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# Uniformity and variation in Tseltal reference frame use

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ABSTRACT

Tseltal (Mayan) speakers have been described as favoring absolute frames of reference (FoRs) in spatial language and cognition (Levinson, 2003; Brown, 2006). We present the results of a new referential communication task conducted in three Tseltal communities. The data show an overall preference for object-centered and landmark-based descriptions over absolute ones. The use of absolute FoRs varied drastically across the communities in correlation with the salience of topographic features. We argue that this variation is evidence of environmental constraints on FoR use, but not of environmental determinism as suggested by Li and Gleitman (2002).



## 1. Introduction[1]

Frames of reference (FoRs) are coordinate systems used to specify the location or direction of motion of a **figure** entity with respect to some reference entity or **ground** (Talmy, 2000) or the orientation of the figure. Levinson (2003) distinguishes three types of FoRs: **intrinsic** FoRs exploit inherent asymmetries of the ground object itself to project regions of space, as in *The cat is behind the house* in the observer-independent sense of *behind*. The other two types of FoRs involve a third element besides figure and ground: **relative** FoRs involve the identification of regions around a ground object according to an observer's viewpoint, as in *The cat is behind the house* under the interpretation in which *behind* selects the region at the far side from the observer. Finally, **absolute** FoRs identify regions around the ground entity based on fixed bearings, independently of both the ground and the observer, as in *The cat is north of the house*. More fine-grained distinctions are introduced below, specifically, a landmark-based type of FoR, involving a landmark distinct from both ground and observer, as in *The cat is toward the tree from the house*.

Spatial FoRs have received a renewed interest in recent years through the discovery of two important facts. The first of these is the discovery that members of different cultures show variation in the FoRs they use and in their preferences for particular types of FoRs. For instance, speakers of Dutch or English prefer relative and intrinsic FoRs, whereas speakers of Guugu Yimithirr (Pama Nyungan, Australia) use exclusively absolute FoRs and speakers of Yucatec (Mayan) regularly use all three types (Pederson et al., 1998; Levinson, 2003; Majid et al., 2004; Levinson and Wilkins, 2006; Bohnemeyer and Stolz, 2006; Bohnemeyer, 2011; *inter alia*). In addition, people have been found to display an alignment between their preferred FoR when speaking and when memorizing and reasoning about spatial arrays: for example, Guugu Yimithirr speakers not only habitually speak in terms of absolute cardinal directions but also memorize scenes the same way, whereas English speakers favor a relative viewpoint for both speaking and thinking about space. This alignment between the types of FoRs

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[1] The following abbreviations are used in this paper: ABS: personal absolutive affix; CL: clitic; DIR: directional particle; PERF: perfect aspect; PL: plural; POS: possessive affix; PREP: generic preposition.

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used in language and cognition is necessitated by the lack of intertranslatability across FoRs: one cannot report a configuration in a different FoR from that in which one remembers it, unless further contextual information allows one to recode it. But what determines, then, which FoRs a particular population prefers in any given context of use? The members of the Cognitive Anthropology Research (now Language and Cognition) Group at the Max Planck Institute for Psycholinguistics have advanced the case that language, along with other observable behaviors, may be a driving force in preferences for FoR selection (Levinson, 1996, 2003; Pederson et al., 1998; Levinson et al., 2002; Levinson and Wilkins, 2006; Majid et al., 2004). This entails a causal effect of language on thought—a "Whorfian" effect. The rationale of this relativistic hypothesis is this: given that there is more variation in FoR use across populations than within, the question is how do children acquire their community's bias for FoR use? The answer, according to the relativistic view, is that the main source of information governing this development is observable behavior, such as speech, gesture, and any other cultural practices that can be directly observed (as opposed to internal practices of thinking). Each population's pattern of FoR use represents a cultural *habitus* of that community, and language and gesture are the primary vehicles through which this *habitus* is transferred across generations.

This line of research has provoked much controversy. Adopting an opposing view, Li and Gleitman (2002) and others have argued that all spatial FoRs are universally available to human beings independently of their language. According to this position, the population-specific preferences, both in terms of linguistic and non-linguistic behavior, do not represent elements of culture-specific knowledge (cultural *habitus* of referential practice), but instead are determined in terms of literacy, education, topography, and population geography (including the distribution of a population over the area they inhabit and their prevailing settlement types). Accordingly, although correlations may exist between language and cognition, there is no causation from the former to the latter (see also Bloom and Keil, 2001).

Data from Tenejapan Tseltal[2] (Mayan, Mexico) have been at the center of this controversy. Tenejapan Tseltal has been described as a language where absolute FoRs are dominant in spatial descriptions and spatial reasoning (Brown and Levinson, 1992, 1993; Levinson, 1996, 2003; Brown, 2006; *inter alia*). Specifically, Tenejapans rely on an 'up'/'down' system, whose axis is abstracted from the general slope of the terrain. In several publications, Brown and Levinson show that this axis is pervasively used absolutely, meaning independently of the local topography, at all scales, including in manipulable space, although the same terms for 'up' and 'down' also have non-absolute uses in reference to the actual local slope and absolute ones in the vertical FoR, which is **anchored** to the Earth's field of gravity, among others (see Section 3). Under Li and Gleitman's view, the Tenejapan absolute system is an effect of living in the mountains in a relatively small and cohesive speech community. Any such society, under the same circumstances, would thus be predicted to use a similar absolute system (Li and Gleitman, 2002).

A recurrent problem in this controversy has been the lack of agreement about the very terms of the debate: categories of analysis of FoRs, as used on the two sides of the debate, do not match. Li and Gleitman (2002) and other publications following the same line (Li et al., 2005; Abarbanell, 2007) rely on a classification widely used in the psychological literature, which distinguishes among egocentric (or 'viewer-centered'), intrinsic (or 'object-centered'), and geocentric (or 'environment-centered') frames (see also, e.g., Carlson-Radvansky and Irwin, 1993; Wassmann and Dasen, 1998). The basis of this distinction is what Danziger (2010) calls the **anchor** of the frame: some entity or environmental feature which defines the axes of the coordinate system. In egocentric representations, the anchor is the body of an observer. In intrinsic representations, a part of the ground object functions as anchor, and in geocentric ones, some environmental entity or feature does. The members of the former Cognitive Anthropology Research Group at the Max Planck Institute for Psycholinguistics have developed a different classification on the basis of evidence from language typology (henceforth, the 'Nijmegen classification'; Levinson, 1996, 2003; cf. also Pederson, 2003 and Danziger, 2010 for proposed refinements). These two classifications are often misunderstood as terminological variants; they in fact group FoRs quite differently. The relative type of the Nijmegen classification singles out exclusively those egocentric representations in which the ground is distinct from the observer's body. *The ball is left of the chair* is relative following the Nijmegen classification, but *The ball is left of me* is intrinsic. An absolute type in the Nijmegen classification includes only those geocentric frames whose axes are abstracted from some environmental gradient or feature and provide bearings treated as fixed throughout the totality of space (Levinson, 2003, pp. 90–92). So *The ball is uphill of the chair* counts as absolute if 'uphill' is understood to denote an abstract direction vector that remains constant regardless of the actual location of ground or observer *vis-à-vis* the hill, and as intrinsic otherwise. Any frame that is neither relative nor absolute is classified as intrinsic. This classification is justified by crosslinguistic evidence: while all languages have both egocentric and geocentric frames, many languages lack relative frames, absolute frames, or both (Pederson et al., 1998; Levinson, 2003; Levinson and Wilkins, 2006).

The first goal of this paper is to clarify in which sense the absolute and geomorphic use of 'up' and 'down' in Tseltal can be said to be influenced by environmental factors. We show that this system, in the way it is used in different communities, is constrained by the local topography, in the sense that the frequency of use of the 'up'/'down' terms depends on the location and orientation of each community with respect to a salient mountain slope that may serve as the anchor of the system. The 'up'/'down' system is also "calibrated" to the local topography in the sense that the inclination of the slope, where one is present, determines the orientation of the central axis of the 'up'/'down' system. We argue that such environmental constraints on the use of geocentric FoRs are special cases of more general principles that govern the accuracy of any FoR

[2] Following recent agreements on orthography, we use *ts* instead of *tz* for the alveo-dental affricate, so we write *Tseltal* instead of *Tzeltal*. This last spelling has been used in most previous publications in English.

use. Such constraints neither support nor contradict the environmental determinism of FoR selection hypothesized by Li and Gleitman.

A secondary goal of this paper is to evaluate the extent of uniformity and variation in the use of relative FoRs. Previous accounts suggest that Tenejapans frequently rely on intrinsic FoRs, based on productive meronymy (Levinson, 1994), but that they almost never use relative FoRs, whereby an observer projects her own left, right, back or front onto a ground object to locate a figure (Brown and Levinson, 1992; Brown, 2006). However, we present evidence of increased use of relative FoRs especially among younger speakers. While the available data do not allow one to conclusively distinguish between bilingualism in Spanish and the non-linguistic factors of literacy and education as possible causes of the apparent spread of relative reference, there is an apparent connection between relative interpretations and the use of Spanish loanwords, which hints at bilingualism as one of the decisive factors. This outcome would be in line with the relativistic hypothesis that language may be a factor influencing FoR use.

This study is based on data collected by the first author in four communities belonging to two Tseltal speaking counties: Tenejapa and neighboring Oxchuc. These data are from four sources: a referential communication task called "Ball & Chair" involving interactions between pairs of speakers (cf. Section 4) conducted in three of the four communities, elicitation on spatial language and orientation conducted with individual speakers, direct observation and interactions in the field, and a large corpus of annotated recordings in Tseltal gathered as part of linguistic documentation projects carried out during the past ten years in several Tseltal communities.

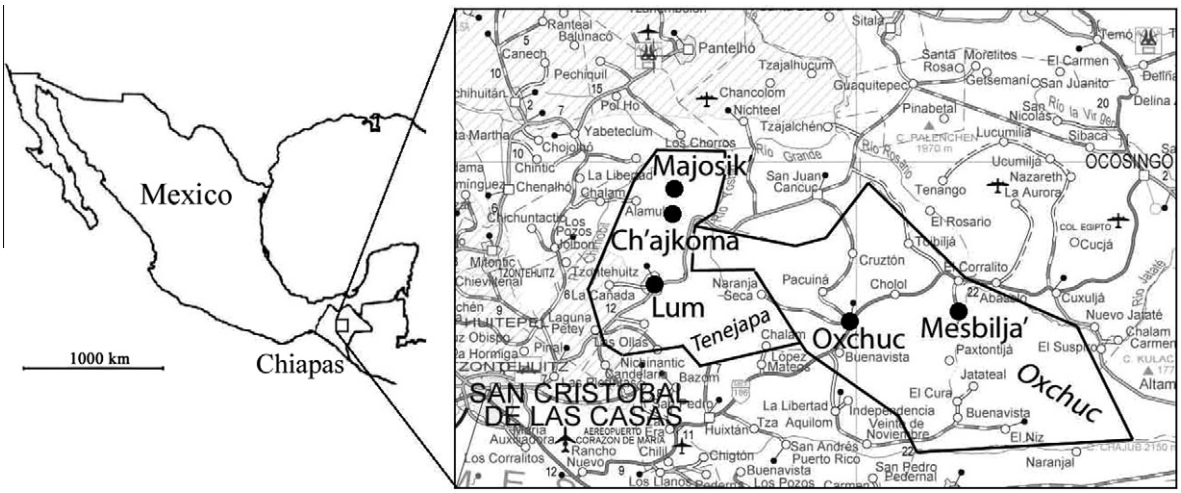
This paper is organized as follows: in Section 2 we present the speech communities under study with their geographical environment, in Section 3 we summarize what we know about Tseltal FoRs from Brown and Levinson's work, in Section 4 we present the Ball & Chair task, the main source of linguistic data for this study, and explain how we coded those data, in Section 5 we discuss the quantitative data from each of the three places where the task was conducted, and finally in Section 6 we draw some conclusions.

## 2. Setting the scene: Tseltal as spoken in Tenejapa and Oxchuc

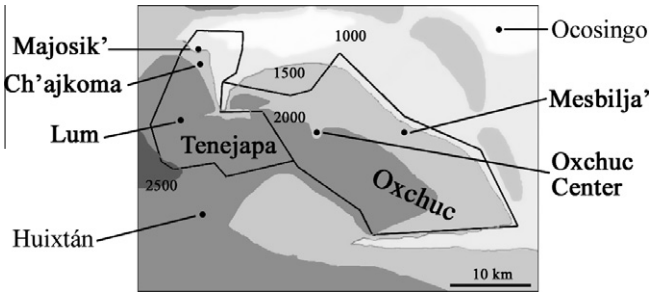
Tseltal is a western Mayan language spoken by more than 400,000 people in southeastern Mexico in the state of Chiapas, bordering Guatemala. It is mildly polysynthetic, head-marking, verb-initial (VOS), with sets of pronominal affixes cross-referencing core arguments on the verb and possessors on the noun. Tseltal is especially known in the linguistic literature for its "highly developed linguistic resources for handling spatial concepts", like positional roots, directional particles, shape-referencing numeral classifiers, etc. (Brown, 2006, p. 230).

Tseltal has moderate dialectal variation, with three approximate zones: north, center and south. The two dialectal forms that concern us here are both from the central zone: Tenejapa and Oxchuc, which correspond broadly to two counties (called *municipios* 'municipalities' in Mexico), as represented in Map 1. Although perceptively different in several linguistic features (some morphological and lexical differences), mutual intelligibility is not an issue at all.

Tenejapa and Oxchuc share a hilly and wooded landscape, which is characteristic of the whole region called Altos, with an altitude ranging from approximately 900 m to 2500 m. In Tenejapa, the incline of the terrain is quite uniform, with altitude decreasing as one goes north or east, whereas in Oxchuc the topography is a little bit more complex. Map 2 illustrates the regional elevation with contour lines indicating 1000, 1500, 2000 and 2500 m above sea level.




**Map 1.** Tenejapa and Oxchuc districts in Chiapas, Mexico, with relevant places highlighted.




**Map 2.** Tenejapa and Oxchuc with contour lines.

**Table 1**
Comparative statistical data indicating the degree of urbanization/rurality in the four studied communities.

| | Ch'ajkoma | Mesbilja' | Lum | Oxchuc |
|---|---|---|---|---|
| Total population | 1413 | 1318 | 1900 | 6468 |
| Average inhabitants per home | 5.56 | 4.83 | 6.27 | 6.25 |
| Percentage of homes with a single bedroom | 51 | 86 | 21 | 29 |
| Average occupants per room | 2.13 | 2.24 | 1.81 | 1.73 |
| Percentage of homes with dirt floor | 84 | 95 | 30 | 35 |
| Percentage of homes with sewage system | 4 | 0 | 89 | 70 |

Tseltal as a language is not acutely endangered in Tenejapa or Oxchuc. However, in these counties, as in the whole state, we observe in recent times a quick rise in bilingualism and literacy in Spanish, along with strong socioeconomic changes linked to globalization (migration, decline of the farming economy, etc.). These changes entail increasing disruption in the inter-generational transfer of cultural and linguistic knowledge and practices, as over time more young people move away from the traditional agricultural way of life and get more acculturated within Mexican *mestizo* society.

This article presents data collected by the first author in four Tseltal communities. The first of these is Ch'ajkoma, a small rural community situated in the northern part of Tenejapa, very close to Majosik', where Penelope Brown and Stephen Levinson have worked for years (cf. Section 3). The second is the town of Tenejapa, the municipal capital of Tenejapa County, which is situated at the bottom of a valley in the center of the county; following Tenejapan usage, it is referred to as Lum here. The third is Mesbilja', a small rural community in Oxchuc County situated along a narrow river that winds northwards between hills. The fourth and last community is the town of Oxchuc, the municipal capital of Oxchuc County, located in a narrow basin amidst hills. Ch'ajkoma and Mesbilja' are fully rural, meaning that the houses are scattered amidst vegetable gardens, corn fields and vegetation, connected only by dirt roads, whereas Lum and Oxchuc Center are visibly more urban-like, that is, displaying concentrated housing with asphalt streets. Further, houses are bigger, with more inhabitants but also more rooms per house, and with a much greater proportion of concrete floors and sewage systems.[3] Table 1 synthesizes the relevant data.

## 3. FoRs in Tseltal

During the 1990s Brown and Levinson conducted a series of investigations on spatial language and reasoning in Tseltal, mainly in the Majosik' community in the northern lowlands of Tenejapa County (see Maps 1 and 2).[4] They showed that in Tseltal absolute FoRs are predominant in locative descriptions in which figure and ground are not proximate. In cases in which figure and ground are proximate, Tenejapans use intrinsic FoRs, relying on a productive meronymic system which identifies parts of the objects according to their internal geometry (Levinson, 1994). From those parts, a region can be projected to locate a figure close to that part of the ground. For example, someone located at the intrinsic front of a car would be said to be 'at the car's head', etc.

Brown and Levinson also showed that Tenejapans hardly use relative FoRs at all. Tseltal does have terms for 'left' and 'right', *xin* and *wa'el*, respectively, but these are restricted to naming the left and right hand, respectively, and there is virtually no projective use of these terms. There are, however, marginal uses of 'back' under relative interpretations with ground objects that lack intrinsic backs.

The type of FoR that has attracted the most attention in the debate on FoRs in Tseltal is the absolute one, which is primarily based on the terms for 'up' and 'down', *ajk'ol* and *alan*, and other associated linguistic devices (verbs for 'go up' and 'go down', relational nouns 'on top of' and 'below', etc.). These terms are not exclusively bound to an absolute interpretation. Brown and Levinson (1993) show that *ajk'ol* and *alan* have no less than five different kinds of uses, summarized in (1).

[3] Statistics based on the 2005 Census of the INEGI (cf. www.inegi.org.mx).

[4] See Brown and Levinson (1992, 1993, 2000, 2009), Brown (1994, 2001, 2006), Levinson (1994, 1996, 2003), Levinson and Brown (1994), Levinson et al. (2002). In this article we use the abbreviated mention of "Brown and Levinson" to refer to this group of publications.

(1) *Ajk'ol* 'up' and *alan* 'down' can be interpreted with reference to:
- (a) The absolute vertical axis (linked to gravity). According to Brown and Levinson, this is not the central usage of these terms in Majosik'. [a]
- (b) On any arbitrary slope, the upper part and the lower part, respectively, independently of the absolute orientation of the slope. The terms are also used in reference to spatial regions projected from these parts and to the directions 'uphill' and 'downhill' with respect to the slope. This is the family of geomorphic uses of the terms.
- (c) The absolute directions approximately 345° NNW (*alan*) and 165°SSE (*ajk'ol*), as located on a compass, and cone-shaped regions formed around these vectors. These directions are abstracted from the dominant orientation of the terrain around Majosik' (and in general in the Tenejapa municipality), which slopes down steeply from south to north. The difference with respect to (b) is that, in this case, *alan* and *ajk'ol* do not refer to the local incline, but to a "conceptual slope" independent of the local terrain, so they can be used in the horizontal. This is the **horizontal absolute** use of *alan* and *ajk'ol*, as opposed to the **vertical absolute**, as in (a).
- (d) At least marginally, the relative distance of two places in front of an observer: *alan* 'down' can refer to a place closer to the observer and *ajk'ol* 'up' to a place further away. This can be interpreted as an effect of the two-dimensional projection of the three-dimensional visual field on the retina: closer points appear lower on the retina, more distant points appear higher.
- (e) Place names: Tenejapan territory is divided into two halves, a northern/lower/hotter part named *alan* or *alan k'inal* (*k'inal* means 'space') and a southern/higher/colder part named *ajk'ol* or *ajk'ol k'inal*. Thus, going *alan* or *ajk'ol* can mean 'going to the lower/higher region of Tenejapa' regardless of the compass direction toward which the figure moves.

[a] As Brown and Levinson point out, when *ajk'ol* 'up' appears as a possessed relational noun, a special derived form with the suffix *-al* is restricted to vertical uses (*ta y-ajk'ol-**al*** 'vertically above it') while the unmarked form (*ta y-ajk'ol*), primarily occurs with the geomorphic sense 'uphill of it'. This does not change the fact that *ajk'ol* by itself has vertical and other (absolute, geomorphic, etc.) senses, and can be used as such without derivation.

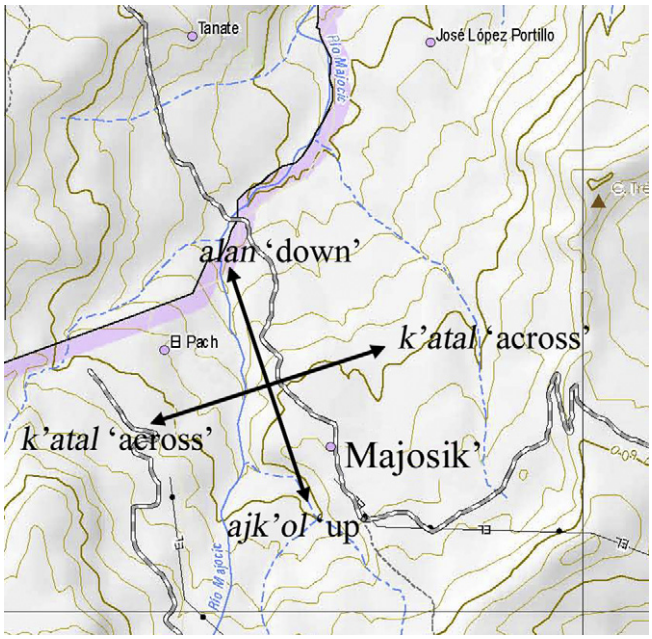
Brown and Levinson gloss *ajk'ol* and *alan* as 'uphill' and 'downhill' instead of just 'up' and 'down', arguing that their primary meanings are not related to verticality, but to (actual or abstracted) inclination of land. We instead assume that, at least on a broader pan-dialectal level, the basic meaning of the terms is the vertical one, reflected in the glosses 'up'/'down' used in this article. The geomorphic uses of the terms and the uses describing distance in the visual field are but special cases of the vertical sense since they can be derived from this sense without additional assumptions, whereas the absolute horizontal uses are metonymic extensions since they cannot be derived without assuming some form of semantic transfer.

Brown and Levinson show two fundamental properties of how people use the absolute axis: it is used as a spatial reference tool both at a geographic scale and also at a manipulable scale in locating a small object with respect to another object. For example, if a bottle is placed north of a chair in the horizontal, even without visual access to the dominant slope (say, inside a house without windows), its location can be expressed as literally 'down of the chair', and indeed that would be a common way of locating it. This means people are constantly aware of the absolute 'up'/'down' axis at every moment and in every place.

Further, the use of this axis does not depend on people being in Majosik': as people from Majosik' travel to other places, with different hills and slopes, they carry with them the same axis and are still capable of communicating successfully among themselves, locating things as 'up' (SSE) and 'down' (NNW) with respect to a ground object. This last property distinguishes true absolute uses of the system from geomorphic uses: the dominant slope is abstracted as a "conceptual slope", present at every moment and every place in the memory of the speakers. However, Brown and Levinson (1992: p. 596, 1993: p. 64) point out that in the salient presence of an actual slope in the environment, geomorphic interpretations (1b) tend to preempt absolute horizontal uses of the terms where the two interpretations do not align. In contrast, in the absence of an actual slope, the absolute interpretation (1c) tends to preempt all other senses.

Map 3 superimposes the absolute 'up'/'down' axis onto a topographic map of the Majosik' area. Note that the actual use of this system is more flexible than the arrows seem to suggest, a more exact representation should rely on cone-shaped regions around the mentioned directions. The contour lines show the alignment with the actual slope of the local topography. Orthogonal to the 'up'/'down' axis, another axis gives an across direction, which is expressed as *k'atal* 'lying crosswise' or *ta jejch* 'on the (other) side'; this last axis can mean either (roughly) 'eastward' or (roughly) 'westward'. In the vertical uses of the system, *k'atal* is interpreted as 'horizontal' (neither up nor down).

Besides showing the predominance of absolute FoRs in the linguistic use of FoRs, Brown and Levinson further conducted non-linguistic experiments that revealed that Tenejapans tend to resolve spatial tasks by also using an absolute FoR. That is, when asked to memorize a spatial array in front of them and then reproduce it under 180° rotation, they would not reproduce the array egocentrically, maintaining the orientation of the array with respect to their own left or right sides, as most speakers of Dutch, Japanese, and other predominantly relative languages have been shown to do (Pederson et al., 1998). Tenejapans would instead maintain the same absolute orientation of the array (say, northwards, southwards, etc.). Brown and Levinson argued language to be a determining factor in this aligned use of FoRs in linguistic and non-linguistic behavior, a Whorfian effect by which language influences cognition, as discussed in Section 1.




**Map 3.** Majosik' and the absolute 'up'/'down' axis.

As mentioned in the introduction, this last claim regarding Tseltal has been controversial: another group of linguists and psychologists (Li and Gleitman, 2002; Li, 2002; Li et al., 2005; Abarbanell, 2007, *inter alia*) have dismissed such a kind of direct connection between language and cognition, arguing instead for a view in which both linguistic and cognitive styles are shaped exclusively by non-linguistic factors—literacy, education, topography, and population geography: "the presence of supralinguistic cultural differences ... predict both the favored linguistic terminology and the spatial reasoning patterns" (Li and Gleitman, 2002, p. 288). Of particular interest for our purposes is the claim that the use of geocentric FoRs may be conditioned by an interaction of topography and population geography. Geomorphic and landmark-based systems can be used in a uniform manner only up to a certain level of distance from the landscape entity or feature that serves as the anchor. This predicts that reliance on such systems is restricted to small communities that live in close proximity of the topographic cue. Consequently, "a single factor—geographical cohesion in community life—plays a major role in predicting why social groups develop preferences in their everyday terminology for referring to regions and directions in space" (*ibid.*, p. 287). This argument was rejected by Levinson and collaborators, countering that such environmental restrictions do not extend to true absolute systems abstracted from geomorphic ones, as is the case with the 'up'/'down' system in Majosik': "landmark cues do not play any special role in absolute systems like the Tzeltal ... system." (Levinson et al., 2002, p. 182). As we show below, this statement is clearly too bold: both the frequency of use of the *ajk'ol*/*alan* system and the orientation of its axes vary strongly across Tseltal communities, evidently depending on the local topography. So the use of geocentric FoRs is indeed constrained by the environment, and we argue that something similar in fact holds for all types of FoRs. However, such constraints must not be confused with determinants. The environment may limit the accuracy with which particular types of FoRs can be used in particular contexts; but there is no evidence that it may *cause* the use of certain kinds of FoRs as opposed to others, as it would have to if Li and Gleitman's attempt to leverage it into an argument against the possibility of linguistic influences were to succeed.

In the remainder of this section, we present additional refined distinctions that can be drawn beyond the three basic FoR categories, namely, intrinsic, relative and absolute. In the present study, we employ a more fine-grained classification, which we adopt from Brown and Levinson's (2009) detailed study of FoR acquisition in Tseltal, with one exception to be explained below. These categories are presented in Table 2 together with the results of Brown and Levinson's (2009) "Farm Animal Interactional Games" study, in which five pairs of Tseltal speakers interacted to describe arrays of toy animals. The authors also present data from children, but as we only focus on adults in this study, the child language data are ignored here. The

**Table 2**
FoR categories and frequency of use among adults in Tseltal (Brown and Levinson, 2009, p. 458).

| Deictic | Absolute | Intrinsic | Landmark | Sunrise/sunset | Relative | Total |
|---|---|---|---|---|---|---|
| 30% | 14% | 22% | 25% | 8% | 1% | 1682 |

numbers and percentages in Table 2 represent the proportion of linguistic forms in the descriptions for each of the spatial categories.

The 'absolute' category of Table 2 actually merges absolute horizontal and geomorphic uses of *ajk'ol* 'up' and *alan* 'down', since these two interpretations cannot easily be distinguished in a place like Majosik', where they align under the conditions of Brown & Levinson's Farm Animals study. We follow this same practice below in presenting our Ball & Chair data, for the same reasons. In their study, Brown and Levinson restrict the use of the term 'intrinsic' to the traditional narrow sense of object-centered frames projected from the axes of the ground and treat landmark-based frames and sunrise/sunset-based frames as separate categories, even though they likewise fall under the broader 'intrinsic' category of Levinson, 2003. They add a further category to their coding schema, namely 'deictic' directional particles ('coming'/'going') in spatial descriptions. We ignore this category in the rest of this study, because deictic terms do not *per se* require FoRs for their interpretation.

'Landmark' refers to the use of entities of the environment as marking the heads or tails of vectors that define axes of FoRs, as in *The bottle is toward the door from the chair*; cf. Bohnemeyer and O'Meara, ms. In the egocentric-intrinsic-geocentric classification widely used by psychologists (see Section 1), including Li and Gleitman (2002), a landmark-based description is treated as geocentric on a par with an absolute description, insofar as it relies on environmental cues external to the observer and external to the ground itself. In the Nijmegen classification, landmark-based systems are treated as a subtype of intrinsic FoRs, because they do not involve the abstract bearings of absolute systems. Landmark-based descriptions such as *toward the door*, like absolute descriptions such as 'north', primarily denote vectors. In the case of landmark-based descriptions, either the head or the tail of these vectors is defined by the location of the landmark, whereas absolute descriptions apply to all vectors that point in a certain direction regardless of their head and tail coordinates (see also Brown and Levinson, 2009, p. 456, and the discussion in Terrill and Burenhult, 2008, pp. 122–124).

The sunrise/sunset category corresponds to references to the points on the horizon where the sun rises and sets. According to Brown and Levinson (2009, p. 457), "these are intermediate between absolute and landmark terms; they provide geocentric directions but these ... are subject to significant solstitial variation, unlike the true absolute terms".

To our knowledge, the data in Table 2 represent the first quantitative data ever published on FoR use in Tseltal. In their previous accounts cited above, Brown and Levinson routinely assert dominance of absolute and, at very close range, intrinsic reference and an absence of relative FoRs. These claims are based on quantitative analyses of the authors' data. However, unlike their 2009 chapter, their earlier publications do not cite actual figures. A representative quote follows:

> The intrinsic uses are very constrained, as Tzeltal speakers prefer to use body-part expressions when figure and ground are in contact or at least in close proximity. In the case where figure and ground are more widely separated in space, Tzeltal speakers use an absolute frame of reference to describe the angle at which the figure lies from the ground (Brown, 2006, p. 263).

The data in Table 2 paint a much more differentiated picture. According to this picture, while the marginal status of relative FoRs is confirmed, object-centered intrinsic and especially landmark-based frames were actually used more frequently than absolute and geomorphic frames during the Farm Animal Interactional Games, at least by adult speakers. Brown and Levinson explain this apparent discrepancy with reference to a putative task-specific effect. The niceties of the Farm Animal Interactional Games motivate a greater degree of precision in spatial reference than what the 'up'/'down' system affords:

> The explanation for the increase of landmark specifications is clear enough. Adults are attempting a level of precision that cannot be communicated by the abstract absolute system alone, which only divides directions into four 90-degree quadrants. To give more precise angles, local landmarks can be brought into play, so one can say in effect 'heading southward, toward Red Cliffs,' now precise to, say, 20 degrees of arc. Caring about precision and having the inventive means to produce it are what mark fully adult speech (Brown and Levinson, 2009, p. 460).

Striking support for the assumption of task-specificity comes from the fact that the absolute/geomorphic 'up'/'down' system was used vastly more frequently by children of all four age groups recruited for Brown and Levinson's study (ages 5–7, 8–10, 11–13, 14–16) than by adults. Among the children, the absolute/geomorphic system was indeed the dominant one. In the data from the three Tseltal communities we present below, a similar preference for object-centered and landmark-based FoRs over absolute and geomorphic ones manifests itself. We conjecture that this preference may likewise be task-specific.

## 4. The task and the coding of the data

As part of the MesoSpace project (see O'Meara and Pérez Báez, 2011; Bohnemeyer, 2008), the first author conducted a series of tasks in Ch'ajkoma, Lum, and Mesbilja' in order to get comparable results, both for internal comparison between Tseltal communities and between Tseltal and other Mesoamerican languages. In this article, we report only the results of the Ball & Chair task (henceforth B&C; see O'Meara and Pérez Báez, 2011, for more information and background on this study). In this task, two speakers are seated together at a table, facing the same direction, with a screen between them preventing visual contact. Facing direction varied across places and across pairs, except for Mesbilja' where all pairs faced west. On the table, two identical sets of twelve photographs featuring a chair and a ball in various configurations are arranged (see some examples of the photographs below). One of the two participants acts as the director and the other as the matcher. The director picks up any one of the photographs and describes it, talking with the matcher until the matcher

finds the matching photograph. Once all photographs have been matched, another set is presented. Four sets are successively laid on the table, 48 photographs in total.

B&C was applied to five pairs of speakers in both Ch'ajkoma and Lum, and to six pairs in Mesbilja'. Participants were all adult native speakers of Tseltal, women and men, living in the village where they participated in the task, most of them born there. Ages ranged from 17 to 57, with varying degrees of bilingualism in Spanish, literacy and schooling. All interactions with participants were in Tseltal.

All sessions were fully transcribed, and spatial descriptions involving FoRs were extracted and organized into two groups: descriptions of the orientation of the chair and descriptions of the location of the ball with respect to the chair. Each description was then analyzed in terms of the strategy it involves, taking into account the six categories presented in Section 3 above: absolute/geomorphic 'up'/'down', sunrise/sunset, relative, intrinsic and landmark. These of course do not exhaust all of the types of strategies that occurred during the task: in particular, there were frequent uses of deixis (as in 'here', 'there', etc.), topological descriptions (as in 'on the chair', 'in between the legs', etc.), and vertical absolute FoRs ('up'/'down' with respect to gravity), which are not relevant for the study at hand and are not dealt with in this article.

### 4.1. Absolute/geomorphic 'up'/'down'

As described by Brown and Levinson, Tenejapa Tseltal uses 'up' and 'down' terms for referring to absolute directions through abstraction of a dominant slope, which generally goes down northwards or eastwards in both Tenejapa and Oxchuc. This is how speakers can make sense of descriptions as in (2), where 'up'/'down' terms apply to a horizontal layout (see Fig. 1).

(2) a. *koel* *ay* *bel* *y-elaw* *te* *silla-e*
downwards is DIR 3POS-face the chair-CL
'The chair is facing downwards.'

b. *te* *pelota-e* *li'* *ay* *ta* ***ajk'ol***
the ball-CL here is PREP up
'The ball is up (with respect to the chair).'

Absolute uses of the 'up'/'down' terms also occur in Mesbilja' Tseltal. As introduced in Section 3, this system relies first on the nouns *ajk'ol* 'up' and *alan* 'down'. Other terms related to verticality are also used, like the two intransitive motion verbs *ko* 'go down' and *mo* 'go up', which appear as main predicates, auxiliaries, or directional particles (in a nominalized form *koel* and *moel*, respectively).

The system observed in Oxchuc County is roughly the same except for the noun *ajk'ol* 'up', which does not exist as such and is only used as a possessed relational noun in a slightly changed form: *y-ajk'l-al* 'on top of'/'above'/'uphill from'. Instead of *ajk'ol*, people from Oxchuc generally use the positional stative form *kajal* 'above' (which is also a lesser used possibility in Tenejapa). *Alan* 'down', *ko* 'go down', and *mo* 'go up' are used in the same way as in Tenejapa.

As mentioned in Section 3, we did not attempt to distinguish between absolute horizontal and geomorphic uses of the 'up'/'down' system in coding the Ball & Chair data. This distinction can only be made when the terms are used beyond

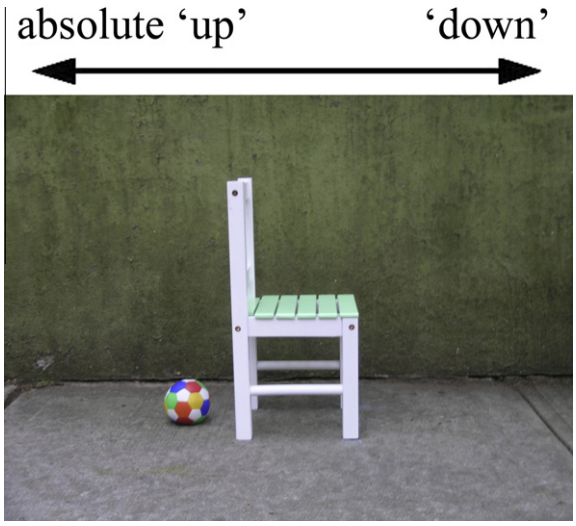



**Fig. 1.** B&C 2.11.

the slope to which they are anchored—such abstract uses are necessarily absolute. We, however, conducted the Ball & Chair task exclusively in the speakers' local communities, where absolute and geomorphic uses align.

### 4.2. Sunrise/sunset

Reference to sunrise and sunset in spatial descriptions is common in several Tseltal communities, including parts of Tenejapa and Oxchuc. Sunrise is expressed as *slok'ib k'aal* (literally, 'coming out of the sun') and sunset as *smalib k'aal* (literally, 'pouring of the sun'), with a possible contraction to *lok'ik'al* and *malik'al*, respectively. This use is illustrated in (3) (see Fig. 2):

| (3) | *ta* | ***lok'ik'al*** | *ay* | *me* | *balon-e* |
|---|---|---|---|---|---|
| | PREP | sunrise | is | the | ball-CL |
| | 'The ball is at (toward) sunrise.' | | | | |

We consider reference to sunrise/sunset as involving another kind of absolute FoR, which we keep separate from absolute 'up'/'down' because the latter is what mainly interests us here. As commented above in Section 3, Brown and Levinson (2009) consider this use as intermediate between absolute and landmark-based FoRs.

### 4.3. Relative FoRs

This type of FoR is defined by the projection of the observer's own asymmetries onto a ground object (in locative and motion descriptions; in orientation description, the frame is projected onto the figure itself) in order to establish projected areas in which to locate a figure, as in (4): the ball is located at the 'back' of the chair, although the search domain in this case is not the intrinsic back, but the area defined as being opposite to the relative 'front', the part facing the speaker's front (see Fig. 3). We show below that this same relator can be interpreted with an intrinsic FoR (see (5)).

| (4) | *ay* | *p'ekel* | *pelota* | *ta* | ***s-pat*** |
|---|---|---|---|---|---|
| | is | lying | ball | PREP | 3POS-back |
| | 'There is a ball behind it [the chair].' | | | | |

Other expressions that were used relatively in the task include the terms for 'left' (*xin* in Tenejapa, *k'exen* in Oxchuc) and 'right' (*wa'el*), and several terms for 'side' (*xujk* or *ts'eel*; see examples in (9) and (10)). This contrasts with previous descriptions according to which there is no projective use of 'left' and 'right' in Tseltal altogether. We argue in Section 5 that there are reasons to think there has been a recent spreading of these relative uses in Tseltal due to contact with Spanish.

### 4.4. Intrinsic FoRs

In this type of FoR, the inherent asymmetries of a ground object are used to locate a figure projecting a region from a part of the ground, as in (5) (see Fig. 4).

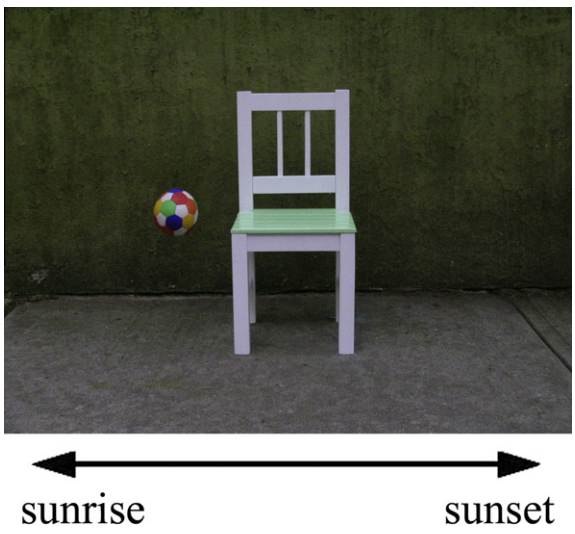



**Fig. 2.** B&C 2.6.

**Fig. 3.** B&C 2.9.

**Fig. 4.** B&C 2.11.

(5) *ay* *p'ekel* *pelota* *ta* *s-pat*
is lying ball PREP 3POS-back
'There is a ball behind it [the chair].'

Note that this description is identical to the relative description in (4). But here, it refers to the intrinsic back of the chair. Another kind of intrinsic description relies on parts of the body of the speaker or the hearer, as in (6) (see Fig. 5).

(6) *li'* *ay* *tal* *ta* *k-elaw-tik*
here is DIR PREP 1POS-face-PL
'It [the ball] is in front of us (lit.: in our face).'

This description is not understood in a relative FoR, because there is no projection of the observer's bodily coordinates onto a ground object: the observer's body is the ground object itself. In other proposals, this would instantiate a distinct type of FoR: Li and Gleitman (2002) merge this kind of intrinsic reference based on the observer's bodily axes with the relative FoR into an egocentric category, whereas Danziger (2010) analyzes it as a new kind of FoR, called 'direct', distinct from both the intrinsic and the relative type. In order to allow comparisons with Li and Gleitman's and Danziger's frameworks, we specify two subcategories of intrinsic: following Danziger's (2010) terminology, **object-centered** refers to intrinsic descriptions based on the chair, as in (5), whereas **direct** refers to intrinsic descriptions based on the body of the speaker, as in (6).

**Fig. 5.** B&C 4.3.

### 4.5. Landmark-based FoR

As explained in Section 3, this strategy corresponds to the use of ad hoc landmarks for directions or location. A prototypical use of a landmark in the data collected from B&C is illustrated in (7). The landmark *mukinal* 'cemetery' was in the direction suggested by the position of the ball with respect to the chair in the actual situation of the recording (see Fig. 6).

(7) *jich p'ekel bel ta stojol* ***mukinal*** *i pelota-i*
thus lying DIR PREP toward cemetery the ball-CL
'The ball is placed toward the cemetery [with respect to the chair].'

Another kind of landmark used by almost all the participants was their own body: the orientation of the chair or the location of the ball was sometimes described as 'toward me', 'toward where we are', etc., as in (8) (see Fig. 7).

(8) *li' ay tal y-elaw ta ba ay-otik-i*
here is DIR 3POS-face PREP where be-1PL.ABS-CL
'It [the chair] is facing toward here where we are.'

For the purpose of maintaining comparability with the proposals that would analyze (8) as instantiating a distinct type of FoR (*i.e.* an egocentric FoR), the landmark category in the tables in Section 5 is broken down into two subcategories: "SAP" refers to the use of speech act participants' bodies as landmarks, as in (8), whereas "general" refers to the use of any other object in the world as a landmark, as in (7).

**Fig. 6.** B&C 2.5.

**Fig. 7.** B&C 2.1.

## 5. FoR preferences by community

### *5.1. Ch'ajkoma*

As described above, Ch'ajkoma is situated directly south of and above Majosik' on the same slope: from the lowest houses of Ch'ajkoma one sees Majosik' a few hundred meters below. The expectation was then to obtain results similar to those of Brown and Levinson, as described in Section 3. B&C was applied to five pairs of speakers in Ch'ajkoma. Information about the speakers' gender, age, bilingualism, literacy and schooling is provided in Table 3. Literacy means literacy in Spanish; although some people may have rudimentary literacy in Tseltal also, there is generally no functional literacy in Tseltal.

Quantitative results of the B&C task in Ch'ajkoma are presented in Tables 4a and 4b. The numbers in Table 4a refer to the number of photographs (out of 48) for which the corresponding strategy was used (generally various strategies were used before the matcher found the photograph that the director was describing). Facing direction for each pair (SW, SE, etc.) is given under each pair's number.

First of all, we can see that the participants from Ch'ajkoma used the absolute/geomorphic 'up'/'down' axis: all pairs used it at least once, but pair 4, and more markedly pair 5, used it much more frequently than the other pairs of speakers. All those references were successful, in the sense that the matcher interpreted them correctly in terms of absolute or geomorphic directions, in spite of the potential ambiguity of the 'up' and 'down' terms (cf. Section 3). This shows that the absolute/geomorphic 'up'/'down' axis belongs to the habitual resources of Ch'ajkoma speakers for describing spatial configurations at a scale within reach.

However, the sunrise/sunset axis was preferred by pairs 2 and 3 over the 'up'/'down' axis. This seems to indicate that the solar compass is also a common resource for establishing a coordinate system to be used in spatial descriptions in Ch'ajkoma.

Going back to Table 4b, we observe that the main strategies used in the B&C task are the use of ad hoc landmarks in describing the orientation of the chair (60%) and the intrinsic FoR in describing the location of the ball with respect to the chair (50%). That is, a prototypical expression for orienting the chair was 'its face is turned toward Majosik'/the car/here where we're sitting/etc.', and a frequent way of locating the ball was 'it is at the chair's side/back/face/etc.' All these result are consistent with the results from Majosik' obtained by Brown and Levinson (2009), as presented in Table 2 above.

The frequencies of use within the individual categories in both B&C and Brown and Levinson's results from Majosik' are quite similar, despite the fact that they come from different tasks. In particular, landmark uses outnumber uses of the abso-

**Table 3**
Ball & Chair participants in Ch'ajkoma.

| Pair | Speaker | Sex | Age | Bilingual | Literacy | Schooling |
|---|---|---|---|---|---|---|
| 1 | 1 | M | 22 | Yes | Yes | Secondary school |
| | 2 | M | 40 | Yes | Some | Some |
| 2 | 3 | M | 48 | Yes | Some | Some |
| | 4 | F | 44 | No | Some | Some |
| 3 | 5 | F | 30 | Yes | Yes | Primary school |
| | 6 | M | 29 | Yes | Yes | Primary school |
| 4 | 7 | F | 22 | No | No | Some |
| | 8 | M | 24 | Yes | Some | Primary school |
| 5 | 9 | F | 29 | No | Some | Primary school |
| | 10 | M | 29 | Yes | Some | Primary school |

**Table 4a**
Strategies used for Ball & Chair in Ch'ajkoma (by dyad).[a]

| Pairs of speakers and description type | | Absolute 'up'/'down' | Sunrise/sunset | Relative | Intrinsic | (o.-c./direct) | Landmark | (General/SAP) | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Orientation of chair | 5 | 1 | 4 | 0 | (0/0) | 23 | (17/6) | 33 |
| SW | Location of ball | 0 | 0 | 9 | 30 | (27/3) | 4 | (2/2) | 43 |
| 2 | Orientation of chair | 1 | 12 | 0 | 1 | (0/1) | 25 | (21/4) | 39 |
| SW | Location of ball | 0 | 22 | 6 | 21 | (21/0) | 3 | (2/1) | 52 |
| 3 | Orientation of chair | 1 | 20 | 0 | 0 | (0/0) | 22 | (22/0) | 43 |
| SE | Location of ball | 0 | 13 | 3 | 28 | (28/0) | 0 | (0/0) | 44 |
| 4 | Orientation of chair | 8 | 2 | 0 | 0 | (0/0) | 29 | (24/5) | 39 |
| SW | Location of ball | 5 | 4 | 1 | 13 | (13/0) | 11 | (7/4) | 34 |
| 5 | Orientation of chair | 20 | 0 | 0 | 5 | (0/5) | 20 | (10/10) | 45 |
| NW | Location of ball | 12 | 0 | 1 | 17 | (17/0) | 13 | (6/7) | 43 |

[a] o.-c. = "object-centered", cf. preceding section on intrinsic FoRs.

**Table 4b**
Strategies used for Ball & Chair in Ch'ajkoma (summary).

| | Absolute 'up'/'down' (%) | Sunrise/sunset (%) | Relative (%) | Intrinsic (%) | (o.-c./direct) (%) | Landmark (%) | (General/SAP) (%) | Total |
|---|---|---|---|---|---|---|---|---|
| Orientation of chair | 18 | 18 | 2 | 3 | (0/3) | 60 | (47/13) | 199 |
| Location of ball | 8 | 18 | 9 | 50 | (49/1) | 14 | (8/6) | 216 |

lute/geomorphic 'up'/'down' axis in both Majosik' and Ch'ajkoma. The only perceptible differences are, on the one hand, the fact that absolute/geomorphic 'up'/'down' references outnumber references to the sun compass in Majosik', whereas it is the other way around in Ch'ajkoma. On the other hand, the relative FoR seems to be less marginal in Ch'ajkoma than in Majosik', a point we return to below.

Nevertheless, there is an important difference between Ch'ajkoma and Majosik': the orientation of the 'up'/'down' axis. Ch'ajkoma is situated on an edge with a slope descending in NNW direction and another one descending in NE direction. There are in fact two distinct uses of *alan* 'down', as represented in Map 4. *Alan* is used in reference to the NNW (thin arrow) by speakers situated on the north(west)-oriented slope – this is the expected greater salience of the actual slope over the abstract, "conceptual slope". But in all other contexts, the dominant *alan* 'down' axis is NE (≈45°) in Ch'ajkoma, with *ajk'ol* 'up' oriented SW (≈225°), whereas in Majosik', the axis is 345°/165° for 'down' and 'up', respectively. Thus, unsurprisingly, topography is crucially involved in defining the axes of the FoRs underlying geomorphic and absolute horizontal uses of 'up'/'down'.

Regarding the relative FoR, we observe in Table 4a that all pairs of speakers used at least one relative expression, but that pair 1 accounts for more than half of all of these expressions. Many of the relative expressions are of the kind 'at the back of the chair' meaning 'behind the chair from our perspective', as exemplified in (4) above. Several speakers also used *xujk* 'side' involving a relative FoR, as in (9), a possibility that had not been observed before by Brown and Levinson in Tenejapa as far as we know, suggesting it could be a recent innovation (see Fig. 8).

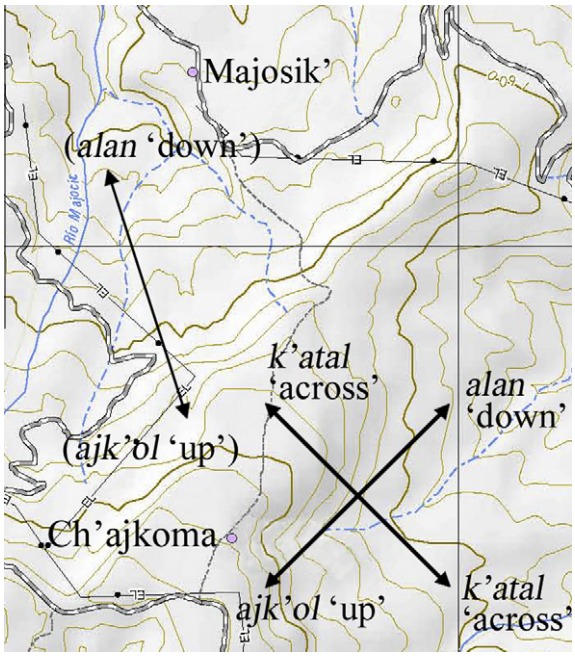
(9) *tey* *ta* *[x]-xujk* *ay* *me* *balon-e*
there PREP 3POS-side is the ball-CL
'There at its side is the ball.'

What is referred to in (9) cannot be an intrinsic side of the chair. It is instead a side imposed by the observer's perspective on the ground, preempting in this case the intrinsic side.

Pair 1 is the only dyad where the speakers rely on terms for 'left' and 'right'. Speaker 1 first introduces them into the interaction. He is 22 years old, fully bilingual and has completed secondary school (which is conducted in Spanish). Speaker 2 is also quite fluent in Spanish, but with a much lower level of literacy and schooling. A careful examination of the data shows that speaker 2 aligns with speaker 1 and starts to also rely on the relative 'left' and 'right', although he only uses it as an ancillary option when absolute, intrinsic or landmark-based attempts failed. An example of the kind of relative use that shows up with pair 1 is given in (10) (see Fig. 9).

(10) *ta* *j-wa'el-k'ab-tik* *wil-em* *moel* *jteb* *pelota-i*
PREP 1POS-right-hand-PL fly-PERF DIR a.little.bit ball-CL
'At our right hand the ball is flying a little bit.'

Two important things must be highlighted from this use of relative FoRs. On the one hand, it confirms that spontaneous projective uses of left and right do exist in today's Tenejapa Tseltal, a fact not registered before. On the other hand, it is reason-




**Map 4.** 'up' and 'down' in Ch'ajkoma.

**Fig. 8.** B&C 2.10.

able to think that this is a recent innovation resulting from contact with Spanish given the fact that twenty years ago this kind of use was uncommon, as reported in the work of Brown and Levinson for the Majosik' community. Second, the diffusers of this phenomenon appear to be young bilingual speakers. At the same time, as native terms for 'left' and 'right' are used projectively, we observe the borrowing of the Spanish terms *izquierda* 'left' and *derecha* 'right' into Tseltal discourse: these were used twice during the task for pair 1. Interestingly, the fact that speaker 2, who is older and less educated than speaker 1, easily adopts the relative strategy during the task in response to speaker 1's initiative shows that this represents no difficulty for him. This is consistent with the findings of Abarbanell (2007), who has shown that it is possible to induce and/or teach Tenejapan people to successfully use relative expressions in specific communication contexts. We take this point up again in Section 6.

### *5.2. Lum*

The B&C task was applied to five pairs of speakers in Lum (the town of Tenejapa), as the data in Table 5 show. These are mostly female speakers, a little bit older than the Ch'ajkoma participants (median age = 35.5, as compared to 29 for Ch'ajkoma).

Quantitative results for Lum are presented in Tables 6a and 6b.

**Fig. 9.** B&C 2.1.

Before highlighting the differences between the Lum and Ch'ajkoma data, we can see at first glance that there are consistencies between the data from the two places. The main strategy for the orientation of the chair is also the use of a landmark-based FoR (although with a higher rate, as we discuss below), and the main strategy for the location of the ball is the intrinsic strategy, with a very similar frequency (48%, as compared with 50% in Ch'ajkoma). The use of relative FoRs is a little bit higher in Lum than in Ch'ajkoma for the location of the ball (14%, as opposed to 9% in Ch'ajkoma), and again a single pair accounts for more than half of all of the tokens.

The main surprise comes from the near complete absence of use of any absolute or geomorphic FoRs: the absolute 'up'/'down' axis is used no more than three times in the whole task, by three different pairs, and the sunrise/sunset axis does not show up at all. The contrast with Ch'ajkoma is significant: we are dealing here with two groups of people who speak the same dialect of the same language, and who both use absolute reference in their daily conversations, as we show below for Lum. But when speakers from the two communities solve a communicative task like B&C, a drastic difference emerges: Ch'ajkoma speakers rely on the 'up'/'down' and sunrise/sunset axes, whereas Lum speakers do not. Literacy and education rates cannot account for this contrast, since they are higher among the Ch'ajkoma speakers who participated in the task than among the Lum speakers. It is not obvious that urbanization can account for the difference. Although it is true that Lum is slightly bigger (the 2005 population census shows a total of 1900 people in Lum, vs. 1413 in Ch'ajkoma; see Footnote 3) and has more urban-like concentrated housing with few green areas between houses, but there are no drastic socioeconomic differences between the two places, as most people maintain similar farming activities. One interesting difference between the two communities that deserves further attention is the presence of 10% monolingual Spanish speakers in Lum, while all Ch'ajkoma inhabitants speak Tseltal. This could account for the slightly more frequent use of relative FoRs in Lum.

Additional studies that the first author conducted in Lum show that people do use both the absolute 'up'/'down' and the sunrise/sunset axes; we focus here only on the former. In Lum, 'up' corresponds to southwest and 'down' to northeast, with the corresponding 'crosswise' axes, as presented in Map 5.

This orientation of the axes is linked to topographic cues, although not as saliently as in Ch'ajkoma or Majosik'. Still, it follows the local (gentle) inclination of the land inside the village. The orientation of the streets, which form a grid oriented from southwest to northeast and from southeast to northwest, may also play a role in the exact orientation of the axes, as does the fact that the main road that crosses Lum and connects it to the upper and lower parts of Tenejapan territory is oriented in approximately a southwest to northeast direction. Nevertheless, other important topographical details contribute to

**Table 5**
Ball & Chair participants in Lum.

| Pair | Speaker | Sex | Age | Bilingual | Literacy | Schooling |
|---|---|---|---|---|---|---|
| 1 | 1 | M | 57 | No | No | None |
| | 2 | F | 53 | No | No | None |
| 2 | 3 | F | 26 | Yes | No | None |
| | 4 | M | 56 | Yes | No | Some |
| 3 | 5 | F | 21 | Yes | Yes | Secondary school |
| | 6 | F | 21 | Yes | Yes | High school |
| 4 | 7 | F | 29 | Yes | Some | Primary school |
| | 8 | F | 33 | Yes | Some | Primary school |
| 5 | 9 | F | 54 | No | No | None |
| | 10 | F | 38 | No | No | Some |

**Table 6a**
Strategies used for Ball & Chair in Lum (pair by pair).

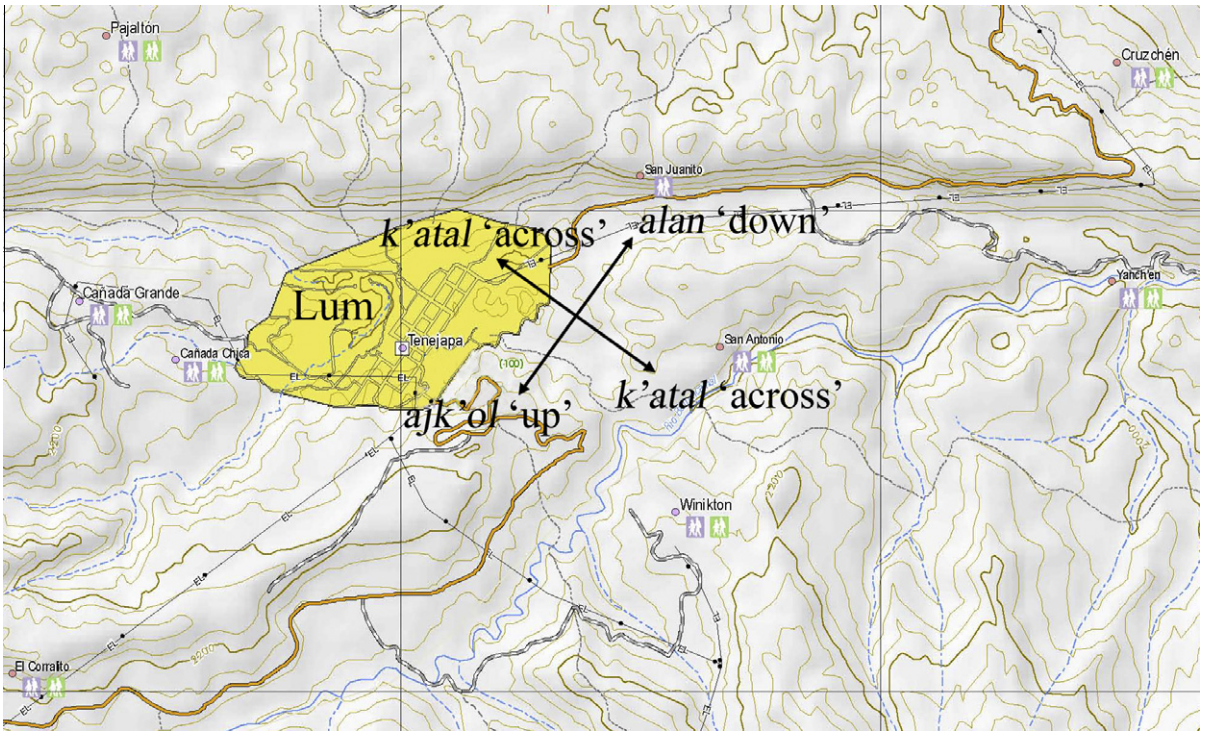
| Pairs of speakers and description type | | Absolute 'up'/'down' | Sunrise/sunset | Relative | Intrinsic | (o.-c./direct) (%) | Landmark | (General/SAP) | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Orientation of chair | 1 | 0 | 0 | 0 | (0/0) | 42 | (25/17) | 43 |
| NW | Location of ball | 0 | 0 | 0 | 16 | (16/0) | 21 | (17/4) | 37 |
| 2 | Orientation of chair | 0 | 0 | 0 | 0 | (0/0) | 33 | (26/7) | 33 |
| E | Location of ball | 0 | 0 | 5 | 26 | (25/1) | 25 | (24/1) | 56 |
| 3 | Orientation of chair | 1 | 0 | 0 | 0 | (0/0) | 42 | (32/10) | 43 |
| E | Location of ball | 0 | 0 | 7 | 24 | (24/0) | 16 | (5/11) | 47 |
| 4 | Orientation of chair | 0 | 0 | 3 | 1 | (0/1) | 23 | (9/14) | 27 |
| NE | Location of ball | 1 | 0 | 17 | 17 | (15/2) | 1 | (0/1) | 36 |
| 5 | Orientation of chair | 0 | 0 | 0 | 1 | (0/1) | 45 | (28/17) | 46 |
| N | Location of ball | 0 | 0 | 2 | 20 | (20/0) | 19 | (14/5) | 41 |

**Table 6b**
Strategies used for Ball & Chair in Lum (summary).

| | Absolute 'up'/'down' (%) | Sunrise/sunset (%) | Relative (%) | Intrinsic (%) | (o.-c./direct) (%) | Landmark (%) | (General/SAP) (%) | Total |
|---|---|---|---|---|---|---|---|---|
| Orientation of chair | 1 | 0 | 2 | 1 | (0/1) | 96 | (62/34) | 192 |
| Location of ball | 0 | 0 | 14 | 48 | (47/1) | 38 | (28/10) | 217 |

making the 'up'/'down' axis less salient. Above all, directly north of Lum there is a huge cliff, which climbs up 300 m almost vertically. This means the absolute 'down' direction quickly implies going up as soon as one exits the village. The general land inclination from high south(west) to low north(east) is thus locally concealed from sight, and the only way of actually going down out of that valley is eastwards (without a steep slope). There is then a complex of contradictory local clues which downgrades the salience of the absolute 'up'/'down' axis.

Even so, Lum speakers do use the absolute 'up'/'down' axis, but for more restricted purposes than people from northern Tenejapa: they mainly use it in expressions of motion—for instance following the main street northeastwards is commonly expressed as 'going down'—and for the respective location of places at geographic scale space, for instance, Balunk'anal (a




**Map 5.** 'up' and 'down' in Lum.

village southwest of Lum) is described as being 'upward' with respect to Lum and Retiro (a village southeast of Lum) is 'across' from Lum with respect to the 'up'/'down' axis, etc. Locating where other people live is also typically done with an indication of 'up' or 'down', as in 'Xun's house is downward (with respect to here or to another specific point)'. But what the B&C data teach us is that, contrary to what happens in the northern part of Tenejapa, such as in Ch'ajkoma or Majosik', the use of the absolute 'up'/'down' axis is more restricted at a small-scale level, that is, the level where objects like balls and chairs are manipulated. It seems reasonable to think that this is an effect of the low topographic salience of this axis onto the local usage conventions.

Aside from this effect on the use of the absolute FoR, the data from Ch'ajkoma and Lum are very consistent. In fact, the sum of absolute 'up'/'down', sunrise/sunset and landmark use remains constant in both places: for the orientation of the chair, we have 18% + 18% + 60% = 96% for Ch'ajkoma and 1% + 0 + 96% = 97% in Lum; for the location of the ball, we have 8% + 18% + 14% = 40% in Ch'ajkoma and 0 + 0 + 38% = 38% in Lum. This suggests that the inappropriateness of the absolute axes for resolving this task in Lum is directly compensated by a more massive use of ad hoc landmarks, and not, for instance, by an increase in the use of relative FoRs.

Turning our attention now to relative FoRs, we observe that four out of five pairs used them at least once. In three of these four pairs, we only find relative uses of the expressions *ta xujk* 'at its side' and *ta spat* 'at its back'. Pair 4 stands out by their more frequent use of relative FoRs, which accounts for 47% of their descriptions. Pair 4 is responsible for 59% of all relative uses in the overall results. These data show that this type is indeed one of the dominant strategies for these speakers. This is also the only pair of speakers who use 'left' and 'right' terms: of the twenty times pair 4 used relative FoRs, 18 correspond to utterances involving 'left' and 'right', and of those, twelve were expressed with the borrowed Spanish terms *izquierda* and *derecha*. A similar spreading of the use of relative FoRs along with that of Spanish loanwords is reported in Hernández-Green et al., 2011, for San Ildefonso Tultepec Otomí. This points to language contact as the source of the apparent rise of relative reference in Tseltal. However, the speakers of pair 4 are neither the youngest nor the most educated of all participants from Lum. In fact, the speakers of pair 3 are the most literate of all the Lum participants, yet their rate of use of the relative FoR is much lower and they did not use left or right even once. This suggests that bilingualism, a linguistic factor, may play a more important role in the use of relative FoRs than the non-linguistic factors of education and literacy. A much larger population sample needs to be tested in order to verify these tendencies.

### 5.3. Mesbilja'

The B&C task was applied to six pairs of speakers in Mesbilja', in Oxchuc County, as summarized in Table 7. Their median age is 32.

Results for Mesbilja' are presented in Tables 8a and 8b:

These results are overall very similar to the results of Ch'ajkoma and Lum: preponderance of landmark-based and intrinsic FoRs for the orientation of the chair and the location of the ball and a low rate of relative FoRs. The use of the absolute 'up'/'down' axis is broadly similar to that of Ch'ajkoma (15% for descriptions of the orientation of the chair and 9% for descriptions of the location of the ball, as compared with 18% and 8%, respectively, in Ch'ajkoma).

Nevertheless, there are also differences between the data from Mesbilja' and Ch'ajkoma: all pairs in Ch'ajkoma relied on absolute strategies, be it the absolute 'up'/'down', the sunrise/sunset axis, or a mix of both. In contrast, two pairs of speakers in Mesbilja' (1 and 2) did not use absolute FoRs at all in the horizontal plane. As for the sunrise/sunset strategy, only one pair of Mesbilja' speakers used it (pair 5).

Another feature of Mesbilja' FoR preferences without a parallel in Ch'ajkoma are the frequent misunderstandings that emerged in the discourse of the four pairs of speakers that used the absolute 'up'/'down' axis. For example, in pairs 3, 4 and 5, all of which were mixed-gender dyads, the woman was the one using the absolute FoR, and the man did not interpret

**Table 7**
Ball & Chair participants in Mesbilja'.

| Pair | Speaker | Sex | Age | Bilingual | Literacy | Schooling |
|---|---|---|---|---|---|---|
| 1 | 1 | M | 56 | Yes | Some | Some |
| | 2 | F | 23 | Yes | Yes | Secondary school |
| 2 | 3 | F | 53 | Some | Some | Primary school |
| | 4 | F | 34 | Yes | Yes | Primary school |
| 3 | 5 | F | 47 | No | No | Some |
| | 6 | M | 48 | Yes | Some | Primary school |
| 4 | 7 | F | 23 | Yes | Yes | High school |
| | 8 | M | 30 | Yes | No | No |
| 5 | 9 | M | 43 | Yes | Yes | Secondary school |
| | 10 | F | 20 | Yes | Yes | High school |
| 6 | 11 | M | 17 | Yes | Yes | Secondary school |
| | 12 | M | 18 | Yes | Yes | Secondary school |

**Table 8a**
Strategies used for Ball & Chair in Mesbilja' (pair by pair).

| Pairs of speakers and description type | | Absolute 'up'/'down' | Sunrise/sunset | Relative | Intrinsic | (o.-c./direct) | Landmark | (General/SAP) | Total |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Orientation of chair | 0 | 0 | 0 | 7 | (0/7) | 38 | (37/1) | 45 |
| W | Location of ball | 0 | 0 | 4 | 22 | (20/2) | 7 | (7/0) | 33 |
| 2 | Orientation of chair | 0 | 0 | 0 | 0 | (0/0) | 7 | (5/2) | 7 |
| W | Location of ball | 0 | 0 | 1 | 23 | (19/4) | 9 | (8/1) | 33 |
| 3 | Orientation of chair | 6 | 0 | 0 | 5 | (0/5) | 28 | (26/2) | 39 |
| W | Location of ball | 16 | 0 | 0 | 14 | (11/3) | 7 | (7/0) | 37 |
| 4 | Orientation of chair | 4 | 0 | 0 | 3 | (0/3) | 32 | (26/6) | 39 |
| W | Location of ball | 0 | 0 | 5 | 22 | (18/4) | 22 | (12/10) | 49 |
| 5 | Orientation of chair | 12 | 8 | 0 | 1 | (0/1) | 34 | (17/17) | 55 |
| W | Location of ball | 4 | 2 | 3 | 18 | (17/1) | 21 | (7/14) | 48 |
| 6 | Orientation of chair | 12 | 0 | 0 | 0 | (0/0) | 32 | (21/11) | 44 |
| W | Location of ball | 0 | 0 | 2 | 11 | (10/1) | 19 | (8/11) | 32 |

**Table 8b**
Strategies used for Ball & Chair in Mesbilja' (synthesis).

| | Absolute 'up'/'down' (%) | Sunrise/ sunset (%) | Relative (%) | Intrinsic (%) | (o.-c./direct) (%) | Landmark (%) | (General/SAP) (%) | Total |
|---|---|---|---|---|---|---|---|---|
| Orientation of chair | 15 | 3 | 0 | 7 | (0/7) | 75 | (58/17) | 229 |
| Location of ball | 9 | 1 | 6 | 47 | (41/6) | 37 | (21/16) | 232 |

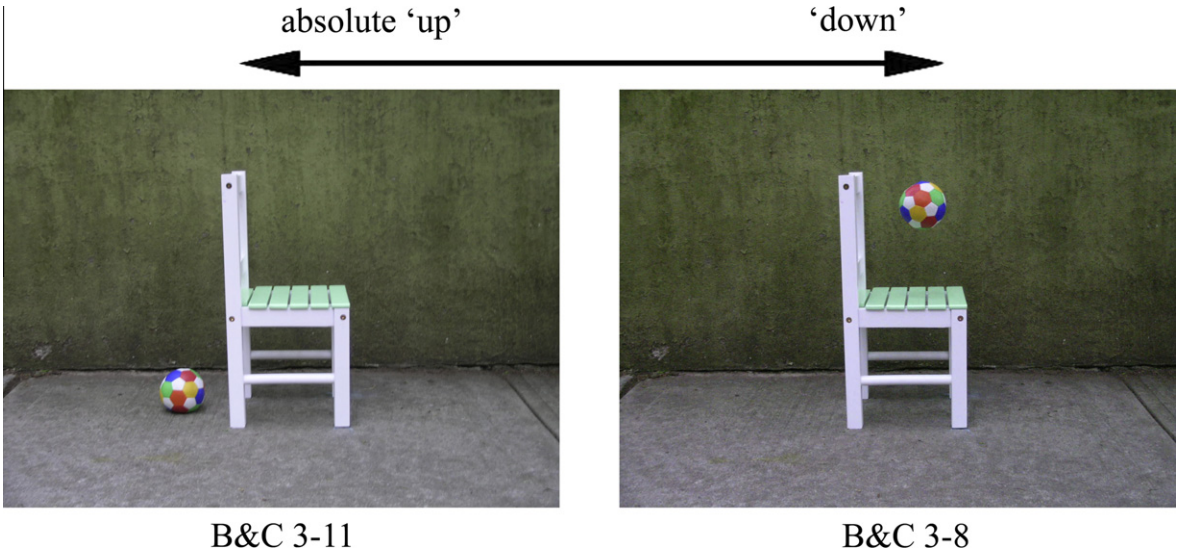
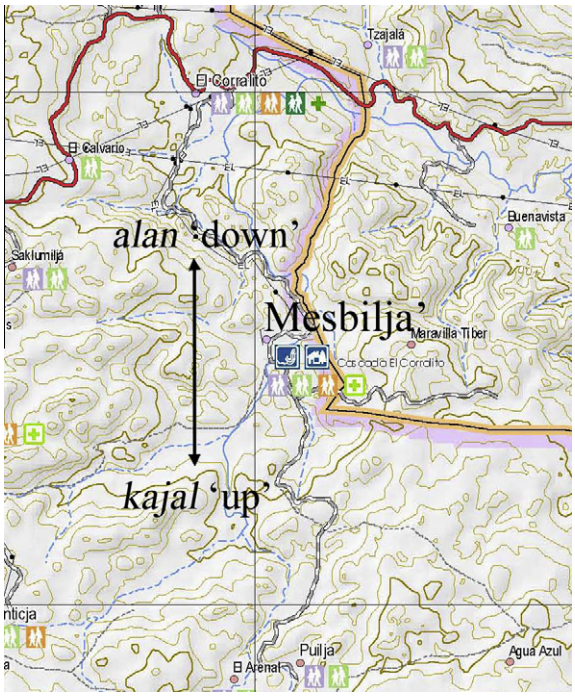



**Fig. 10.** The ball is horizontally 'up' in B&C 3–11 and vertically in B&C 3–8.

it correctly most of the time. The only pair managing an effective communication with the absolute type of FoR was pair 6, composed of two young men, suggesting that no hasty conclusion should be derived in terms of the factors of gender and age in the mastery of this FoR type. The misunderstandings involving the 'up'/'down' absolute FoR cannot be explained by an ignorance of this type of FoR. Instead, the relative salience of the various possible interpretations of 'up' and 'down' are the issue: the speakers showing the misunderstandings favored a vertical interpretation of these terms, and were reluctant to apply these terms in that context of the B&C task to the absolute horizontal directions. For instance, in reaction to a description of photograph 3.11 in terms of 'the ball is up' –*yajk'lal*– with respect to the chair, they would tend to select photograph 3.8 instead (see Fig. 10).




**Map 6.** 'up' and 'down' in Mesbilja'.

These same speakers would happily say 'I went down to the coffee plantation' or 'my house is up from here', referring respectively to a movement or a direction northward or southward on the flat terrain. Again, we are facing a problem in the application domain of the absolute 'up'/'down' axis: all speakers use it at a geographical scale for motion and for locating places, but not all extend it to the small-scale of the B&C task. Does this mean that the speakers who did not rely on the absolute axis in this particular task would never use it for expressing spatial relations at a small-scale level in general? We think this is the case, although we acknowledge the evidence for this claim is still insufficient. These results are particularly surprising since the dyads in question consist of nuclear family members – pairs 3 and 4 are husband and wife, pair 5 is a father and his daughter. That is, we are not dealing here with different populations speaking different dialects of Tseltal.

As for the orientation of the 'up'/'down' axis in Mesbilja', it follows the local river drainage direction from south to north (see Map 6), so the axis closely aligns with local topography. We have not registered an 'across' axis as of now that is similar to the *k'atal* axis of Tenejapa. There is no unique dominant slope at a regional level around Mesbilja': east also goes down just passing the hill line, and going 10 km south one finds another downward slope descending south. This lack of uniformity is reflected in the lack of a shared conceptual slope at a regional level: there are locally defined 'up'/'down' axes usable for spatial communication in Oxchuc County, as in Mesbilja'; but there is no single system all communities in Oxchuc converge on, just as there is no such single standard in Tenejapa county.

Finally, with respect to relative FoRs in Mesbilja', all pairs except for one used them at least once, but no pair relied heavily on them, unlike what was the case with one dyad each in Ch'ajkoma and Lum. Even among young bilingual and fully literate speakers, such as those of pair 6, the relative type played only a marginal role. Relatively interpreted expressions in Mesbilja' included 'at its back', 'at its side', and a few projective uses of 'left' and 'right', mainly involving autochthonous Tseltal terms.

### 5.4. Oxchuc Center

The B&C task was not applied in Oxchuc Center (the capital of Oxchuc County), so we do not have quantitative data to compare to those from the other three communities. However, a large amount of general documentation of Tseltal has been conducted here by the first author over the course of more than ten years, covering varied speech genres like spontaneous conversation, interviews, procedural speech, prayers, rituals, etc.,[5] complemented by direct observation and interactions in the field (see Polian, 2006). This documentation has not registered any use of the terms for 'up' and 'down' in a horizontal absolute FoR at all in Oxchuc Center. Considering that the corpus includes a great diversity of spatial descriptions making use of FoRs, and

[5] Part of this corpus is available at *The Archive of the Indigenous Languages of Latin America*, at http://www.ailla.utexas.org. and at The Endangered Languages Archive, at http://elar.soas.ac.uk/deposit/polian2007tseltal.

**Table 9**
Summary of the results of Ball & Chair in the three Tseltal communities.

| | | Absolute 'up'/'down' (%) | Sunrise/sunset (%) | Relative (%) | Intrinsic (%) | (o.-c./direct) (%) | Landmark (%) | (General/SAP) (%) | Total |
|---|---|---|---|---|---|---|---|---|---|
| Ch'ajkoma | Orientation of chair | 18 | 18 | 2 | 3 | (3/0) | 60 | (47/13) | 199 |
| (Five pairs) | Location of ball | 8 | 18 | 9 | 50 | (49/1) | 14 | (8/6) | 216 |
| Lum | Orientation of chair | 1 | 0 | 2 | 1 | (0/1) | 96 | (62/34) | 192 |
| (Five pairs) | Location of ball | 0 | 0 | 14 | 47 | (47/1) | 38 | (28/10) | 217 |
| Mesbilja' | Orientation of chair | 15 | 3 | 0 | 7 | (0/7) | 75 | (58/17) | 229 |
| (Six pairs) | Location of ball | 9 | 1 | 6 | 47 | (41/6) | 37 | (21/16) | 232 |

that spatial descriptions are very common in the daily interactions in which the first author has taken part for years, we conclude from this absence of absolute reference acts that at least a part of the Oxchuc Center speakers communicate spatially without fixed bearings associated with the terms for 'up' and 'down'. That is, no absolute horizontal 'up'/'down' axis is used by those speakers, and the only registered uses of these terms correspond either to verticality or to actual slopes.

More than any of the other three communities considered in this study, Oxchuc Center is heterogeneous in terms of its population: it is mainly populated by people from all over Oxchuc County who settled in the capital in the course of the past century. This county is currently much less uniform topographically than Tenejapa County. This means that people from different communities seldom share a dominant slope from which to abstract an absolute axis. And the town of Oxchuc Center itself does not provide such a clear incline, as it is located in a small basin surrounded by hills, with no river and no local drainage outlet. Both these conditions of the mixed origin of the population and the absence of a local slope provide a possible explanation as to why there should be no shared absolute axis in Oxchuc Center, contrary to what occurs in particular communities inside Oxchuc territory, like Mesbilja', where locally defined axes have been conventionalized for absolute references.

## 6. Summary and discussion

In Table 9 we present a summary of the results from the three communities in which the B&C task has been applied.

The B&C data reveal a strong convergence in the three communities in terms of strategies used to solve this kind of spatial task. First of all, all three places converge in terms of preferred strategies. On the one hand, the orientation of the chair was predominantly described through the use of ad hoc landmarks. On the other hand, to locate the ball with respect to the chair participants relied mostly on meronyms projecting regions from the parts of the chair, involving an intrinsic FoR. As discussed in Section 3, this prevalence of landmark-based and intrinsic FoRs over absolute ones confirms Brown and Levinson's (2009) findings. We see no reason at this point not to go along with Brown and Levinson's conjecture that this bias may be task-specific. If the need for great precision favors landmark-based over absolute FoRs, then such a need may well be driven by the use of landmark-based frames in the B&C task given the high number and the subtlety of the spatial contrasts in the B&C pictures.

All three groups show a low use of relative FoRs. The higher results in both Ch'ajkoma and Lum are in each case mainly attributable to a single pair of speakers, which suggests that the use of this type of FoR is not uniform across the members of a community and that certain speakers are acting as diffusers of this pattern. There are also data suggesting that Spanish is a factor in this diffusion, since the use of 'left' and 'right' for projecting spaces from the viewpoint of the observer is frequently done in connection with the Spanish loanwords *izquierda* 'left' and *derecha* 'right', although Tseltal words for 'right hand' and 'left hand' are also used. This influence manifests itself through bilingual speakers, but not necessarily through the ones with the highest degree of literacy or schooling. But beyond the use of 'left' and 'right', which is the most significant sign of the spreading of relative FoRs in Tseltal, other terms seem to be extending their potential as relative relators: *spat* 'its back' and *xujk*/*sts'eel* 'its side'. Of these, only the first had been documented with relative interpretations in previous descriptions, and only as a marginal and secondary use. The B&C data speak of a much more regular use of these terms involving relative interpretations. Our tentative conclusion is that the use of relative FoRs is generally on the rise among Tseltal speakers, and that this rise may be caused by a linguistic factor, namely, language contact.

The main differences between usage in the three places have to do with the use of FoRs based on the absolute/geomorphic 'up'/'down' and the sunrise/sunset axes. In each place, a different pattern of use of these axes was observed. In Ch'ajkoma, all pairs of speakers used at least one of these axes, and with most pairs it was one of the dominant strategies; the communication through this kind of FoR was effective. In Lum, we hardly observed any use of these axes at all: speakers did not rely on this strategy. As for Mesbilja', the absolute 'up'/'down' axis was used by four out of six pairs in a proportion similar to those of Ch'ajkoma, but in three of these four pairs, communication was not quite effective: one of the two speakers tended to interpret 'up' and 'down' in terms of the vertical axis instead of the absolute interpretation. Nevertheless, observation and interactions in the field outside of this task suggest that all speakers in both Lum and Mesbilja' do use the absolute 'up'/'down' axis for other purposes, such as in motion descriptions and descriptions of the location of objects in large-scale space. Variation is greatest in smaller-scale locative descriptions. This kind of restriction on the use of the absolute FoR is quite common crosslinguistically. For example in the Australian language Jaminjung, the absolute FoR is said to be "predominantly

for larger-scale geographic space, really only used in manipulable space for direction orientation of a featured figure, or motion" (Levinson and Wilkins, 2006, p. 567). At a broader level, all languages that display frequent use of absolute FoRs in daily conversation show the kind of tendencies that we see at play here: they use the absolute FoR for orientation rather than for location, for motion rather than for static location, and to describe large-scale space rather than small-scale space (Levinson and Wilkins, 2006, p. 549). All of these tendencies are reflected in the B&C data as compared to general uses of the 'up'/'down' axis in Tseltal.

More importantly, we observed differences in the application domains of absolute FoRs in three places that are very close to each other: Ch'ajkoma, where absolute FoRs are used for B&C, is only 7 km away on a straight line from Lum (or twenty minutes away by road), where absolute FoRs seem much less adequate in manipulable space.[6] Both places are part of the same county, where a single dialect is spoken. As for Mesbilja', it is 27 km away on a straight line from both Ch'ajkoma and Lum, and the variety of Tseltal spoken there is only slightly different from Tenejapa Tseltal. Remarkably, members of the same household do not use the absolute type of FoR with the same frequency in Mesbilja'.

Variation in the same language in the use of FoRs has been documented, for example between urban Tamils, who prefer relative FoRs, and rural Tamils, who favor absolute FoRs (Pederson et al., 1998, p. 583, reporting Pederson, 1993). But minor variation between individuals as displayed in Tseltal is more similar to the gender specialization reported for Yucatec in Bohnemeyer and Stolz (2006), where men rely on the cardinal axes whereas women do not. This gender bias is reportedly related to differences in cultural practices: the four edges of the *milpa*, a slash-and-burn garden, are customarily aligned according to cardinal directions, and so are the walls of houses. So the activities of making a *milpa* and building a house, which are quite common in the male domain, but rare in the female, require familiarity with the cardinal directions (Le Guen, 2006; Bohnemeyer, 2011).

For Tseltal, it may be the case that the differences observed in the application domain of absolute FoRs among the four communities can be attributed to the local topography. The higher or lower salience of the 'up'/'down' axis in terms of the local slope is most likely a determining factor in the propensity of use of this axis in different contexts. For instance, the low salience of the axis in Lum, where the dominant slope at the regional level is concealed by local topography, correlates with the fact that people seem reluctant to use 'up' and 'down' at a small spatial scale, contrary to what happens in northern Tenejapa, in Majosik' or Ch'ajkoma, where the slope is very salient and people readily use absolute 'up' and 'down' at any scale. Likewise, the lack of regional uniformity of the terrain and the elevation in the Oxchuc region could play a role in the lack of agreement between Mesbilja' inhabitants about what the exact application domain of the absolute 'up'/'down' axis is, and in the fact that no instance of an absolute up'/'down' axis has been registered at all in a large corpus of data recorded in Oxchuc Center. We could say that topography constrains the frequency of use of the absolute 'up'/'down' system: the more salient the presence of one single mountain slope is in a given locale as unique anchor of geocentric FoRs, the more likely FoRs anchored to this slope will be used in this locale and the more likely they will apply at a small-scale level. This appears to be but a special case of a more general constraint on the use of any kind of FoR, which may be formulated as in (11):[7]

(11) **Salient anchorage constraint:** The accuracy and unambiguousness of spatial reference in a given FoR in any given context is a function of (i) the extent to which the axes of that FoR can be unambiguously determined in that context and (ii) the extent to which the location/motion of the figure with respect to the ground (in locative/motion descriptions; the orientation of the figure in orientation descriptions) aligns with these axes.

This constraint entails, for example, that the location of the ball is harder to describe in object-centered terms in Fig. 9 above, where it is at roughly a 45° angle with respect to both the front-back axis and the left–right axis of the chair, than in Fig. 8, where it is right on the front-back axis. Similarly, (11) causes speakers of English and Japanese to project relative FoRs much more readily onto grounds that are straight ahead in their field of vision than onto grounds that are sideways from or behind them. It also explains why left–right confusion is much more common than front-back confusion among relative speakers and thinkers. Tseltal speakers are more likely to apply the 'up'/'down' system to figure-ground configurations that align with the 'up'/'down' axis than to those that fall on the undifferentiated 'across' axis, let alone to those that fall on neither (Brown, 2006, p. 267). Principle (11) explains this. And, as mentioned in Section 3, geomorphic uses of the terms, i.e., uses dependent on an actual local mountain slope as anchor, to the extent that they are possible in a given community, preempt absolute uses. Principle (11) likely accounts for this distribution as well. To use an example of Brown and Levinson (1993, p. 64), let us suppose that the figure is positioned locally on an incline, such as a tilted table, which is itself situated on the slope on which the regional absolute system is modeled. In this scenario, the small local incline is more salient than the larger slope, and (11) therefore predicts that geomorphic references based on the tilted table can be resolved more accurately and unambiguously than absolute references based on the regional slope. This means that in every community in which there is a salient unique mountain slope, geomorphic usage anchored to this slope would be expected to preempt absolute use. In theory, this does not necessarily prevent the various communities from converging on a single absolute system. As Levinson (2003, pp. 225–243) demonstrates, based on data collected by a number of researchers from three predom-

[6] Although, as an anonymous reviewer pointed out to us, passable roads are a very recent phenomenon in this community.

[7] Of course, (11) requires extensive experimental testing, which we cannot provide here. We are merely proposing it as part of a possible explanation for the inter-community variation in our data from the B&C task.

inantly relative and three predominantly absolute populations including Tenejapans of Majosik', speakers of absolute languages have vastly superior 'dead-reckoning' skills as compared to speakers of relative languages, meaning they are much more adept at mentally tracking their bearings as they change place and orientation. However, in order for all Tseltal communities to adopt an absolute system anchored not with respect to their local topography, but with respect to that of one single "model" community, that model community would have to combine the presence of a unique salient mountain slope with an enormous amount of cultural prestige throughout the Tseltal area, and in actual fact, there is no such community. Also, given the absence of a single uniform absolute type of FoR accessible to all Tseltal speakers, speakers in communities that lack a unique salient mountain slope, such as Lum and Mesbilja', display a much more limited use of the 'up'/'down' system, mainly for long-distance usage and in the vertical, as predicted by (11), and as borne out in the data presented above. The preference for geomorphic and absolute FoRs in geographic space can be explained in light of (11) with respect to their anchors being geographic entities, and in the case of absolute FoRs, with reference to the abstracted nature of their axes, which at least in theory extend to the totality of space.

We have shown that local topography also "calibrates" the orientation of the 'up'/'down' axis. This fact becomes very clear if one compares data from Majosik' and Ch'ajkoma, two immediately neighboring communities: the former displays a south/north axis, whereas the latter shows a dominant southwest/northeast axis. Likewise, Mesbilja' speakers in Oxchuc who do use the absolute 'up'/'down' in B&C consistently agree on a south/north orientation, following drainage direction in their valley.[8] Again, (11) readily accounts for this variation.

The picture that emerges from these facts is a topographic constraint of the 'up'/'down' axis, very similar to that observed in other regions of the world.[9] Brown and Levinson (1993, p. 52) hint at this fact when they report the visit to Majosik' by a Tenejapan from another community, where the slope falls eastwards and northwards: that visitor consequently "claimed 'downhill' was further east than our folk [i.e., people from Majosik'] will allow." This fact led the authors to remark that: "familiarity with a particular territory may, at least for some individuals, be essential to exact use of the ['up'/'down' system]". As a matter of fact, we can now claim that this link to a particular territory is not merely a fact of "some individuals", but rather must be taken as the rule at least for Tseltal speakers from Tenejapa and Oxchuc counties.

However, while (11) explains why topography, in connection with population geography, constrains the use of geocentric FoRs, this constraint does not support the environmental determinism, which seems to us to be entailed by Li and Gleitman 2002's proposal. Li and Gleitman's view appears to be that population-specific styles of cognition, such as adeptness at using one kind of FoR instead of another, are not a learned cultural *habitus* transferred across generations through speech, gesture, and other observable cultural practices, but are the direct result of adaptations to properties of the physical and social environment. For their position to be viable, they have to maintain that language cannot influence FoR selection. Environmental influences can only serve as evidence against linguistic influences if it can be shown that environmental factors determine FoR use independently of language. Li and Gleitman's position predicts, for example, that if one were to discover somewhere in the Rocky Mountains an English-speaking community in a place whose topography is the exact replica of that of Majosik's, then, all else being equal, those English speakers should use the terms *up* and *down* in the same way the inhabitants of Majosik' use *ajk'ol* and *alan*, and those English speakers would show the same linguistic and cognitive bias in favor of absolute FoRs. This kind of environmental determinism entails that any population that has a suitable feature in its local environment exploits it for modeling FoRs on it, which is clearly not the case for most English-speaking riverine or mountainous (etc.) communities. Anthropologists have long ago stopped trying to find strong determinants for a group's spiritual or cosmological beliefs. Similarly, linguists are unable to strictly predict on cultural and environmental grounds what kind of color term system, demonstrative system, or tense-mood-aspect system a given language has. There appears to be no reason to assume that the relation between environmental factors and FoR use in language and cognition is any more direct. And the indirect, constraining role of topography and population geography confirmed in the present study in no way precludes language from playing a key role in guiding the acquisition of culture-specific styles of referential practice.

## 7. Conclusions

What has been described as one of the best documented cases of a language with a dominant absolute FoR, upon the collection and analysis of new data, has shown evidence of a situation more complex than previously thought. We knew from Brown and Levinson's work that speakers from a particular Tenejapan community, Majosik', relied heavily on absolute FoRs based on an 'up'/'down' axis both in talking and in thinking about space. A broader inspection including communities close to and farther away from Majosik' shows that the frequency of use of the 'up' and 'down' terms varies considerably. Their use can even be completely absent in a community, like in Oxchuc Center, as commented in Section 5.4. And in communities in which it is present, it is calibrated to local topography, which influences the exact orientation of the axis and the range of application it will have. What remains constant among different places is the geomorphic interpretation of 'up' and 'down' with reference to any local slope or to the gravitational vertical, which corresponds to their primary meaning. Tseltal as a

[8] The orientation of the 'up'/'down' axis as used during the B&C task was confirmed by subsequent elicitation sessions and direct observation of conversations in the field, showing this was not a task-specific effect.

[9] This panorama in particular is reminiscent of the case of Bali island, as described by Wassmann and Dasen (1998), where the up/down axis shifts as one goes around the island according to the direction of the central mountain range.

whole looks then more similar to Balinese (Wassmann and Dasen, 1998) or Jaminjung (Schultze-Berndt, 2006), as opposed to a strongly absolute language like Guugu Yimithirr (Haviland, 1993, 1998; Levinson, 2003).

We have argued that the observed constraints in terms of topography and population geography on the use of geocentric FoRs are a special case of a more general principle, the salient anchorage constraint, which affects the frequency of use of all types of FoRs. The existence of such constraints neither contradicts nor supports the environmental determinism of FoR use proposed by Li and Gleitman (2002). Such constraints determine the relative accuracy of spatial descriptions in one type of FoR vs. another, but they do not cause speakers or thinkers to select one kind of frame as opposed to another independently of language and culture.

Through the results of the B&C task, we have shown in this paper that, besides differences in the use of absolute FoRs, Tseltal is very consistent in terms of other spatial strategies: orientation information is mainly coded by means of landmarks, and location in close contiguity to a featured ground is mainly coded within intrinsic FoRs.

Furthermore, a tendency observed in the data is the spreading of the use of relative FoRs through contact with Spanish and schooling. Projective uses of left and right, either with borrowed Spanish words or in Tseltal, manifested themselves in all three Tseltal communities where B&C was applied. It should be noted however that the increased use of relative FoRs does not necessarily imply a decrease in the use of absolute FoRs in the discourse of young people, several of whom appear to be at ease with both strategies.

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