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How does the environment shape spatial language? Evidence for sociotopography

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Abstract: This article investigates the extent to which the way individuals describe spatial relationships correlates with features of the local landscape. Drawing on empirical data from two unrelated languages, Dhivehi (Indo-Aryan) and Marshallese (Austronesian), across a range of topographic environments, we examine the linguistic resources available to speakers, and spatial referential strategy preferences across languages and environments. We find that spatial language shows sensitivity to features of the topography, but this is mediated by the way speakers interact with the landscape. This leads us to propose a Sociotopographic Model, modelling the complex interplay of language structure, local environment, cultural practices, and language use, at odds with competing claims about the primacy of language or of environment in shaping spatial cognition.

Keywords: Dhivehi, Marshallese, spatial language, topography

1 Introduction

To get to the store, do you turn left at the post office? Or south, or lagoonward, or upriver, or downwind, or inland? The answer will depend on where in the world you are, as well as what language you speak, and how you and your community

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interact with your environment. Considerable diversity in spatial reference across languages is well attested (Levinson 2003; Levinson & Wilkins (eds.) 2006). Different languages have been shown to favour or even require the use of different Frames of Reference (FoR), for example. A FoR is a strategy for assigning an asymmetry to a scene so that one object (a "figure") can be located in relation to another (a "ground") on the basis of a coordinate system fixed to a particular "anchor". Three FoRs are established, following Levinson (1996, 2003), Majid et al. (2004), etc.: intrinsic, relative, and absolute. In the intrinsic FoR the coordinate system is anchored in the ground object on the basis of a perceived intrinsic asymmetry in the facets of that object itself (e.g., *in* FRONT *of the chair*). In the relative FoR the coordinate system is anchored in the location of a viewpoint (e.g., *in front of* [i.e., on the viewer's side of] *the post*). Absolute FoR invokes a set of coordinates imposed on the scene (e.g., *west of/inland from the house*), with the anchor in those external coordinates (e.g., the west, the inland). Within each FoR further diversity also exists across languages. These and other strategies for spatial reference can also be divided into those which are egocentric, such as those invoking participants in the speech event as landmarks or through the relative FoR (e.g., *on my side of/in front of the post*), and those which are geocentric, invoking features of the external world, either through the absolute FoR, or through reference to landmarks (e.g., *downriver/towards the coast from the village*) (e.g., Bohnemeyer & Tucker 2013: 640–641; O'Meara & Pérez Báez 2011: 839–843).

The fact that absolute FoR and other geocentric strategies seem to invoke topography and other aspects of the external world suggests that the environment plays an important role in shaping spatial concepts. However, the extent to which the environment determines or at least influences FoR choice is heavily contested. Levinson and collaborators have argued for the primacy of linguistic categories and other largely arbitrary cultural choices in shaping spatial thinking (e.g., Levinson 1996, 2003; Majid et al. 2004; Pederson et al. 1998), with a shared linguistic system coercing speakers' conceptual systems into shared directions (Levinson 1992: 25). Others argue that FoR choice is largely determined by the immediate physical environment (Li & Gleitman 2002; Palmer 2002; Pinker 2007), in particular whether or not we have visual access to salient landmarks (Li & Gleitman 2002). More recently, some scholars have proposed an intermediate position, acknowledging that while FoR choice cannot be fully predicted by the environment, the environment appears to play some role (e.g., Bohnemeyer et al. 2014; Dasen & Mishra 2010).

In this article we report on findings of a study investigating spatial language in two atoll-based languages, Marshallese (Austronesian; Marshall Islands) and Dhivehi (Indo-Aryan; Maldives). Our study was designed to test hypotheses about the role of the physical environment in shaping spatial language, with

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the objective of modelling the interplay of factors involved in the conceptual representations of space, including human responses to salient features of the external environment, sociocultural interaction with the environment, and linguistic resources available to speakers to refer to spatial relationships.

2 The role of the environment in shaping spatial cognition

In perhaps all languages some spatial concepts are lexicalized or expressed in a grammaticized way, while others are relegated to periphrastic expression. Grammatical and lexical systems provide a window on what is conceptually "important" to speakers, what is frequently mentioned, and the structure of conceptual representations (see, e.g., Enfield 2002; Heine 1997; Lucy 2011; Talmy 1983). These lexicalized and grammaticized expressions are key to understanding the extent to which spatial reference displays universal tendencies, and the extent to which variation is systematic.

Although languages display considerable diversity in spatial reference, some systematicity and widespread tendencies can be detected, and salient landscape and other external-world features appear to play a role. The physical environment of a language locus may emerge in language through reference to landmarks, Frame of Reference choice, and the structure and semantics of systems invoking absolute Frame of Reference. Salient aspects of the environment appear to correlate with the detail of systems involving absolute FoR (e.g., Dasen & Mishra 2010: 307; Palmer 2002, 2015), and with FoR choice (Bohnemeyer et al. 2014), with a correlation between relative FoR and urban environments observed (Dasen & Mishra 2010: 116–117, 307–309; Majid et al. 2004: 112; Pederson 1993, 2006; Pederson et al. 1998). Geocentric spatial reference, including the use of absolute FoR as well as topographic landmarks, invokes aspects of the external world, suggesting that linguistic systems are responsive to the environment in which a language is spoken. This relationship between environment and spatial language has been formulated by Palmer (2015) as a Topographic Correspondence Hypothesis (TCH), which predicts that aspects of linguistic spatial systems will correlate with salient features of the physical environment in which a language is spoken. By testing this hypothesis against actual linguistic spatial systems in their physical environments, TCH reveals those aspects of individual spatial systems that do correlate with the environment, and those that do not, allowing for conclusions on the extent to which correlations with environment can account for aspects of spatial reference that are universal or that vary in systematic ways.

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3 Sociolinguistic variation in spatial reference

Although some correlations are evident between the environment and linguistic spatial systems, those aspects of the environment that are perceived as salient can vary across cultures. Moreover, the way humans interact with their environment influences their use of spatial language, as seen in demographic variation within individual languages in FoR choice (e.g., Pederson 1993), and in geocentric versus egocentric strategies more generally (Palmer et al. 2016). Previous work on Frames of Reference has tended to focus on demonstrating crosslinguistic diversity (e.g., Levinson & Wilkins (eds.) 2006; Majid et al. 2004), or on arguing for or against linguistic relativity (e.g., Levinson 2003; Levinson et al. 2002; Li & Gleitman 2002; Majid et al. 2004). By contrast, sociolinguistic variation in FoR choice among speakers of the same language has received less attention. However, what work has been done shows that sociolinguistic factors can play a role.

In some cases, different patterns of sociocultural interaction with the environment of the language locus resulting from variation in subsistence mode may explain differences in FoR choice in spatial reference as well as in non-linguistic spatial behaviour. In a non-verbal spatial memory task carried out by 97 individuals in a predominantly Ancash Quechua-speaking community in the Peruvian Andes, Shapero (2017) found significantly higher rates of geocentric responses among participants who had experience working in the surrounding highlands as herders. As Shapero (2017: 1294) explains, "both highland pastoralism and the use of the Absolute FoR draw on a similar cognitive ability to keep track of one's position among various landmarks in a fixed coordinate system".

Gender is another factor that is sometimes associated with variation in spatial reference. In Yucatec (Mayan; Mexico/Belize), for example, men but not women use cardinal direction terms (Bohnemeyer 2011: 904; Bohnemeyer & Stolz 2006: 308–309; Le Guen 2011). This appears to reflect occupational biases and cultural practices specific to men, specifically gardening. For example, Bohnemeyer (2011: 904) notes that "[...] the four edges of the *milpa*, the tropical garden where people [by which he is referring specifically to men – PLSG] plant their corn, beans, squash, chili, and so on, are supposed to be aligned with the cardinal directions, as are the walls of a traditional house". Similarly, in Mopan (Mayan; Belize/Guatemala), cardinal directions are used more often by men, who work in the fields, than by women, who work in the home or in the village (Danziger 1999). Additionally, studies on urban wayfinding among English speakers demonstrate that women tend to have a better memory of the locations of objects and subsequently tend to use landmarks more often than men, who conversely tend to prefer cardinal directions (Halpern 2012: 138–140; Wolbers & Hegarty 2010).

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Some recent studies have revealed intergenerational change in FoR choice. This appears to be occurring, for example, in certain northern Australian communities in which the traditional languages are Gurindji (Pama-Nyungan; Meakins 2011) or Iwaidja (Iwaidjan; Edmonds-Wathen 2013). In these communities, older speakers are reported to use the absolute FoR more frequently than younger speakers, who use a mixture of various other strategies. This shift in spatial reference strategy is probably connected with a contemporaneous shift to other languages (such as Gurindji Kriol and Aboriginal English) in younger generations, but may also be related to the introduction of schooling and with other changes to ways of life.

4 Project design

4.1 Approach

To cast light on the relationship between spatial language, non-linguistic spatial behaviour and the environment and to test Palmer's (2015) Topographic Correspondence Hypothesis (TCH), we investigated spatial reference in two languages spoken in the topographic environment of the atoll: Marshallese (Austronesian; Marshall Islands) and Dhivehi (Indo-Aryan; Maldives). Atolls are an unusual environment for human habitation, comprising narrow strips of land around a central lagoon (see Maps 1 and 2). A preliminary study of spatial reference in four atoll-based languages (Palmer 2007) found similarities in their spatial systems that are anchored in aspects of the physical environment in which the languages are spoken, including aspects tailored specifically to the topography of the atoll, principally an atoll-specific lagoonside-oceanside axis.

To test TCH, Palmer (2015) proposes the Environment Variable Method (EVM), an approach designed to treat environment as a controlled variable. TCH makes predictions along two parameters: (A) that a single language spoken in diverse environments will display commensurate diversity in spatial reference; and (B) that diverse languages spoken in a single environment will display commensurate similarities in spatial reference. EVM tests (A) by holding the language constant and varying the environment. Prediction (B) is harder to test, because while the environment is to be held constant and the language varied, the environment cannot be held constant to the extent of investigating diverse languages in a single location, as it would be impossible to rule out similarities between languages arising from contact. Instead, language loci that are as similar as possible are to be used.

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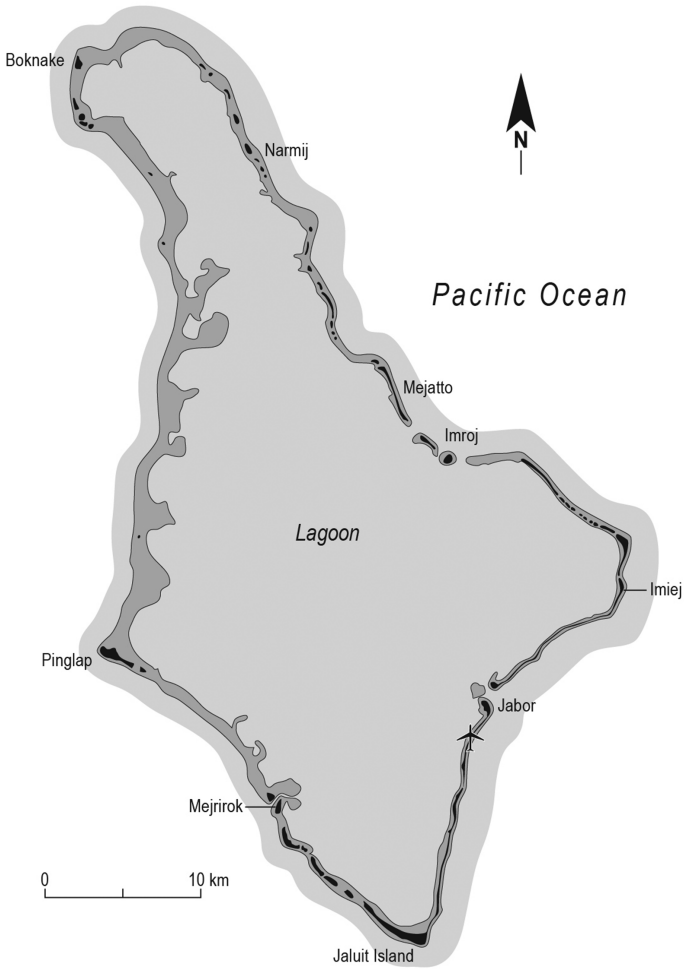

Map 1: Map of Jaluit Atoll, Marshall Islands.

Following EVM, we identified a baseline language-environment pairing of Marshallese spoken on an atoll (Jaluit Atoll; Map 1). Holding the language constant but varying the environment (parameter A), we compare Jaluit Marshallese with Marshallese spoken (i) on a non-atoll island in the Marshall Islands (Kili), and (ii) in urban Springdale, Arkansas, continental USA. Following the second parameter (parameter B), holding the environment constant but varying the language, we compare the baseline Marshallese pairing with genetically and areally unrelated Dhivehi spoken on Laamu Atoll (Map 2), an atoll selected for its topographic similarity to the primary Marshallese site. Within each field site,

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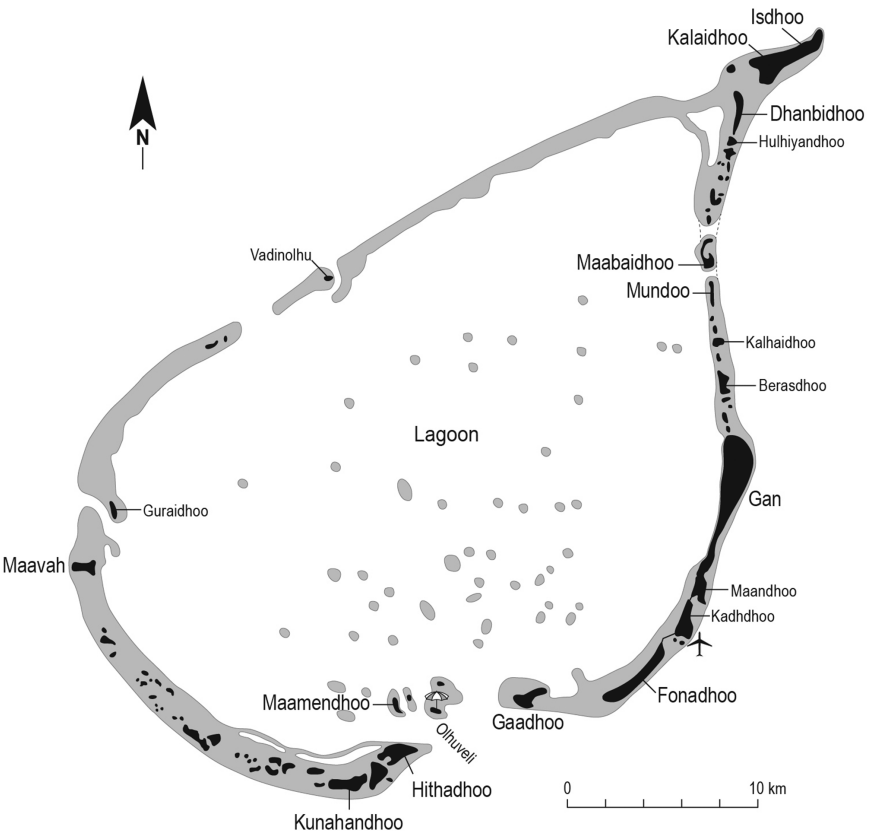

Map 2: Map of Laamu Atoll, Maldives.

experimental task-based data were elicited from participants across a range of demographic variables including age, gender, education, and occupation, and in a range of locations of varying dominant subsistence modes and degrees of population density. To complete the coverage, comparative Dhivehi data was collected from urban Addu, and densely urban Malé, the Maldivian capital.

4.2 Data collection

Identical task-based elicitation techniques were used in all locations to ensure maximal comparability of data. Once gathered, the data was subject to statistical analysis.[1] In addition to established elicitation techniques such as the Man and

1 See Lum et al. (in preparation) for details of the statistical analysis and results.

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Tree task (Senghas version; Terrill & Burenhult 2008), Animals-in-a-Row task (Levinson et al. 2002), and Route Description task (Wilkins 1993), we developed and deployed several new experimental tasks, including an Object Placement Task (Schlossberg et al. 2016), a Virtual Atoll Task (Lum & Schlossberg 2014), and a verbal adaptation of the Animals-in-a-Row task.

We report here on results of the Man and Tree task. This task is run with two participants separated by a screen. Each has an identical set of 16 photographs of a toy man and tree in various configurations. A "director" selects images to describe to a "matcher", who identifies the corresponding image from their own set. The matcher may ask questions during the task. Once all images have been identified, the participants exchange roles and repeat the task. Within each pair, participants were matched in gender and approximate age, and 59 Dhivehi and 48 Marshallese-speaking pairs participated (39 in the Marshall Islands and 9 in Springdale, Arkansas). Table 1 presents pertinent metadata relating to both participants and the sites of testing. Note that the Maldivian atoll Laamu is divided into two location types, "fishing" or "non-fishing". In fishing islands the dominant occupation is fishing. In non-fishing villages the dominant occupations involve indoor work and small-scale local farming.

4.3 Referential anchors

In analysing our results we considered the nature of the referential anchor in each spatial description. In order to classify each spatial expression in terms of the anchor invoked by that expression we applied a typology of referential anchors on the basis of whether the anchor is internal or external to the figure-ground array, and for external anchors, whether the anchor is egocentric or geocentric (see Bohnemeyer & Tucker 2013; Dasen & Mishra 2010; O'Meara & Pérez Báez 2011). Each referential strategy described in Section 5.2 below was assigned to the relevant anchor type in this typology, giving the classification in (1).

(1) Figure/ground-internal anchor (intrinsic FoR, tree in Man and Tree descriptions)

Figure/ground-external anchor

Egocentric anchor (relative FoR, speech act participant landmarks)

Geocentric anchor (absolute FoR, topographic landmarks, ad hoc landmarks)

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Table 1: Man and Tree results.

	Dhivehi				Marshallese			
Location	Malé	Addu	Laamu (non-fishing)	Laamu (fishing)	Jaluit (Jaluit island)	Jaluit (Jabor island)	Kili	Springdale
Type	island city	urban atoll	atoll	atoll	atoll	atoll	single island	inland city
Population density	very high	medium-high	medium	medium	low	medium	low-medium	medium
English fluency	medium-high	medium-high	low-medium	low-medium	low	medium	medium-high	medium-high
Pairs	4	5	22	28	11	16	12	9
Location description	270	293	1181	1269	490	640	452	351
Orientation descriptions	170	176	775	880	340	541	336	223
Total descriptions	440	469	1956	2149	830	1181	788	584

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5 Linguistic resources

Marshallese and Dhivehi both provide their speakers with a wide range of strategies for referring to space. All three FoRs outlined in Section 1 are available to speakers, as are a range of other egocentric and geocentric strategies. In addition to periphrastic references to landmarks and the like, both languages provide speakers with terms that lexicalize a range of spatial concepts. A subset of these terms are also grammaticized, in the sense that they participate in specialized constructions.

5.1 Lexicalized and grammaticized spatial categories

In the following discussion, we distinguish spatial concepts that are lexicalized or grammaticized from those that are not. By lexicalized, we refer to a lexical item that expresses a spatial concept (rather than that concept being expressed periphrastically) (e.g., 'north', 'seaward', 'lagoonside', etc.). By grammaticized we refer to a spatial term that participates in a specialized spatial construction. To be grammaticized, a concept must be lexicalized. However, not all lexicalized concepts are also grammaticized.

5.1.1 Lexicalized spatial concepts

Marshallese and Dhivehi both display numerous lexical items that express spatial concepts. These include (but are not limited to) terms for cardinal directions (NSEW); terms for front, back, left, and right (FBLR) that operate in both the intrinsic and relative Frames of Reference; terms for distinctions within the vertical domain (e.g., 'above', 'below'); terms expressing topological relations ('on', 'inside' etc.); deictic demonstratives; and so on. Both also lexicalize salient aspects of the atoll and island topography of the language loci. Both have terms for the lagoon side and ocean side of an atoll island (Marshallese *iar* 'lagoonside', *lik* 'oceanside'; Dhivehi *daṣē* 'lagoon shore', *matifuṣ̊* 'ocean shore'), concepts that are commonly, perhaps universally, lexicalized in atoll-based languages (see Palmer 2007).[2] Both languages also

2 Although Palmer discusses the use of Marshallese *lik* (Palmer 2007: 103) and Tokelauan *tua* (Palmer 2007: 114) to refer to both intrinsic back and the oceanside of an atoll island, the oceanside use of these terms is erroneously absent from his Table 2 (Palmer 2007: 116).

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have terms that make reference to landward versus seaward directions, however they differ in precise meaning and domain of use. In Marshallese, *āne* 'landward' and *meto* 'seaward' are confined to use on the lagoon or ocean within sight of land. In Dhivehi *atiri* 'beach' can be used to refer to the direction of the shore while on land, while the opposing term, *eggamu* 'land, inland' can be used to refer to the direction of land while on the lagoon or ocean, or towards the interior away from the shore while on land. Both languages also lexicalize the opposition between the shore and interior of an island. Dhivehi employs the inland/beach terms *eggamu* 'land, inland' and *atiri* 'beach', discussed above, while Marshallese employs a term, *ooj*, referring to the wilderness area or interior of an island, as well as a term to refer to the shore on either side of an island, *parijet*. In both languages, the term for the interior/inland contrasts both with a term for shore or beach undifferentiated for side of the island, as well as with the terms that do differentiate lagoon and ocean sides discussed above.

The precise semantics of each of these terms, the frequencies of their use, and the extent to which they are grammaticized as well as lexicalized, varies between the two languages. However, a broad correlation exists between lexicalized concepts invoking the atoll environment and salient topographic features of the language loci across the two languages.

5.1.2 Specialized spatial constructions and grammaticized terms

5.1.2.1 Marshallese

Spatial relations may be expressed in Marshallese using a general oblique construction in which the ground is expressed as an NP inside a locative PP, e.g., (8a) and (10a) below. Marshallese also has two specialized spatial constructions, involving sets of grammaticized spatial terms: a local construction involving local nouns, and a directional construction involving directional morphemes.

Like many Oceanic languages (Ross 2004), Marshallese has a category of local nouns. These are defined for Marshallese as a subcategory of nouns displaying two characteristics not available to common (i.e., non-local) nouns: they have inherent case so may participate in a specialized local construction in which they function as a locative oblique without a preposition to assign oblique case (e.g., (4a), (5a), (6a), (11a)); and they may carry the locative case marker *i-* (4a). Two subtypes occur: relational nouns and locative nouns. Relational nouns principally express topological relations

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and must carry direct possessor-indexing. Of relevance to the present discussion is the second subtype: locative nouns, shown in Table 2. These differ from relational nouns in two ways: they may occur as a bare root without possessor-indexing (5a), and may occur with the bound formative *tu-* 'side' (e.g., (4a), (6a), (7a)). In other words, they are characterized in part by their ability to occur in the local construction with or without possessor-indexing, while relational nouns must be directly possessed. However, a small number of locative nouns are not also relational, and do not occur with possessor-indexing. These are indicated with an asterisk in Table 2. Nouns referring to topographic features other than the locative nouns in Table 2, such as *aelōn* 'land, atoll, singleton island', do not participate in the local construction, so appear to be solely common nouns. The terms for 'left' and 'right' in Table 2 are bracketed because some speakers in the Marshall Islands use them as locative nouns and others do not.

Marshallese also has a set of directional morphemes, termed here "allocentric directionals", that participate in a specialized directional construction (see Table 3). In this construction, used to express path in motion events or direction in orientation descriptions, these directionals occupy a position in the verb complex between the verb and a position occupied by a separate category of deictic directionals including *tok/tak* 'towards speaker' (gloss: DIR1); *waj* 'towards addressee' (DIR2); and *ļǫk* 'towards 3rd person; away from speaker and addressee' (DIR3). Non-deictic path is typically expressed using an allocentric directional, such as *ar=* in (2), although a locative noun in either the local or general oblique construction may be used instead (compare (7a)).

(2) *E=j* *kā=ar=tak.*
3SG.S=PRS jump=lagoonward=DIR1
'He is jumping hither towards the lagoon side.'

As a comparison of Tables 2 and 3 shows, some allocentric directionals are identical in form to a corresponding locative noun, while others are formally related but not identical, with the remainder being formally unconnected to the semantically corresponding locative noun. In addition, some allocentric directionals lack a semantically corresponding locative noun and vice versa. The terms for 'left' and 'right' in Table 3 are bracketed because they do not appear to function as directionals in the Marshall Islands, but are used in this way by speakers in Springdale, Arkansas.

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Table 2: Attested Marshallese locative nouns (Ral.=Ralik dialect (western Marshall Islands, including Jaluit and Kili); Rat.=Ratak dialect (eastern Marshall Islands)).[a]

Topographic					
iar	sheltered side of island (lagoon side/ lee shore)[b]	*lik*	exposed side of island (ocean side/ windward shore)	*ọọj*	wilderness
āne	land, islet	*meto*	sea		
lọjet	sea*[c]	*parijet*	shore*		
Cardinal					
iōñ (Ral.), *eañ* (Rat.)	north	*rōk*	south		
rear	east	*rilik* (Ral.), *rālik* (Rat.)	west		
Front-Back-Left-Right					
ṃaan	front	*lik*	back, behind		
(*anmiin, almiin*)	left	(*anmoon, almoon*)	right		
In/Out/Topological					
nabōj	outside	*ioḷap*	middle	*ioḷapḷap*	very middle
Vertical					
lōñ	top, above	*lal*	bottom, below, ground		
Interrogative					
ia	where?*				

a. Approximate phonetic values for Marshallese orthography: <j> = [t^j] or [c], <ṇ> = [n^w], <ñ> = [ŋ] or [$ŋ^w$], <ṃ> = [m^w], <ḷ> = [l^w], <d> = [r^j], <b> = [$p^ɣ$]. Vowels: <ā> = /ɛ~æ/, <ō> = [ə~ʌ], <ū> = [ɯ], <ọ> = [ɒ]. Other symbols approximately as expected.

b. The terms *iar* and *lik* refer to opposing locations and directions on land. On an atoll island such as Jaluit, *iar* refers to the sheltered lagoon side of the island, while *lik* refers to the exposed ocean side of an island. On a singleton island such as Kili, *iar* refers to the lee side of the island sheltered from prevailing winds and currents, while *lik* refers to the exposed windward side of the island. These facts suggest underlying meanings in which *iar* refers to an island's sheltered side and *lik* refers to an island's exposed side. (See Sections 7.1 and 7.2.3.)

c. The semantic difference between *meto* and *lọjet* is not clear. Both are used to refer to the sea, both within a lagoon and on the open ocean.

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Table 3: Marshallese allocentric directionals.

Topographic					
ar	towards sheltered side of island (lagoonward, towards lee shore)	*lik*	towards exposed side of island (oceanward, towards windward shore)	*ɋɋj*	wildernessward, towards island's interior
meto	seaward		*āne*	landward	
Cardinal					
niña	northward		*rōña*	southward	
ta	eastward		*to*	westward	
Front-Back-Left-Right					
ɱaan	forward		*lik*	backward	
(*anmiiñ, almiiñ*)	leftward		(*anmoon, almoon*)	rightward	
In/Out/Topological					
deļɋñ	inward		*nabōj*	outward	
Vertical					
lōñ	upward		*laļ*	downward	
Interrogative					
ia	to where?				

5.1.2.2 Dhivehi

Three general constructions exist in Dhivehi[3] which may be used to express spatial relations: a general dative construction, expressing the goal in descriptions of path or orientation (e.g., (10b)); a relative clause construction; and what Lum (2017) terms the *dimā(lu)* construction, also expressing directed motion or orientation, and occasionally location. In the *dimā(lu)* construction the relational noun *dimā(lu)* 'direction' occurs with a complement noun expressing the goal, to which it assigns comitative case (e.g., (8b), (9b)). The relative clause construction typically expresses location (7b), but can also express orientation or direction of

3 This discussion is based on the Laamu Atoll dialect of Dhivehi. For a summary of the main differences between this dialect and standard Dhivehi see Lum (2017).

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motion. However, in this sense it indicates orientation or direction towards the side of the ground object that faces the referential anchor, expressed in a relative clause modifying a head noun, not towards the anchor itself, as in (3). These three constructions are in principle available to all nouns in the language.[4]

(3) *Mīhā hurī* [*gahu-ge* [[***eggam-ā vī***] ***farātu-ga***].
person stand.PST.FOC tree-GEN inland-COM be.PST.PTCP side-LOC
'The person is on the inland side of the tree (lit., at the tree's side that is with the inland).'

Like Marshallese, Dhivehi has a class of relational nouns which express topological relations. However, unlike Marshallese, these are not defined by their participation in a specialized construction, but by their capacity to assign case, usually but not always genitive, to a nominal complement, and by their function of expressing topological relations (e.g., (4b), (11b)).

In addition, Dhivehi has two specialized spatial constructions, involving sets of grammaticized spatial terms: a locative-dative construction involving what we are terming "projective nouns", and a bare N construction involving what we are terming "locative adjunct nouns". In the locative dative construction, the noun expressing the anchor carries dative rather than locative case (5b). Use of dative case in this construction indicates that the referent is not itself the location of the figure. Instead the figure is in a region projected off the facet of the ground closest to the referent anchor. The use of dative with this projective function means the construction somewhat resembles the use of *to* in English constructions such as *to the north of*. We term the class of nouns that participate in this construction projective nouns because they refer to a region projected off the ground in a direction determined by the anchor, rather than referring to the anchor itself. For example, when occurring with locative case in a general construction *mati* 'top' means 'on the top of', while when occurring as a projective noun in the locative dative construction it means 'above', i.e., in a region projected off the top. Attested projective nouns are shown in Table 4. Although the lagoon side and ocean side of atoll islands are lexicalized in

4 Following Gnanadesikan (2017), the superscript ring diacritic in the transliteration of Dhivehi indicates a neutralized pronunciation. For example, the phonemes /s̥/ <ṣ>, /t̥/ <ṭ>, and /k/ <k> are all realized as a glottal stop [ʔ] word-finally and transliterated as $\mathring{s}$, $\mathring{t}$, and $\mathring{k}$ respectively in this environment. Word-final nasals are neutralized as [ŋ], with the superscript ring over *n* or *m* indicating this neutralized pronunciation while still showing the underlying form. Following Cain & Gair (2000), a superscript ^{n} or ^{m} before a consonant indicates prenasalization. Subscript dots indicate retroflex consonants. Vowel macrons indicate length.

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Table 4: Attested Dhivehi projective nouns used on Laamu (L=Laamu dialect; SD=Standard Dhivehi).

Topographic					
atiri	beach	*eggamu*	inland, land		
Cardinal					
uturu	north	*dekonu, dekona* (L) *dekunu* (SD)	south	sidereal compass terms (see Lum 2017)	
ira, iramati (L) *iru, irumati* (SD)	east	*huḷa^{n}gu*	west		
Front-Back-Left-Right					
kurumatu (L) *kurimati* (SD)	front	*furagaha* (L) *furagas* (SD)	back (esp. of animate)	*fahaɬ̊*	back
vāɬ̊	left hand	*kanāɬ̊*	right hand		
Topological/Other					
matu (L) *mati* (SD)	top	*tiri*	below	*dimā(lu)*	direction
farāɬ̊	side	*saiḍu*	side	*aru(matu)* (L) *ari(mati)* (SD)	flank, side
koḷa (L) *koḷu* (SD)	end	*faḷu* (L) *faḷi* (SD)	section		

Dhivehi, and participate in the specialized bare N construction discussed below, they do not participate in the locative-dative construction.

The bare N construction is used to express location, direction, and orientation. This resembles the relative clause construction in that the oblique head is a relational noun, often *farāɬ̊* 'side' or *koḷu* 'end', with a genitive case-marked complement noun expressing the ground (the tree in (6b)), and an adjunct modifying the head identifying the referential anchor. However, unlike the relative clause construction where the adjunct is a relative clause, in the bare N construction the adjunct is one of a limited set of locative adjunct nouns that occur without case or any modifiers (the right hand in (6b)). Several but not all of the nouns in the locative-dative construction can participate in the bare N construction, along with a number of additional nouns including

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Table 5: Attested Laamu Dhivehi locative adjunct nouns.

Topographic					
atiri	beach	*eggamu*	inland, land	*fuṭṭaru*	outer reef
matifuṣ	ocean shore	*daṣē*	lagoon shore		
Cardinal					
uturu	north	*dekonu, dekona* (L) *dekunu* (SD)	south	sidereal compass terms (see Lum 2017)	
ira, iramati (L) *iru, irumati* (SD)	east	*huḷa^{n}gu*	west		
Front-Back-Left-Right					
kurumatu (L) *kurimati* (SD)	front	*furagaha* (L) *furagas* (SD)	back (esp. of animate)		
vāɬ	left hand	*kanāɬ*	right hand		
Topological/Other					
etere	inside	*bēru*	outside	*daṣ*	bottom
aɬ-doṣ	near	*biɬ-doṣ*	far		

the atoll-based topographic terms: *daṣē* 'lagoon shore', *matifuṣ* 'ocean shore', and *fuṭṭaru* 'outer reef' (i.e., perimeter reef on the ocean side of an atoll). Attested locative adjunct nouns are shown in Table 5. Common nouns and other relational nouns do not occur as bare nouns in this construction, even other nouns referring to topographic features, such as *eterevari* 'inner lagoon' and *ka^{n}ḍu* 'open ocean'.

5.2 Referential strategies

Marshallese and Dhivehi both afford their speakers a similar wide range of linguistic resources to express spatial location, direction, and orientation, including strategies involving all the referential anchors discussed in Section 4.3 above. In Section 6.2 below we classify experimental results in terms of eight referential strategies afforded speakers by both languages: intrinsic, absolute, and relative Frames of Reference, topographic landmarks, ad hoc

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landmarks, speech act participants as landmarks, array-internal landmarks (e.g., the tree in the Man and Tree task), and the vertical domain. Each type is exemplified here.

(4) Intrinsic FoR
a. Marshallese
Wūt ṇe e=j pād [***i-tu-ṃaani-n ļe ṇe***].
flower DEM2 3SG.S=PRS be.located LOC-side-front-3SG.P man DEM2
'The flower is located in front of the man.'
b. Dhivehi
[***Mīhā kurumattu***] *gaha hurū dō?*
person.GEN front.LOC tree stand.PST.FOC TAG
'The tree is in front of the person, yeah?'

(5) Absolute FoR
a. Marshallese
E=j pād [***rilik***].
3SG.S=PRS be.located west
'He is west.'
b. Dhivehi
[***Mi=mīhā-ge utur-aṣ̊***] *hurū gaha*.
DEM1=person-GEN north-DAT stand.PST.FOC tree
'To this person's north is the tree.'

(6) Relative FoR
a. Marshallese
Ṃōṃaan e e=jutak [***tu-anmooni-n wōjke e***]...
man DEM1 3SG.S=stand side-right-3SG.P tree DEM1
'This man is standing to the right of this tree...'
b. Dhivehi
Mīhā hurī [***gahu-ge*** [***kanāt̊***] ***farātu-ga***].
person stand.PST.FOC tree-GEN right.hand side-LOC
'The person is on the right-hand side of the tree.'

(7) Topographic landmarks
a. Marshallese
I-ta=ļo̧k [***ñan tu-iari-n*** *men būrōrō e*]
go-eastward=DIR3 to side-lagoonside-3SG.P thing red DEM1
'Go eastwards to the lagoon side of this red thing.'

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b. Dhivehi
[[***Atiri-ā*** ***vī***] ***farātu***] *esora hurū*.
beach-COM be.PST.PTCP side-LOC he stand.PST.FOC
'He is on the beach side [of the tree] (lit., at the side that's with the beach).'

(8) Ad hoc landmarks
a. Marshallese
Wōjke ŋe e=j pād [***ilo high school***].
tree DEM2 3SG.S=PRS be.located at high.school
'That tree is at the high school [i.e., on the side of the photo closer to the school].'
b. Dhivehi
Mihāru [***sukūl-ā*** ***dimāl-aṣ̊***] *gaha e=innanū*.
now school-COM direction-DAT tree DEM3=sit.PRS.PROG
'Now the tree is towards the school [i.e., on the side of the photo closer to the school].'

(9) Speech act participants as landmarks
a. Marshallese
Mōŋŋaan eo ŋe me e=j pād [***ij-ŋe*** ***ippā-ŋ***].
man ART DEM2 REL 3SG.S=PRS be.located LOC-DEM2 with-2SG.P
'That man there who is located there near you.'
b. Dhivehi
Mīhā kurumatu [***mā*** ***dimāl-aṣ̊***].
person.GEN front 1SG.COM direction-DAT
'The front of the person [is] towards me.'

(10) The tree in Man and Tree tasks
a. Marshallese
E=j jit=ļǫk [***ñan wūt eŋ***].
3SG.S=PRS face=DIR3 to plant DEM3
'He is facing towards this plant.'
b. Dhivehi
Mīhā inū [***gah-aṣ̊***] *kurumatu lai=geń*.
person sit.PST.FOC tree-DAT front put.CVB=SEQ
'The person is facing the tree (lit., sitting putting the front to the tree).'

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(11) The vertical domain
a. Marshallese
Wōjke ŋe e=pād [***lōñi-n ļe e***].
tree DEM2 3SG.S=be.located top-3SG.P man DEM1
'That tree is located above this man.'
b. Dhivehi
[***Mīhā-ge tirī***] *gaha hurū*.
person-GEN low.LOC tree stand.PST.FOC
'The tree is below the person.'

6 Findings

6.1 Overall

The study's findings provide some support for TCH. In terms of the linguistic resources available to speakers, both languages employ a landward-seaward axis correlating to the boundary between land and sea. However, in Marshallese this is only used at sea, while in Dhivehi it is used on land, with only one term also used at sea. The distinction between an island's lagoonside and oceanside is also lexicalized and grammaticized in both languages. However, in Dhivehi these terms only participate in one specialized construction and are extremely infrequent in that construction, typically occurring in non-specialized constructions, while in Marshallese they occur in both available specialized constructions with high frequency.

Some of our quantitative findings also support TCH. For example, analysis of our Man and Tree data reveals a strong preference for egocentric referential strategies in urban settings, but a preference for geocentric strategies in most of the less urban island locations, supporting previous findings of an urban preference for egocentric reference (Dasen & Mishra 2010: 116–117, 307–309; Majid et al. 2004: 112; Pederson 1993; Pederson et al. 1998: 584). Our results are discussed in more detail below.

While our findings provide some support for TCH, quantitative analysis reveals a more nuanced picture than TCH alone allows. While Marshallese and Dhivehi provide speakers with a similar range of strategies for spatial reference, strategy preference varies significantly between the languages, and within each language on the basis of demographic and locational variables. A range of linguistic resources are available to speakers of both languages, including absolute, intrinsic, and relative FoR; reference to topographic landmarks; reference to ad hoc landmarks; Speech Act Participants as landmarks; and reference

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anchored in the toy tree in Man and Tree orientation descriptions. These resources are discussed in detail for each language in Section 5 above. Variation takes the form of tendencies in strategy preference, rather than the exclusive choice of one strategy over others. Our findings introduce a crucial caveat to TCH: social and cultural factors mediate between language and environment, such that a simple, predictable relationship between the two does not exist. Lexicalized and grammaticized systems of spatial reference may correlate with aspects of the environment, but the extent to which they do, and which aspects of the environment are invoked, varies in part on the basis of affordance, and on degree and nature of cultural interaction with environment.

6.2 Strategy preference results

Our Man and Tree data were subjected to quantitative analysis on the basis of the nature of the referential anchor as typologized in Section 4.3 above. The results show some variation on the basis of language, as well as variation that cross-cuts language on the basis of demographic variables considered below. Figures 1 and 2 show, for each testing site, the relative frequencies of each spatial reference strategy. Figure 1 presents the proportion of spatial reference strategies in descriptions of location (e.g., 'the man is standing to the right of the

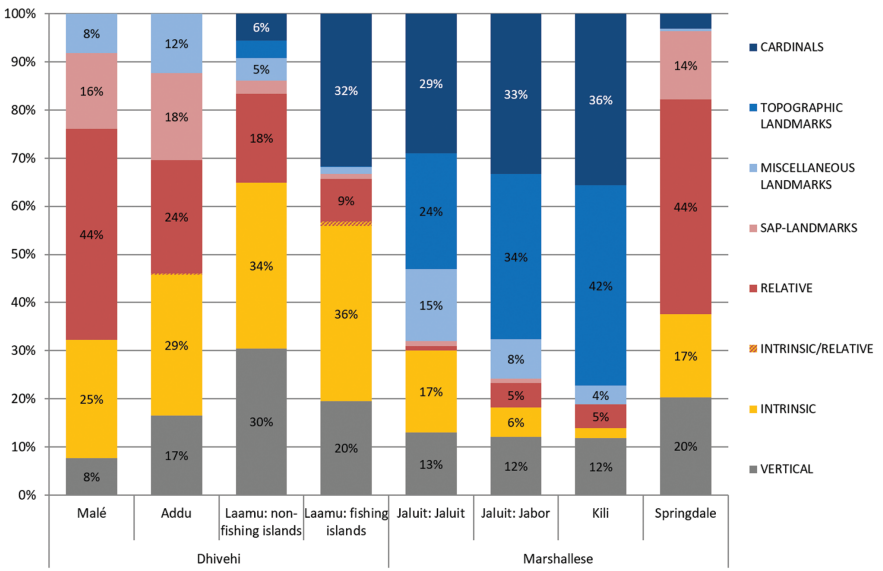

Figure 1: Man and Tree location descriptions.

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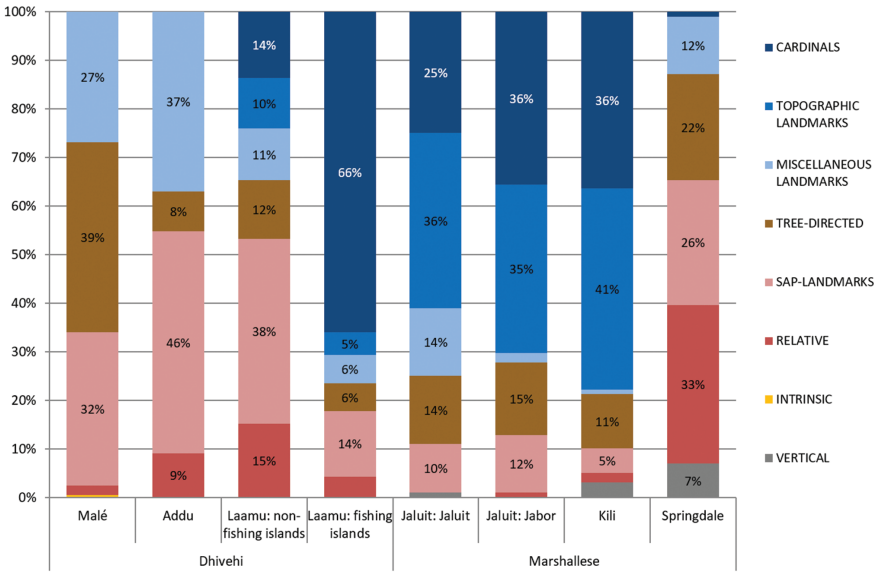

Figure 2: Man and Tree orientation descriptions.

tree'), while Figure 2 presents the proportion of spatial reference strategies in descriptions of orientation (e.g., 'the man is facing away from the tree').

In location descriptions, array-internal references involve intrinsic FoR. As Figure 1 shows, intrinsic FoR accounts for a significantly higher proportion of references in Dhivehi than in Marshallese, regardless of site. Preference for this array-internal strategy therefore correlates with language, not environment or demographic factors. The same is not true of the orientation-specific array-internal strategy of anchoring the reference in the tree. In Figure 2 the array-internal tree-oriented strategy is significantly more highly represented in the principally urban environments of Dhivehi-speaking Malé and Marshallese-speaking Springdale. Here the variation correlates with urban versus non-urban environment.

Correlation with environment is also seen in use of relative FoR. In location descriptions, the Dhivehi results show a broad correlation between the use of relative FoR and how urban the environments are: highly urban Malé shows a very high proportion of relative references; urbanized Addu shows intermediate frequency of relative FoR; and much less urban Laamu shows still lower frequency. For Marshallese the picture is even more striking. Inland suburban Springdale shows a very high proportion of relative reference, with the numbers and distribution of relative FoR and SAP

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landmarks closely resembling the results for Malé, while atoll and island Marshallese shows very low proportions of relative FoR use. In orientation descriptions the picture is less crisp. However, relative FoR is again the most frequently used strategy in Springdale Marshallese, while it occurs with extremely low frequency in atoll and island Marshallese. In part at least this must reflect the impossibility of using atoll-based topographic terminology such as lagoonside, oceanside, landward, and seaward in a continental inland environment.

There is also diversity in the distribution of references to cardinal directions and topographic landmarks across sites, but on a different basis. The use of these two strategies is confined almost exclusively to the less urban environments of Laamu for Dhivehi, and atoll and island sites for Marshallese. In urban Malé and Addu and inland suburban Springdale both strategies are almost unrepresented in the data. At the sites in which these strategies are well represented, their relative distribution differs between Dhivehi and Marshallese. While a similar total number of the two strategies is present across the two languages, in Marshallese cardinals and topographic landmarks are both well represented, while in Dhivehi cardinals overwhelmingly outnumber topographic landmarks. Here the effect correlates with grammaticized terminology. In Marshallese, several topographic landmarks terms are grammaticized, including high-frequency terms for the lagoon/lee side and ocean side of an island. Moreover, these participate in two specialized constructions (see Section 5.1.2.1 above). In Dhivehi fewer topographic landmark terms are grammaticized, and these occur with low frequency. However, in both languages the combined total of cardinal and topographic landmark terms are dominated by grammaticized terms in specialized constructions. The linguistic resources and patterns of usage frequency of Dhivehi mean these are predominantly cardinal, while the resources and frequency patterns of Marshallese lead to both cardinals and landmarks being well represented.

6.3 Egocentric versus geocentric preference

Once array-internal strategies are removed, patterns of preference for egocentric versus geocentric in array-external strategies emerge. Figures 3 and 4 show array-external references only, with egocentric and geocentric strategies generalized. For Marshallese, Figure 3 shows an overwhelming preference for geocentric strategies in atoll and island locations in the Marshall Islands, contrasting with an equally strong preference for egocentric strategies in

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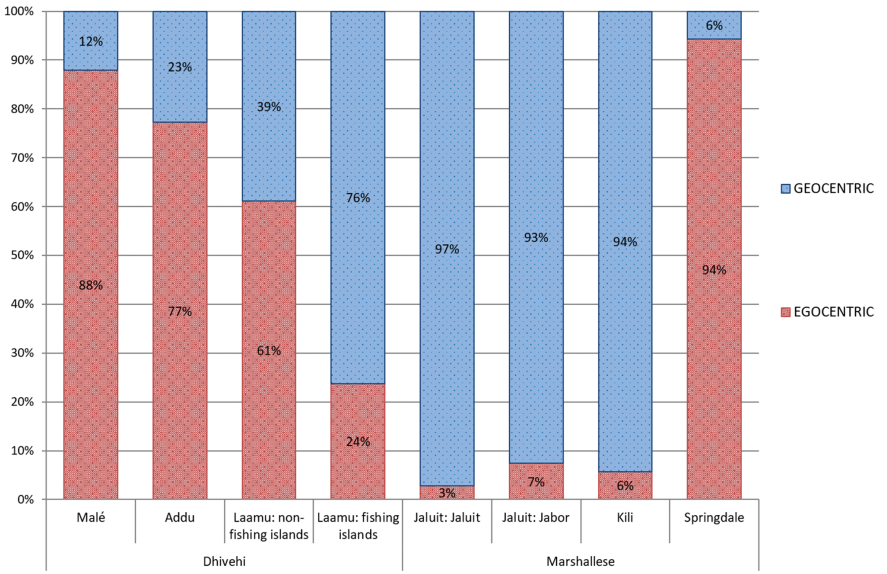

Figure 3: Man and Tree location – egocentric versus geocentric preference.

urban Springdale. The pattern for Dhivehi is less crisp. However, a significant preference for egocentric strategies correlates with the dense urban environment of Malé, while Laamu fishing islands more resemble Marshallese atoll/island locations in a significant preference for geocentric strategies. Preferences in relatively urban Addu again lie between Malé and Laamu. The variation between fishing and non-fishing communities on the same atoll, Laamu, is striking. Here the variation correlates with dominant subsistence mode, not environment. Communities dominated by fishing occupations, involving intensive interaction with the ocean and atoll-wide environment, display a preference for geocentric strategies, while communities on the same atoll dominated by white-collar work or small-scale local farming display a preference for egocentric strategies. Figure 4, showing egocentric versus geocentric preference in array-external orientation descriptions, gives a clearer instance of the same pattern. Dhivehi displays a moderate preference for egocentric strategies overall, with the exception of Laamu fishing communities, which share geocentric preference with atoll/island-based Marshallese. Again, urban Springdale displays a significant preference for egocentric strategies.

Similar patterns emerge when the demographic variables are age, gender, and level of education, agreeing with the findings of several of the studies

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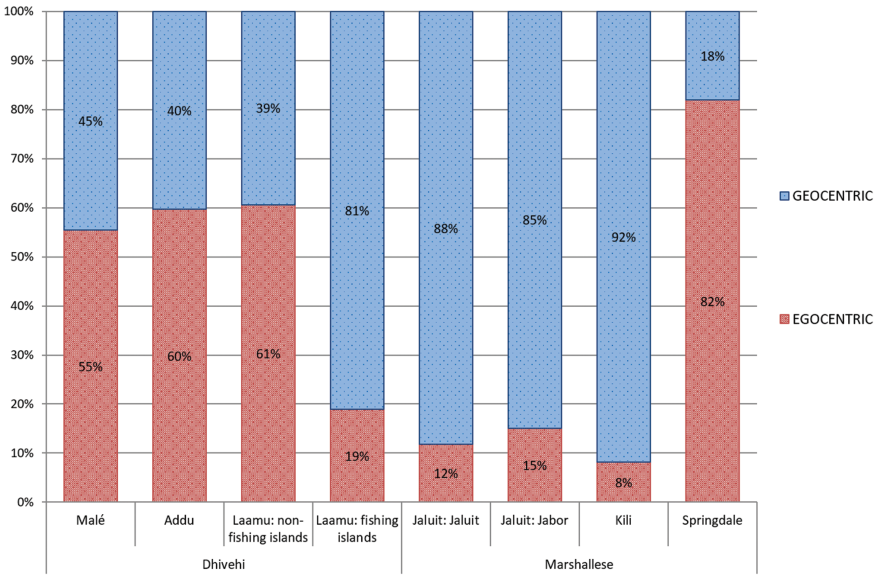

Figure 4: Man and Tree orientation – egocentric versus geocentric preference.

discussed in Section 3 above. In our Dhivehi results, men, who traditionally worked as fishermen or sailors, displayed higher use of geocentric strategies than women. Older speakers, who are more likely to have spent at least part of their lives in outdoor occupations, displayed higher use of geocentric strategies than younger speakers, who are more likely to have only experienced indoor work. In the Marshallese results, use of absolute FoR correlates with lower education, and with lower frequency of reading and/or writing, while the use of SAP-landmarks correlates with higher levels of education and of reading and/or writing. The overall picture is one in which environment plays a role, but nature and degree of engagement with environment is also significant in strategy preference. Our results on the basis of these other sociolinguistic variables such as gender and age are presented in more detail by Lum et al. (in preparation).

A further factor warranting consideration, particularly in regard to the egocentric preference and use of relative FoR in the Springdale sample in comparison to the Marshall Islands sites, is exposure to English. However, as Table 1 above shows, the Marshallese Springdale community as a whole is not significantly more fluent in English than participants at the Marshall Islands sites, particularly Kili and Jabor. Springdale participants do have more exposure

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to L1 English speakers than speakers at any Marshall Islands sites, although the Jabor and Kili communities are home to a small rotating community of L1 English teachers, and consume English language media.[5] All but one of the Springdale participants were born in the Marshall Islands and subsequently migrated to the US, and display a range of English fluency similar to that of the Kili and Jabor samples. Similarly, the variation in the Dhivehi results cannot be explained simply in terms of varying levels of English fluency. For example, speakers living on fishing islands in Laamu have the same level of English as speakers on non-fishing islands (see Table 1), although the two groups show different patterns of FoR use, as seen in Figures 1 to 4. In any case, a comparison of monolinguals and bilinguals in Laamu revealed very few statistically significant differences in FoR choice, and none for rates of egocentric FoR usage (see Lum 2017).[6] Nonetheless, the possibility that language contact has some influence on FoR choice warrants further investigation, as to date comparatively little research has been carried out into how language contact and bilingualism influences FoR selection (but see Hill 1982; Bohnemeyer et al. 2014; Meakins & Algy 2016).

7 The Sociotopographic Model

7.1 Sociotopography

Findings such as those outlined above demonstrate that topography and other aspects of the external environment play a role in constructing conceptual representations of space, but that this is mediated by a range of sociocultural

5 At the time fieldwork was conducted there were at least four L1 English speakers on Jabor and two on Kili.

6 The Maldives was a British protectorate until 1965 and the Republic of the Marshall Islands a territory of the United States until 1979 and in free association with the USA since 1986. As a result, some degree of English competency is common in both countries, although many Marshallese and Dhivehi individuals know little or no English. Due to sensitivities about level of English ability, at many of our field sites it was not practical to collect reliable and fine-grained metadata on this. However, in the case of the Dhivehi sample, it was possible at least to categorize speakers as either "monolinguals" in the sense that they only spoke Dhivehi or "bilinguals" in the sense that they knew Dhivehi and at least some English (see Lum 2017). Nevertheless, a profile of the approximate level of overall English fluency in each community is shown in Table 1.

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factors, and that the linguistic resources available to speakers also plays a role. Sociocultural factors include nature and degree of human interaction with environmental features, such that the features that play a significant role in the lives of speakers are invoked in constructing spatial reference. For example, oppositions between the coast and interior of an island, and between the lagoon side and ocean side, are salient in the lives of atoll dwellers in the Marshall Islands and the Maldives, and those oppositions are both lexicalized and at least to some extent grammaticized in both languages. However, differences in the frequency of use of these lexical items, and in referential strategy preference, display diversity that would be obscured by consideration only of the resources of the relevant languages. For example, both languages provide speakers with cardinal terms, and with terms for aspects of the atoll and island topography of the language loci. However, individuals who live in communities where extensive interaction with the topographic environment is important in the dominant subsistence mode, such as in Laamu fishing communities, display a preference for geocentric reference, while individuals who live in communities dominated by indoor and small-scale local outdoor work, such as in Laamu non-fishing communities, display a preference for egocentric strategies. As another example, Marshallese provides its speakers with lexicalized and grammaticized terms for left and right. In the Marshall Islands these almost never appear in spatial descriptions. However, in urban continental Springdale, Arkansas, removed from the topographic anchors of the geocentric strategies, speakers employ the left and right terms with considerably higher frequency.

The affordances of the environment itself also play a role in the way spatial relationships are conceptualized and described. On atoll islands, for example, the lagoon side of an island is relatively sheltered. This influences human interaction with the environment. The sheltered lagoon side of atoll islands is typically furnished with beaches opening on to calm waters where boats can be safely launched, while the exposed side is more likely to have fewer beaches and more exposed reef, with rougher seas. The sheltered nature of the lagoon side of an atoll island typically leads to that side being the focus of human settlement. This in turn leads to the lagoon side being viewed as being inhabited, within social control, and safe, while the ocean side is viewed as uninhabited, dangerous, and outside social control (Palmer 2015: 218–219, see Hoëm 1993). The affordances of an atoll island contribute to a socioculturally salient distinction between lagoon and ocean sides that is lexicalized and grammaticized in both languages, although it is more heavily grammaticized and invoked with greater frequency in Marshallese than in Dhivehi. The distinction between lagoon side and ocean side is grammaticized in Marshallese as locative nouns, and as directional particles within the verb complex, while in Dhivehi the lagoon

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shore and ocean shore terms are only grammaticized as locative adjuncts (see Section 5.1 above). As a result of this grammaticization, topographic landmark terms, principally lagoonside and oceanside, comprise a significantly higher proportion of geocentric references in Marshallese than in Dhivehi, where the majority of geocentric references are cardinals.

Language use in turn plays a role in shaping the resources of the language itself. For example, the Marshallese term *iar* refers to the lagoon side of an atoll island. However, on a singleton island lacking a lagoon, such as Kili, *iar* refers to the sheltered lee side of the island, in contrast with the exposed windward side, suggesting an underlying more abstract meaning of the sheltered side of an island. Use of this 'sheltered side' term on an atoll to refer to the lagoon side and a singleton island to refer to the lee side in turn influences the semantics of the term to give it these more specific senses in each type of location.

In response to our results and findings we have developed a Sociotopographic Model (STM) of the interaction of environment, sociocultural factors, and language (Figure 5). Major landscape and other environmental features are salient to humans and may play a role in constructing conceptual representations of space that then contribute to shaping linguistic spatial expressions. However, this interaction is mediated by sociocultural interaction with the environment. The linguistic resources of the language itself also contribute to non-linguistic representations of space, mediated by language use. Each of the interactions between components is bidirectional. The environment through its features and affordances shapes sociocultural interaction with that environment. However, human interaction with the environment also plays a role in shaping the environment

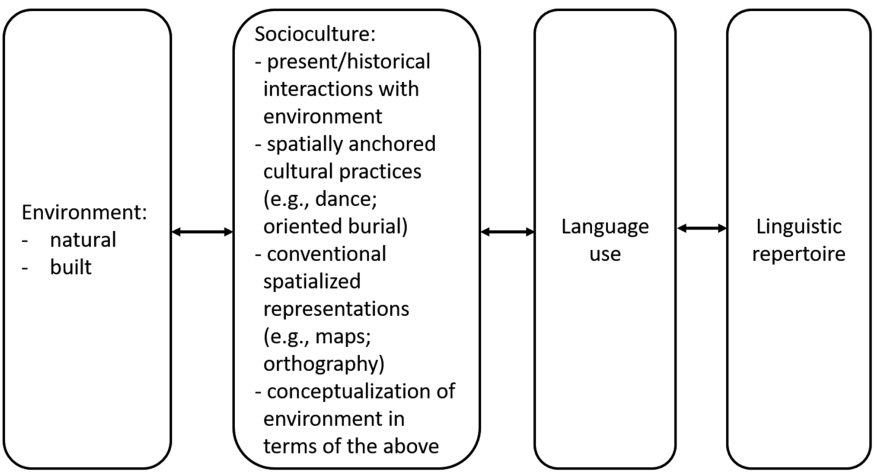

Figure 5: The Sociotopographic Model (STM).

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itself through modification and development, such as the built environment, and through associations imposed on the environment, e.g., the association of safety with lagoon side influencing settlement patterns. Linguistic resources shape language use, by providing speakers with lexicalized and grammaticized terms and specialized constructions with which to refer to the world. The spatial categories speakers use may also contribute towards sociocultural interpretations of the environment. However, influence in the opposite direction also occurs: sociocultural practices expressed through language use may play a role in shaping linguistic resources.

Sociotopography is thus defined in terms of: natural topography (broadly construed, including path of the sun, prevailing winds, etc.); the built environment; affordances of the natural and built environment; sociocultural interaction with and associations assigned to the natural and built environment; and language structure and use. Sociotopography is culturally "constructed": humans modify their environment; and humans conceptualize existing topography in terms of use, associations, and meanings attached to it, so that elements of a local landscape that are not attended to by some cultures may be prominent to others. The Sociotopographic Model may be schematized as follows:

7.2 Implementations

To exemplify the model we present three implementations.

7.2.1 Laamu fishing versus non-fishing islands

Significant differences in referential strategies were observed between islands on the Dhivehi-speaking atoll Laamu where fishing was the dominant subsistence activity, and islands on Laamu dominated by indoor work and some small-scale farming. In the former, geocentric strategies dominated, while in the latter egocentric strategies were more common (see Section 6.3). Both types of community occupy the same environment – topographically similar islands of similar population density on the same atoll. Both types of community also have access to the same linguistic resources, including the same set of both geocentric and egocentric referential strategies. In one type of community, the dominant subsistence mode involves habitual, high-frequency, high-intensity interaction with the open ocean and the large-scale topography of the island and atoll. This interacts with the linguistic resources offered by Dhivehi to

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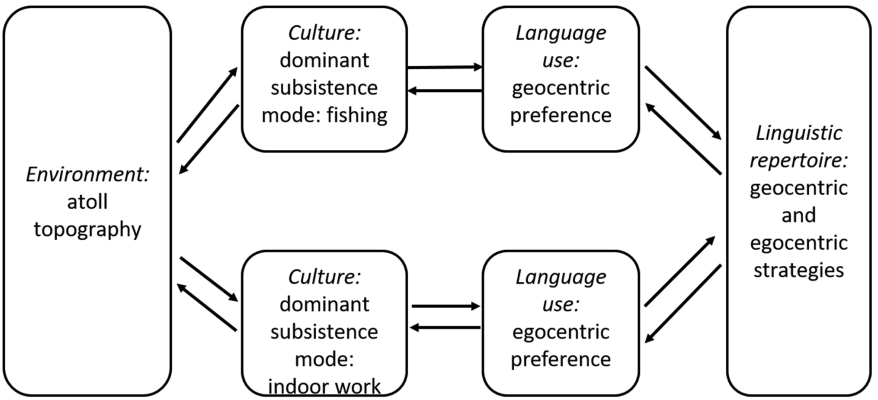

Figure 6: Strategy tendencies and subsistence mode in Laamu fishing versus non-fishing communities.

produce a community-wide tendency to make greater use of the geocentric strategies among those offered by the language. In the other type of community, a predominance of indoor work and some small-scale local farming results in little interaction with island or atoll-wide topography. This interacts with the language's resources to produce a lower tendency to employ geocentric strategies and a significantly higher tendency to make use of egocentric strategies.

7.2.2 Dhivehi and Marshallese linguistic resources and cardinals versus topographic landmarks

The atoll-based Dhivehi and Marshallese speech communities interact with highly similar topographic environments. However, the two languages offer their speakers slightly different linguistic resources invoking that environment. While cardinals are grammaticized in both languages, terms for lagoon side and ocean side are grammaticized in Marshallese in two constructions, as locative nouns, and as directionals occurring inside the verb complex, while in Dhivehi they are grammaticized only as locative adjuncts occurring in one specialized construction. While topographic landmarks are available to speakers of both languages in the form of non-specialized constructions, the greater availability of grammaticized landscape terms for lagoon side and ocean side in Marshallese corresponds with a significantly higher proportion of geocentric

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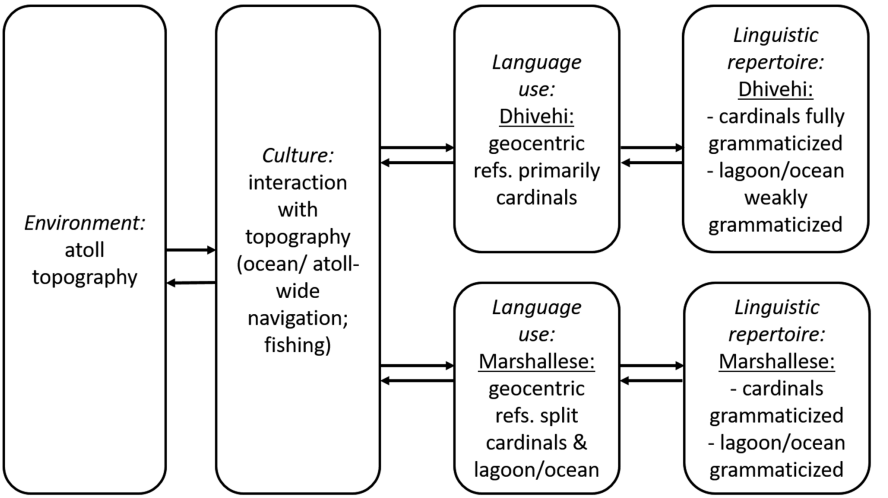

Figure 7: Grammaticized terms and landmark reference tendencies in Dhivehi and atoll Marshallese.

references in that language involving topographic landmarks than in Dhivehi, where the majority of geocentric references involved cardinals.

7.2.3 Marshallese *iar* 'sheltered side' on atolls and singleton islands

The Marshallese lexicon provides its speakers with the term *iar*, which has an underlying meaning referring to the sheltered side of an island. How this is interpreted varies depending on the nature of the topographic environment in which it is used (see Section 7.1). The topography of the language locus, mediated through sociocultural interaction and associations with that environment, shapes what the term denotes. In the environment of an atoll, where the sheltered side of an island is the inner lagoon side, the term is used to refer to the lagoon side of the island. On a singleton island, where there is no lagoon to provide a sheltered side, the side away from the prevailing winds and currents is more sheltered. In this environment *iar* is used to refer to the lee side of an island. Here the environment is shaping language use. Moreover, this language use has itself affected the semantics of the term, resulting in divergence between the senses 'lagoon side', as used on an atoll island, and 'lee side' as used on a singleton island.

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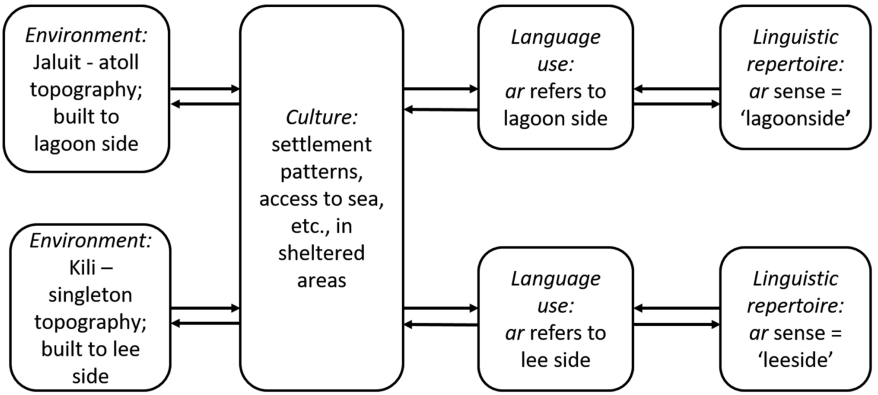

Figure 8: Use and semantics of *iar* on atolls and singleton islands.

8 Conclusions

Our findings reveal significant variation in which spatial reference strategies are preferred by the speakers of two languages which afford their speakers a similar range of options. To a certain extent, preferences may correlate with aspects of the local environment, such as a preference for egocentric strategies in urban Malé and Springdale, in contrast with a geocentric preference in atoll/island Marshallese. We also see a correlation between strategy preference and the degree and nature of interaction with environment. This is particularly evident in the contrast between Dhivehi fishing and non-fishing villages. Strategy preference also correlates with the grammaticization of linguistic resources, as seen in the high proportion of topographic landmarks in geocentric references in Marshallese, contrasting with a higher proportion of cardinals in Dhivehi. Some preferences, such as the higher proportion of intrinsic references in Dhivehi compared with Marshallese, do not correspond to environment, demographic variables, or linguistic resources, but simply to conventions of language usage in a language community.

Our findings demonstrate that human spatial behaviour cannot be understood by appeal solely to language or culture or environment alone, contrary to claims in much of the literature on spatial language. Instead, spatial behaviour reflects a complex interplay of responses to salient features of the natural and built environment; its affordances; sociocultural interaction with the environment including uses, associations and meanings attached to it; and the linguistic repertoire available to speakers.

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Abbreviations: 1/2/3 = 1st/2nd/3rd person; ART = article; COM = comitative; CVB = converb; DAT = dative; DEM1 = this (near speaker); DEM2 = that (near addressee); DEM3 = that (away from speaker and addressee); DIR1 = towards speaker; DIR2 = towards addressee; DIR3 = away from speaker and addressee; DIRECT = direct case; FOC = focus; GEN = genitive; LOC = locative; P = possessor; PROG = progressive; PRS = present; PST = past; PTCP = participle; REL = relative; S = subject; SEQ = sequential; SG = singular; TAG = question tag.

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