Diversity in Spatial Language Within Communities: The Interplay of Culture, Language and Landscape in Representations of Space

Bill Palmer
University of Newcastle, Australia
bill.palmer@newcastle.edu.au

Alice Gaby
Monash University, Australia
alice.gaby@monash.edu

Jonathon Lum
Monash University, Australia
lum.jonathon@gmail.com

Jonathan Schlossberg
University of Newcastle, Australia
schlossberg.jonathan@gmail.com

Abstract

Significant diversity exists in the way languages structure spatial reference, and this has been shown to correlate with diversity in non-linguistic spatial behaviour. However, most research in spatial language has focused on diversity between languages: on which spatial referential strategies are represented in the grammar, and to a lesser extent which of these strategies are preferred overall in a given language. However, comparing languages as a whole and treating each language as a single data point provides a very partial picture of linguistic spatial behaviour, failing to recognise the very significant diversity that exists *within* languages, a largely under-investigated but now emerging field of research. This paper focuses on language-internal diversity, and on the central role of a range of sociocultural and demographic factors that intervene in the relationship between humans, languages, and the physical environments in which communities live.

2012 ACM Subject Classification Information systems → Geographic information systems

Keywords and phrases spatial language, Frame of Reference, landscape, sociotopography

Digital Object Identifier 10.4230/LIPIcs.GIScience.2018.53

Category Short Paper

Funding This research was funded by Australian Research Council Discovery Project DP120102701. We gratefully acknowledge this support.

Acknowledgements We are grateful for the comments of three anonymous reviewers. Any errors remain ours. We thank our language consultants in the Marshall Islands and the Maldives.

1 Introduction

Diversity in the way languages structure spatial reference has been amply demonstrated, and has been shown to correlate with diversity in spatial behaviour in other, non-linguistic, cognitive modalities (navigation and wayfinding; memory recall and memory recognition; inferential reasoning; gesture; etc.). Some theories have argued for a primary role of language in shaping conceptual representations of space [9, 12, 20]. Others have focused on the role of the environment in which communities live and languages are spoken in motivating spatial representations that are manifest across modalities, including language [15].

Here we present findings on diversity in preferred Frame of Reference in linguistic expressions of spatial relations. In this context, a Frame of Reference (FoR) is a conceptual strategy for locating an object ("figure") or path in relation to another object ("ground"). This is done by assigning an asymmetry to a scene so that a path or a search domain in which the figure can be found can be projected off the ground object on the basis of a coordinate system fixed to a particular "anchor". Different FoRs are different strategies for assigning this asymmetry, involving different anchors, and therefore represent different types of coordinate systems. Three FoRs are established: intrinsic, relative, and absolute [8, 9, 12, 15] (see Figure 1). 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* – the search domain/path is projected off a perceived intrinsic 'front' of the ground chair, itself the anchor). In the relative and absolute FoRs the anchor is external to the Figure_Ground array. 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* - the search domain/path is projected off the facet of the ground post facing the viewpoint anchor). Absolute FoR invokes a set of external coordinates imposed on the scene (e.g., *west of the house* - the search domain/path is projected off the facet of the ground house facing west in an external cardinal coordinate system, with the anchor in those external coordinates).

The two externally-anchored FoRs and a number of other referential strategies for expressing spatial relations can also be divided into those which are egocentric, such as those invoking participants in the speech event as landmarks (e.g., *on my side of the post*) or through the relative FoR (e.g., *in front of the post*); and those which are geocentric, invoking features of the external world, either through the absolute FoR (e.g., *seaward from the village*), or through reference to landmarks (e.g., *towards the sea from the village*) (e.g. [4, 14, 17]).

2 Diversity across languages

Most research in spatial language to date has focused on diversity between languages. This has primarily focused on which referential strategies are represented in the grammars of individual languages [9, 10, 12, 20]. For example, in terms of FoR, some languages provide specialised grammatical means of expressing spatial relations in the relative FoR, and others do not. To a lesser extent research has focused on which of these strategies are preferred overall out of the referential strategies available in individual languages [12]. For example, Mopan (Mayan, Belize) has been characterized as employing intrinsic and absolute (geocentric) FoR, but not relative (egocentric) FoR, with intrinsic preferred and absolute only available in restricted contexts [12]. Tamil (Dravidian, India), on the other hand, has been characterized as allowing intrinsic, relative and absolute, but dispreferring intrinsic [12]. However, considering each language as a whole fails to recognise the very significant diversity that exists *within* languages, a largely under-investigated but now emerging field of research.

3 Diversity within language communities

A handful of recent studies have now shown that diversity among speakers within a language can be considerable, and that individual language communities are far from homogeneous [2, 17]. Language-internal diversity based on environment has previously been observed in a preference for relative FoR among urban communities and absolute FoR among rural communities [12], for example between urban and rural Tamils [18, 19], and on the basis of scale (table-top space versus navigational scale). However, recent studies have found significant variation on the basis of individual demographic factors such as age, gender and occupation, and community-wide cultural practices such as dominant subsistence mode.

Some language-internal diversity may correlate with different patterns of sociocultural interaction with the environment of the language locus. For example, in one Ancash (Quechuan, Peru) community in the Andes, individuals who work in the highlands as herders show significantly higher rates of geocentric reference than those who do not: "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" [22]. Gender is another factor that may correlate with variation in spatial reference. Mopan is cited above as preferring intrinsic FoR with absolute used in restricted contexts [12], but this language-level generalisation oversimplifies the situation and masks patterns of behaviour. For example, cardinal directions are used across the board more often by Mopan men, who work in the fields, than by Mopan women, who work in the home or in the village [5]. Similarly, among Yucatec Mayans (Mexico), men but not women use cardinal direction terms, reflecting occupational biases and cultural practices specific to men, particular in garden work [1, 3, 7]. Other factors such as age or education also play a role. In Dhivehi (Indo-Aryan, Maldives) older speakers, men, and less well educated individuals, who were more likely to have worked outdoors or on the sea, were more likely to use geocentric references than younger speakers, women, and better educated speakers, who were more likely to have always worked indoors [11]. Sometimes community-wide cultural practices play a role. On one Maldivian atoll, speakers living on islands where fishing was the dominant subsistence mode used geocentric expressions at significantly higher rates, independent of the occupation of individual community members, than speakers on other islands on the same atoll where indoor work dominated, who favoured egocentric strategies (see below) [11]. Other studies show inter-generational change. In Australia's Indigenous Gurindji community, older speakers use absolute FoR more frequently than younger speakers, apparently correlating with a shift to Gurindji Kriol and Aboriginal English, perhaps also related to schooling and other changes to way of life [13].

4 Diversity within Marshallese and Dhivehi

Quantitative analysis of a corpus of data gathered in a recent study of language-internal and language-external variation in spatial reference in two atoll-based languages presents a picture of systematic and partially parallel variation within each language community [11, 16, 17, 21]. One of the first systematic large-scale investigations of language-internal variation in spatial behaviour, this study was conducted among speakers of Marshallese (Austronesian, Marshall Islands) and Dhivehi (Indo-Aryan, Maldives), in order to test the Topographic Correspondence Hypothesis (TCH) [15]. TCH hypothesises a correlation between the features of linguistic spatial referential systems and features of the topography of the environment in which a language is spoken. The results of the atoll study partially support TCH, but demonstrate that language-internal variation exists correlating with a

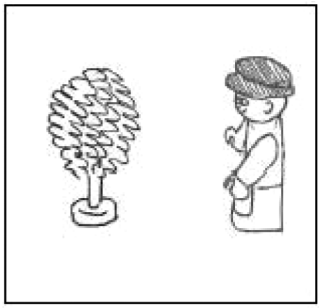

Figure 1 Sample "Man and Tree" card [6].

range of sociocultural factors beyond the scope of TCH, revealing the limitations of the hypothesis's focus on environment alone.

Data in this study was elicited using an identical set of formal experimental task-based methodologies, some established, some developed for the project, in each of a range of diverse communities in a range of environments in both languages. A total of 96 participants for Marshallese and 118 for Dhivehi were involved, making this the largest such study by a considerable margin. Data presented below are from the results of a "Man and Tree" elicitation task [23]. In this task, one participant, a 'director', selects a card from a set of cards bearing images of a toy man and a toy tree in various configurations, and describes the configuration so a second participant, a 'matcher', who selects the corresponding card from their own set, yielding data heavy in spatial reference.

The tree is *in front of* the man (intrinsic FoR).

The tree is *to the left of* the man (relative FoR).

The tree is *west of* the man (absolute FoR).

Quantitative analyses of task results revealed not coarse-grained FoR choice (absolute versus relative, etc.), but preferences among a wide range of referential strategies offered by each language, some involving specialised grammatical constructions, some not. In other words, each language provides its speakers with a range of spatial referential strategies, and speakers vary on which strategies they prefer, and how strong those preferences are. Patterns of strategy preference emerged based on a range of factors. Some representative findings are presented here. Some patterns of strategy preference correlated simply with overall language community regardless of location or individual demography. For example intrinsic FoR accounted for 31% of spatial descriptions offered by Dhivehi participants in a Man & Tree task, but only 10% of descriptions offered by Marshallese participants. However, environment also played a role. For example, among externally-anchored Dhivehi Man & Tree location descriptions, preference for egocentric strategies correlated with degree of urbanisation: egocentric strategies account for 88% of descriptions in the densely urban Maldivian capital Malé, 77% in less urban Addu atoll, and an average of 43% in rural Laamu atoll.

Community-wide practices were also a factor. On Laamu atoll the dominant subsistence mode on some islands is fishing, but on others it is indoor work and small scale farming. Quantitative analyses found 79% of all externally anchored Man & Tree descriptions were geocentric on islands where the dominant subsistence mode is fishing, but only 39% on islands where indoor work and small scale farming dominate, independent of the individual occupation of each participant (see Figure 2). Moreover, individual demographic factors were also important. Laamu participants aged 17-34 produced 44% geocentric descriptions, while the figure for ages 35-49 was 67%, and ages 50-70 was 77%. Cross-cutting that, among

fishermen and sailors, 93% of Man & Tree descriptions were geocentric, but among indoor workers only 55% were. Variation was also observed on the basis of education, literacy, and bilingualism [11, 21]. Finally, linguistic resources and language use were factors: topographic features and cardinals were invoked in equal numbers in Marshallese, but references invoking topographic features were almost entirely absent in Dhivehi, correlating with the encoding of key topographic features in specialised terms in high frequency constructions in Marshallese but not Dhivehi.

5 Sociotopography

Findings such as those outlined in sections 3 and 4 provide strong support for the Sociotopographic Model (STM) [17], an attempt to model the interaction of environmental, sociocultural and linguistic factors in spatial referential systems. Major environmental features are salient to humans and play a role in conceptual representations of space that then interact with linguistic spatial expressions, consistent with the Topographic Correspondence Hypothesis. However, sociocultural factors, as well as affordances of the environment, mediate in the relationship between humans and landscape, a fact that cannot be accounted for within TCH but is captured by STM. In addition, the linguistic resources of the language itself contribute to nonlinguistic representations of space, mediated by language use. Each of these interactions is bidirectional. For example, topographic features and affordances of the environment shape human sociocultural interaction with that environment, while that interaction itself in turn plays a role in modifying and developing the environment through the built environment [17]. Sociotopography is defined in terms of: the natural environment (broadly construed, including topography, path of the sun, prevailing winds etc.); the built environment; and affordances of and sociocultural interaction and associations with the natural and built environment. It is culturally 'constructed': humans modify their environment; and conceptualise existing topography in terms of uses, associations and meanings attached to it. Consequently, elements of the landscape that are not attended to by some individuals and by some communities may be prominent to others. A sample implementation of the model is presented in Figure 2.

6 Conclusion

A tendency of much previous research to focus on a language's overall spatial system rather than individual choices among available spatial referential strategies within a language has led to failed attempts to attribute a determining role to a single factor: to language, or to landscape, or to culture. Our findings demonstrate that all these factors and more play a role. Attending only to strategy choice in languages as a whole obscures patterns that reveal the complex interplay of factors at work in shaping conceptual representations of space: patterns reflecting the nature of the environment, the degree and nature of engagement with the environment, cultural associations placed on the environment, individual and community-wide cultural practices, the linguistic resources of the language itself, and patterns of language use. The Sociotopographic Model attempts to model the interplay of these diverse factors.

References

1 Jürgen Bohnemeyer. Spatial frames of reference in Yucatec: Referential promiscuity and task-specificity. *Language Sciences*, 33:892–914, 2011.

2 Jürgen Bohnemeyer, Katharine T. Donelson, Randi E. Tucker, Elena Benedicto, Alejandra Capistrán Garza, Alyson Eggleston, Néstor Hernández Green, María de Jesús Selene, Hernández Gómez, Samuel Herrera Castro, Carolyn O'Meara, Enrique Palancar, Gabriela Pérez Báez, Gilles Polian, and Rodrigo Romero Méndez. The cultural transmission of spatial cognition: Evidence from a large-scale study. In *Cogsci 2014 Proceedings*, pages 212–217, 2014. URL: `https://mindmodeling.org/cogsci2014/papers/047/paper047.pdf`.

3 Jürgen Bohnemeyer and Christel Stolz. Spatial reference in Yukatek Maya: A survey. In Stephen C. Levinson and David Wilkins, editors, *Grammars of space: Explorations in cognitive diversity*, pages 273–310. Cambridge University Press, Cambridge, 2006.

4 Jürgen Bohnemeyer and Randi Tucker. Space in semantic typology: Object-centered geometries. In Peter Auer, Martin Hilpert, Anja Stukenbrock, and Benedikt Szmrecsanyi, editors, *Space in language and linguistics: Geographical, interactional, and cognitive perspectives*, pages 637–666. Mouton de Gruyter, Berlin, 2013.

5 Eve Danziger. Language, space and sociolect: Cognitive correlates of gendered speech in Mopan Maya. In Catherine Fuchs and Stéphane Robert, editors, *Language diversity and cognitive representations*, volume 3, pages 85–107. John Benjamins Publishing Company, Amsterdam, 1999. `doi:10.1075/hcp.3.09dan`.

6 Cris Edmonds-Wathen. *Frame of Reference in Iwaidja: Towards a culturally responsive early years mathematics program*. PhD thesis, RMIT, Melbourne, 2012.

7 Olivier Le Guen. Modes of pointing to existing spaces and the use of frames of reference. *Gesture*, 11(3):271–307, 2011. `doi:10.1075/gest.11.3.02leg`.

8 Stephen C. Levinson. Frames of reference and Molyneux's question: Crosslinguistic evidence. In Paul Bloom, Mary A Peterson, Lynn Nadel, and Merrill F Garrett, editors, *Language and Space*, pages 109–169. MIT Press, Cambridge, 1996.

9 Stephen C. Levinson. *Space in language and cognition: Explorations in cognitive diversity*. Cambridge University Press, Cambridge, 2003.

10 Stephen C Levinson and David Wilkins, editors. *Grammars of space: Explorations in cognitive diversity*. Cambridge University Press, Cambridge, 2006.

11 Jonathon Lum. *Frames of spatial reference in Dhivehi language and cognition*. PhD thesis, Monash University, Melbourne, 2018.

12 Asifa Majid, Melissa Bowerman, Sotaro Kita, Daniel B.M. Haun, and Stephen C. Levinson. Can language restructure cognition? The case for space. *Trends in Cognitive Sciences*, 8(3):108–114, 2004.

13 Felicity Meakins, Caroline Jones, and Cassandra Algy. Bilingualism, language shift and the corresponding expansion of spatial cognitive systems. *Language Sciences*, 54:1–13, 2016. `doi:10.1016/j.langsci.2015.06.002`.

14 Carolyn O'Meara and Gabriela Pérez Báez. Spatial frames of reference in Mesoamerican languages. *Language Sciences*, 33(6):837–852, 2011. `doi:10.1016/j.langsci.2011.06.013`.

15 Bill Palmer. Topography in language: Absolute Frame of Reference and the Topographic Correspondence Hypothesis. In Rik De Busser and Randy J. LaPolla, editors, *Language structure and environment. Social, cultural and natural factors*, pages 179–226. John Benjamins Publishing Company, Amsterdam, 2015.

16 Bill Palmer, Alice Gaby, Jonathon Lum, and Jonathan Schlossberg. Socioculturally mediated responses to environment shaping universals and diversity in spatial language. In Paolo Fogliaroni, Andrea Ballatore, and Eliseo Clementini, editors, *Proceedings of workshops and posters at the 13th International Conference on Spatial Information Theory (COSIT 2017)*, pages 195–205. Springer International Publishing, Cham, 2018. `doi:10.1007/978-3-319-63946-8_35`.

17 Bill Palmer, Jonathon Lum, Jonathan Schlossberg, and Alice Gaby. How does the environment shape spatial language? Evidence for sociotopography. *Linguistic Typology*, 21(3), 2017. doi:10.1515/lingty-2017-0011.

18 Eric Pederson. Geographic and manipulable space in two Tamil linguistic systems. In Andrew U. Frank and Irene Campari, editors, *Spatial Information Theory: A theoretical basis for GIS*, pages 294–311. Springer-Verlag, Berlin, 1993.

19 Eric Pederson. Spatial language in Tamil. In Stephen C. Levinson and David Wilkins, editors, *Grammars of space: Explorations in cognitive diversity*, pages 400–436. Cambridge University Press, Cambridge, 2006.

20 Eric Pederson, Eve Danziger, David Wilkins, Stephen C. Levinson, Sotaro Kita, and Gunter Senft. Semantic typology and spatial conceptualization. *Language*, 74(3):557–589, 1998.

21 Jonathan Schlossberg. *Atolls, islands and endless suburbia: space and landscape in Marshallese*. PhD thesis, University of Newcastle, Newcastle, Australia, 2018.

22 Joshua A. Shapero. Does environmental experience shape spatial cognition? Frames of Reference among Ancash Quechua speakers (Peru). *Cognitive Science*, 41:1274–1298, 2017. doi:10.1111/cogs.12458.

23 Angela Terrill and Niclas Burenhult. Orientation as a strategy of spatial reference. *Studies in Language*, 32(1):93–136, 2008. doi:10.1075/sl.32.1.05ter.

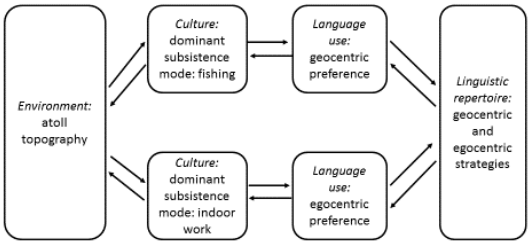

Figure 2 Strategy tendencies and subsistence mode in Laamu fishing versus non-fishing communities [17].