Geospatial Natural Language in Indigenous Australia: Research Priorities

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Abstract

Australian languages are widely believed to exemplify abstract spatial conceptual systems, manifest as cardinal terms. In fact, Australian languages typically make heavy use of terms invoking local environmental features. We report on research investigating correlations between linguistic spatial systems and topography, and the role of socio-cultural factors in individual variation in spatial referential strategy choices.

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1 Claimed wider significance of Australian languages

Australian Indigenous languages loom large in the theoretical literature on spatial language and cognition as exemplifying languages in which absolute abstract cardinals such as east and south dominate, and egocentric concepts such as left and right are largely absent [22, 336] [26, 112]. A number of influential assumptions are widespread about space in Australian languages. Key among these are that absolute Frame of Reference (FoR) dominates, and that relative (i.e. egocentric) FoR is highly marginal. The preference for absolute FoR carries through to the extent that even intrinsic (object-centred) FoR is often marginal. "As is well known, Australian languages typically make use of absolute, rather than relative [FoR]" [31, 148] (see also e.g. Dasen & Mishra [8, 301-302]). Moreover, within absolute FoR, abstract cardinals are assumed to be the norm in Australian languages, rather than geocentric concepts invoking aspects of the environment. "[T]here is typically a closed class of spatial nominals, which includes four cardinal direction terms..." [22, 75] (see also e.g. Meakins & Algy [32, 480] 2016:480). Non-cardinal absolute systems are rare and confined

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to riverine terms: “most of the Australian languages make essential use of such [cardinal] systems with the exception of those in the Daly River area, where ‘upriver’, ‘downriver’ notions may take their place" [22, 336], although these are attested in other areas of Australia (see Schultze-Berndt [44, 103]).

This posited dominance of absolute FoR in Australia is reflected in Majid et al.’s [26] survey of 20 languages from across the globe. Four languages in their sample are Australian: of these, three are described as completely lacking relative FoR (Arrernte, Guugu Yimithirr, Warrwa). Guugu Yimithirr also completely lacks intrinsic FoR (the only language in Majid et al.’s sample to do so, and one of the few languages reported to lack it). The fourth Australian language in the sample, Jaminjung, has intrinsic as the dominant FoR, with absolute used only in restricted contexts, while relative FoR is extremely marginal in its use (see Schultze-Berndt [44, 109]). From this perspective, it is perhaps significant that the three languages in which absolute dominates are described as having only cardinal absolute terms [22, 53-54] [31, 148-149] [48, 53-54], while the language where it is not dominant makes use of non-cardinal riverine terms [44, 106].

Based on this claimed dominance of abstract cardinals over terms invoking topographic features and relative projections, Australian languages are cited as evidence of a potential for humans to conceptualize the world in terms of an entirely abstract spatial system. Corresponding abstract concepts in non-linguistic behaviour are taken as evidence of language shaping cognition. Numerous studies have shown that the preferred FoR represented in a language correlates with the FoR choice employed for non-linguistic tasks by speakers of that language [12, 22] [26, 110] [35] [48, 62]. For example speakers of the relative-dominant Dutch language employ relative FoR when performing non-linguistic tasks such as memory recall, memory recognition and inferential reasoning, while speakers of absolute-dominant Guugu Yimithirr use absolute FoR for the same tasks [22, 130-146]. This is interpreted by many as evidence of a neo-Whorfian effect of linguistic relativity – that the spatial representations encoded by the language direct speakers to conceptualize space in corresponding ways [21, 22, 26]. The claimed dominance of absolute FoR, and within that of abstract cardinals, coupled with cross-modal correlations of FoR choice, has formed the basis for claims that largely arbitrary categories of spatial language shape conceptual spatial representations, and the largely tacit assumption that cardinals are somehow the default or basic conceptual system in absolute FoR.

2 Diversity in Australian spatial systems

In fact, space in Australian languages is much more complex than traditional perspectives suggest, and landscape plays a much greater role than generally recognized. Familiar claims about the theoretical significance of space in Australian languages are based on a small number of case studies, several predating recent developments in the understanding of spatial reference, and do not represent the actual complexity present across the continent. Many Australian languages employ geocentric terms alongside cardinals, and many do not use abstract cardinals at all, referring instead to river drainage, high country vs lowlands, coast vs inland, orientation of coastline, seasonal wind direction, path of the sun, and even in one unique case, tidal flow [15]. In many languages, multiple systems coexist, raising questions of what determines preference for each, whether they complement each other or are alternatives, and how they interact. While absolute FoR overall is important in Australian languages, recent work has shown that intrinsic and relative are also widespread, and one language, Murrinhpatha, even makes no use of grammaticized cardinal or geocentric terms at all [1].

Even the correspondence between linguistic and non-linguistic FoR preference turns out to not always apply (see Meakins et al. [33] and Meakins & Algy [32] for Gurindji). While Murrinhpatha is unique in the Australian context for lacking absolute spatial terms, its speakers generally employ absolute FoR in non-linguistic behaviour [10], a FoR mismatch of a type only just beginning to be recognized [2, 5, 23].

Across the world's languages, diversity exists within absolute FoR in which environmental features are invoked, and it transpires that Australian languages are no exception. Across languages correlations exist between salient environmental features and grammatical systems [4] [8, 307-309] [36]. The extent to which this is true in Australia is unknown. Current theoretical perspectives on spatial cognition in Aboriginal languages are based on a handful of case studies that often underestimate the diversity and complexity of their spatial systems, give limited consideration to the role of culture or to features of the landscape, and ignore variation within communities. Indigenous Australia is an important natural laboratory for testing theories of spatial language. It is home to a wide range of topographic environments, Indigenous Australians hold intimate connections with their landscapes [6, 18, 34, 42, 47], and the diverse lifestyles and subsistence strategies of Indigenous groups involve diverse habitual interactions with those environments. Spatial reference has been investigated in a handful of Indigenous languages, but no detailed study of spatial language across Australia exists. Australia provides a unique and untapped opportunity to cast light on the way humans interact with their environments and cultures to build conceptual representations of space.

3 Current research

While a number of important case studies exist of Australian spatial systems, no overall picture exists of space in Australian languages. A program of research, dubbed the OzSpace project, is in the early stages of attempting to characterize spatial systems across Indigenous Australia, test hypotheses about the role of the environment in shaping such systems, and determine the extent to which, and ways in which, sociocultural factors mediate between individuals and their environment through habits of interaction with landscape. The project seeks to develop an empirical basis for answering questions about the extent to which languages are shaped by the physical environment in which they are spoken, and the extent to which they are shaped by cultural patterns.

3.1 Topographic correspondence study

One branch of the OzSpace project investigates the effects of topography on linguistic spatial systems by testing the Topographic Correspondence Hypothesis (TCH) [36] in more than 220 languages across Australia for which data exists. TCH predicts that unrelated languages in similar environments will display similarities in spatial systems correlating with environmental similarities, while closely related languages in different environments will display commensurate differences in spatial systems. Australia is ideal for this study as it contains diverse topographic environments; and although its Indigenous languages may all be related, this is not universally accepted, and they are related to very varying degrees of closeness. This will enable us to compare languages based on the closeness or distance of relatedness, cross-cut by similarity or difference of environment. In order to implement these comparisons, we are trialling an interactive online database tool to represent features of each language's system of spatial reference and salient topographic features of its locus [40]. To ensure comparability of data, data is coded along two sets of controlled variables: one for linguistic features, and one for topographic features. For each language

we identify which spatial concepts are expressed by lexicalized and/or grammaticized terms. We are trialling a preliminary classification of spatial concepts at a number of levels. At the highest level, each FoR present is categorized (intrinsic, relative, absolute). Within each FoR, classifications relevant to that FoR are represented. For relative and intrinsic FoR, if present, the encoding of the sagittal (front-back) axis and transverse (left-right) axis are treated separately, as many languages encode only the sagittal and not the transverse. For both axes, the alignment (facing, reflectional, rotational) is then represented. For absolute FoR, if present, the first-order type is represented (abstract cardinal; solar (path-of-sun); drainage (river flow); elevation; wind direction; etc). Within each type, each attested concept is represented (abstract:east; path-of-sun:east; elevation:high-country; elevation:low-country; drainage:downriver; drainage:upriver; etc). For all FoRs and all types, actual terms and their semantics form the final node of each branch of the tree. To maximise comparability of data, the set of spatial language features are built in as selectable preset variables. However as the store of data builds up, this set of features is amended and expanded to accommodate features that emerge from the study but are not yet represented in the initial set.

A parallel set of selectable preset variables are required in the database for topographic features. To ensure maximal comparability we need consistent topographic data for each language locus. Surprisingly, no single standard set of topographic feature types for Australia currently exists. A preliminary set of features [40] has been developed drawing in part on the approach of Mark, Turk and Stea [27, 28, 30, 29, 46]. We are employing the Ethnophysiography Descriptive Model [46] to expand the preliminary set of features, and as more data emerges from the study this feature set will also be refined and expanded.

The database is designed to be maximally flexible in the questions that can be asked of it. The preliminary pilot version of the database is still in development in terms of interrogatibility. Comparisons will be made employing TCH's accompanying Environment Variable Method [36] in which a) language is held constant and environment varied (the spatial systems of a single language or closely related languages in diverse environments are compared); and b) the environment is held constant and language varied (the spatial systems of unrelated or distantly related languages in similar environments are compared). These comparisons show the extent to which language-environment correlations exist, and more crucially, cases where predicted correlations are absent or only partially present, allowing us to target closer investigation.

3.2 Sociotopographic study

The second branch of the project, currently in the planning stages, investigates the relationship of spatial language and environment with culture, lifestyle, and habitual activities of the speaker community, modelled on the recent Atoll Space project [25] [39, 37, 38] [43]. Diversity in spatial strategy choice correlating with gender has previously been observed (e.g. Danziger [7] and Lawton [20]). Recent work shows that within communities, differences in individual speakers' spatial strategy preferences occur, correlating with topography, diverse demographic factors (occupation, age, education, gender, etc, typically as proxies for how individuals engage with their environment), and community-level cultural factors (e.g. dominant subsistence mode) [4, 3, 5, 8, 32, 39, 37]. Each factor plays a role to varying degrees in spatial language use at the level of individual speakers as well as community level linguistic practices, captured by the notion of sociotopography [39]. Where a topographic correspondence study is broad in scope, a sociotopographic study requires detailed information on individual and community level sociocultural interaction with, and associations assigned to, the environment; the referential strategy choices individual speakers make when talking about space, including in

varying contexts; and demographic variables that may correlate with patterns in speaker strategy preferences. It is only viable to target a small number of languages for this level of intensive research. The OzSpace project is focussing the sociotopographic study on a sample of six language communities (Table 1) selected for their comparative value, including across diverse environment types (desert, riverine, coastal and island), and for the size and demographic diversity of their speaker communities (unfortunately a challenge in the Australian Indigenous context).

Table 1 Sociotopographic study target languages

	Environment Type	Region	Family	Speakers	Absolute System
Central-Eastern Arrernte	desert	Central Australia	PN, Arandic	2000	cardinal/river
Wik Mungkan	coastal	Cape York	PN, Paman	1050	cardinal
Kune dialect (Bininj Kunwok language)	riverine	Arnhem Land	Gunwinyguan	2000 (Bininj Kunwok)	cardinal/river/ elevation
Burarra dialect (Gujingaliya language)	coastal	Arnhem Land	Maningrida	2000	coast/wind/ elevation/sun
Kala Lagaw Ya	island	Torres Strait	PN, isolate	1000	coast/wind
Murrinhpatha	coastal	Daly	Southern Daly	3000	none

3.3 Classification of environment

Different bases are required to classify environment for the topographic correspondence study and the sociotopographic study. We adopt Turk's [45] distinction between *terrain* (raw landforms), *topography* (terrain plus built environment) and *landscape* (system of physical, utilitarian, cultural and spiritual relationships that an individual or community has with their terrain) [45, 46]. For the topographic correspondence study, the comparative value of topography and limited availability of information on landscape for more than 220 languages make topography appropriate and landscape unviable. However, the notion of landscape, encompassing the idea of *country* (see Douglas [9, 2fn]), is essential for the sociotopographic study, focusing as it does on the role of sociocultural constructs of environment in shaping spatial behaviour.

4 Pilot study

A pilot testing of the database tool is underway with the first stage completed [40]. This study tested the database against a fragment of the Australian continent, a region of the western Top End of the Northern Territory identified as containing six languages [19]. The principle objective of the pilot was to test sourcing and applying linguistic spatial features to the database categories. The region chosen was suitable for this purpose as the languages present offer a range of data source types to be interpreted for application to the database.

In addition they are phylogenetically diverse. The data source types included: field notes on spatial data collection including spatial task-based elicitation; published grammatical descriptions that include discussion of directional terms; unpublished grammatical sketches containing some spatial data but no discussion of spatial terms; an available researcher to consult for a language for which no useful published or ms material exists; a dictionary; and a corpus of elicitation transcripts.

The languages present in the sample region are:

- Ngan'gityemerri - published grammars [13, 41] (including description of spatial language)
- Wagiman - discussion with expert (Harvey pers. com.); corpus of elicitation recording transcripts
- Kamu - unpublished grammatical sketch [11] (no description of spatial language, minimal relevant data)
- MalakMalak - discussion of spatial system [14, 16]; field notes [17]; spatial language data collection; dictionary [24]
- Matngele - own field notes [17]; spatial language data collection
- Marrimaninjsji - no data found

Based on the spatial categories identified in the languages, the preset set of linguistic database variables was revised and extended. Pilot study results for these languages identify a range of spatial features present. All five languages for which data was available make intrinsic FoR available to speakers on the sagittal axis. MalakMalak, Matngele, Ngan'gityemerri and Wagiman also employ relative FoR on the sagittal, in the facing strategy. No data was found for relative FoR in Kamu. All languages in the pilot sample for which relevant data exists therefore make use of relative FoR, at odds with Majid et al.'s [26] findings and the typical perception of relative in Australian languages. On the transverse axis, MalakMalak and Matngele also encode both intrinsic and relative FoR on the transverse, but this appears to have marginal usage, and may result from contact with Kriol and English. Ngan'gityemerri and Wagiman are reported as not encoding intrinsic or relative on the transverse. No data on the transverse was found for Kamu for either FoR. While both relative and intrinsic are typically available on the sagittal, they are much less widespread on the transverse, with implications for the future interpretation of spatial data cross-linguistically: the absence of transverse terms such as left and right is not sufficient to claim the absence of relative or intrinsic FoR, as is sometimes the case.

In absolute FoR a number of geocentric axes occur in the pilot sample, all invoking aspects of the topography. Abstract cardinals are not attested in any of the five languages, and are definitely known to be absent from all but Kamu, where the data is too limited to be conclusive. Attested absolute systems variously invoke topographic elevation (high country-low country), drainage (upriver-downriver), path of the sun, and seasonal wind direction. All five languages invoke topographic elevation. All but Kamu invoke river drainage either as direction and location (Ngan'gityemerri and Wagiman), or just as location (MalakMalak and Matngele). MalakMalak and Matngele invoke seasonal wind direction. Path of the sun is employed in MalakMalak and Matngele, and is attested but highly marginal in Ngan'gityemerri, but is absent from Wagiman and unattested in Kamu. MalakMalak and Matngele add an additional dimension to the familiar solar system by encoding north as solar zenith (located in the north in the southern hemisphere). However, while solar:east and solar:west are high frequency in those languages, solar:north is rarely used.

Table 2 Pilot study languages

	Linguistic features in absolute FoR	Key topographic features
Ngan'gityemerri (Southern Daly family)	▬ Drainage:upriver (*ganggi*) drainage:downriver (*warrifi*). ▬ Elevation:high country (*ganggi*); elevation:low country (*warrifi*). ▬ Solar:east (*mirri meng-ge-tet* 'sun rises') and solar:west (*mirri yenim-dum* 'sun sinks') encoded but highly marginal in use.	Large permanent watercourse (Moyle River); escarpment separating high country and low country; sandstone mesas; flood plain.
Wagiman (isolate)	▬ Drainage:upriver (*gangga*) drainage:downriver (*dubay*). ▬ Elevation:high country (*wolok*); elevation:low country (*munya*).	Large permanent watercourse (Daly River, Fish River); sandstone mesas; rock country.
Kamu (Eastern Daly family)	▬ Elevation:high country (*wuluk*); elevation:low country (*wupetjeng*). ▬ No other axes attested	Large permanent watercourse (Daly River, Fish River, Reynolds River); mountains.
MalakMalak (Northern Daly family)	▬ Seasonal-wind:wet (*nuly-en*); seasonal-wind:dry (*dangid-en*). ▬ Solar:east (*miri(-nen) pai-ka* 'sun come'); solar:west (*miri(-nen) tjalk* 'sun descend'); solar:north (*miri(-nen) kantjuk* 'sun be on top') (marginal use). ▬ Drainage:upriver (*menyik-en*) drainage:downriver (*matjan-en*). ▬ Elevation:high country (*menyik-en, kantjuk(-en)*); elevation:low country (*matjan-en*).	Large permanent watercourse (Daly River); mountains; floodplain; seasonal winds.

Matngele (Eastern Daly family)	▬ Seasonal-wind:wet (*kurruwa*); seasonal-wind:dry (*dangarr*). ▬ Solar:east (*muerrue karrarr-ka* 'sun ascend'); solar:west (*muerrue tjalk* 'sun descend'); solar:north (*muerrue wuluk* 'sun be on top') (marginal use). ▬ Drainage:upriver (*merriyiny*) drainage:downriver (*menginy*). ▬ Elevation:high country (*wuluk*); elevation:low country (*menginy*).	Large permanent watercourse (Daly River); mountains; floodplain; seasonal winds.

The MalakMalak and Matngele wind-based system poses an as yet unresolved challenge for the classification of spatial features. Salient seasonal winds occur, but the terms do not encode upwind-downwind. Instead, they encode direction towards the source of each wind – an axis from the source of the *nuly* wind in the northwest, an ocean wind prevailing during the wet season, to the source of the *dangid* wind in the southeast, an inland wind prevailing during the dry season. Here these have been given an interim characterization as seasonal-wind:wet and seasonal-wind:dry, but these may well be too specific. Further cross-linguistic data is required to determine whether this seasonal characterization is more widely applicable.

This pilot study is intended to test and refine the database tool, rather than generate empirical findings at this stage. However, the very limited sample in Table 2 is suggestive that the presence of distinct highlands and lowlands, the drainage direction of large permanent watercourses, and dominant wind directions associated with a highly salient distinction between the wet season and dry season, are all likely to be invoked in constructing linguistic representations of space, with the path of the sun also available to supplement a system involving one or more of the other axes – but in no language in the sample was path of the sun the dominant geocentric axis. A second phase of the pilot study is currently underway, involving an expanded sample of a further nine languages of the western Top End.

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