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Frames of spatial reference in five Australian languages

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ABSTRACT

Australian Indigenous languages are widely cited as depending overwhelmingly on abstract cardinal terms for spatial reference. However, considerable under-recognized diversity exists, with systems invoking aspects of local topography or egocentric projections.

The first step toward an empirically grounded understanding of the wider implications of Australian spatial reference systems is to establish what components of spatial systems actually occur in what combinations across the continent. This article examines the spatial systems of five Australian languages to test hypotheses about the role of the environment in shaping linguistic representations of space, revealing under-recognized aspects of Australian systems, including the use of egocentric ("relative") reference frame but only on the sagittal axis; a nearside-farside system; and multiple systems invoking diverse salient environmental features.

KEYWORDS

Spatial language; Australian languages; frames of spatial reference; Topographic Correspondence Hypothesis; Sociotopography

1. Introduction[1]

The Indigenous languages of Australia are widely understood to exemplify languages in which abstract cardinal directions such as *east* and *south* dominate, and viewpoint-based egocentric concepts such as *front, back, left*, and *right* are largely or entirely absent (Dasen & Mishra, 2010, p. 301-302; Levinson, 2003, pp. 75, 336; McGregor, 2006, p. 148; Meakins & Algy, 2016, p. 480), and for which, projective geocentric concepts invoking aspects of the environment have been largely ignored.[2] In Majid et al.'s (2004) survey of 20 languages from across the globe, three of the four

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[2]An exception being abstracted upriver-downriver terms noted in the Daly River region (Levinson, 2003, p. 336, note 3; Schultze-Berndt, 2006) and occasionally elsewhere (Schultze-Berndt, 2006, pp. 63, 103).

Australian languages are classified as completely lacking the relative (egocentric) frame of reference (FoR), one of which, Guugu Yimithirr, is also classified as completely lacking the intrinsic (object-centered) FoR, the only language in Majid et al.'s sample to do so. 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 entirely abstract spatial coordinates. Corresponding abstract concepts in non-linguistic behavior are taken as evidence of language shaping cognition, a neo-Whorfian effect of linguistic relativity in which spatial representations encoded in language direct speakers to conceptualize space in corresponding ways (Le Guen, 2011; Levinson, 2003; Majid et al., 2004). The claimed dominance of this "absolute" FoR, and within that, of abstract cardinals, coupled with cross-modal correlations in 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 languages that have an absolute, or even geocentric, FoR.

In fact, space in Australian languages is much more complex than these perspectives suggest, and landscape plays a much greater role than generally recognized (Hoffmann, 2016; Hoffmann et al. 2021; Palmer et al. 2019). Familiar claims about the theoretical significance of space in Australian languages are based on a small number of individual case studies, several predating recent developments in research on spatial language (e.g. Furby & Furby, 1976; Laughren, 1978; Lewis, 1976a, 1976b), and do not reflect the actual complexity that exists across the continent. The present article employs recent developments in approaches to spatial language to carry out a systematic investigation of a representative sample of Australian languages, chosen for their phylogenetic diversity, spoken in a tight geographic region. No detailed survey of spatial reference in Australian languages exists, but recent preliminary work suggests that many Australian languages employ geomorphic terms alongside cardinals, while many do not use abstract cardinals at all, referring instead to topographic features such as river drainage, high country versus lowlands, and more (Hoffmann, 2016; Hoffmann et al., 2021) (see §2.3). Recent preliminary findings suggest that in many languages, multiple systems coexist, raising questions of what governs the use of each. While abstract cardinals are important in many Australian languages, geomorphic systems appear to be much more widespread than generally recognized, and recent work has shown that intrinsic and even relative FoRs are also widespread, with at least one language, Murrinhpatha, making no use of lexicalized or grammaticized cardinals or geomorphic directional terms (Blythe et al. 2016). Even the correspondence between linguistic and non-linguistic FoR preference turns out not to always apply. Younger Gurindji speakers with high levels of literacy and bilingualism in English employ relative FoR in speech, while continuing to employ the absolute FoR of traditional speakers in non-linguistic tasks (Meakins & Algy, 2016; Meakins et al. 2016). Even more strikingly, while Murrinhpatha speakers make heavy use of absolute FoR in non-linguistic behaviors such as co-speech gestures and

problem-solving tasks, the language displays no geocentric spatial terms (Blythe et al., 2016; Bohnemeyer et al., 2021; Gaby et al. 2016).

In Australia, as elsewhere in the world, diversity exists within geocentric FoRs in which environmental features are invoked. Cross-linguistically, correlations between salient environmental features and grammatical systems are well-attested (Bohnemeyer et al., 2014; Dasen & Mishra, 2010, pp. 307-309; Palmer, 2015), although the extent to which such correlations apply in Australia is unknown. Spatial reference has been investigated in a handful of Australian languages, but no detailed continent-wide study has been carried out. 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, and the diverse lifestyles and subsistence strategies of Indigenous communities involve diverse habitual interactions with those environments (Bawaka Country et al., 2015; Kingsley et al. 2013; Merlan, 1981, pp. 133-148; Rumsey, 1993; Verstraete & Hafner, 2016). 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.

The first step toward an empirically grounded understanding of the implications of Australian spatial reference systems is to establish what components of spatial systems actually occur in what combinations across the continent. This article contributes to this goal by investigating spatial language in a rigorously selected set of Australian languages, applying an adapted systematic classification of projective spatial relations. This classification itself is reported on here, as it includes a rarely recognized category of egocentric extrinsic reference – the "nearside-farside" or "SAP-landmark" strategy, and a new classification of relative FoR types proposed here for the first time.

The investigation of spatial reference in the selected languages includes a central focus on the effects of topography on linguistic spatial systems, following the Topographic Correspondence Hypothesis (Palmer, 2010, 2015), which predicts in part that languages spoken in similar environments will display similarities in spatial systems correlating with those environmental similarities, while languages in different environments will display commensurate differences in spatial systems. Australia is ideal for this study as it contains diverse topographic environments. Whether all Australian languages are related remains a matter of debate, but at any rate they are related to very varying degrees of closeness.

The languages selected for the present study occupy a fragment of the Australian continent: an area of the Daly River region of the western Top End in Australia's Northern Territory that includes six languages (see §3). This is a useful sample as the languages involved belong to five separate families that are only distantly related, if at all, minimizing the likelihood that any similarities in spatial systems result from shared inheritance. Data is drawn from a range of sources of very diverse types, from spatial studies involving task-based elicitation of spatial data (Hoffmann, 2013,

2019), to grammatical descriptions of directional forms (Reid, 1990), to text corpora, to field notes, to consultation with language researchers.

Section 2 of this article presents the classification of spatial expression types employed in this study. Section 3 reports on the empirical findings of the application of that classification to five languages of the Daly River region of Australia's Northern Territory. Section 4 provides conclusions. Section 5 points to future research directions.

2. Background

2.1. Expressing spatial relations

Spatial concepts may be expressed in any language using three levels of linguistic specialization: circumlocution (no linguistic specialization), lexicalization, and grammaticization. Any spatial concept can be expressed in any language using a circumlocution, a common strategy to express ad-hoc spatial information. For example, any spatial location, direction or orientation may be expressed in English by circumlocutions, such as *Go **in the direction the river flows**, Face **where the dry season wind comes from***, or *Go **with the tide***. However, in all languages some spatial concepts are encoded by dedicated lexical terms, while others are not. In English, the first of these concepts is lexicalized, by the adverb *downriver*, as in *Go **downriver***, but the second and third are not. In MalakMalak, however, the second concept is lexicalized by the noun *dangid* "[towards the source of] the inland wind that blows during the dry season" (1) (as opposed to *nuly* "[toward the source of] the ocean wind that blows during the wet season," see §3.4.4), and in Bardi the third concept is lexicalized as *joodarrarr* "with the tide" (2) (as opposed to *arrinarr* "against the tide"). Note that (1) does not mean facing in the direction the *dangid* wind blows, but toward its source.

(1)[3] *Yinya nende* ***dangid**-en* *pud* *wu-runguny…* MALAKMALAK
man thing/person inland.wind-DIR face 3PL.SUBJ-go/be.IPFV
'The people, they are facing **towards the inland wind** …' (Hoffmann 2019, p. 12)

(2) ***Joodarrarr*** *a-ng-arr-gal~al-ij* *Bawoordoo-ngan.* BARDI
with.the.tide 1.SUBJ-PAST-AUG-move~PL-PRF B.-ALL
'We went **with the tide** to Bawoordoo.' (Bowern 2016, pers. com.)

[3]Morpheme-by-morpheme glosses of data in this article are standardized and slightly simplified to make the data more accessible to linguistic non-specialists. Abbreviations used largely conform to the Leipzig glossing rules and are: 1 "1st person"; 2 "2nd person"; 3 "3rd person"; ABL "ablative case"; ALL "allative case"; ANAPH "anaphora"; AUG "augmented number" (roughly = plural); AUX "auxiliary verb"; CL "noun class"; CONT "continuous aspect"; DIR "directional"; DIST "distal"; DU "dual"; EXCL "exclusive"; FOC "focus"; FRDIST "far distal"; FUT "future tense"; HAB "habitual aspect"; IMP "imperative mood"; INSTR "instrumental case"; IPFV "imperfective aspect"; IRR "irrealis modality"; ITR "detransitiver"; LOC "locative case"; MASC "masculine gender"; MIN "minimal number" (roughly = singular); NEG "negative"; NEUT "neuter gender"; NPFV "non-perfective aspect"; NRDIST "near distal"; NSG "non-singular"; OBJ "object"; OBL "oblique case"; PART "participle"; PAST "past tense"; PFV "perfective aspect"; PRF "perfect aspect"; PERG "pergressive case (= 'via')"; PL "plural"; PRES "present tense"; PROX "proximate"; PUNC "punctual aspect"; REAL "realis modality"; SBJV "subjunctive mood"; SG "singular"; SUBJ "subject"; VIS "visible".

While the concepts "with the tide" and "against the tide" are lexicalized in Bardi, meaning that there are dedicated terms encoding those concepts, they are not grammaticized, meaning that those terms do not participate in a specialized restricted construction or display specialized restricted morphology. Bardi *joodarrarr* and *arrinarr* are adverbs whose syntactic and morphological behavior is the same as other members of a large heterogeneous lexical category of adverbs defined on grammatical grounds (Bowern, pers. com.).

MalakMalak *dangid* and *nuly*, on the other hand, are grammaticized, as while they display directional case like other nouns, they form a morphologically restricted subclass of nouns defined by their inability to carry locative or ablative case. Moreover, they only derive their directional meaning when suffixed with the directional suffix *-en*. Similarly, in Wagiman the concept "downriver" is lexicalized, as in English. However, unlike English, the term is also grammaticized, being one of exactly four members of a subclass of nouns, all spatial, which are defined by their inability to occur with locative or allative case (3), despite occurring with ablative case (see §3.2.4) (Harvey, pers. com.). In Dyirbal, the same concept is even more heavily grammaticized, being expressed by a member of a class of six spatial suffixes occupying a dedicated position in the morphological structure of demonstrative nouns (4).

(3) *Ngal-marttiwa gahan* ***dubay*** *g-a-yu.* WAGIMAN
female-old.woman that downriver PRES-3.SUBJ-be
'That old woman is **downstream**.' (Harvey n.d.)

(4) *ŋaɟa bani-ŋu ba-ŋum-**balbul**-u ɲina-ɲ.* DYIRBAL
1SG.SUBJ come-REAL DIST.VIS-ABL-DOWNRIVER-FRDIST sit-IRR
'I, who have come from a long way **downriver**, will sit down.' (Dixon 1972, p 100)

2.2. Frames of spatial reference

Languages provide their speakers with a range of strategies for referring to spatial relations. These include reference to topographic landmarks (*toward the beach, near the hill*, etc.), *ad hoc* landmarks (*toward the door, near that house*, etc.), and speech act participants as landmarks (*toward us, near you*, etc.); as well as lexicalized or grammaticized terms encoding a FoR (*in front of . . . , east of . . . , downriver from . . .* , etc.). Frames of reference encode projective space: Individual frames of reference are strategies for projecting a domain, path or orientation off an object, entity or place. This is achieved by assigning an asymmetry to a spatial situation. For example, in location descriptions, an entity (a "figure" or "referent") is located in relation to another entity (a "ground," aka "reference object" or "relatum"): In *the ball is in front of the chair*, the figure *ball* is located in relation to the ground *chair*

on the basis of an asymmetry assigned to the figure-ground array, using a strategy that invokes the chair's front.

Three frames of reference (FoR) have been widely adopted in discussing linguistic spatial reference, following Levinson (1996, 2003): intrinsic, relative and absolute. More recently, a classification of geocentric frames that includes absolute has been refined to fill a gap in Levinson's typology, in order to encompass spatial concepts that invoke features of topography but are insufficiently abstracted to qualify for Levinson's narrow definition of absolute (Bohnemeyer et al., 2015; Bohnemeyer & O'Meara, 2012; O'Meara & Pérez Báez, 2011). Three subtypes of geocentric space are proposed: geomorphic, in which vectors align with the actual trajectory of a proximate topographic feature (e.g. *downriver*); landmark-based, in which vectors point toward or away from a landmark (e.g. *seaward*); and absolute, in which vectors are abstracted from environmental anchors (e.g. *east*).[4]

2.2.1. Intrinsic frame of reference

Intrinsic FoR is a binary relation in which a domain or path is projected off a ground object on the basis of an asymmetry assigned to the ground object itself, on the basis of perceived intrinsic facets of the ground, for example, its front, back, left, or right (e.g. *the car is **in front of** the house*, where the ground *house* is perceived as having an intrinsic front).

A further distinction proposed by Danziger (2010) splits the intrinsic FoR described above into two FoRs, depending on whether the ground object anchor is egocentric (in some approaches the speaker, in others a notional observer) (e.g. *the car is in front of **me***), or allocentric (an entity other than the speaker/observer) (e.g. *the car is in front of **the house***). Danziger argues that allocentric and egocentric intrinsic references have different properties, terming the former an "object-centered" FoR and the latter a "direct" FoR. However, for the purposes of this study, we adopt Levinson's (2003, p. 38) assumption that intrinsic is a unitary category independent of the egocentric or allocentric (deictic or non-deictic) nature of the ground.

However, in this study, we found that it is not sufficient to simply identify the presence or absence of intrinsic FoR in a language. Instead, it is necessary to treat the sagittal (front-back) axis and transverse (left-right) axis separately, because the lexification of one in a language does not necessarily imply the presence of the other: It transpires that some languages encode only one. In Wagiman in our study, for example, only the sagittal is encoded (see §3.2.1). The absence of an encoded transverse axis where a sagittal exists is also attested in the Australian languages Eastern Arrernte (Wilkins, 2006, pp. 53, 60), Jaminjung (Schultze-Berndt, 2006, p. 108), and Warrwa (McGregor, 2006,

[4]Unfortunately, Bohnemeyer et al.'s (2015, p. 175) table summarizing frames of reference appears to place absolute outside geocentric. It is clearly intended to be a geocentric subtype (see e.g. Bohnemeyer & O'Meara, 2012, pp. 218–220).

p. 131) (see §2.2.2). The available evidence suggests that if a language only encodes one axis in intrinsic or relative FoR, it is always the sagittal (i.e. no attested language encodes the transverse but not the sagittal).[5] However, suffice to say that a language may have one without the other, so in order to accurately represent what is happening in such a language, we are treating the two as separate variables.

2.2.2. Relative frame of reference – Front-Back-Left-Right (FBLR)

Relative FoR is an extrinsic relation, meaning that the relation is anchored in an entity external to the figure-ground array, unlike intrinsic FoR, where the anchor is in the ground object itself. Relative FoR is an egocentric extrinsic relation in which a domain or path is projected off a ground object on the basis of an asymmetry assigned to the situation based on a third participant, a viewpoint or observer, as anchor. Traditionally, the observer's own spatial disposition (front, back, left and right) is understood to be projected onto the ground object, in what can be termed FBLR relative (e.g. *the ball is* ***in front of*** *the tree*, where the ground tree is not perceived as having a front, instead the observer's front is projected onto the tree – in this case the *front* is the side of the tree closest to the observer). However, it is not merely the FBLR spatial structure of the observer, but the location of the observer that is crucial in relative FoR: e.g. the *front* is the facet of the ground facing toward the location of the observer, in the reflectional strategy familiar from English. For the same reasons as with intrinsic FoR, we are treating the sagittal and transverse axes as separate variables for relative FoR. Although FBLR relative involves the same two axes as intrinsic, it involves an additional layer of complexity related to the alignment strategy employed by each axis. Traditionally, these strategies have been characterized without separating the sagittal and transverse axes. The standard approach recognizes three relative strategies: reflectional, translational, and rotational (Hill, 1982; Levinson, 2003, p. 84–89) (Figure 1). The reflectional strategy imposes a human-like asymmetry on the ground as if it were a mirror image: the front is the facet closest to the observer, the back is the facet furthest from the observer, and left and right are the facets corresponding to the observer's left and right. In the translational strategy a human-like asymmetry is imposed on the ground as if it were a person in line with the observer, facing in the same direction: the left and right correspond to those of the observer, but the front is the facet furthest from the observer, and the back the facet closest. Both reflectional and translational properties are widely attested. The rotational strategy is rarer. Here a human-like asymmetry is imposed on the ground as if it were a person facing the observer: the front is

[5]One anonymous reviewer pointed out that literacy may be a confound in this. It would be worth considering in future research a correlation between literacy, with its alignment along the transverse axis from the perspective of the reader, and a preference for (or even availability of) a transverse axis in languages with a tradition of widespread literacy.

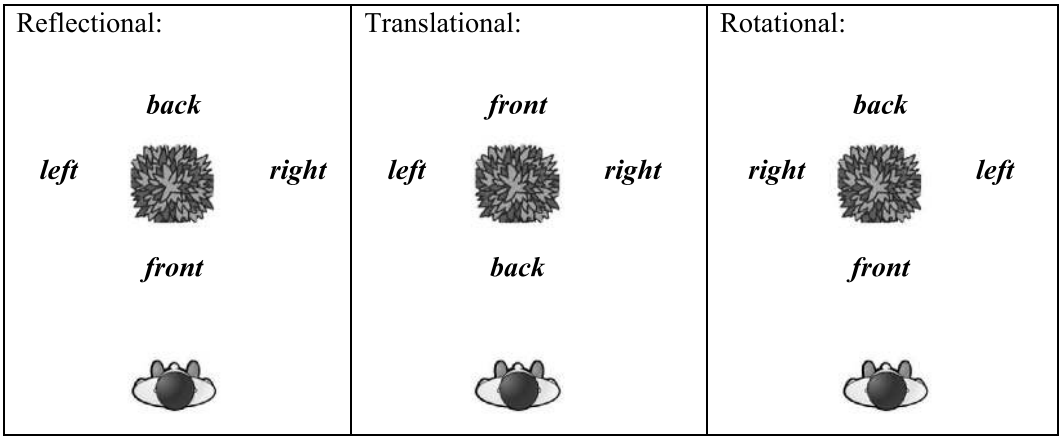


Figure 1. Traditional relative strategies (following Hill, 1982; Levinson, 2003, pp. 84–89).

the facet closest to the observer and the back is the facet furthest from the observer, but left and right are the reverse of those of the observer.

However, this standard typology of relative FoR is inadequate for two reasons. First, it cannot recognize commonalities that cross-cut the three subtypes. In reflectional and rotational, front and back are assigned in the same way. In reflectional and translational, left and right are assigned in the same way. Second, it cannot be applied when only one axis is encoded. If only the sagittal is encoded, a system in which the front is the facet closest to the observer cannot be classified as it conforms to both the reflectional and rotational types. This is the case with Wagiman in our sample (§3.2.2) as well as Eastern Arrernte, Jaminjung, and Warrwa (see §2.2.1). Conversely, if only the transverse were encoded (unattested but logically possible), a system in which the left and right sides correspond to the observer's left and right would conform to both translational and reflectional. Both problems arise because the traditional typology does not separate the sagittal and transverse axes, yet languages do treat the two separately. For this reason, we typologize the two axes as distinct variables. For the sagittal axis, we recognize two possible orientations in which a human-like asymmetry is imposed onto the ground object: a "facing" strategy, in which the facet closest to the observer is the front and that furthest away is the back, and an "aligned" strategy, in which the facet furthest from the observer is the front and that closest is the back (Figure 2). For the transverse axis, we also recognize two possible settings in which a human-like asymmetry is imposed onto the ground: an "aligned" strategy, in which the facet corresponding to the observer's left is the ground's left and that corresponding to the observer's right is the ground's right, and a "rotated" strategy, in which these are reversed (Figure 3). The three traditional relative are manifestations of differing interactions between sagittal and transverse strategies (Table 1).

Cross-linguistically, discussions of whether relative FoR is present in a language, or preferred or dispreferred if present, rarely consider the sagittal and transverse axes separately. In some cases, a language is described as

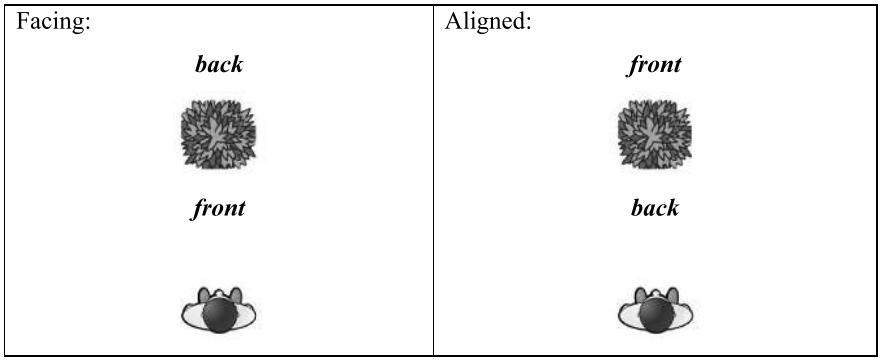


Figure 2. Sagittal axis strategies.

lacking relative FoR on the basis that terms for left and right are not used projectively, leaving open the possibility that some languages reported to lack relative FoR do employ it but only on the sagittal axis.[6]

A difference in preference for each axis when both are present has also been occasionally noted as in, for example, Tamil, where relative FoR is more frequently used for sagittal than transverse relations (Pederson, 2006, p. 433), a fact Pederson attributes to sagittal references being easier to produce and more communicatively effective due to the considerably greater asymmetry of the human front-back dimension than the left-right dimension (Pederson, 2006, p. 433). A similar difference in usage occurs in MalakMalak in our sample (§3.4.2), and has been noted for the Papuan isolate Yélî Dnye (Levinson, 2006, p. 183).

The absence of an encoded transverse axis where a sagittal does occur in intrinsic FoR (§2.2.1) in Wagiman, Eastern Arrernte, Jaminjung and Warrwa also applies to the relative FoR in those languages (Hoffmann, 2019, pp. 7-8; McGregor, 2006, p. 130; Schultze-Berndt, 2006, p. 109; Wilkins, 2006, pp. 35, 58, 60).

We predict that differences in usage or even presence of encoding of each axis are more widespread than reported for both intrinsic and relative FoR. The absence of an encoded transverse axis in some languages, and a dispreference for the transverse in comparison with the sagittal in some other languages, accords with greater difficulties in the acquisition of left and right compared with front and back among children (Shusterman & Li, 2016), and difficulties with left-right identification among a significant minority of cognitively normal adults, even members of a predominantly egocentric strategy-preferring language community such as the Dutch (van der Ham et al.

[6]For example, Warrwa is described as conforming to the "typical" Australian pattern of using absolute rather than "relative, speaker-based, frames of reference", because terms for left and right are not used to specify a location or direction with respect to a ground (McGregor, 2006, p. 148), and Majid et al. (2004, p. 112) classify Warrwa as lacking relative FoR. However, the language does employ terms for front and back in both an intrinsic and relative way (McGregor, 2006, p. 130). Similarly, speakers of Jaminjung are reported to not make use of relative FoR because terms for left and right are not used projectively (Schultze-Berndt, 2006, p. 103) although terms for front and back can have relative projective uses (Schultze-Berndt, 2006, p. 109; Hoffmann, 2019, pp. 7–8).

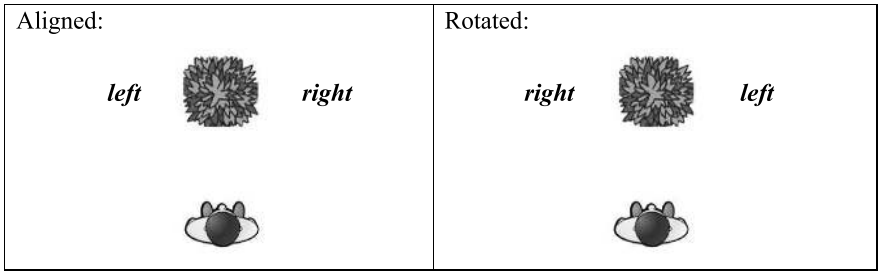


Figure 3. Transverse axis strategies.

Table 1. Interactions of relative FoR sagittal and transverse strategies with traditional classification.

sagittal: \ transverse:	aligned	rotated
aligned	"translational"	?unattested
facing	"reflectional"	"rotational"

2020). On the basis of the kind of evidence presented above, we predict that where only one axis is encoded in a language in either intrinsic or relative FoR, it will be the sagittal.

2.2.3. Nearside-farside relations

In FBLR relative FoR in §2.2.2 a human-like asymmetry is assigned to the ground object relative to the location of an observer. However, another type of asymmetry can be assigned to a ground object based solely on the location of the observer, without ascribing a human-like spatial disposition to the ground. This strategy, infrequently discussed in the spatial literature, differs from the traditional relative FoR in that a human-like spatial asymmetry (front-back-left-right) is not projected onto the ground object. Instead, a domain is projected off the ground object solely on the basis of the location of the observer: an asymmetry is assigned to the ground object on the basis of the facet closest to the observer ("nearside") and the facet furthest from the observer ("farside"). In a reference such as *the ball is* ***on the far side of*** *the tree*, the figure ball is located in a domain projected off the facet of the ground tree furthest from the observer. Despite the use of *on* in this English example, this is not a non-disjunctive topological relation but is instead projective: The figure ball is not in contact with the ground tree, but is located in a domain projected off a facet of the tree identified by an asymmetry assigned to the tree on the basis of the observer's location alone. Like the traditional FBLR relative FoR, "nearside-farside" is an egocentric extrinsic strategy: egocentric because the anchor is a viewer or observer, and extrinsic because the anchor is outside the figure-ground array. An extrinsic strategy in which the anchor is egocentric has been treated as a landmark

strategy where the extrinsic anchor is a speech act participant (speaker, addressee), sometimes referred to as a SAP-landmark (Lum, 2018, pp. 79-81; Polian & Bohnemeyer, 2011, p. 878; Romero-Méndez, 2011, pp. 930–933).

Whether the nearside-farside strategy can be regarded as a form of relative FoR depends on how "relative" FoR is defined. If "relative" is an overall term for egocentric extrinsic references, nearside-farside and FBLR constitute types of relative. If "relative" definitionally requires the assignment of a human-like asymmetry or projection of the anchor observer's spatial disposition onto the ground, nearside-farside is not relative, but both are types of egocentric extrinsic relations.

As the nearside-farside strategy is less well known than the other more familiar FoRs discussed here, it requires a little more explanation. This type is exemplified in (5), from Ngan'gityemerri in our sample (§3.1.3). Ngan'gityemerri displays deictic locatives (equivalent to terms like English *here* and *there*) encoding proximal, near distal and far distal locations. When they occur with the instrumental enclitic *=ninggi* they have a separate function, not indicating a location proximal or distal to the speaker, but a domain projected off the facet of a ground object closest to or furthest from the speaker (Hoddinott & Kofod, 1988, p. 188; Reid, 1990, pp. 367–369), regardless of how distant the locations are from the speaker. For example, a location that is *kin=ninggi Darwin* "PROX=INSTR Darwin" may be very distant from the speaker despite the proximal root, but is in a domain projected off the side of Darwin closest to the speaker (Reid, 1990, p. 368). In (5a) the figure "it" is located in a domain projected off the facet of the ground "car" closest to the observer, while in (5b) the figure "two hills" is located in a domain projected off the facet of the ground "Peppimenarti hill" (lit. "big hill") furthest from the observer. Note that these involve FoR as they indicate domains projected off facets of the ground objects, not the facets themselves. For example, *kin=ninggi* in (5a) does not refer to the facet of the car closest to the observer. Instead, it refers to a domain projected off that facet, conforming to the definition of FoR as a strategy for projecting a domain, path or orientation off an object. It is not yet clear whether a transverse axis can exist with the nearside-farside strategy.

(5) a. *Mudiga* *madi-**kin=ninggi*** *ngariny-fi-tyat.*
car chest-PROX=INSTR 1SG.SUBJ.PFV.poke[3SG.OBJ]-manipulate-place
'I put it down **on this side** of the car.' (Reid 1990, p. 369)

b. *Fepi* *minbadi=nide* *madi-**wun=ninggi*** *fepi* *wagarri*
hill big=LOC chest-FRDIST=INSTR hill two
widdibemgu.
3PL.SUBJ.PRES.stand.DU.SUBJ
'On the other side of Peppimenarti hill, there are two (other) hills.' (Reid, 1990, p. 369)

Bohnemeyer and O'Meara (2012, pp. 220, 231-232) briefly discuss this type of strategy, illustrating it with examples from Yucatec Mayan and the Mexican isolate Seri. Despite saying that with this type "the anchor is frequently the body of the speaker or addressee" (2012, p. 231), they do not classify references such as these as relative, because they do not involve transposition of the observer's axes onto the ground. It is therefore the location of the observer's body, not its internal spatial disposition, that they recognize as the anchor. Instead, they classify this as an egocentric intrinsic relation, corresponding to Danziger's direct FoR, as, like direct relations, they are not object-centered (Bohnemeyer & O'Meara, 2012, pp. 219–220). However, while such references are clearly egocentric (the anchor is the observer), they are extrinsic, not intrinsic, as the anchor is not the ground, conforming to the standard distinction between intrinsic, in which the anchor is in the ground object (as in Danziger's direct FoR, where the speaker is both ground and anchor) and extrinsic, where it is not (see e.g. Bohnemeyer et al., 2015, p. 175; Levinson, 2003, pp. 42–43). The nearside-farside strategy is therefore not in intrinsic FoR (*pace* Bohnemeyer & O'Meara, 2012), as it is dependent on and anchored in the position of an observer, who is not also the ground. In (5a), for example, the ground is the car, while the anchor is the location of the speaker. Likewise, in Bohnemeyer and O'Meara's Yucatec and Seri examples (both elicitations using the Ball and Chair referential communication task) the figure *ball* is located in a domain projected off the ground *chair* on the basis of the location of the anchor speaker. The same is true of an English reference such as *the ball is* ***on my side/this side of*** *the chair*. This strategy is attested in all four languages in our study for which sufficient data exists. Although rarely discussed in the spatial literature, this projective strategy (i.e. FoR) appears to be common cross-linguistically.

2.2.4. Geocentric frame of reference

Geocentric FoR is an allocentric extrinsic relation in which an asymmetry is assigned to a situation on the basis of environmental features or other coordinates outside the spatial array of figure and ground, other than the observer: e.g. *the house is* ***east/seaward/downriver from*** *the shop*, where a domain is projected off the ground shop on the basis of the absolute coordinate *east*; the location of a landmark (the sea in *seaward*); or the geomorphic direction of flow of a watercourse (the river in *downriver*). The scope of the term "absolute" varies widely in the literature on spatial language. In Levinson's original typology and Bohnemeyer's classification of geocentric subtypes, absolute refers to a subset of allocentric extrinsic relations that involves fixed abstract axes such as cardinal terms, and notions such as *downriver* where the encoded direction is abstracted from the actual direction of flow of the river (Bohnemeyer & O'Meara, 2012, p. 5; Bohnemeyer et al., 2015, pp. 175-176; Levinson, 2003, p. 48–49). However, in the spatial descriptive literature, "absolute" is often used to refer to all allocentric extrinsic frames (=

geocentric). Danziger (2010) classifies as absolute all allocentric relations in which the anchor is not the ground (i.e. is extrinsic), where, "the Anchor is located in the landscape or the cosmology surrounding the Figure-Ground scene" (Danziger, 2010, p. 169). Palmer (2015) uses "absolute" in a similar way, as does Hoffmann's (2016, 2019) work on space in Australian languages, among others. In the present article, we adopt the more precise classification of referring to all extrinsic allocentric spatial relations as geocentric (§2.2.4).

The two extrinsic relations, relative and geocentric, can be distinguished as follows: Relative FoR is egocentric (projections are relative to an observer), while geocentric FoR is allocentric (projections are relative to an environment that is extrinsic to the figure, ground and observer), apparently a fundamental cognitive distinction (Volcic & Kappers, 2008, p. 200).

2.3. Spatial reference in Australian languages

Australian languages are well known in the wider literature on spatial language and spatial cognition as exemplifying languages with a dominant absolute FoR in the form of an abstract cardinal system (Dasen & Mishra, 2010, pp. 301-302; Levinson, 2003, pp. 75, 108, 336; McGregor, 2006, p. 148; Schultze-Berndt, 2006, p. 63). This claim is based on detailed studies of a small number of languages, particularly Guugu Yimithirr (Haviland, 1993, 1998; Levinson, 2003, pp. 113-146) and Eastern Arrernte (Wilkins, 1997, 1999, 2006). The findings for Guugu Yimithirr have been assumed to be representative of Australian languages: "Like most Australian languages, Guugu Yimithirr makes essential use of terms for cardinal directions" (Levinson, 2003, p. 115). This view of the primacy of cardinals in Australian referential systems is consistent with early descriptions of cardinal systems in languages like Garrwa (Furby & Furby, 1976), Warlpiri (Laughren, 1978) and Western Desert (Lewis, 1976a, 1976b).

More recent studies of individual languages have shown that Australian languages vary in the extent to which they favor absolute FoR. One reported language, Murrinhpatha, appears to be unique in the Australian context by lacking not merely absolute spatial language, but lexicalized or grammaticized geocentric projective terms entirely (Blythe et al., 2016). Within geocentric FoR Australian languages vary widely on the basis on which their geocentric systems are constructed, with many referring to axes other than cardinal directions: geomorphic or landmark-based axes that invoke some aspect of the physical environment in which the language is spoken (see Hoffmann, 2016, 2019, p. 8; Hoffmann et al. 2021). These include: watercourse drainage (Jaminjung upriver/downriver: Hoffmann, 2019, pp. 9-10; Schultze-Berndt, 2006); elevation (Dyirbal uphill/downhill: Dixon, 1972, p. 48; Wagiman high country/lowlands: Harvey pers. com.); prevailing wind (Kala Lagaw Ya upwind/downwind/across-wind: Bani, 2001, p. 477; Stirling, 2010); seasonal wind (MalakMalak dry season wind/wet season wind: Hoffmann, 2019, p. 12); coast (Iwaidja ocean/inland: Edmonds-Wathen, 2012, pp. 142–143); path of the sun

(solar east-west) (Adnyamathanha toward-sun-come-up/toward-sun-enter: Schebeck, 1973, p. 40); and even, apparently uniquely, tidal flow (Bardi with the tide/against the tide, see (2): Bowern 2012, pp. 566-567, 2016).

Despite this diversity, the extent to which Australian spatial systems invoke environmental features is under-represented in the wider spatial literature. The extent to which non-cardinal geocentric axes coexist with cardinals in individual languages is also largely uninvestigated. For example, Eastern Arrernte is described in detail as employing abstract cardinals (Wilkins, 2006, pp. 53–60). However, an alternative upriver-downriver axis also exists, but is reported in the spatial literature only in a single footnote (Wilkins, 2006, p.54, note 7). Many Australian languages employ geocentric axes that are not absolute in the narrow sense. Moreover, many Australian languages employ more than one geocentric axis (Hoffmann et al., 2021).

Australian languages are also well known for lacking relative FoR. However, preliminary evidence suggests this perception is largely due to a lack of projective terms on the transverse (left–right) axis, when terms on the sagittal (front–back) axis are used projectively in relative FoR (§2.2.2). All three Australian languages represented by sketch grammars of space in Levinson and Wilkins' (2006) compilation, Jaminjung, Arrernte and Warrwa, encode relative FoR, but only on the sagittal (§2.2.2). In Majid et al's (2004, p. 112) survey of 20 languages around the globe, five are shown to be lacking relative FoR. Two of those are Arrernte and Warrwa, which it transpires do employ relative FoR, but only on the sagittal axis. Of the four Australian languages in their sample, three therefore do employ relative FoR (the third is Jaminjung), but all only on the sagittal. Only Guugu Yimthirr in Majid et al.'s Australian sample appears to actually lack relative FoR. In our sample (below), enough data exists for three languages to determine the status of relative FoR. Of these, one is known to lack relative, even on the sagittal (Ngan'gityemerri), one is known to encode relative on the sagittal but not the transverse (Wagiman), and one is known to encode relative on both the sagittal and transverse, with the transverse rarely used (MalakMalak).

Together, these studies suggest first that the encoding of relative is not rare in Australian languages after all, but widespread, and second, that Australian languages typically encode relative only on the sagittal. The widespread presence of relative FoR in Australia is masked by a tacit assumption that if relative FoR is present, it will be encoded on both axes.

Overall, while Australian languages are held to cast light on spatial cognition, actual data on spatial reference systems across Australia are very limited, giving a partial and skewed picture. Diversity in Australian spatial language is significantly under-investigated and there are many unreported or under-reported elements, a situation this study attempts to address for a fragment of the continent.

3. Languages in this study

This study targets a section of the Daly River region of the western Top End of the Northern Territory (Map 1). The region encompasses six languages, with very diverse source material in terms of extent and quality. For one, Marrimaninjsji (aka Marimanindji), the only source (Tryon, 1974, pp. 104–119) contains no data on spatial language. For the remaining five, Ngan'gityemerri, Wagiman, Kamu, MalakMalak and Matngele, sources provided data of varying degrees of extent. The languages are also phylogenetically distinct. Only two, Kamu and Matngele, belong to the same Australian language family (Eastern Daly). The others are maximally distant in phylogenetic terms, belonging to separate families.

3.1. Ngan'gityemerri

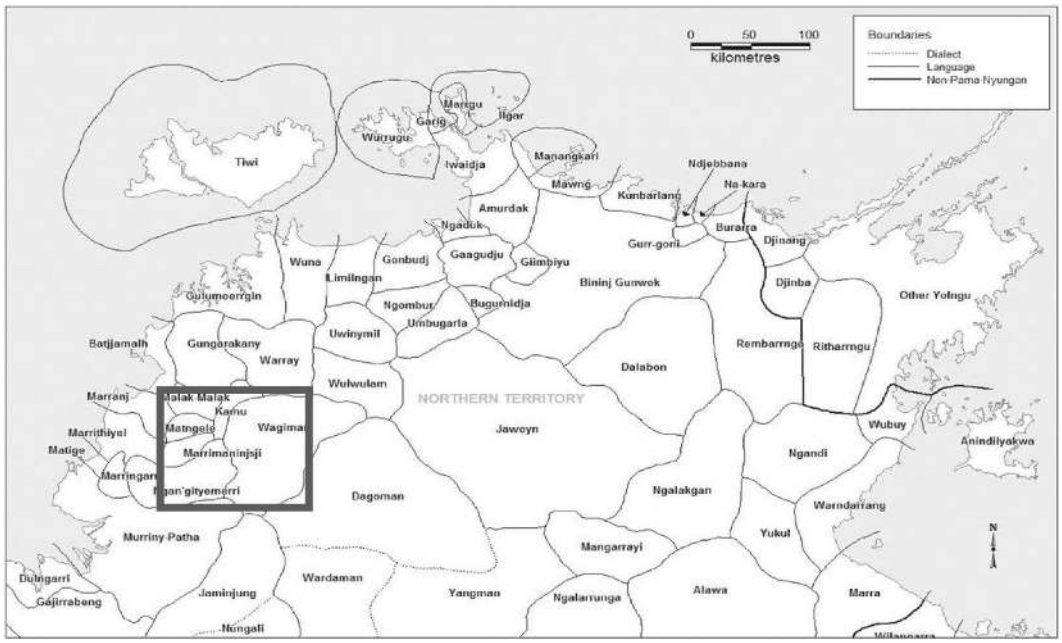
Ngan'gityemerri is a language of the Southern Daly family, spoken today by around 180 people (Reid pers. com.), down from perhaps as many as around 275 of all dialects in the 1980s. Ngan'gityemerri sources included two published grammars (Hoddinott & Kofod, 1988; Reid, 1990). Reid's (1990) grammar includes a brief but insightful description of spatial language. Published sources were supplemented by consultation with Reid. The variety described here is the traditional language spoken by individuals over the age of about 40 consulted by Reid in the 1980s. The data below are principally from the Ngan'giwumirri (NgW) dialect (Reid, 1990), with additional consideration of Ngan'gikurunggurr (NgK) dialect data collected between 1967 and 1982 (Hoddinott & Kofod, 1988). Reid's data were collected mainly at Peppimenarti and also in Wudi Gapil Diyerr and Nauiyu Nambiyu (Daly River Mission) (Reid, 1990, p. 23). The data here are NgW unless otherwise indicated.

The country of Ngan'gi includes a variety of topographic features. The Wingate mountains have deep gorges between arid sandstone mesas. West of the Wingates, a sandstone escarpment splits the country into two zones. The high country on top of the escarpment gently slopes southwards. This area is dry and rocky with spinifex and sparse trees while the lip of the cliff wall is well-watered by permanent vegetated springs. In the lower country, the Moyle River and its tributaries gently descend westwards from pockets of rainforest along the base of the escarpment wall, through open forests into large flood plains before disappearing into vast wetlands (Reid, 1990, pp. 12–13).

3.1.1. Ngan'gityemerri intrinsic

Intrinsic FoR on the sagittal axis is grammaticized in Ngan'gityemerri with the local nouns *fangu* "area at the front of, in front" and *syirre* "area at the back of, behind" (Reid, 1990, pp. 369–370).[7] These occur very infrequently in the data with their projective spatial sense.

[7]Local nouns in Ngan'gityemerri are defined by their ability to take ablative case ("from") but not locative ("at") or allative ("to") case.



Map 1. Languages in this study (map from Koch & Nordlinger, 2014, p. xiv, with highlighted region).

(6) a. *Ep awa-nyin falmi fagarri* ***syirre-****derri girrunggu.*
perhaps HUMAN-ANAPH woman two behind-back 3PL
'Maybe those two women are **behind there**.' (NgK) (Hoddinott & Kofod 1988, p.131)

b. ***Fangu*** *yaga girribem wembem=nide.*
front TOPIC 3SG.SUBJ.PRES.stand house=LOC
'He is standing **in front** of the house.' (NgK) (Hoddinott & Kofod 1988, p.187)

No intrinsic "left" or "right" occurs in Reid's (1990) or Hoddinott & Kofod's (1988) descriptions of spatial language or in their data. On this basis, we inferred that the transverse axis is not lexified in Ngan'gityemerri, given that Reid's careful consideration of spatial terminology would be expected to refer to notions like "left" and "right" if they were employed. This inference was confirmed by Reid (pers. com.).

3.1.2. Ngan'gityemerri relative

The intrinsic front-back terms do not also occur with a relative meaning in Ngan'gityemerri, so do not also encode the sagittal axis in relative FoR. No relative projective left-right terms occur. The FBLR relative FoR is therefore not encoded in Ngan'gityemerri (Reid pers. com.).

3.1.3. Ngan'gityemerri nearside-farside

Ngan'gityemerri displays three locative nouns encoding proximal, near distal and far distal deictic categories with meanings approximating the English deictic locative adverbs *here, there*, and *yonder* (Reid, 1990, pp. 366–367). However,

when they occur with the instrumental enclitic *=ninggi* (7) (Hoddinott & Kofod, 1988, p. 188; Reid, 1990, pp. 367–369) they do not indicate a location proximal or distal to the speaker, but a domain projected off the facet of a ground object closest to or furthest from the speaker (§2.2.3), see (5). In (8) the camp is in a location projected off the side of the Adelaide River furthest from the speaker. In (11) the location is projected off the side of the creek closest to the speaker.

(7) a. *kin=ninggi* (NgW) / *ki=ninggi* (NgK)[8] 'on the nearside of' (PROX=INSTR)
b. *werrfe=ninggi* (NgW) / *err=ninggi* (NgK) 'just on the farside of' (NRDIST=INSTR)
c. *wun=ninggi* (NgW) / *wu=ninggi* (NgK) 'a long way on the farside of' (FRDIST=INSTR)

(8) *Minbe ngatypirr Amungal-nimbi* ***wun=ninggi*** *nganniny-du.*
NEG far Adelaide.River-ABL FRDIST=INSTR 1EXCL.PL.SUBJ.IRR.go-sleep
'We camped at a place **a little the other side** of Adelaide River.' (Reid 1990, p.368)

3.1.4. Ngan'gityemerri geocentric

Ngan'gityemerri has two sets of geocentric directional terms: one colexifying vertical, elevational and drainage axes; and one encoding solar east-west. No abstract cardinal terms exist.

3.1.4.1 Elevation/drainage

The first pair (9a-b), used to encode the vertical axis (10a-b), also encode high and low locations in topographic elevation (10c).[9] In addition, the terms encode directions with or against the direction of flow of watercourses. These are geomorphic references, rather than absolute in a narrow sense: e.g. toward the high country and upriver are anchored in the actual locations and directions invoked, independent of any abstraction or cardinal vector. The Ngan'gityemerri country is covered with a network of rivers and creeks of all sizes, and Ngan'gityemerri speakers make heavy use of *ganggi* and *warrifi* to encode directions invoking the drainage of those watercourses (9), (11) (Reid, 1990, p. 371). The drainage use of *ganggi* and *warrifi* does not simply refer to elevation, with watercourses descending from higher ground. Much of Ngan'gityemerri country is open plains with minimal incline. In this context, the directions referred to are anchored in drainage flow, not the location of higher country.

The watercourse system includes a third term, *dide-*, which encodes locations or directions across a watercourse. It does not refer to locations across any other boundary. It is highly grammaticized, occurring only with the instrumental enclitic (9c), see (11) clause 2.

[8]Hoddinott & Kofod (1988) represent the instrumental enclitic as *=ningki,* rather than Reid's (1990) *=ninggi,* and the 'high' term as *gangki* rather than Reid's *ganggi*. These are purely orthographic differences and Hoddinott & Kofod's data has been modified here for consistency.

[9]The status of the vertical axis in frames of reference is not crucial here. Data such as (10a-b) in this section and other sections below is given only to show that terms used for topographic elevation in geocentric FoR are those also used with the vertical axis.

(9) a. *ganggi* ‘high, above, upstream’
b. *warrifi* (NgW) / *apukek* (NgK) ‘low, below, downstream’
c. *dide-* (NgW) / *direr-* (NgK) ‘across river’

(10) a. *Mi-dirwi* *wannam-madi-way* ***ganggi***=*wurru.*
CL-green.plum 3PL.SUBJ.FEET.PFV-chest-thwart high=UNSATISFACTORY
‘They were unable to reach the greenplums, being so high.’ (Reid 1990, p.253)

b. *Keninggisyi=nide* ***warrifi*** *wibem* *meringgi.*
canoe=LOC low 3SG.SUBJ.PRES.lie shade
‘He’s lying in the shade **beneath** [lit. ‘…downward of] the boat.’ (Reid 1990, p.370)

c. *...fepi* *yerr-fenggu* *yerr-mulfang* *wirringe* *tyalak-tye* ***ganggi***.
rock CL-long CL-pointed 3SG.SUBJ.stand.PAST upright-PAST high
'…a long pointed stone stood **high up** [on the hill].' (Hoddinott & Kofod 1988, p.248)

(11) *Kamintyam* *dirr-**kin**=ninggi* *yana-minmi-ket=pe.*
K. TEETH-PROX=INSTR 2SG.SUBJ.FEET.IRR-elbow-cut=FUT
‘Turn off **on the nearside** [bank] of Kamintyam Creek,

Minbe *yani-kavarr* ***dide***=*ninggi,*
NEG 2SG.SUBJ.IRR.go-cross CROSS.RIVER=INSTR
Don’t cross **to the other side**,

*dirr-**kin**=ninggi* *yana-minmi-ket=pe*
TEETH-PROX=INSTR 2SG.SUBJ.FEET.IRR-elbow-cut=FUT
turn off **on this nearside**,

ganggi=*pe* *yana-minmi-ket=pe,*
upstream=FUT 2SG.SUBJ.FEET.IRR-elbow-cut=FUT
turn **upstream**

yumu-tyerr=pe *ba-wedi* *nyin.*
2SG.SUBJ.IRR.do-MOUTH=FUT arm-small ANAPH
and follow that little creek up.’ (Reid 1990, p.372)

3.1.4.2 Path of sun

Reid reports that two clauses referring to sunrise and sunset, “function in a minor capacity as compass directionals” (1990, p. 371, note 3), i.e. encoding solar east-west (12). These do not represent a cardinal system as they are not abstract vectors but explicitly invoke the path of the sun. Reid reports that they are rarely used and appear disfavored. No examples of context occur in the data, so it is not possible to assess how they fit structurally into the main clause.

(12) a. *mirri* *meng-ge-tet*
sun 3SG.SUBJ.PRES.HANDS.ITR-BELLY-arise
‘The sun comes up.’

b. *mirri* *yenim-dum*
sun 3SG.SUBJ.PRES.go-sink
‘The sun sinks.’

3.2. Wagiman

Wagiman is an isolate within the Australian family, with now only two remaining fluent speakers. The information here is drawn from discussions with Mark Harvey and more than 2200 pages of Harvey's recording transcripts, supplemented by discussions with Daniel Kraußе, and a 220-page dictionary (Anon, 2009) and three grammatical studies (Cook, 1987; S. Wilson, 1999; A. Wilson, 2006), all based on data collected at times when a larger number of speakers could be consulted. The data were collected mainly in Pine Creek, the largest settlement, as well as various other locations in Wagiman country.

Wagiman country features rock country with mesas, escarpments, bush, forest, springs, permanent rivers and creeks, seasonal creeks, permanent and seasonal billabongs. Seasonal wind directions are also salient.

3.2.1 Wagiman intrinsic

Intrinsic FoR on the transverse axis is not lexified in Wagiman. Intrinsic FoR on the sagittal axis is lexicalized with different lexical categories for the two directions: the region behind a ground object is encoded by a local noun (13a) (14a),[10] but the region in front is encoded by a coverb (13b) (14b). A second coverb seems to also encode "front" (13c) (14c), but Harvey (pers. com.) suspects this actually means "lead," rather than projecting a domain off a ground.

(13) a. *jumbany* 'area at the back of s.th., behind'
b. *yonggorn* 'be in front'
c. *jert-* 'go in front' (probably actually 'lead')

(14) a. *Barp-pa g-a-ni nganung* ***jumbany***.
hunker-NPFV PRES-3.SUBJ-be 1SG.OBL behind
'He is hunkering **behind** me.'

b. ***Yonggorn-na*** *m-i-ya nganung.*
be.in.front-NPFV IMP-2SG.SUBJ-go 1SG.OBL
'You go **in front** of me.'

c. ***Jert-ta*** *m-i-ya-ngga nganung.*
go.in.front-NPFV IMP-2SG.SUBJ-go-IRR 1SG.OBL
'You go **in front** of me.'

3.2.2 Wagiman relative

The relative transverse axis is not lexified in Wagiman. On the sagittal axis the same local noun *jumbay* "area behind" and coverb *yonggorn-* "be in front" seen in intrinsic FoR also operate in relative FoR, with facing alignment. *Jert-* is unattested in relative FoR.

[10]As in Ngan'gityemerri, Wagiman local nouns are defined by their ability to take ablative but not locative/allative case.

(15) a. *Magu* *yerdengh-a=giwu* *g-a-ba-yu=guju* *wir-laying* ***jumbany***.
FRDIST be.out.of.sight-NPFV=DU PRES-3.SUBJ-NSG-be=DU tree-LOC behind
'Them two are out of sight over there **behind** the tree.'

b. *Magu* *wir-laying* *g-a-yu* *dup-pa,* ***yonggorn****-a=wu.*
FRDIST tree-LOC PRES-3.SUBJ-be sit-NPFV be.in.front-NPFV=FOC
'She is sitting over there by the tree, **at the front** [i.e. speaker's side] [of the tree].'

3.2.3 Wagiman nearside-farside

Wagiman displays nearside-farside terms for domains and paths projected off the facet of a ground object closest to or furthest from the observer (16)-(17). As in Ngan'gityemerri, these involve proximal, near distal and far distal deictic forms, in this case with a suffix *-baban*. The suffix is glossed here as SIDE, but only occurs in these terms, and is confined to a domain projected off the relevant facet of the ground in the nearside-farside strategy.

(16)[11] a. *mayh-baban / banagan* 'on the near side of' (PROX-SIDE)
b. *muny-baban / muny-jaban* 'just on the far side of' (NRDIST-SIDE)
c. *magu-baban* 'a long way on the far side of' (FRDIST-SIDE)

(17) a. *Magu* *g-u-ya* *dup-ba-ma* *guda-laying* ***muny-baban***.
FRDIST PRES-2PL.SUBJ-go sit-NPFV-FOC fire-LOC NRDIST-SIDE
'Go and sit on **the other side of** the fire.'

b. A. *Ya-nggi* ***muny-baban*** *goron.*
[3SG.SUBJ]go-PAST NRDIST-SIDE house
'He has gone to **the other side of** the house.'

B. *Wihya* ***mayh-baban*** *g-a-ni.*
no PROX-SIDE PRES-3.SUBJ-be
'No he is **this side**.'

3.2.4. Wagiman geocentric

The geocentric FoR in Wagiman is expressed by four local nouns encoding two geomorphic axes, one elevational, one drainage-based (18). No cardinal terms are present in the language.

(18) a. *wolok* 'upper area, high country'
b. *munya(lan)* 'lower area, interior, low country'
c. *gangga(ran)* 'upstream'
d. *dubay/dubaran* 'downstream'

[11]The proximal and far distal forms include the deictic roots *mayh-* and *magu-* that occur in other morphological constructions. However, the near distal root *muny-* only occurs in this nearside-farside construction. In other constructions the near distal root *gayh-* occurs (see, e.g. the ablative forms *mayh-gunda*, *gayh-gunda* and *magu-gunda*). *Muny-* is perhaps connected historically with *munya* 'low, inside' (see below), although no elevation or containment is synchronically encoded.

3.2.4.1. Elevation

As in Ngan'gityemerri, terms referring to locations and directions on the vertical axis (19a-b) also encode a distinction between high country and low country, both in location descriptions (20) and directed motion descriptions (21). In addition to encoding low locations, *munya* has a topological meaning of containment (19c).

(19) a. *Darrp me-ge* ***wolok*** *lamarra-gunda!*
be.up 2SG.SUBJ-put[IMP] high dog-ABL
'Put it **up high** so the dogs won't get it!'

b. ***Munya****-ma wirin-laying ngonong-a yerri-ba,*
low-FOC tree-LOC do.like.that-NPFV shade-LOC
'**Underneath** the tree, like that in the shade,

wahan durdurt-da-yi ngonong-a, gahan
water run-NPFV-PAST do.like.that-NPFV there
water runs like that, there.'

c. *Warren* ***munya*** *g-a-yu goron-laying.*
child low PRES-3.SUBJ-be house-LOC
'The kid is **inside** the house.'

(20) a. *Galh-ma-yan ba-ya-ngga-jan danganyin g-a-ya* ***wolok****.*
climb-NPFV-IPFV NSG-go-IRR-PAST.HAB veg.food PRES-3.SUBJ-go high
'They used to climb up because there is tucker **in the high country**.'

b. ***Wolok*** *ng-a-ya-nggi wilh-ma…*
high PAST-1SG.SUBJ-go-PAST walk-NPFV
'I walked on top [along the cliff top]…

Lagiban-giwu wilh-ma ba-ya-nggi-guju ***munya****.*
man-DU walk-NPFV NSG-go-PAST-DU low
There were two men walking along **below**.'

(21) a. ***Wolok*** *ba-ya-nginy galh-ma, garradin.*
high NSG-go-? climb-NPFV hill
'They climbed **up** to the top, of the hill.'

b. *Galh-ma ng-a-ya-nggi, let ng-a-nanda-yi,* ***munyalan****,*
climb-NPFV PAST-1SG.SUBJ-go-PAST look PAST-1SG.SUBJ-see-PAST low
'I climbed up and looked **down**,

bawort ng-a-ge-ng, lahan.
look.over PAST-1SG.SUBJ-AUX-? country
and looked over the country.'

3.2.4.2. Drainage

Unlike Ngan'gityemerri, the Wagiman elevation terms do not also lexify a drainage-based axis. Instead, dedicated local nouns have this function, occurring in both location (22) and direction (23) descriptions. No cross-river term is attested.

(22) a. *Wahan buluman linyi-rra magu* ***gangga***.
rain big.one fall-PAST FRDIST upstream
'A big rain fell up there **upstream**.'

b. *Ngal-marttiwa gahan* ***dubay*** *g-a-yu.*
female-old.woman that downstream PRES-3.SUBJ-be
'That old woman is **downstream**.'

(23) a. ***Gangga*** *ba-ya-nggi.*
upstream NSG-go-PAST
'They went **upriver**.'

b. *Magu* ***dubay*** *g-a-ba-ya.*
FRDIST downstream PRES-3.SUBJ-NSG-go
'They are going **downriver**.'

3.3. Kamu

Kamu is an extinct language of the Eastern Daly family. The only source material on the language is an unpublished sketch grammar (Harvey, 1990), based on work with the last individual with "any significant knowledge" of the language (Harvey, 1990, p. 7). This does not include any description of spatial language and contains only minimal relevant data. The data collection location is unknown. However, it was almost certainly not on Kamu country, as the Kamu language community had largely moved off their country to the area of Adelaide River town by the 1920s. Kamu country includes various rivers and river valleys including the Daly, Reynolds, and Fish Rivers. There are also billabongs (Fish Billabong) and mountains (Mt Hayward). No other topography is mentioned by Harvey (1990).

3.3.1. Kamu intrinsic

The limited Kamu data contains one attestation of intrinsic FoR on the sagittal axis (24), with the terms *nguwerem* "in front" and *ngunjiba* "behind."[12] The Kamu data contain no evidence of the intrinsic transverse.

(24) ***Nguwerem****=ning.girri nung.gurr-ma.*
front=2AUG.SUBJ.go.SBJV 2-??
'You lot go **in front**.

Ngerru ***ngunjiba*** *garruy-in.*
1AUG behind 1AUG.SUBJ.go.FUT-HITHER
We will come **behind**.' (Harvey 1990, p.64)

3.3.2 Kamu relative

The Kamu data contains no evidence of relative FoR in either the sagittal or transverse axes.

[12]The data is insufficient to determine whether these are local nouns, however the lack of overt case is consistent with that status or that of adverbs.

3.3.3. Kamu nearside-farside

The Kamu data contains no evidence of nearside-farside terms.

3.3.4. Kamu geocentric

As in Ngan'gityemerri and Wagiman, the Kamu data contains evidence of an elevational system, lexified here by *wuluk* "high" and *wupetjeng* "low." These encode the vertical axis (25) and the distinction between high and low country (26).[13]

(25) *Guyu* *darrp-ma* ***wuluk***.
3MASC.SUBJ.lie.PRES hang-IPFV high
'It is lying hanging **up high**.' (Harvey 1990, p.49)

(26) *Wertma* ***wupetjeng***-*ba* *ga=arrayn.*
NEG low-PERG come=1AUG.SUBJ.AUX.PAST.PRF
'No we came by **the low** [road].' (Harvey 1990, p.33, cf. Harvey 1990, p.41)

3.4. MalakMalak

Today, only five speakers remain of this language of the Northern Daly family. MalakMalak data are from field notes of spatial language data collection (Hoffmann, n.d.a.), spatial descriptions (Hoffmann, 2013, 2019), and a dictionary (Lindsay et al. 2017). Data were collected mainly at Wooliana, a small settlement near Nauiyu Nambiyu (Daly River Mission). MalakMalak country is dominated by the tidal Daly River. The land includes bush, forest, springs, hills and mountains, permanent rivers, and creeks, seasonal creeks, permanent and seasonal billabongs, and floodplains. Seasonal wind directions are also salient, with winds blowing from the inland southwest to northwest during the dry season, and winds blowing from the sea northwest to southeast during the wet season.

3.4.1 MalakMalak intrinsic

Intrinsic FoR on the sagittal axis is lexicalized in MalakMalak by nouns encoding the regions in front of and behind a ground object (27), (28).

(27) a. *elimiri* 'in front'
b. *angun(du)* 'behind'

(28) a. ***Elimiri*** *wabag-ali* *e-nu* *pawurrk.*
in.front put-PART 1SG.SUBJ-sit.PAST ground
'I put it **in front** [of me] on the ground.'

b. *Tjung* ***angundu***-*na* *mu-yu.*
tree behind-LOC 3SG.NEUT.SUBJ-stand.PAST
'The tree stood **behind** [the man]'

[13]It is not possible to determine from the data whether or not these terms are grammaticized as local nouns, however, the presence of the pergressive suffix *–ba* in (26) indicates they are nouns of some sort. This is not inconsistent with status a local nouns, as the pergressive in Ngan'gityemerri occurs with local nouns, even stacking with the ablative.

Unlike in Ngan'gityemerri and Wagiman, and as far as can be determined, Kamu, the transverse axis is lexicalized in MalakMalak. Coverbs encode regions to the intrinsic left or right of a ground object (29), (30).[14] This occurs infrequently in the data, even in spatial elicitation tasks such as Ball and Chair.

(29) a. *tjalmiyiny* 'right, straight'
b. *yanbarr* 'left'

(30) *Pi* *e-nue* ***yanbarr**-en.*
go 1SG.SUBJ-sit.PRES left-DIR
'I go **left**.'

3.4.2. MalakMalak relative

The sagittal and transverse terms employed with intrinsic FoR also apply in relative FoR in MalakMalak, the sagittal (31) with the facing strategy and the transverse (32) with the aligned strategy. Again, the transverse occurs infrequently in the data, but is attested more often in relative FoR than in intrinsic FoR.

(31) a. *Wuendueny* ***elimiri*** *wu-yu* *chair=we.*
3SG.NEUT in.front 3SG.NEUT.SUBJ-stand.PAST chair=FOC
'The chair is **in front** [of the ball].'

b. *Nga=we* ***angundu*** *yi-de* *yinya.*
1SG=FOC behind 3SG.MASC.SUBJ-go/be.PRES man
'For me, the man is **behind** [the cow].'

(32)[15] a. *Yerra* ***tjalmiyiny*** *dek* ***kanjuk*** *purrat-ma* *wuta.*
PART right/straight place high jump-CONT 3SG.NEUT.SUBJ.go.PAST
'Now it [the ball] is **on the right** [of the chair, from my perspective], jumping **up**.'

b. ***Yanbarr**-en* *mu-yu* *mi* *nende.*
left-DIR 3SG.NEUT.SUBJ-stand.PAST veg.food thing/person
'The food is **towards the left**.'

c. *Futbol=we* *tjin* ***tjalmiyen**-many=na* *wu-yu.*
football=FOC bottom right/straight-ABL=FOC 3SG.NEUT.SUBJ-stand.PAST
'The football is at the bottom **on the right hand side** [of the chair, from my perspective]'

3.4.3. MalakMalak nearside-farside

As with Wagiman and Ngan'gityemerri, MalakMalak employs terms denoting domains projected off facets of the ground closest to and furthest from the observer (33), (34). In MalakMalak these are nouns bearing additional obligatory suffixes adding deictic orientation toward or away from the observer.

[14]The transverse coverbs also occur as nouns. The sagittal and transverse nouns do not appear to be local nouns as they display the same case properties as other common nouns.

[15]These examples are not intrinsic projections from the ground's own left and right. In (32a), for example, the ball is in front of the chair's intrinsic front in the stimulus photograph (Hoffmann 2013, p. 3).

(33) a. *ki-na-nggi* 'on nearside, facing towards observer' (PROX-LOC-HITHER)
b. *ki-na-ngga* 'on nearside, facing away from observer' (PROX-LOC-THITHER)
c. *ngun-na-nggi* 'on farside, facing towards observer' (DIST-LOC-HITHER)
d. *ngun-na-ngga* 'on farside, facing away from observer' (DIST-LOC-THITHER)

(34) ***Ngun-na-nggi-na*** *wu-yu* *duk* ***puyunduk***.
DIST-LOC-HITHER-LOC 3SG.NEUT.SUBJ-stand.PAST place low
'It [the ball] was **on the far side** [of the chair], **underneath**.

Ki-na-ngga *wue-de* *chair=we.*
PROX-LOC-THITHER 3SG.NEUT.SUBJ-go/be.PRES chair=FOC
The chair is **on near side** [of the ball].'

3.4.4 MalakMalak geocentric

MalakMalak has four sets of terms encoding directions in geocentric FoR, encoding: elevational and drainage axes, seasonal wind directions, and solar east-west.

3.4.4.1 Elevation

The vertical axis and geomorphic elevation are encoded by a pair of nouns (35a-b) and a pair of coverbs (35c-d).

(35) a. *kantjuk(-en)* 'top, high place, Top End'
b. *puyunduk(-en)* 'bottom, low place'
c. *karrarra* 'go up'
d. *tjalk* 'go down'

(36) a. ***Karrarr*** *a-da* *walk-na* ***kantjuk*** *dat* *a-ya.*
go.up 1SG.SUBJ-go/be.PAST rock-LOC high look 1SG.SUBJ-do.PUNC
'I climbed [lit. **went up**] the mountain and look around.'

b. *Dek-yingga* *pi* *nu-nu* ***puyunduk*** *ngun…*
place-LOC move 2SG.SUBJ-sit.PAST low DIST
'You sit down in that place **down** there…'

3.4.4.2. Drainage

A pair of nouns encodes geomorphic directions with or against the direction of flow of watercourses (37), (38), and by extension, the mouth and high country source respectively of the Daly River. The nouns themselves are common nouns referring to the body parts "throat" and "foot." However, when marked with the directional suffix *-en* "DIR", they derive their FoR meanings.[16]

[16]Directions toward a location are encoded in MalakMalak with either the locative/allative case suffix *-yinnga/-na(na)* or the directional case suffix *-nen/-(y)en*. The locative/allative suffix encodes a static location or endpoint of a telic motion event. The directional case suffix encodes the direction of an atelic, ongoing or future motion event or of orientation.

(37) a. *menyik-en* 'upstream' (lit. 'throat-DIR')
b. *matjan-en* 'downstream' (lit. 'foot-DIR')

(38) a. ***Matjan-en*** *ka* *wu-da.*
foot-DIR come 3SG.NEUT.SUBJ-go/be.PAST
'It came **downstream**.'

b. *Wendi-wang* *p-e-nung=ga* ***menyik-en***.
canoe-INSTR move-1SG.SUBJ-go/be.FUT=THITHER throat-DIR
'I will go **upstream** with the canoe.'

3.4.4.3. Seasonal wind

The MalakMalak wind-based system involves seasonal wind directions prevailing in the wet and dry seasons, respectively. As with the drainage terms, these are nouns that derive their directional meaning when suffixed with the directional *-en* (39). The term *nuly* refers to the wind that blows in the wet season from the sea in the northwest toward the southeast, while *dangid* refers to the wind that blows in dry season in the opposite direction from the inland in the southeast toward the northwest. The derived directional terms do not encode the direction of the wind itself, but a direction toward the source of the wind. These terms are absolute in the strict sense, as they encode directions on an abstracted axis running from the northwest source of the wet season wind to the southeast source of the dry season wind. These terms are only used in motion event descriptions (40a) or orientation descriptions (40b) and cannot be used to describe locations.

(39) a. *nuly-en* 'towards source of wet season wind' (lit. 'NWwind-DIR')
b. *dangid-en* 'towards source of dry season wind' (lit. 'SEwind-DIR')

(40) a. *Keen* *p-e-nung-ga* ***dangid-en***.
PROX move-1SG.SUBJ-go.FUT-THITHER SEwind-DIR
'I, myself will go there **towards *dangid*** [i.e. the southeast].'

b. ***Nuly-en*** *pud-ang* *tjed-ali* *yu-yu*
NWwind-DIR chest-give stand-PART 3SG.MASC-stand.PAST
'He is facing **the *nuly* direction** [i.e. the northwest].'

3.4.4.4. Path of sun

The solar-based system includes the phrases *miri(-nen) pai-ka* "sunrise; east" (lit. "sun(-DIR) change.location-come") and *miri(-nen) tjalk* "sunset; west" (lit. "sun(-DIR) go.down").[17]

[17]A third, [*miri(-nen) kantjuk*] "zenith; midday; north" (lit. "sun(-DIR) be.on.top") is not attested outside of elicitation.

(41) a. ***Miri tjalk-ma*** *wuru-ma* *wu-ta*
sun go.down-CONT stand-CONT 3PL.SUBJ-go/be.PAST
'They were standing [where] the sun sets [i.e. west of here].'
(Not also *'They were standing and the sun set/was setting.')

b. *Yinya nende dangid-en pud wu-runguny,*
man thing/person SEwind-DIR chest 3PL.SUBJ-go/be.IPFV
'The men are facing towards the southeast wind direction,

miri-nen pai-ka-ma.
sun-DIR change.location-come-CONT
towards where the sun comes up.'

3.5. Matngele

Matngele, is an extinct language of the Eastern Daly family, the other member being Kamu (§3.3). Matngele spatial data are very limited. The data used here were collected by Harvey (MH) (Harvey n.d.a) in the 1980s and 1990s when there were still several fluent speakers, and by Crocombe in 2010 (Crocombe, n.d.) and Hoffmann (DH) in 2014 (Hoffmann, n.d.b.). Zandvoort (1999, pp. 47–49) discusses demonstratives briefly. All Zandvoort's relevant spatial data are from Harvey's field notes, so examples are identified here by their MH reference. Matngele is traditionally associated with the country surrounding Hermit Hill in a region extending from Fish Billabong (Gumani) to the Dilk Range, bordered in the north by the Daly River (Harvey 1989, p. 7; Zandvoort, 1999, pp. 1–2). However, during the 20th century Matngele speakers relocated to locations outside their country, principally Wooliana. All relevant spatial data were collected at Wooliana.

Matngele country includes bush, forest, springs, hills and mountains, permanent rivers, and creeks (including the Daly), seasonal creeks, permanent and seasonal billabongs, and floodplains. As in MalakMalak country, the same seasonal wind directions are salient.

3.5.1. Matngele intrinsic

The intrinsic sagittal axis in Matngele is lexified by local nouns *nguwerem* (MH)/*ngurem* (DH) "front" and *ngunyuwa* "back" (42).[18]

(42) a. *Wangari pu-enyu* ***nguwerem***.
2MIN go-2MIN.SUBJ.go[IMP] front
'You go **in front**.' (MH326)

b. *Gay-burrutak-awa* ***ngunyuwa****-rdiyn.*
yell.out.to-3AUG.SUBJ.stand-1MIN.OBJ behind-ABL
'They yelled out to me from **behind**.' (MH357)

[18]These terms take ablative case but are not attested with locative or allative, consistent with status as local nouns.

Terms for left hand (*janbar*) and right hand (*jadmar*, also "straight") are unattested with a projective function, so there is no evidence that the transverse is lexified, with one possible exception. Harvey's field notes contain one occurrence of *janbar* "left hand" (43). The presence of allative case is consistent with the term projecting a domain; however, the absence of a context (or even free translation) for this data fragment renders it inconclusive.

(43) ***janbar**-yin*
left.hand-ALL (MH155)

3.5.2. Matngele relative

There is no evidence in the limited Matngele data of sagittal or transverse terms used in relative FoR.

3.5.3. Matngele nearside-farside

Like Ngan'gityemerri, Matngele constructs a set of "nearside"/"farside" terms by marking the proximal and distal deictic nouns *ngin* "this, here" and *ngun* "that, there" with a suffix *–ini* that closely resembles instrumental case *-ni*.

(44) *Nguru yuru-**ngin-ini** guritj-yin-ayanggak,*
1MIN ground-this-INSTR go.around-HITHER-1MIN.SUBJ.go.PAST
'I came around **this side** [of the billabong],

*guna-ma **ngun-ini** yuru-**ngun-ini**.*
3MIN-FOC that-INSTR ground-that-INSTR
he [went] **that side**.' (MH191)

3.5.4. Matngele geocentric

Geocentric FoR in Matngele is attested with directional terms colexifying the geomorphic elevational and drainage axes with the vertical axis. Two further sets of terms invoking seasonal prevailing winds and solar east-west also appear to occur corresponding to the MalakMalak equivalents, but no data is attested exemplifying this.

3.5.4.1. Elevation/drainage

The Matngele terms *wuluk* "high, high country, upstream" and *wubajang* (MH)/*wupetjeng* (DH) "low, low country, downstream" lexify the vertical axis (45), high versus low country (46), and upriver versus downriver (47). These alternate with the body part terms *meny* "throat" and *mar* "foot," which when marked with allative case indicate directions corresponding to *wuluk* and *wupetjeng* (48) (47B-C).

(45) *Yim-yende* ***wuluk*** *pakma wapam purrangak.*
tree-LOC high sit put 3AUG.SUBJ.go.PAST
'They put them **up** in the tree.' (MC10_A02_07.132)

(46) a. A. *An ga anyanggak jal* ***wuluk****.*
where come 2MIN.SUBJ.go.PAST road high
'You came by the **top** road.'

B. *Daka jal* ***wubajang*** *guyu-yu,*
NEG road low 3MIN.SUBJ.lie.PRES-?
may-u ga ayanggak
that-SPEC come 1MIN.SUBJ.go.PAST
'No, I came by that **bottom** road.' (MH163)

b. ***Wuluk*** *pui karar kawayak.*
high go climb 1MIN.SUBJ.go.FUT
'I went **up to the top** [of the hill].' (DH15 A18 02)

(47) A. *Ngun an-yin puy purany?*
DIST where-ALL go 3AUG.SUBJ.go.PRES
'Where are that lot going?'

B. *Ngun berder* ***wuluk****-yin puy purany,* ***meny-gin****.*
DIST river high-ALL go 3AUG.SUBJ.go.PRES throat-ALL
'They are going **upriver**, in **front**.'

C. ***Mar-yin****.*
foot-ALL
'[No, they are going] **downriver**.' (MH143)

(48) a. *Puy purunggak* ***meny-gin****.*
go 3AUG.SUBJ.go.PAST throat-ALL
'They went **higher up**.' (MH184)

b. *Puy purunggak* ***mar-yin****.*
go 3AUG.SUBJ.go.PAST foot-ALL
'They went **lower down**.' (MH215)

3.5.4.2. Seasonal wind

The Matngele wind-based system resembles MalakMalak, with nouns distinguishing the wet season wind from the northwest, *kurruwa* "towards source of *kurruwa* wind (northwest)," and the dry season wind from the southeast, *dangarr* "towards source of *dangarr* wind (southeast)." These appear to be used with a directional function similar to the corresponding MalakMalak terms, but no clear data demonstrates this.

3.5.4.3. Path of sun

The Matngele solar terms also resemble and correspond to the MalakMalak terms, with a similar phrasal structure. No clear data exemplify their directional use. The Matngele terms are *muerrue karrarr-ka* "sunrise; east" ("sun go.up-?") and *muerrue tjalk* "sunset; west" ("sun go.down"), with *muerrue wuluk* "zenith; ?midday; north" ("sun be.on.top") also attested.

3.6. Summary of data

Languages in the sample region make heavy use of elevational and drainage geocentric systems, along with intrinsic FoR on the sagittal axis, and a nearside-farside system. In the northwestern part of the sample region, heavy use is made of a referential system encoding dominant seasonal winds. Table 2 summarizes the findings.

All five languages employ intrinsic FoR on the sagittal axis. The transverse axis is considerably more marginal, known to occur only in MalakMalak, and known to not occur in Ngan'gityemerri and Wagiman. The situation in Kamu and Matngele is unknown.

Relative FoR is less widely attested, and where present, appears to be more rarely employed. The intrinsic sagittal terms are also employed in relative FoR in MalakMalak and Wagiman, but not in Ngan'gityemerri, with the transverse axis only employed in MalakMalak. Again, the situation in Kamu and Matngele is unknown, but as relative FoR is not attested in the limited data it can be assumed that if present, it is considerably less frequent in those languages. It is perhaps significant that the language for which relative FoR is most securely attested, along with the transverse axis in both relative and intrinsic, is MalakMalak, the only language in our sample for which focused research on spatial language using targeted elicitation methods has been carried out. It is also significant in terms of wider claims about Australian languages that the relative sagittal axis occurs in the present sample much more widely than the transverse, both across languages, and in frequency where it does occur. Claims of the absence of relative FoR in Australian languages often invoke the absence of projective left-right terms as evidence, leaving open the possibility that it is unreported in languages where it occurs but only on the sagittal (see §2.3).

Four of the five languages are known to employ a nearside-farside system, with no attested cross axis. The situation with Kamu is unknown. The languages display interesting variations, with Ngan'gityemerri adding a distinction between near and far distal on the farside, and MalakMalak adding a distinction of orientation facing toward or away from the deictic center in both the nearside and farside terms.

In geocentric FoR, none of the five languages make use of the type of abstract cardinal system widely held to typify Australian languages. Terms for the solar east-west are attested in three of the languages, but are extremely marginal in use, and only weakly lexicalized or grammaticized, all transparently referring to the rising and setting of the sun. In a region dominated by broad low-lying country bearing large permanent rivers punctuated by mesas and escarpments, spatial reference is dominated by elevational and drainage systems, supporting the Topographic Correspondence Hypothesis (Palmer, 2010, 2015). All five languages extend terms for the vertical axis to encode a distinction between high country and low country, both in overall altitude, and in immediate higher and lower locations, with no attested cross axis. All but Kamu are also known to encode an upriver-downriver axis, both in the overall direction of flow across the country, and actual direction of flow in the immediate riverine setting. The situation with Kamu is unknown. Two of the languages distinguish lexically between the elevational and drainage systems, and two colexify them. Finally, two languages in the northwest of the target region, MalakMalak and Matngele, employ a seasonal wind-based system of a type that does not seem to have been previously reported.[19] While a shifting seasonal upwind-downwind system is reported elsewhere (e.g. Kala Lagaw Ya: Bani, 2001, p. 477; Stirling, 2010), that system encodes an upwind-downwind distinction that switches direction when the seasonal prevailing winds switch direction. The MalakMalak and Matngele system instead invokes directions associated with the two seasonal winds that remain fixed at all times of the year: a fixed direction toward the source of the dry season wind and a fixed direction toward the source of the wet season wind. This in effect constitutes an absolute northwest-southeast axis that can be deployed at any time. However, they are not cardinals as they explicitly invoke the seasonal winds. It is not known at this stage whether seasonal winds are more salient in the regions in which MalakMalak and Matngele are spoken than in the other language areas, or whether their distribution does not correlate with an environmental difference.

4. Conclusions

Indigenous languages of Australia are widely held to encode abstract cardinal representations in projective space rather than egocentric or even geomorphic projections. Referential systems encoding aspects of the topographic environment, however, remain substantially under-investigated. This article investigates systems of projective spatial reference across a fragment of the Australian continent containing five languages for which data of diverse types, qualities

[19]Brown (1983, pp. 132–133), however, identifies wind names as a source of what he regards as cardinal direction terms in several languages (none Australian), principally for “north” and “south”.

and quantities exist (a sixth language lacked any source material with spatial information). The study focused on the extent to which: a) egocentric systems are encoded; and b) linguistic spatial representations invoking the environment occur.

Features of linguistic systems were investigated following an adapted classification of referential types and subtypes of projective space. Four strategies for projective space were recognized. Three comprise standard frames of reference used in descriptions of linguistic spatial systems: intrinsic, relative (i.e. egocentric extrinsic), and geocentric (i.e. allocentric extrinsic, including the well-known absolute FoR as well as geomorphic and landmark-based systems). The fourth is an under-investigated system involving projections off the nearside and farside of a ground object (a "SAP-landmark" strategy, see §2.2.3). For intrinsic and relative frames of reference, the sagittal (front-back) and transverse (left-right) axes were classified separately, in order to capture the differential encoding of these axes (e.g. some languages encoding only sagittal and not transverse). This required developing a new classification of relative FoR, separating subtypes on the basis of each axis separately, rather than the standard typology in which both axes are taken together – the standard typology therefore being unable to classify systems in which only one axis is present, or capture shared characteristics of pairs of the traditional categories.

Information on the spatial systems of the target languages was extracted from source materials on each language. Information on each type and subtype was not available for every language in the sample, but meaningful comparisons were possible across those languages where a specific type or subtype was represented in the data.

The results of the study revealed the use of intrinsic FoR on the sagittal axis in all five languages, but the intrinsic transverse axis attested in only one and known to be absent in two.

The nearside-farside system is also attested in all four languages for which sufficient data exists. Relative FoR is usually understood to be largely absent from Australian languages. Our findings reveal instead that FBLR relative is present in two of our sample languages and known to be absent from only one. Again, sagittal is more widely employed, present in both languages in which FBLR relative is attested, with the relative transverse only occurring in one language. This is crucial as the claimed absence of relative FoR in Australian languages is often based on the absence of projective left-right terms, allowing the possibility that relative FoR is under-reported in languages where it occurs but only on the sagittal. Overall, the distribution of FBLR relative in our sample supports the view that is it not universal in Australian languages, but that it is significantly more widespread than usually recognized.

In geocentric FoR, the abstract cardinal system widely held to typify Australian languages is absent from all five languages. Instead of abstracted absolute systems in

the narrow sense of absolute, all five languages display geomorphic systems invoking local topography: all five display an elevational system distinguishing high country from low country, and all four for which sufficient data exists display a river drainage system with an upriver-downriver axis, correlating with a topography dominated by low country bearing large rivers interspersed with mesas and escarpments. A true absolute system is only found in two languages. However, these are not cardinals but explicitly invoke an environmental feature in the form of dominant seasonal wind directions. A system associated with the path of the sun is attested in three of the languages, but is extremely marginal in use, and only very weakly lexicalized or grammaticized, all transparently referring to the rising and setting of the sun. In all languages in the sample, multiple geocentric systems co-occur in which several geomorphic and in two cases also absolute (but non-cardinal) systems are available to speakers. On the basis of these findings, we predict that the saliency of features of the physical environments in which humans live, mediated by the nature of individual and group-level interactions with those environments, correspond to spatial systems that invoke readily accessible anchors in geomorphic and landmark-based systems, supporting both the Topographic Correspondence Hypothesis (Palmer, 2010, 2015) and the Sociotopographic Model (Gaby et al. 2021; Lum et al. 2021; Palmer et al. 2017, 2018a, 2018b). Where true absolute systems occur, they may involve explicit abstractions from environmental features such as dominant winds or watercourse trajectories, rather than a default geocentric system of abstract cardinals. On the basis of the findings presented here, we predict that humans will make use of multiple geocentric systems, invoking whatever salient environmental features present themselves as handy devices for anchoring spatial representations.

5. Future directions

With larger scale work now underway, we intend to test predictions arising from the study reported here against as many languages across Australia for which sufficient data exists, or can be developed by our research team (Palmer et al., 2019). The overarching goal of this larger research, dubbed the *OzSpace project*, is to test wider hypotheses about the extent to which human interaction with the physical environment shapes linguistic and conceptual representations of space, and the extent to which such interactions are mediated by sociocultural factors.[20] This project will test for the effects of topography on linguistic spatial systems by testing for correlations between features of linguistic systems and salient aspects of the topography of the language locus, following the Topographic Correspondence Hypothesis (Palmer, 2010, 2015). Drawing on the notion of Sociotopography (Gaby et al., 2021; Lum et al., 2021; Palmer et al., 2017, 2018a, 2018b) it will also investigate the extent to which

[20]We are grateful to the Australian Research Council for funding under DP200101079 supporting the OzSpace project.

Table 2. Data summary.

	Ngan'gi.	Wagiman	Kamu	Matngele	MalakMalak
intrinsic sagittal front	*fangu*	*jumbany*	*nguwerem*	*nguwerem/ngurem*	*elimiri*
intrinsic sagittal back	*syirre*	*yonggorn-*	*ngunjiba*	*ngunyuwa*	*angun(du)*
intrinsic transverse left	x	x	?	?	*yanbarr*
intrinsic transverse right	x	x	?	?	*tjalmiyiny*
relative sagittal front	x	*jumbany*	?	?	*elimiri*
relative sagittal back	x	*yonggorn-*	?	?	*angun(du)*
relative transverse left	x	x	?	?	*yanbarr*
relative transverse right	x	x	?	?	*tjalmiyiny*
nearside	*kin=ninggi*	*mayh-baban /banagan*	?	*ngin-ini*	*ki-na-nggi, ki-na-ngga*
farside (near distal)	*werrfe=ninggi*	*muny-baban*	?	*ngun-ini*	*ngun-na-nggi, ngun-na-ngga*
farside (far distal)	*wun=ninggi*	*magu-baban*	?	*ngun-ini*	*ngun-na-nggi, ngun-na-ngga*
high/up	*ganggi*	*wolok*	*wuluk*	*wuluk/meny-gin*	*kantjuk(-en), karrarra*
low/down	*warrifi/apukek*	*munya(lan)*	*wupetjeng*	*wubajang/wupetjeng/ mar-yin*	*puyunduk(-en), tjalk*
high country	*ganggi*	*wolok*	*wuluk*	*wuluk/meny-gin*	*kantjuk(-en), karrarra*
low country	*warrifi/apukek*	*munya(lan)*	*wupetjeng*	*wubajang/wupetjeng/ mar-yin*	*puyunduk(-en), tjalk*
upstream	*ganggi*	*gangga(ran)*	?	*wuluk/meny-gin*	*menyik-en;*
downstream	*warrifi/apukek*	*duba(y)(ran)*	?	*wubajang/wupetjeng/ mar-yin*	*matjan-en*
across river	*dide-/direr-*	?	?	?	x
NWwind	x	x	?	*?kurruwa*	*nuly-en*
SEwind	x	x	?	*?dangarr*	*dangid-en*
toward sunrise	*?mirri meng-ge-tet*	?	?	*?muerrue karrarr-ka*	*miri(-nen) pai-ka*
toward sunset	*?mirri yenim-dum*	?	?	*?muerrue tjalk*	*miri(-nen) tjalk*
toward zenith	?	?	?	*?muerrue wuluk*	*miri(-nen) kantjuk*

socio-cultural factors mediate between individuals and their environment in constructing representations of space, by investigating the relationship of spatial language with the culture, lifestyle, and habitual activities of the speaker community, including individual speakers' spatial strategy preferences correlated with demographic factors (occupation, age, education, gender, etc.), as well as community-level cultural factors (e.g. dominant subsistence mode), typically as proxies for how individuals engage with their environment.

This larger project will test traditional wider claims about the theoretical significance of spatial reference in Australian languages against a broad set of data. While we intend to test the predictions outlined in this article against Australian languages more widely, we anticipate that those predictions may hold beyond Australia in spatial linguistic systems elsewhere in the world.

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