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TECHNICAL REPORT

Re-mapping topographic terms indoors: A study of everyday spatial construals in the mountains of Papua New Guinea

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Vol. 17, No.3, December 2005

Effects of Broca's aphasia and LIPC damage on the use of contextual information in sentence comprehension
Eileen R. Cardillo
CRL & Institute for Neural Computation, UCSD
Kim Plunkett
Experimental Psychology, University of Oxford
Jennifer Aydelott
Psychology, Birbeck College, University of London)
Vol. 18, No. 1, June 2006

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Victor S. Ferreira
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Vol. 18, No. 2, December 2006

Arab Sign Languages: A Lexical Comparison
Kinda Al-Fityani
Department of Communication, UCSD
Vol. 19, No. 1, March 2007

The Coordinated Interplay Account of Utterance Comprehension, Attention, and the Use of Scene Information
Pia Knoeferle
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Vol. 19. No. 2, December 2007

Doing time: Speech, gesture, and the conceptualization of time
Kensy Cooperrider, Rafael Núñez
Depatment of Cognitive Science, UCSD
Vol. 19. No. 3, December 2007

Auditory perception in atypical development: From basic building blocks to higher-level perceptual organization
Mayada Elsabbagh
Center for Brain and Cognitive Development, Birkbeck College, University of London
Henri Cohen
Cognitive Neuroscience Center, University of Quebec
Annette Karmiloff-Smith
Center for Brain and Cognitive Development, Birkbeck College, University of London
Vol. 20. No. 1, March 2008

The Role of Orthographic Gender in Cognition
Tim Beyer, Carla L. Hudson Kam
Center for Research in Language, UCSD
Vol. 20. No. 2, June 2008

Negation Processing in Context Is Not (Always) Delayed
Jenny Staab
Joint Doctoral Program in Language and Communicative Disorders, and CRL
Thomas P. Urbach
Department of Cognitive Science, UCSD
Marta Kutas
Department of Cognitive Science, UCSD, and CRL
Vol. 20. No. 3, December 2008

The quick brown fox run over one lazy geese: Phonological and morphological processing of plurals in English
Katie J. Alcock
Lancaster University, UK
Vol. 21. No. 1, March 2009

Voxel-based Lesion Analysis of Category-Specific Naming on the Boston Naming Test
Juliana V. Baldo
Analía Arévalo
David P. Wilkins
Center for Aphasia and Related Disorders, VANCHCS
Nina F. Dronkers
Center for Aphasia and Related Disorders, VANCHCS
Department of Neurology, UC Davis
Center for Research in Language, UC San Diego
Vol. 21. No. 2, June 2009

Phonological Deficits in Children with Perinatal Stroke: Evidence from Spelling
Darin Woolpert
San Diego State University
University of California, San Diego
Judy S. Reilly
San Diego State University
University of Poiters
Vol. 21. No. 3, December 2009

Dynamic construals, static formalisms: Evidence from co-speech gesture during mathematical proving
Tyler Marghetis
Rafael Núñez
Department of Cognitive Science, UCSD
Vol. 22. No. 1, March 2010

RE-MAPPING TOPOGRAPHIC TERMS INDOORS: A STUDY OF EVERYDAY SPATIAL CONSTRUALS IN THE MOUNTAINS OF PAPUA NEW GUINEA

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Abstract

The Yupno of Papua New Guinea make extensive use of topographic terms—such as *uphill* and *downhill*—for conceptualizing spatial relations (Wassmann, 1994). Given the ubiquity of topographic distinctions in everyday Yupno language, an interesting question is whether such contrasts are also used when topographic landmarks are not available, such as within traditional houses. Yupno houses have flat, oval floor plans, a central fireplace, and few, if any, windows. Yet in natural conversation topographic terms are still widely used indoors. We conducted a field experiment to test whether the use of these terms indoors followed a pattern, and, if so, whether the pattern was motivated by the orientation of the houses in macro-space or, instead, by the houses' own intrinsic asymmetries. 16 Yupno adults (8 men, 8 women) participated in a reference disambiguation task in which they pointed to or grabbed real-word objects in response to pre-recorded imperative sentences (e.g. "Point to the uphill orange"). The auditory stimuli consisted of four topographic target words (two contrasting pairs). Two different traditional houses were used between participants: one faced a downhill direction in the macro-scale topography outside the house; the other faced an uphill direction. Results demonstrate that in both houses participants systematically evoked a micro-world construal of absolute, topographic terms: objects toward the door were construed as downhill, while objects away from the door were construed as uphill, irrespective of the topographic conditions outside. Our results are best explained by a systematic conceptual mapping of an asymmetry of the macro-world (downhill, uphill) onto an asymmetry of the micro-world (toward the door, away from the door). We discuss different factors that serve to support this construal, as well as some implications for the taxonomy of spatial frames of reference.

Introduction

Recent cross-cultural research has demonstrated considerable diversity in how humans talk about and reason about space (Pederson et al., 1998; Levinson, 2003). Particularly striking is the finding that certain cultural-linguistic groups favor what is called an absolute frame of reference. Such groups rely principally on cardinal directions (*north, south*) or environmental features (*uphill, downhill*) to describe spatial relations. What's more, absolute-dominant cultures may be more common than previously appreciated. They have now been documented in Australia, Mexico, Indonesia, Nepal, and elsewhere (see contributions and references in Levinson & Wilkins, 2006); and in certain parts of the world, such as Oceania, they appear to predominate (Heeschen, 1982; Francois, 2004). Despite extensive linguistic documentation of the spatial lexicon in a number of absolute-dominant cultures, interesting questions remain open. Do different kinds of absolute systems—e.g. *cardinal* versus *environment-based*—have different cognitive consequences for their speakers? Are absolute systems used flexibly in different cultural settings? In this paper we take up such questions by examining a particular case study: a surprising spatial construal among the Yupno of the mountains of Papua New Guinea in which absolute, topographic spatial terms are systematically re-mapped inside traditional houses.

Spatial relations between objects are often analyzed in terms of how one object—the *figure*—is construed in relation to another object—the *ground* (Talmy, 2000). Three fundamentally different ways of describing figure-ground relationships—or "frames of reference"—have been distinguished, each based on a different asymmetry in or around the figure-ground array[1]. The first, the *intrinsic* frame of reference, relies on an asymmetry within the ground

[1] The discussion of frames of reference distinctions here draws on the cogent analysis presented in Burenhult (2008), especially pg. 104-106.

object. For example, in *The chair is in front of the car,* the *chair* (figure) is located in terms of the front/back asymmetry of the *car* (ground). The second, the *relative* frame of reference, relies on the asymmetry of an ego external to the figure-ground array. In *The chair is right of the car,* the *chair* is located in terms of the left/right asymmetry of the ego viewing the array. Finally, the *absolute* frame of reference relies on an asymmetry that is outside of the figure-ground array. We can distinguish, however, two broad subtypes of absolute frame of reference terms. In *The chair is east of the car,* the *chair* is located in terms of a large-scale, cardinal east-west asymmetry of the world; by contrast, in *The chair is uphill of the car,* the chair is located in terms of the uphill-downhill asymmetry of the local topography.

Though these two different subtypes of the absolute frame of reference are often grouped together, it is important to recognize the differences between them. The first subtype—which, following Burenhult (2008, pg. 112), we call "abstract"—relies on idealized, fixed angles to reckon spatial relations (as used, for example, by speakers of Guugu Yimidhirr; see Haviland, 1993). The second subtype—which we will call "concrete" (*ibid*, pg. 112)—relies on concrete, visible landmarks (as used by the Balinese; see Wassmann & Dasen, 1998). In the island of Bali, for example, the use of terms meaning *toward the mountain* and *toward the sea* is not determined by fixed cardinal directions, but by concrete topographic landmarks that remain invariant as one moves along the island's seashore[2]. While both subtypes can be used to describe spatial relations on different scales, only concrete systems such as the topographic system described here need to be constantly adjusted to local conditions[3]. It bears emphasis, then, that concrete and abstract systems may have different cognitive consequences for their users, though this issue remains largely unexplored in the literature.

Here we investigate the use of a concrete, topographic system by the Yupno in a particular setting: the traditional house. The Yupno are an indigenous group of Papua New Guinea's Finisterre Range, with a population of over 5000. The community has no electricity or roads, lives by subsistence farming, and is largely uneducated; its territory consists of approximately twenty small villages spread over uneven terrain (for more complete ethnographic details, see Wassmann, 1994 and Keck, 2005). The present study was carried out in Gua, a Yupno village in the Upper Yupno Valley, which is closed in by mountains on all sides. As has been previously documented, the Yupno make extensive use of topographic, slope-based contrasts for conceptualizing space on both small and large scales (for more complete linguistic details, see Wassmann, 1994). These contrasts emerge in different word classes—spatial adverbs (*uphill*/ *downhill*), verbs of motion (*go up*/ *go down*), and spatial deictics (*that above*/ *that below*)—forming a recurrent template, or "semplate" (Levinson & Burenhult, 2009). Though use of the Yupno system can reflect elevation differences on all scales, it often reflects the large-scale slope of the valley down toward the mouth of the Yupno river. Given that the system of contrasts is so ubiquitous in everyday language—but is also based on visible topographic landmarks—we wondered how it might be used within Yupno houses.

The traditional Yupno house is central in everyday life, serving as a key site for cooking, eating, conversation, and warmth. Indeed, the majority of buildings in Gua and the surrounding Yupno territory are houses constructed in the traditional style, with oval floorplans and a long central fireplace (see Figure 1, next page). Traditional houses have a small anteroom at the entryway with a few stairs that lead up to the open main compartment. Usually, the houses have only one window—if any at all—and thus have very few openings to the outside world other than an entryway at one end of the fire[4]. Given that there is no electricity in Gua, the houses are extremely dark, even during the middle of the day. Together the lack of windows and the darkness contribute to a sense—at least to an outsider—that entering a traditional Yupno house is entering a micro-world, which is self-contained and clearly demarcated from the world outdoors. Houses provide

[2] Concrete absolute systems can also be rooted in any number of environment-based contrasts, such as onshore/ offshore, toward lagoon/ away from lagoon, and upriver/ downriver, among others. The topographic, slope-based system described in this paper appears to be one of the more common.

[3] Complicating somewhat the distinction between abstract and concrete absolute frames is the fact that many languages draw their cardinal terms from topographic features (Brown, 1983). And in certain cases the absolute terms are polysemous, with both fixed cardinal and flexible topographic senses (e.g. Tzeltal Maya; see Brown & Levinson, 1992).

[4] Both of the houses used in the present study have single windows on the length of one side wall, which admit some light during the day. However, it should be noted that the windows are very small, and are placed too high up to allow any expansive views of the outside world from a seated position at the fireplace.

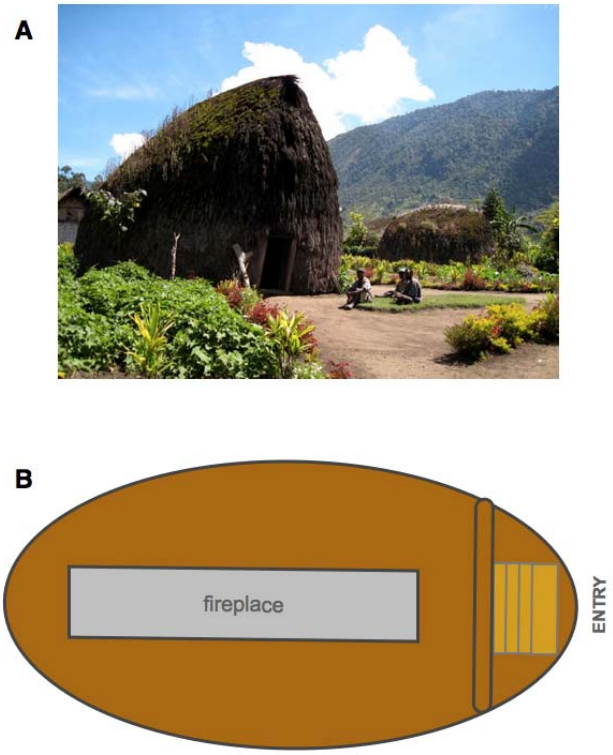

Figure 1. *(A) An example of a traditional Yupno house in the village of Gua. Houses usually contain a large oval-shaped interior, have few if any windows, and have only one point of entry. (B) A schematic overhead view of the traditional house floor plan.*

virtually the only indoor experience for Yupno people, with the exception of a handful of more recent buildings such as churches and classrooms.

Despite the lack of visible topographic landmarks while indoors—and despite the fact that the house floors are flat—informal observations confirm that topographic terms are still commonly used indoors. In a sense it is hardly surprising, given the terms are so widespread in the everyday lexicon, that they would still be used indoors rather than abandoned altogether. But are they used in a systematic way by different speakers and in different houses? We considered two possible construals of topographic terms indoors: a *macro-world construal* and a *micro-world construal*. According to a *macro-world construal*, topographic terms are used just as they would be used on flat surfaces outside. For example, if two oranges sit beside each other on the level floor of the house, the orange closer to the downhill slope in the macro-world topography can be referred to as the one that is *downhill.* Usage of a macro-world construal on flat surfaces indoors has been reported in other groups that rely on slope-based contrasts (Brown & Levinson, 1992; Bickel, 1999). Another possibility would be a *micro-world construal*, in which terms are mapped onto the structure of the house, disregarding the macro-world topography outdoors.

We glimpsed just such a pattern in informal interviews[5], in which Yupno speakers seemed to conceptualize the area of space toward the door as downhill and the area away from the door as uphill. In explicating topographic terms during interviews outdoors, our informants would invariably do so by reference to features of the visible terrain, such as salient local slopes. During indoor interviews, however, the terms were often explicated by reference to the axis of the fireplace. Impressionistically, this pattern was evident in co-speech gesture and *ad hoc* material representations (e.g. drawings made in the ashes of the fireplace), as well as in speech. These observations fit with earlier anthropological reports that the Yupno concept of the macro-space terrain "is replicated in the structure of the traditional Yupno house" (Wassmann, 1994, pg. 658). Wassmann notes, parenthetically, that this replication is reflected in linguistic usage: "[I]f I am sitting at the fireplace in the upper part, 'uphill', of the house, the person opposite is 'beyond above a "border"', somebody at the other, lower end near the door, 'downhill' therefore, is 'beyond below a "border"'' (*ibid*., pg. 655-6). Such a re-mapping is of considerable theoretical interest, and, to our knowledge, has not been previously described in other cultures. However, from the informal observations described above it is not possible to tell whether the Yupno *invariably* construe topographic terms in this micro-world sense, or whether they only do so when the fireplace is a close-enough approximation of the macro-scale uphill-downhill axis. Here we report a field experiment designed to test whether the Yupno favor a micro-world construal of space indoors, and, more specifically, if this preference holds in all houses.

Methods

16 Yupno adults (8 men, 8 women) participated voluntarily, one-by-one, in a reference disambiguation task. Participants sat on either side of the house's central fireplace, with a row of four commonplace household objects—an orange, a

[5] Interviews were conducted in a mixture of Yupno, Tok Pisin (the widely used English-based creole), and English and were facilitated by the presence of field assistants with varying degrees of competence in all three languages.

Figure 2. *The reference disambiguation task.*

tomato, a mug, and a netbag—to their left and another row of the same four objects to their right (see Figure 2, above). Which side of the fire the participant started on (right or left, looking in from the door) was counterbalanced across participants. After the participant was seated in the eight-object array, the experimenter took a seat behind the participant and played simple imperative sentences, pre-recorded in Yupno language, from a laptop computer. Each sentence required the participant to either point to or grab one of the eight objects.

The stimulus sentences were as follows, with an approximate gloss in brackets:

1) Usoden moori suwa. **[uphill orange point]**
2) Omoden moori suwa. **[downhill orange point]**
3) Usoden tomato suwa. **[uphill tomato point]**
4) Omoden tomato suwa. **[downhill tomato point]**
5) Yok abdang awu. **[bag grab come-up]**
6) Yok abdang abba. **[bag grab come-down]**
7) Kap abdang awu. **[cup grab come-up]**
8) Kap abdang abba. **[cup grab come-down]**

Stimulus sentences were designed such that a single topographic word (underlined above) disambiguated which of the two candidate objects was meant. In four of the sentences (1-4), a topographic spatial adverb (*uphill*/ *downhill*) disambiguated which of the two objects was meant; in the other four sentences (5-8), a slope-marked verb of motion (*come up*/*come down*) disambiguated the reference object. Each participant participated in two blocks of eight trials each. A block of trials consisted of all eight stimulus sentences presented randomly. After finishing the first block, the participant was asked to move to the other side of the fire for another block.

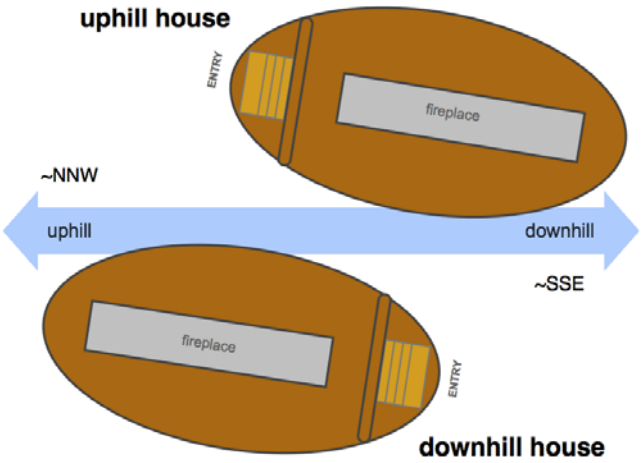

Figure 3. *Schematic showing the two houses used in the study, which face opposite directions relative to the topography of the valley.*

Across participants, two different traditional houses were used (Figure 3, above). A first house, hereafter the "downhill house", faced the valley's macro-scale downhill (approximately south-south-east). A second house, hereafter the "uphill house", faced the valley's macro-scale uphill (approximately north-north-west). Both houses had level floors and conformed to the basic architectural template described above: a small anteroom at the single entryway, a large main oval room, and a long central fireplace. Responses in the uphill house are of particular importance, as they allow us to dissociate the micro- and macro-world construals. Note, finally, that if participants were to answer at random, their responses would be consistent with a micro-world construal 50% of the time.

Results

Yupno participants understood the task, and acted on the correct type of object in 100% of trials. Participants overwhelmingly favored a micro-world construal of spatial relations: objects toward the door were understood as being *downhill*, while objects away from the door were understood as being *uphill*. The mean proportion of participants' responses that were consistent with the micro-world construal was 0.90, significantly higher than chance (one-tailed t-test, $t(15)=10.1$, $p<0.001$). The distributions of these proportions were rather homogenous, with an overall standard deviation of 0.15 (0.10 for the downhill house; 0.17 for the uphill house).

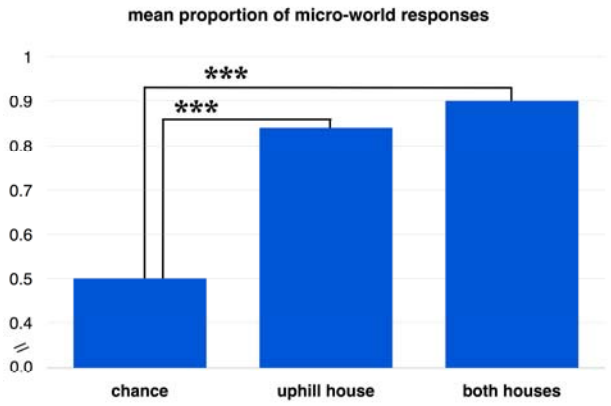

Figure 4. *Mean proportions of micro-world consistent responses were higher than chance in the critical "uphill house" [one-tailed t-test, t(7)= 5.23, p<.001] and in both houses combined [one-tailed t-test, t(15)=10.1, p<.001].*

Crucially, participants in the critical uphill house also favored the micro-world construal (one-tailed t-test, t(7)=5.23, p<0.001) (see Figure 4, above). However, house orientation and construal preference were not independent (two-way χ^2=8.39, df=1, p=0.004), and this with a small-to-medium effect size (Cramer's V = 0.18). Post hoc analyses show that participants favored the macro-world construal more frequently in the uphill house than in the downhill house (adjusted standardized residuals = 2.9). None of the eight participants in the critical uphill house favored the macro-world over the micro-world construal. No effects were found of gender, word class, or of which side of the fire participants started on, suggesting the main factor affecting participants' responses was the position of objects relative to the house's structure.

Discussion

In our study, we found that Yupno speakers operate with a micro-world construal of topographic terms when inside traditional houses. That is, they discount the orientation of the house relative to the surrounding macro-space topography, and instead construe topographic terms relative to the house's internal structure[6]. Objects away from the door are considered *uphill*, and objects toward the door are considered *downhill*. This finding is consistent with earlier anthropological reports, as well as with our own observations outside of the experimental task setting.

It is tempting to suggest that what we are calling a "construal" is in fact regimented by the lexicon. However, the experimental use of target words from different word classes, both spatial adverbs and verbs, makes it unlikely that these results can be explained by pure polysemy—i.e. that the word for *uphill* also means *away from the door*. We argue that our results are better explained by a systematic conceptual mapping of a salient asymmetry of the macro-world (*downhill, uphill*) onto a salient asymmetry of the micro-world (*toward the door, away from the door*). Further support for the conceptual mapping interpretation is found in the fact that participants favored the macro-world construal more frequently in the critical uphill house. This suggests that the Yupno experience some cognitive dissonance when the two construals are at odds. A purely lexical-semantic explanation would not predict such dissonance.

At first glance, the phenomenon described above appears similar to cases in English—and many other languages—in which vertical terms are used when, strictly speaking, no verticality is involved. One can *walk down a hallway*, *pass papers up*, *move down a seat*, *walk up to the cockpit*, and so on[7]. Such uses may be of some interest, but are different from the Yupno phenomenon. For one, the English expressions above appear to be more constructional than conceptual, as evidenced by the fact that the opposite spatial terms cannot be used to mean motion in the opposite direction (i.e. "up the hall" and "down the hall" do not have opposite meanings). In the Yupno case, we suggest that the whole topographic conceptual template is re-mapped indoors, not just one or two isolated lexical items. Second, we argue that the present phenomenon is of special interest because of the foundational nature of the topographic template in everyday Yupno language and conceptualization.

Why do the Yupno favor the micro-world construal over a macro-world one? Building practices—and

[6] One possible framing of the re-mapping phenomenon is that terms that are *absolute* topographic terms outdoors become *intrinsic* terms indoors: the ground object is the house and it has an uphill side and a downhill side. According to Levinson's account of the logical structure of the different frames of reference (2003, pgs. 50-3, cited in Burenhult, 2008), however, this usage is still absolute because the appropriate application of the terms does not change with rotation of the viewer or of the objects themselves, but does change with rotation of the entire object array.

[7] We thank a reviewer for pressing us to be clear about how the present case differs from such mundane cases in English.

their continuity over time—have likely played a role. Again, the interiors of traditional houses are very dark, and there is almost no visual access to topographical landmarks. While it is certainly possible to stay absolutely oriented in such a closed-off space, keying on concrete, visible landmarks within the space itself is presumably less effortful. Further, floorplans from house to house do not deviate much from the archetype described above: an oblong shape, a door on one end only, and a long central fireplace. Traditional houses in this style still predominate in the Yupno valley: in an architectural census of a neighboring Yupno village (Gangalut), we found 46 out of 55 houses (84%) to be constructed in the traditional style. A second factor supporting the micro-world construal is the subtype of absolute frame of reference involved. Again, the Yupno absolute spatial system is concrete and topographic—not fully abstract—meaning that Yupno speakers are necessarily adept at flexibly adapting their use of the terms in different reference situations and different surroundings. Re-mapping of the kind we observed is perhaps less surprising for a group using concrete absolute terms than it would be for a group using abstract absolute terms.

The particulars of the mapping present another puzzle: Why is *uphill* mapped to away from the door and not the other way around? There are at least two possible explanations. One possibility is that, historically, Yupno houses were canonically oriented toward the macro-scale downhill direction (c.f. Wassmann, 1994). Another possibility involves the manner in which one enters or exits the house, mentioned earlier. Entering a Yupno house involves ascending a few stairs to reach the elevated floor, and so travel along the vector of entry might be construed as going up even if one is already inside the house; in the same way, travel along the vector of exit might be construed as going down. Indeed, the entryway is the point of demarcation between the world outside and the micro-world indoors, and therefore the bodily orientation and action pattern (going up or going down) performed at that point may be metonymically extended to the rest of motion along those axes inside the house.

It is important to note that our findings are provisional in several ways. To supplement evidence from our reference disambiguation task, evidence from informal Yupno conversation indoors will be required to fully understand the place of the micro-world construal *vis à vis* other types of possible spatial construals. How commonly used are topographic terms indoors? And assuming they are as widely used as we suggest, is the micro-world construal the *default* way of talking about the spatial relations of objects? Or is it just one of several alternatives? Further, evidence from non-linguistic tasks would be especially valuable in testing our claim that the topographic re-mapping is conceptual, rather than purely lexical.

Absolute-dominant linguistic groups have now been documented around the world. But more research is urgently needed, first, to better understand the different cognitive consequences of abstract, cardinal systems versus concrete landmark-driven systems, and, second, to explore how such systems are deployed in different settings. Of particular interest, perhaps, are the kinds of conceptual processes involved in the extended, non-canonical use of absolute terms. As this study demonstrates, absolute space systems are not necessarily rigid; they can be conceptually plastic and entwined with particular cultural practices—for example, in the present case, a building style central to everyday life.

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