989). The significance of this issue for agency is highlighted by Malpass (1999, p. 95): "Understanding an agent, understanding oneself, as engaged in some activity is a matter both of understanding the agent as standing in certain causal and spatial relations to objects and of grasping the agent as having certain attributes - notably certain relevant beliefs and desires - about the objects concerned". Hence, in order to fully comprehend Yindjibarndi geographic concepts, it is necessary to adopt a method of inquiry that allows this possibility. Treating the spiritual as real is in conflict with prevailing Western philosophical assumptions underlying ontological investigation. Hence, a way of resolving this conflict needs to be found, especially, if the objective is to provide information systems suited to specific users (Remenyi et al, 1997; Wilson, 1998). A pluralist approach to knowledge systems would seem necessary (Watson-Verran and Turnbull, 1995). Robin Horton's efforts to reconcile African traditional thought with Western science may provide a viable approach for integrating spirituality into a comprehensive ontology of landscapes for information system design, as may Searle's (1995) ideas for characterizing the nature of social reality within a realist ontological framework. We plan to conduct further research that could lead to an integration of cross-cultural belief systems into geographic ontology and geographic information systems.

5. Ethnophysiography?

The research reported here appears to open a new research topic, which might best be called *ethnophysiography*. The Oxford English Dictionary gives one meaning of physiography as "physical geography", which captures the domain we are studying very well. We also came to realize during the research that the methods employed in this study parallel the methods used in ethnosciences such as ethnobiology (Berlin, 1992; Medin and Atran, 1999). Considering the importance of landscape to culture, it would be surprising if ethnographic methods have not been used to study common-sense categories for landscape elements, yet we have been unable to find examples of such work.

Conclusions

The results of this study support the hypothesis that people from different places and cultures use different conceptual categories for geographic features. Hence, if GIS are to be most effective, their design needs to take account of such matters. These research findings have practical implications. For instance, if the current Ngarluma-Yindjibarndi native title land claim is at least partially successful, it may well lead to joint management arrangements between the Yindjibarndi people and the State Government for large national parks in their country (Turk, 1996; Walsh and

Mitchell, 2002). If a GIS were to be used to support this management, it would probably be based on the digital version of the relevant 1:100,000 maps, which incorporate the sorts of ontological assumptions and feature codes (AUSLIG, 2002) discussed above. The results of this study indicate that such an approach might not reflect Yindjibarndi landscape concepts, and hence a more complex inter-cultural approach would need to be adopted. To do otherwise would amount to ontological imperialism, and perhaps ontological assimilation.

This paper reports only some of the initial findings of an ongoing research project. As indicated above, much more research is needed before it is possible to arrive at a reasonably comprehensive understanding of the way geographic categories are expressed in the Yindjibarndi language.

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