Language Sciences 33 (2011) 943–960

Contents lists available at SciVerse ScienceDirect

Language Sciences

journal homepage: www.elsevier.com/locate/langsci

Spatial frames of reference preferences in Juchitán Zapotec

Gabriela Pérez Báez *

Department of Anthropology, Smithsonian Institution, P.O. Box 37012, National Museum of Natural History, Washington, DC 20013-7012, United States

ARTICLE INFO

Article history:
Received 26 February 2011
Accepted 22 June 2011
Available online 1 September 2011

Keywords:
Zapotec languages
Mesoamerican languages
Spatial frames of reference
Semantic typology
Linguistic relativity

ABSTRACT

This article reports on spatial frames of reference (FoRs) preferences in Juchiteco (Zapotec, Otomanguean). The data show that speakers exhibit a strong preference for the absolute and object-centered FoRs, both observer-independent, and overall disfavor most other FoR types. Of particular interest is the limited use of the relative (observer-dependent) FoR. This is relevant in a language such as Juchiteco, which has a productive meronymic (part-naming) system, as it supports the hypothesis put forth by the *Spatial Language and Cognition in Mesoamerica* project that productive meronymy correlates with a bias against the use of the relative FoR.

Published by Elsevier Ltd.

1. Introduction[1]

This article reports on spatial **frames of reference** (FoRs) preferences in discourse in Juchiteco[2] (Zapotec, Otomanguean). Spatial frames of reference are coordinate systems which allow for a spatial region to be projected from a referential entity, enabling the description of the location of an object with respect to it. The data show that speakers of Juchiteco have a preference for the **absolute** FoR in descriptions of orientation and location in tasks conducted at a manipulable scale. In other words, a system abstracted from cardinal directions is prevalently used at a tabletop scale, not only at a geographic scale. The second most frequently used FoR is the **object-centered** FoR in which the point of origin of the FoR is a reference object. In contrast, there are types of FoRs that were found to occur very infrequently or not at all in the data collected for this study. Of special interest is the reduced occurrence of the **relative** FoR which uses the body of the speaker/observer as the point of origin for the projection of an FoR. This is relevant in a language such as Juchiteco, which has a productive meronymic (part-naming) system, as it supports the hypothesis that productive meronymy correlates with a bias against the use of the relative FoR. The hypothesis is based on the notion that it is less likely for speakers of a language with productive meronymy to rely on a relative FoR which is observer-dependent, when part-naming can facilitate the use of object parts as grounds in an FoR. This hypothesis is put forth by the *Spatial Language and Cognition in Mesoamerica* project (MesoSpace, NSF Award #BCS-0723694). One of the focal points of the MesoSpace project is to explore FoR preferences across Mesoamerican languages (cf. Bohnemeyer, 2008;

* Tel.: +1 202 633 0880.
E-mail address: perezbaezg@si.edu

[1] The following orthographic conventions and abbreviations are used in this presentation: !, high tone; *, rising tone (low tone is default and unmarked); 3, third person; 3I, third person inanimate; 3H, third person human; B&C, Ball & Chair picture-matching task; BPT, body part term; CAU, causative; CMP, completive; DEM, demonstrative; FoR, frame(s) of reference; HAB, habitual aspect; JCH, Juchiteco; MED, mediopassive; MesoSpace, Spatial language and cognition in Mesoamerica; NA, New Animals recall memory task; NEG, negative particle; NDF, indefinite article; POS, possessive; Q, question particle; STA, stative; V', glottalized vowel; VV, rearticulated vowel.

[2] The language is referred to by its speakers as *diidxa za*. The denominations Juchitán Zapotec and Juchiteco (abbreviated JCH) are the denominations for the language spoken in and around Juchitán de Zaragoza, Oaxaca, Mexico as used in the Project for the Documentation of the Languages of Mesoamerica (PDLMA) with which I have been affiliated since 2003. For the sake of brevity, Juchiteco is the favored denomination in this paper. In the literature, the language is also commonly referred to as Isthmus Zapotec or *Zapoteco del Istmo* in Spanish.

0388-0001/$ - see front matter Published by Elsevier Ltd.
doi:10.1016/j.langsci.2011.06.012

O'Meara and Pérez Báez, 2011). For this purpose, a portfolio of elicitation and experimental tasks was designed to explore meronymy as well as FoR preferences in language and cognition across 13 Mesoamerican languages and two non-Mesoamerican control languages.

Most Juchiteco data presented here were collected as part of MesoSpace. The account presented here is the most comprehensive study published on FoR preferences in a language of the complex family of Zapotec languages and is only one of three studies conducted on FoR preferences in languages of the vast Otomanguean stock (see also Lillehaugen, 2006; Hernández-Green et al., 2011). Overall, this study along with the nine other articles in this special issue entitled *Frames of reference in Mesoamerican languages* touches on the wealth of knowledge about human language and cognition that lesser studied languages can offer, and that can be lost as these languages become increasingly endangered.

The structure of this article is as follows. Section 2 of this article presents an introduction to Juchiteco and the community of speakers of La Ventosa where fieldwork for this study was conducted. An overview of typological features of the language relevant to the study at hand is included in this section. Concepts related to the notion of FoRs and the operating classification of FoRs used by the MesoSpace project, and for the analysis of Juchiteco data in this paper, is presented in Section 3. A description of the meronymic system in Juchiteco is in Section 5 prefaced by a presentation of the data collection methods in Section 4. With this background in place, FoR preferences in linguistic and non-linguistic tasks are described in Section 6. The article closes with a summary and discussion in Section 7, and concluding remarks in Section 8.

2. Juchiteco and its community of speakers

Juchiteco is spoken in and around the municipality of Juchitán de Zaragoza in the southern coast of the Isthmus of Tehuantepec in Oaxaca, Mexico, as shown in Map 1. An in depth analysis of the vitality of Juchiteco has yet to be conducted but some estimates can be offered here. The entire municipality of Juchitán is reported to have just over 50,000 speakers of some indigenous language (INEGI, 2005).[3] The primary language across the municipality is Juchiteco but speakers of Mixe, Chontal of Oaxaca, and Huave reside there as well. Residents of the municipality of Juchitán who are of Zapotec origin amount to 79% of the municipality's population (Serrano Carreto et al., 2006). This could mean that the number of speakers of Juchiteco could be as high as 40,000 across the municipality.

The data presented in this article were collected in La Ventosa which is one of 26 towns belonging to the municipality of Juchitán de Zaragoza. La Ventosa is located about 15 km northeast of Juchitán itself and is reported to have a population of 4201 inhabitants (INEGI, 2005).[4] According to the same source, there are 3793 people over the age of 5, of which 2586 people were identified as speakers of an indigenous language. The language native to La Ventosa is Juchiteco. However, there is a community of immigrants from San Miguel Chimalapa where a Zoque language is spoken and who have settled in a neighborhood called *San Miguelito* 'Little San Miguel'. The census data does not show how large this community is, but estimates by La Ventosa residents suggest that the San Miguel Chimalapa community might include 200–300 members. Considering that the reported population of La Ventosa ages 5 and older is 3793, the reported population of speakers of an indigenous language, whether Juchiteco or Zoque, is 2586, and the reported size of the San Miguel Chimalapa population is 200–300, it can be estimated that 65% of the La Ventosa population over the age of 5 speaks Juchiteco-approximately 2500 people. In La Ventosa, bilingualism is at 60% of the population speaking an indigenous language (again, whether

Map 1. Juchitán de Zaragoza, Oaxaca, Mexico.

[3] The 2005 Mexican census was consulted online at www.inegi.org.mx on July 15, 2010.
[4] The 2005 Mexican census was consulted online at www.inegi.org.mx on July 15, 2010.

Juchiteco or Zoque). More fine grained data regarding language use across age groups was not available for La Ventosa from the INEGI online database.

While the Juchiteco speaker base is one of the largest among indigenous languages in Mexico, the language is by no means immune to the pressure to shift to Spanish. From my experience conducting fieldwork, I have been able to observe that the youngest speakers who consider Juchiteco to be their native or primary language are now in their mid- to late-teens and it is unsettlingly common to see parents in their early twenties raising their children in Spanish. Schooling in La Ventosa is in Spanish[5] and no textbooks in Juchiteco are in use despite the fact that a practical orthography for the language was developed over 50 years ago (Anonymous, 1956) and has been used in published language documentation materials such as dictionaries and grammars (Pickett et al., 1988, 1998; *inter alia*), and literature by authors including Víctor de la Cruz and the late Andrés Henestrosa.

2.1. Typology overview

Juchiteco belongs to the Zapotecan branch of the Otomanguean stock of Mesoamerican languages. The dialectal complexity of Zapotec languages has been observed dating back to Fray Juan de Córdova's *Arte en lengva zapoteca* (Cordoua, [1578] 1987) and a number of proposals have been made for the classification of Zapotec languages throughout the history of their documentation (a detailed overview of this is in Smith-Stark, 2003). The Summer Institute of Linguistics proposes a flatter classification, with Zapotec as a macrolanguage that includes 57 member languages (Lewis, 2009).[6] Similarly, Mexico's Instituto Nacional de Lenguas Indígenas identifies 62 language variants in the Zapotec language group. Kaufman (personal communication) considers Zapotec languages to constitute a language complex defined as a set of closely related languages. He proposes five language areas or virtual languages within the family of Zapotec languages: northern, central, southern, eastern and western. Following Kaufman's classification, Juchiteco is considered to be a variety of central Zapotec. The interaction between speakers of Zapotec languages who participated in a dialectal survey conducted by the Project for the Documentation of the Languages of Mesoamerica (PDLMA) under Terrence Kaufman's supervision and coordinated by Mark Sicoli between 2007 and 2009 supports at least some twenty distinct languages as sub-branches of the aforementioned five virtual languages (Sicoli, personal communication). While there is no consensus yet as to the dialectal classification of Zapotec languages, the point to be made here is that the diversity of Zapotec languages is extremely rich.

Juchiteco exhibits VSO constituent order and is a head-marking language. The language is primarily analytical with morphology almost limited to aspect and causative markers that attach to verb roots as proclitics, and person and number markers that attach as enclitics. An example of this is in (1).

(1) *Ro*sa* r-u-chaa=be* *nisa* *ira*'* *sya!* *do7*
Rosa HAB-CAU-heat=3H water every dissolve calm
'Rosa heats up water every morning' [RLC07]

Two traits in Juchiteco are of relevance to the topic of spatial descriptions involving FoRs. The first is the type of possessive constructions where the possessed is followed by the possessor. Example (2) shows the noun *dxumi** 'basket' and (3) shows the same noun in a possessive construction of the type 'his $noun_1$ (the) $noun_2$' where alienable possession is marked on the head. The same word order applies in inalienable possession constructions such as in (4) but the marker of possession is not used.

(2) *ti* *dxumi**
NDF basket
'a basket'

(3) *x-xumi** *gunaa*
POS-basket woman
'the woman's basket'

(4) *bi=chaa** *Fa!n* *lu* *Pe*dru*
CMP=clean John face Peter
'John cleaned Peter's face' [RLC07]

[5] There are recent reports that a local kindergarden is teaching Juchiteco, but as of the time this article went to press I had not been able to corroborate this information personally nor do I have information as to the extent to which Juchiteco is used in the classroom.

[6] Lewis, 2009 was consulted online at http://www.ethnologue.com/show_language.asp?code=zap on October 1, 2010.

The second trait of relevance is the role of relational nouns, and most often of body part terms, in possessive constructions of the type shown Kerning in (4) is very uneven. These relational nouns function more specifically as **meronyms** – terms which refer to a part of a whole – and when the possessive construction is used in locative descriptions, the meronym relates a noun referring to an object whose location is described in relation to a second object which possesses the meronym. An example is offered in (5), and a detailed description of the role of meronyms in locative description is provided in Section 5. First, however, Section 3 presents the FoR classification used in this study and of the hypothesis driving the research.

(5) *n-anda** *ti* *gamizha!'* *[lu* *ga*ndxu*]*
STA-hanging NDF shirt face hook
'the shirt is hanging from the hook' [RGL03]

3. Frames of reference classification and theoretical background

Three notions are necessary for the classification of FoR types. The terms **figure** and **ground** closely follow the definitions in Talmy (2000, p. 184). As such, the figure is the "moving or conceptually movable entity" and the ground is the object "with respect to which the figure's path, site, or orientation is characterized". That which is considered as immovable or fixed in the array is the **anchor**, an entity which creates a gradient or asymmetry in the environment from which the spatial FoR is copied or abstracted (Levinson, 1996; Danziger, 2010).

The FoR classification used by the MesoSpace team takes into consideration previous FoR classifications and builds upon them. First, it takes as a point of departure the three-way classification proposed in Levinson (1996, 2003) which identified the **intrinsic**, relative and absolute FoRs. The criteria for this classification relied on rotation sensitivities affecting (or not) the truth conditions of a locative description. Roughly, under this classification, the intrinsic FoR is that in which a FoR is projected from the ground, and rotation of the ground would invalidate the truth conditions of a description. This would be the case in the English description *The cat is at the back of the chair* which would be invalidated if the chair is rotated along the horizontal plane. The relative FoR is projected from the geometry of the body of the observer. The truth conditions of the English sentence *The cat is to the right of the chair* (from the observer's perspective) would be invalidated if the observer turns around. In the absolute, the FoR is abstracted from some kind of environmental gradient. Thus in the English example *The car is south of the truck*, rotation of either the figure or the ground would not affect the truth conditions of the description. However, rotation of the car and the truck together as an array would invalidate the description.

This paper follows closely the classification proposed by the MesoSpace project (O'Meara and Pérez Báez, 2011) but differs in the particulars of the definition of an observer-dependent FoR – the **direct** FoR. In the remainder of this subsection, the classification used in this study is presented, and points of convergence and divergence between coding principles in this study and the MesoSpace classification are explained. The coding principles used in the analysis of Juchiteco data center on the identity of the anchor and ground in any given FoR configuration. First a distinction is made according to whether the anchor is the same as the ground or not. Second, a distinction is made as to whether the ground is the same as the observer (egocentric or observer-dependent FoRs) or rather is some other entity altogether (allocentric or observer-independent FoRs), much in line with criteria proposed in Danziger (2010).

Two types of FoRs in which the anchor is the ground can be identified: object-centered and direct FoRs. The object-centered FoR is defined in this paper as in the MesoSpace classification as a coordinate system in which the anchor and

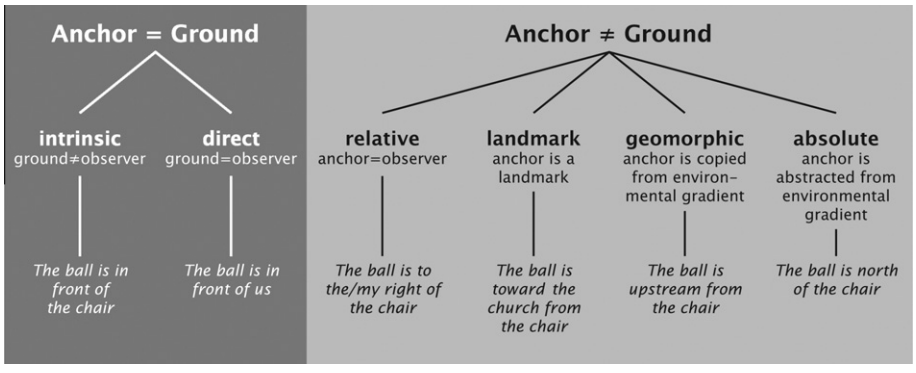

Fig. 1. Frames of reference classification.

ground are the same object but are distinct from the observer. As such, the object-centered FoR is defined in narrower terms than the intrinsic FoR is defined in Levinson (1996, 2003). The definition of the direct FoR used in this paper is in keeping with that proposed in Danziger (2010) in which the ground is the same as the anchor, and the observer's body serves as the ground. English examples for the object-centered and direct FoRs as used in this study are offered on the left section (dark gray) in Fig. 1.

The right side of the graphic in Fig. 1 shows four types of FoRs in which the anchor and the ground are different entities. Moving from right to left, in the absolute FoR, the anchor is derived from an environmental gradient as in the case where cardinal points are used to locate objects. There is a subtype of the absolute FoR, the **vertical** FoR, in which the anchor is the force of gravity. An example of the vertical FoR would be the array described by the English sentence *The ball is above the chair*. The vertical FoR is coded separately from the absolute FoR that is derived from cardinal directions and which is used dominantly in the Juchiteco data. The reason for this distinction is that cross-linguistic variability in the availability of the absolute FoR in the horizontal has been documented, yet no such data exist regarding the vertical FoR. The **landmark-based** and the **geomorphic** FoRs also use elements in the environment as anchors. However, in both cases, there is no process of abstraction. In the landmark-based FoR, an entity in the environment, i.e. some object in the vicinity, a structural part of a building or a building itself serves as anchor. In the geomorphic FoR, a physical gradient found in the environment as would be the case of a flow of water or a mountain incline, becomes the anchor and sets the asymmetry from which the coordinate system is copied. Finally, in the relative FoR, the anchor is also not the ground, but in this case, the anchor must be the observer's body.

As stated earlier, the classification used in this study follows closely the classification proposed by the MesoSpace project (cf. O'Meara and Pérez Báez, 2011) with one important exception: the definition of the direct. In the MesoSpace project, the direct FoR is used to code two types of arrays: (i) cases where the observer is both ground and anchor as in 'The ball is in front of you' and (ii) cases in which the observer serves as anchor but is not the ground as in 'The ball is toward you' where the ground is not explicitly identified. In this paper, the direct FoR is used in a manner consistent with Danziger (2010) thereby restricting it to the first of these two cases where the observer is both anchor and ground. Cases such as (ii) are coded as cases of the landmark-based FoR. This decision has little impact on the analysis of FoR preferences in Juchiteco as only three orientation descriptions out of 295 and two locative descriptions out of 420 which pattern with the example in (ii) would be affected by a decision to use one definition of the direct over the other. The definition used in this paper preserves, however, the basic distinction of arrays in which the anchor and ground are the same entity and only a total of two entities are involved in the array (binary FoRs) and arrays where the anchor is not the ground but rather a third entity (ternary FoRs). This distinction proved essential in developing an elegant and efficient analysis of the Juchiteco data, as is shown in extensive detail in Section 6.

3.1. Hypothesis: meronymy and frame of reference preferences

This work follows up on cross-linguistic work initiated at the Max Planck Institute for Psycholinguistics and reported in Pederson et al. (1998). This comparative work revealed significant differences in the selection of spatial FoRs in discourse and cognition across languages, and even restrictions for or against certain types of FoRs. Of interest to this paper are languages such as Kilivila (Austronesian), Mopan and Tseltal (Mayan), Arandic (Pama-Nyungan) and Longgu (Austronesian) whose speakers were found to rely on FoRs other than the relative FoR when presented with tasks in tabletop space (*ibid.)*. Such findings put into question the proposal that an egocentric division of space is a basic human strategy in locating objects in space, and that it universally influences linguistic descriptions of spatial relations (Clark, 1973; Miller and Johnson-Laird, 1976; Lyons, 1977).

Of special relevance is the case of Tseltal, a Meosamerican language described as having a productive part-naming system based on algorithmic calculations (Levinson, 1994), and one where the use of the relative FoR has been described as remarkably limited (Brown and Levinson, 1993; Levinson, 1996, 2003; Brown and Levinson, 2009; Polian and Bohnemeyer, 2011, for more recent results on a somewhat expanded use of the relative FoR). Productive meronymy is considered an areal feature in Mesoamerican languages (Campbell et al., 1986) and has been documented for a number of them.[7] Specifically, with regards to Zapotec languages, meronymy has been documented for Ayoquesco Zapotec (MacLaury, 1989), Valley Zapotec (Lillehaugen, 2006) and Juchitán Zapotec (Pérez Báez, in press). The MesoSpace project set out to investigate whether there is a correlation between productive meronymy and a bias against the relative FoR. The rationale for such a proposal is, as mentioned in the introduction, that a language with productive part-naming systems would capitalize on the attention placed on object geometry and be less likely to resort to using an observer's point of view as the origin of an FoR (cf. O'Meara and Pérez Báez, 2011). In order to test this hypothesis, various tasks were designed to investigate meronymy and FoR preferences. These are explained in the section that follows.

[7] Meronymic systems have been described for the following Mesoamerican languages: Mopan (Danziger, 1996), Tseltal (Stross, 1976; Levinson, 1994) and Yucatec (Goldap, 1992; Bohnemeyer and Stolz, 2006) of the Mayan family, Mixtec and Trique belonging to the Mixtecan family of languages (Brugman, 1983; Brugman and Macaulay, 1986; Hollenbach, 1987, 1988), various Zapotec varieties (MacLaury, 1989; Lillehaugen, 2006; Pérez Báez, in press), as well as Cora (Casad, 1982), Totonac (Levy, 1999, 2006) and Tarascan (Friedrich, 1969, 1970, 1971).

4. Methods

Preliminary research on the semantics of body part terms in spatial descriptions with Juchiteco speakers was initiated prior to the MesoSpace research (Pérez Báez, in press). Within MesoSpace, two types of tasks were designed to investigate meronymy and FoR preferences. As the tasks were administered, consultants were audio and/or video recorded. All audio was subsequently transcribed and translated in the field with the assistance of native speaker consultants. This section provides an overview of the data collection tasks. More information on the MesoSpace methods is presented in O'Meara and Pérez Báez (2011), and is available in extensive detail in the MesoSpace Field Manual (Bohnemeyer, 2008).

The first type of task was intended to investigate the productivity of the semantic extension of body part terms in Mesoamerican languages. For this purpose, nine objects were designed with a number of criteria in mind to test proposals put forth in MacLaury (1989) and Levinson (1994) to explain the mechanics of productive meronymy in Ayoquesco Zapotec and Tseltal Maya, respectively. Further, seven of these objects were designed not to resemble objects that consultants might be familiar with, as to test the degree of productivity of meronymic systems in the languages of the MesoSpace sample. The set of novel objects was used in two object-to-object matching elicitation tasks with six pairs of consultants each, one taking the role of director and the other, the role of the matcher in alternating turns. The consultants were asked to sit at a table, facing the same direction and with a screen in between them as to prevent visual contact and to stimulate an oral exchange of information. The first task was a part identification task in which small dots of colored clay were placed on a novel object given to the director. The direct was asked to instruct the matcher to place his own pieces of clay on a novel object with no preset clay markings. In the second task, the novel object was presented to the director on a table with clay dots in strategic positions on the table, rather than on the object itself. Once again, the director would instruct the matcher to reconstruct the arrangement of clay dots around the novel object. Data obtained with these two tasks show that Juchiteco has a highly productive meronymic system, as explained in Pérez Báez (2010) and summarized in Section 5 of this paper.

FoR preferences were tested with a referential communication task called Ball & Chair (B&C) intended to collect linguistic data, and a memory recall task called New Animals (NA) intended for the documentation of FoR preferences in cognition. As mentioned above, the linguistic data for this study was recorded using the B&C referential communication task (Bohnemeyer, 2008). The stimulus consisted of four sets of 12 photos each showing a chair and a ball of significantly smaller size, in various configurations designed to test non-projective vs. projective relations, and within the latter, the preference for one FoR type vs. another. Relevant photo examples are included with data in this section. Two consultants were involved per trial, sitting side by side at a table, divided by a screen. A set of photos was set on the table in front of each of the consultants, with the photos in random order. One consultant would act as director and would describe one photo at a time to the matcher who would need to identify the described photo based on the oral description. There were four rounds per trial, and consultants switched roles at each trial so each consultant was both director and matcher for two trials each. All instructions to consultants and interaction with the researcher were in Juchiteco. For a more detailed overview of the B&C elicitation task see Section 3.2 in O'Meara and Pérez Báez (2011).

A total of 12 native speakers of Juchiteco from La Ventosa participated in this task. All were speakers of Juchiteco as their first language, and all were bilinguals in Spanish as well. There were three male consultants and eight female consultants. All were over the age of 18. All but two consultants were literate in Spanish. The same two were the only ones not to have attended school. All others had at least some elementary school education with six consultants having high school education either completed, or at least initiated, as was the case of the youngest consultant. Table 1 summarizes the profiles of the consultants who participated in the B&C task.

Non-linguistic data on FoR preferences was collected using the New Animals (NA) task, closely modeled after Animals-in-a-Row, which was designed by researchers at the Max Planck Institute for Psycholinguistics to test non-linguistic manifestations of spatial FoR preferences (Pederson et al., 1998). The purpose of the original task was to test whether speakers of

Table 1
Profiles of ball and chair consultants.

Dyad	Speaker	Sex	Age	JCH/SP	Literacy	Schooling
1	1	F	40s	Y	Y	Some
	2	F	50s	Y	N	None
2	3	F	20s	Y	Y	High school
	4	F	20s	Y	Y	High school
3	5	M	18	Y	Y	High school
	6	M	30s	Y	Y	High school
4	7	M	20s	Y	Y	High school
	8	F	30s	Y	Y	High school
5	9	F	40s	Y	Y	Some
	11	F	50s	Y	N	None
6	18	F	40s	Y	Y	Unknown
	19	F	30s	Y	Y	Unknown

maximally different languages in terms of FoR preferences in discourse would perform in a distinct way in non-linguistic tasks. Thus, speakers of languages that either favored only relative FoRs or favored only absolute FoRs were compared. In NA, one consultant at a time stands between two tables, and is presented with an array of three toy animals lined up one after the other, all facing the same direction. The consultant is asked to memorize the array, and having done that, the array is taken away for 30–60 seconds. The consultant is then given the same three animals back plus a fourth one, all in a bunch to avoid leading the consultant as s/he is asked to recreate the array of animals in the second table – the response table. This requires the consultant to recreate the array under a 180° rotation. Each consultant participates in six trials and all responses are coded on a standard sheet applicable to all languages in the MesoSpace sample. A total of 19 consultants participated in the NA task, nine female consultants between the ages of 18 and 39, and 10 male consultants between the ages of 18 and 49. All participants spoke Juchiteco as their mother tongue and Spanish as a second language. At least 17 of the consultants were literate in Spanish (literacy level for two of the consultants is unknown) and all had received some level of schooling with at least three male and six female consultants having attended high school. The results of all data collection tasks administered are presented in the sections that follow. Section 5 below describes the meronymic system in Juchiteco and Section 6 presents results on FoR use both in linguistic and non-linguistic tasks, which show a dispreference for the relative FoR.

5. Productive meronymy in Juchiteco

In Juchiteco, meronyms are used productively in the description of object geometry and spatial relations (Pérez Báez, 2010, in press). Most meronyms used in locative descriptions are human and animal body part terms, which can be extended to inanimate object geometry on the basis of an analogy based primarily on shape. This process is highly productive in that some body part terms can extend to objects regardless of the complexity or simplicity of the object's geometry and independently of whether the object has many or only a few parts that can be identified and named. As part of the MesoSpace project, an inventory of body part terms that could extend to refer to parts of known objects as well as novel objects was developed through a series of elicitation tasks (for more details, see Section 3.1 in O'Meara and Pérez Báez (2011)). In a first exercise, a series of 19 drawings of the human body, animals and plants, and seven real life objects common to La Ventosa were used to elicit meronyms from 12 native speaker consultants. This exercise produced an inventory of 133 meronyms, 82% or 109% of which are body part terms. Out of these, a set of 13 body part terms could be used to name parts of plants and objects as well. Table 2 lists those body part terms that were readily extended to name parts of plants and objects. The glosses in Table 2 refer to the meronyms as body part terms. Figs. 2 and 3 illustrate the use of some of these terms to name parts of objects. Both the basket and the car are objects that are part of daily life in La Ventosa. The basket is an example of an object with relatively simple geometry, while the car presents complex geometry.

Table 2
Juchiteco body part terms extended to object partonomy.

JCH	English gloss	JCH	English gloss
deche	back	*ndaani*	stomach, abdomen, gut
dyaga	ear	*nyee*	legs, hind legs of an animal or insect
gye lu	eye	*rwaa*	mouth
ike	head	*x.kipi!'*	belly button
kwe'	flank	*zha'na*	buttocks
lu	eye, face	*zhii*	nose
*na**'	arm, front legs of an animal or insect		

Fig. 2. Body part terms applied to an object of simple geometry.

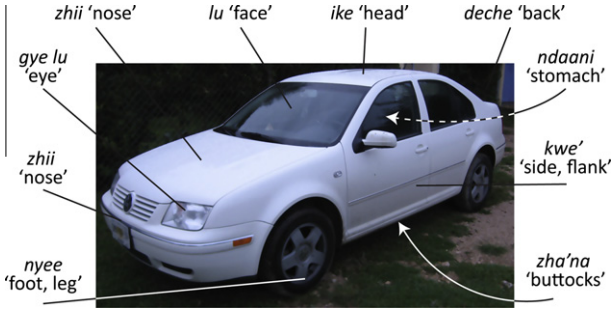

Fig. 3. Body part terms applied to an object of complex geometry.

Data from the two novel objects tasks described in Section 4 show that in Juchiteco, body part terms could indeed be extended to these novel objects. An example of this is provided in (6) where the body part term *x.kipi!'* 'belly button' is used to refer to a circular depression on the larger sphere of Novel Object 9 shown in Fig. 4, where a piece of black clay was placed. Examples such as that in (6) confirm the productive nature of the semantic extension of body part terms to name object parts.

(6) *ti* ***x-kipi!'*** *wiini* *la!* *gi!'di* *ti* *na-yase!'*
NDF **POS-belly.button** small Q adhered NDF black
'A black [piece of clay] is stuck to his belly button.' (NOPI_1-2:7.9)

Fig. 4. Novel object 9.

5.1. Meronyms in locative constructions

Meronyms can serve as heads of ground phrases in descriptions of the location of a given figure (Pérez Báez, in press). The locative construction by which the location of a figure can be described in relation to a ground is shown in (7), which is an answer to the question 'Where is the cup?'. In (7), the location of the figure, a cup, is described in relation to a part of the ground, the surface of a table. The body part term *lu* 'face', one of the body part terms in Table 2 which are frequently extended to object parts, functions as the head of the ground phrase *lu mezha!'* 'on the table' by virtue of the fact that the ground phrase is a possessive construction in which the meronym *lu* 'face' is possessed by the ground object *mezha!'* 'table'.

(7) **Positional Figure.Phrase [Relator Noun.Phrase]$_{\text{Ground.Phrase}}$**
zu!=waa *ta*sa* *[lu* *mezha!']*
standing=stand.up cup [face table]
'A cup is standing on the table'

The structure of the locative construction is shown in (8), although constituent order variation allows for the ground phrase or the figure phrase to be fronted to satisfy pragmatic demands. Having described the system of meronymy in Juchiteco and the role of meronyms in structuring spatial descriptions, we move to Section 6 which presents the analysis of FoR use in the language.

6. Frames of reference preferences in linguistic data

This section begins with an explanation of the data coding and analysis principles used in this study. Following the methods of semantic typology (described in detail in Section 3 in O'Meara and Pérez Báez, 2011) an etic grid was designed to record various categories of words, as well as the FoRs attested in the data collected with the B&C task described in Section 4 above. Specifically and with regards to the chair, which functioned as the ground, information related to its disposition, orientation and location in the picture was coded for every description. As for the ball, which functioned as the figure,

disposition, location with regards to the chair, location with regards to the speaker and location in the picture were coded. (8) is an example of a description of B&C photo 2.1, which contains a phrase referring to the disposition of the chair, a phrase referring to its orientation, and a third phrase referring to the location of the ball with regards to the chair. Tables 3 and 4 illustrate how this utterance was coded in the etic grid. Overall, the data was quantified following MesoSpace analysis criteria, which dictated that only one instance of a FoR would be counted per photo, yet if more than one type of FoR was used per photo each would be counted once. Subsequently all instances in which each FoR occurred across the corpus resulting from the six trials were added and percentages were calculated based on this number. The results are presented and explained in Sections 6.1 and 6.2.

(8) *zu!=waa* *ti* *asye*ntu* *la!*
standing=stand.up NDF chair Q

r-uuya *dxi** *la*du* *ri=ndani* *gubidxa* *la!*
HAB-watch quiet(ly) side HAB=be.born sun Q

ne *n-uu** *ti* *pelo*ta* *la*du* *gya*'* *de* *laa=ni**
and STA-exist NDF ball side north of 3=3I

'A chair is standing, OK? It is staring toward the East, OK?
And there is a ball to the north side of it' (B&C_1-2:2.1)

Fig. 5. B&C 2.1.

6.1. Dominance of the absolute frame of reference in descriptions of ground orientation

The orientation of the chair was overwhelmingly described in utterances involving an absolute FoR which uses an abstraction of a fixed environmental gradient to divide space. As shown in Table 5, the absolute FoR was used in 231 out of a total of 295 descriptions, equivalent to 78% of the descriptions in which the orientation of the chair was specified.

Examples 9–12 illustrate the use of cardinal direction terms consistent with the absolute FoR and which were used to describe the orientation of the chair. The only other strategy rivaling the use of cardinal points was to not refer to the orientation of the chair at all: no description of the orientation of the chair was provided for a total of 50 photographs, equivalent to 17% of describable photos across the six trials. In Table 5, all possible FoR types are listed for the sake of consistency in data presentation. However, it should be noted that the lack of descriptions using the object-centered FoR is a feature of the task at hand: the orientation of a ground, of course, cannot be described as oriented with respect to itself so the object-centered FoR is not an option for this component of the task, hence the italicisation of the respective row in Table 5.

Table 3
Sample coding for ball and chair – chair disposition, orientation and location.

Picture	Disposition	Orientation						Location in the picture	
		Facing direction Relator	FoR	Location of seat or legs or front Relator	FoR	Location of back or seat Relator	FoR	Relator	FoR
2.1	*zu!=waa r-uuya dxi*=ni**	*la*du ri=ndaani gubidxa*	abs	–	–	–	–	–	–

Table 4
Sample coding for ball and chair – location of the ball with regards to the chair.

Disposition	Location wrt. chair Relator	Part of chair referred to	FoR	Location wrt. speaker	Part of chair referred to	Location in the picture Relator	FoR
–	*la*du gya*'*	–	abs	–	–	–	–

(9) *ti* *asye*ntu* *n-u=dxii* *lu* *gya*'*
NDF chair STA-CAU=face face north
'a chair is facing north' (BCH_9-11_3.9)

Fig. 6. B&C 3.9.

(10) *n-u=dxii* *lu=ni** *la*du* *gete!'*
STA-CAU=face face=3I lado south
'it is facing the south side' (BCH_18-19_2.9)

Fig. 7. B&C 2.9.

(11) *zu!=waa* *ti* *asye*ntu* *r-uuya* *dxi*=ni**
standing=stand.up NDF chair HAB-watch quiet(ly)=3I

*la*du* *ri=ndani* *gu-bidxa*
side HAB=be.born sun

'a chair is standing, it stares (toward) the east side' (BCH_1-2_2.2)

Fig. 8. B&C 2.2.

(12) *n-uu** *ti* *asye*ntu* *n-u=dxii* *lu=ni**
STA-exist NDF chair STA-CAU=face face=3I

neza *r-y-aaze* *gubidxa*
road HAB-MED-submerge sun

'there is a chair, it is facing toward the west' (BCH_3-4_1.8)

Fig. 9. B&C 1.8.

Table 5
Frame of reference preference in description of ground orientation.

Type of spatial relation	FoR	SPK 1 & 2	SPK 3 & 4	SPK 5 & 6	SPK 7 & 8	SPK 9 & 11	SPK 18 & 19	Total	%
Non-projective	Topological	6	0	0	0	0	0	6	2
FoR: anchor = ground	*Object-centered*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Direct	0	0	0	0	0	0	0	0
FoR: anchor ≠ ground	Absolute	30	38	37	40	46	40	231	78
	Vertical	0	0	1	0	1	0	2	*
	Landmark-based	1	0	3	2	0	0	6	2
	Geomorphic	0	0	0	0	0	0	0	0
	Relative	0	0	0	0	0	0	0	0
No description of ground orientation		12	8	14	7	1	8	50	17
Total		49	46	55	49	48	48	295	100

* Less than 1%.

Beyond highlighting the striking dominance of the absolute FoR, it is important to note that among the underrepresented FoRs in the data, as per Table 5, is the relative FoR. This observer-dependent FoR was not used at all by any of the speakers for the purposes of describing the orientation of the chair. This is in line with the MesoSpace hypothesis, which predicts that in a language with productive meronymy such as Juchiteco, the relative FoR is disfavored.

6.2. Frames of reference use in descriptions of figure-ground relations

As it pertains to descriptions of the location of the ball with respect to the chair, and as shown in Table 6, the absolute FoR was the most frequently used FoR, as it occurred in a third of the descriptions. In descriptions of figure-ground relations, however, the absolute is not as dominant as it is in descriptions of the chair's orientation, and other FoRs were attested in the data at significant percentages. The object-centered FoR is a close second to the absolute FoR, as it was documented in 26% of the descriptions. The vertical FoR, also a type of absolute FoR, was documented in 13% of the descriptions. In addition to the use of the object-centered, vertical and absolute FoRs, another frequent strategy used in describing the location of the ball with respect to the chair, was to do so without resorting to the use of a FoR and describing instead a topological (non-projective) relation between the figure and the ground. In this case meronyms, which in most cases were body part terms, function as heads of ground phrases to describe a relation of containment, contact, support, proximity or contiguity between the figure and the ground.

Table 6 also shows that in opposition to the three most used FoRs, object-centered, absolute and vertical, there are four types of FoRs that are significantly underrepresented or not represented at all in the data. Of course, this is not to say that these strategies are not at all available to speakers or that they might not be used in every day discursive contexts. Simply, the B&C task shows that in tabletop space, under the conditions established by the task, the direct and geomorphic FoRs were not utilized. Underrepresented are the landmark-based and the relative FoRs, the latter having been used in only 3% of descriptions. The fact that relative FoRs were disfavored as a strategy to describe the location of a figure in relation to a ground in tabletop space is, again, in line with the hypothesis driving this study: that in a language with productive meronymy such as Juchiteco, which devotes attention to the geometry of objects, the relative FoR will be disfavored. In fact, a stronger claim can be made regarding Juchiteco, in that its speakers seem to disfavor the two egocentric FoRs, the relative and the direct, in the tasks at hand.

In support of these observations, it is important to show the coding criteria used in analyzing the JCH data as per the guidelines established by the MesoSpace project. Example (13) is a description consistent with the use of an object-centered

Table 6
Frames of reference preferences in descriptions of figure-ground relations.

Type of spatial relation	FoR	SPK 1 & 2	SPK 3 & 4	SPK 5 & 6	SPK 7 & 8	SPK 9 & 11	SPK 18 & 19	Total	%
Non-projective	Topological	17	11	18	6	29	10	91	22
FoR: anchor = ground	Object-centered	23	20	14	8	27	19	111	27
	Direct	0	0	0	0	0	0	0	0
FoR: anchor ≠ ground	Absolute	13	33	28	28	5	31	138	33
	Vertical	6	11	9	10	6	11	53	13
	Landmark-based	1	0	0	1	0	0	2	*
	Geomorphic	0	0	0	0	0	0	0	0
	Relative	0	2	1	2	5	1	11	3
No description of a figure-ground relation		2	2	0	5	0	0	9	2
Total		62	79	70	60	76	73	420	100

* Less than 1%.

Table 7
B&C stimuli for examples 13–16.


Fig. 10. B&C 1.7


Fig. 11. B&C 2.8


Fig. 12. B&C 3.7


Fig. 13. B&C 3.8

FoR, offered as a description of the photo in Fig. 10 (B&C 1.7) shown in Table 7. The key criterion in coding (13) as an example of the use of an object-centered FoR is that the validity of the description depends on the orientation of the ground. Depending on the orientation of the chair, the meronym selected for the description changes. In (13) the meronym used is *deche* 'back' and in (14), which refers to the photo in Fig. 11 (B&C 2.8), the meronym changes to *kwe'* 'side'. In both of the photos in Figs. 10 and 11, the ball is in the exact same position. Also, in both photos, the chair is in the same spatial location and in fact the legs of the chair are placed on fixed points that were marked on the floor for accuracy while setting the props to be photographed. The only variable between Fig. 10 and 11 is the orientation of the chair and that alone triggers the use of a different meronym. This shows that the speaker is resorting to the use of an object-centered FoR where the set of coordinates originates in the ground and uses its geometry to partition the space projected from it in order to locate the figure. In other words, the description of the figure-ground relation in Figs. 10 and 11 is resolved by using a FoR in which (a part of) the chair functions both as ground and anchor.

(13) *pelo*ta ka! n-uu* neza…ko', deche=ni**
ball DEM STA-exist road NEG back=3I
'that ball, it is toward…no, at its back' (BCH_3-4_1.7)

(14) *nexe!' ti bo*lla kwe'=ni**
lying NDF ball side=3I
'a ball is lying at its side' (BCH_5-6_2.8)

Figs. 12 and 13 in Table 7 elicited descriptions using the vertical FoR which uses the direction of the Earth's gravity force as anchor. Examples (15) and (16) are descriptions which both use the relator *lu gya**' 'above (lit. face north)' to describe the location of the ball with respect to the chair independently of the orientation of the chair. This shows that the FoR in use does not depend on the orientation of the chair. The FoR does not depend on the orientation of the observer either, as the description remains true independently of it, and is therefore observer-independent. The FoR at play then is governed by the direction of the force of gravity and the resulting coordinate system is described with the terms *lu gya**' 'above (lit. face north)' and *zha gete*!' 'below (lit. buttocks south)'.

(15) *ne* n-uu* ti pelo*ta lu bi, lu gya*'=ni**
and STA-exist NDF ball face air face north=3I
'…and the ball is floating, it is above it [the chair]' (BCH_3-4_3.7)

(16) *aja!, lu gya*' de asye*ntu ka!*
uhu, face north of chair DEM
'uhu, it is above that chair' (BCH_3-4_3.8)

Examples 17–20 are the use of cardinal direction terms consistent with an absolute FoR in descriptions of configurations of the ball and chair in the B&C photographs.

(17) *n-uu** *ti* *bo*lla* *laa=ka!* *neza* *gya*'*
STA-exist NDF ball 3=DEM road north
'there is a ball also toward the north' (BCH_18-19_3.12)

(18) *n-uu** *ti* *pelo*ta* *la*du* *gete!'* *de* *laa=ni**
STA-exist NDF ball side south of 3=3I
'a ball is to the south of it' (BCH_5-6_2.1)

(19) *n-exe!'* *ti* *bo*lla* *kwe'=ni** *la*du* *ri=ndani* *gubidxa*
STA-lying NDF ball side=3I side HAB=be.born sun
'a ball is lying by its side, on the east side' (BCH_5-6_2.8)

(20) *n-uu*=ni** *lade** *nyee* *asye*ntu* *ka!*
STA-exist=3I between leg chair DEM

*pe*ru* *la*du* *r-y-aaze* *gubidxa*
but side HAB-MED-submerge sun

'it is between the legs of that chair but on the west side' (BCH_9-11_3.10)

To summarize, in describing the location of the figure with respect to the ground in the B&C task, in Juchiteco, speakers relied on descriptions of topological (non-projective) relations, on object-centered FoRs and on absolute and vertical FoRs, both of which rely on absolute coordinates. Other FoRs were greatly underrepresented: landmark-based, geomorphic and direct, which occurred minimally or not at all, and the relative FoR which was attested in 3% of descriptions. Given that the hypothesis driving this study centers on the proposed bias against the use of relative FoRs, an overview is offered in Section 6.3 of the instances in which they were used.

6.3. The relative FoR in Juchiteco data and the MesoSpace hypothesis

Bohnemeyer and Stolz (2006) observe that the use of the relative FoR in Yucatec Maya correlates with a lack of facets that would permit the use of an object-centered FoR. In Bohnemeyer (2011) this observation is rephrased to state that the relative FoR can indeed be used in relation to an object with identifiable facets such as a front, back or sides, but that these facets are more often used intrinsically. In Juchiteco there is also a correlation between the usefulness of a given facet when used intrinsically as ground, and the option to resort to the use of the relative FoR (Pérez Báez, 2010). In the B&C task, the relative FoR occurs in cases where identifying a part of the chair does not represent a useful strategy in locating the ball. Table 8 shows the six photos in the 48-photo B&C stimulus that elicited a description consistent with the use of a relative FoR. In the first five of these cases, the part of the chair closest to which the ball was located,

Table 8
B&C configurations which elicited the relative FoR.

B&C Photo	 Fig. 14. B&C 1.3 and 4.4		 Fig. 15. B&C 2.9	 Fig. 16. B&C 3.9	 Fig. 17. B&C 3.10	 Fig. 18. B&C 1.9	 Fig. 19. B&C 1.10
Attested Relators	*deche* 'back'	*atra!* 'behind'	*atra!* 'behind'	*dela*nte* 'in front'	*lu* 'face' *dela*nte* 'in front'	*biga!'* 'left'	*biga!'* 'left'

was one of the chair's intrinsic sides.[8] Identifying which of the two sides was relevant to locating the ball was possibly hampered by the fact that the intrinsic left and right were not used much at all by Juchiteco speakers in resolving the B&C task. In fact, of the 420 descriptions, only three involved mention of the intrinsic left using the term *biga*!' 'left' as in the case of Fig. 18 in Table 8. The term *zu*!=*ndi**' 'right' was not at all attested in the entire data set. This motivates the explanation that identifying a part of which a ground has more than one, as would be one of the two sides of the chair, with respect to which the figure can be located, is not sufficiently precise. This is the case of the first five photos in Table 8 where referring to *kwe*' 'side' turns out to be ambiguous. Such circumstances open the door for the use of a relative FoR as an alternative and more precise strategy as shown in (21) and (22).

(21) Q: *pa* raa n-uu* pelo*ta ka!*
if where STA-exist ball DEM
'where is the ball?'

A: *deche asye*ntu ka!*
back chair DEM
'behind the chair there' (BCH_3-4_1.3)

(22) *zi!=waa asye*ntu… deche=ni* la! n-uu* nexe!' ti bo*lla*
standing=stand.up chair… back=3I Q STA-exist lying NDF ball
'the chair is standing…the ball is lying behind it' (BCH_18-19_1.3)

(23) a. *n-u=dxii lu=ni* gete!'*
STA-CAU=face face=3I South
'it is facing south'

b. *pelota ka! n-uu* neza deche*
ball DEM STA-exist road back
'the ball is behind it'

c. *la*du kwe'=ni**
side flank=3I
'at its flank'

d. *la*du r-y-aaze… este… gubidxa*
side HAB-MED-dive… uh… sun
'on the west side' (BCH_3-4_1.3)

Both (21) and (22) are descriptions of the photo in Fig. 14 (B&C 1.3). Example (21) is coded as an instance of a relative FoR because the meronym relating the ball to the chair is *deche* 'back', yet (21) is not true as an object-centered description of the ball with regards to the back of the chair. The description is true, however, as a relative description in which the ball can be located within a FoR that originates at the observer/speaker. The same is true for (22).

It should be noted that it is not the case that the relative FoR is the only or the preferred strategy when speakers are faced with the need to resolve some degree of ambiguity. In fact, of the 73 descriptions that were provided for the photographs in Table 8, the absolute was again the most frequently used FoR, occurring in 23 descriptions equivalent to 32% of the descriptions of such photos. The object-centered FoR occurred in 17 descriptions (23%), and 13 descriptions (18%) referred to topological relations. The relative FoR, in descriptions of the photos in Table 8, was used in eight descriptions (11%) and was the fourth most used description, only more frequent than the vertical, which was used seven times (9%), and a landmark-based FoR which made an appearance in this data subset once. Of course, in addition to whatever strategies were used to describe the location of the ball with respect to the chair in the photos above, descriptions of the orientation of the chair in combination with the use of the meronym *kwe*' 'flank' made for useful descriptions that efficiently assisted the matcher to identify the correct photograph. Example (24) shows various strategies used by a speaker to overcome ambiguity when describing Fig. 14 (B&C 1.3). Example (24a) is a description of the orientation of the chair that is consistent with the use of an absolute FoR. Examples (24b)–(d) describe the location of the ball with respect to

[8] It is visibly obvious that B&C 1.10 in Fig. 19, Table 8 is not in line with the explanation provided. However, given that of the 11 relative descriptions in the data ten support the explanation provided, no further consideration is given to B&C 1.10 which is only included here for the sake of transparency.

the chair. In particular, (24b) is an example of the use of a relative FoR. As in the case of (22) and (23) above, we know that the relative FoR is at play because the ball is not in the proximity of the intrinsic back of the chair. Rather the set of coordinates is observer-dependent. In contrast, the meronym *kwe'* in (24c) is used intrinsically given that the truth of the description depends on the orientation of the chair. Finally, a cardinal direction term is used in (24d) consistent with the use of an absolute FoR.

(24) a. *n-u=dxii* *lu=ni** *gete!'*
STA-CAU=face face=3I South
'it is facing south'

b. *pelota* *ka!* *n-uu** *neza* *deche*
ball DEM STA-exist road back
'the ball is behind it'

c. *la*du* *kwe'=ni**
side flank=3I
'at its flank'

d. *la*du* *r-y-aaze…este…gubidxa*
side HAB-MED-dive…uh…sun
'on the west side' (BCH_3-4_1.3)

6.4. Non-linguistic data on FoR preference

Moving onto non-linguistic data, two types of response patterns can be coded using the Animals-in-a-Row task and the same applies to the NA task. The first is that in which consultants rotate the array by 180° as they recreate it in the response table. In other words, the array is rotated as the consultant rotates. This pattern is consistent with the two egocentric (observer-dependent) FoRs, the relative and the direct. The second pattern is that in which the array is reproduced with the animals facing the same direction as they were in the stimulus table. In other words, while the consultant rotates 180°, the array is not rotated. This response pattern is consistent with absolute, landmark-based and geomorphic FoRs, in other words, with allocentric (observer-independent) FoRs. Response patterns consistent with an object-centered FoR can emerge as either one of the two possible response patterns, or as a combination of both and as a result, cannot be coded individually. Despite this important limitation, the Juchiteco non-linguistic data reveals once again a clear dispreference for responses that pattern with relative and direct FoRs, both observer-based (egocentric) FoRs.

The dominant response type of 16 out of 19 participants was consistent with absolute/landmark-based/geomorphic FoRs. In other words, 16 of the 19 participants in at least four out of six trials reproduced the animal arrays facing the same direction in the recall table as in the array originally presented in the stimulus table. Of these same 16 consultants, ten did so in all six trials and made no use of any other strategy. The three remaining consultants of the 19 total participants made use of a unidirectional strategy in which all animals are lined up facing the same direction at every trial, independently of the direction in which the animals are presented. Strikingly, only one consultant in one trial out of the 19 consultants having participated in six NA trials each produced a response consistent with the relative or the direct FoR. That is equivalent to one single instance out of 114 trials in which the response array was consistent with the relative and direct FoRs as it was reproduced under a full 180° rotation.

7. Summary and discussion

This article has provided both linguistic and non-linguistic data showing a correlation between productive meronymy and a dispreference for the relative FoR. Section 5 has been devoted to an overview of the mechanics of the meronymic system in Juchiteco, which is based on body part terms that can be used to name parts of objects in a productive way. Meronyms are frequently used as heads of the ground phrase in the description of the location of a figure with respect to a ground. The data presented in Section 6 shows that Juchiteco speakers, in resolving the tabletop space tasks at hand, restricted their FoR choices to three types, the absolute, object-centered and vertical FoRs. Other FoR types were clearly dispreferred and even downright not used. The geomorphic and direct FoRs are not at all attested in the data, and the landmark-based FoR occurs minimally. Compare these results to those of Yucatec (Bohnemeyer, 2011) for instance. Yucatec is described as "referentially promiscuous" as it lacks a default FoR type. Juchiteco speakers, in contrast, clearly prefer the use of two types of allocentric FoRs, the absolute and the object-centered. Further, Juchiteco speakers did not often switch between referential strategies within a single description. In fact, 75% of descriptions of projective descriptions of location in the corpus involved one single FoR type.

The flip side to the clear preferences that Juchiteco speakers exhibit is their clear dispreference for egocentric FoRs: relative and direct. The latter was not at all attested in the entire B&C corpus. As for the relative FoR, it only amounted to 3% (11

out of 420) descriptions of the location of the ball with regards to the chair. In descriptions of chair orientation neither the relative nor the direct was used. Further, and as mentioned at the end of the previous section, this dispreference is also evident in the non-linguistic NA task where response patterns that could be consistent with the relative FoR were all but non-existent. This shows a strong alignment in FoR use both in linguistic and in non-linguistic tasks. The particulars of meronymy in Juchiteco, coupled with the striking FoR preferences documented lend solid support to the MesoSpace hypothesis: that languages with productive meronymy are less likely to seek an observer's point of view as the origin of a FoR, and instead exploit the attention to object geometry involved in meronymy.

The preferences and corresponding dispreferences in FoR use among speakers of Juchiteco can be summarized as follows. There are two distinctions relevant to explaining FoR use in Juchiteco. The first observation relates to the division of labor across the FoRs used. At the outset of this investigation, the expectation was that the attention to object geometry involved in the productive meronymic system of the language would translate into a preference for the object-centered FoR. However, a clear preference did not emerge. What became evident instead is a streamlined system of two strategies: looking at the object which functions as the ground to provide the anchor, and looking for the anchor outside the ground and in a third entity. The use of the object-centered FoR follows the former and the absolute (and vertical) FoRs follows the latter. Hence the relevance of a distinction between intrinsic and extrinsic FoR types. Second, and consequently, speakers of Juchiteco do not use observers as anchors except under very restricted conditions making the distinction between observer-independent (allocentric) and observer-dependent (egocentric) FoRs relevant.

Beyond the documentation of FoR preferences and the analysis of their correlation with systems of meronymy, the alignment of FoR preferences in linguistic and non-linguistic tasks observed in the Juchiteco data is of relevance to the larger debate regarding the influence that linguistic practices may or may not have in cognition. Pederson et al. (1998) argue that an alignment in FoR preferences both in language and cognition are the result of influence of language on the conceptualization of space. The rationale for this claim is that agreement on FoR use within a speech community could only be reached through linguistic negotiation. For instance, under this approach, the strong consistency across Juchiteco speakers to resolve the administered tasks through a restricted set of basically three types of FoRs would have been the result of shared linguistic practices. A counterproposal was made in Li and Gleitman (2002) suggesting that cultural factors are at least as relevant as language in dictating non-linguistic behavior. Some variables have been considered in establishing such a correlation, notably literacy and education but also community size and relation to the local environment, rural vs. urban living, modes of subsistence, etc. (Li and Gleitman, 2002; Majid et al., 2004). For instance, it has been proposed that the use of the relative FoR would correlate with high literacy and education and conversely, that the absolute FoR would be associated with low schooling and low literacy.

The Juchiteco data will be able to strongly contribute to this debate in the context of a comparative study alongside data collected and analyzed by all members of the MesoSpace team to be undertaken in the near future. It is possible to begin to point out that the Juchiteco data will contradict an explanation that links literacy and education and the FoR preferences just mentioned. Notably, recall Table 1 in Section 4 which shows that of the 12 participants in the B&C task, six had completed high-school, and at least two more had some exposure to the educational system which until now has used Spanish exclusively as a medium of instruction. In terms of literacy, all but two of the 12 participants were literate. In the larger pool of 19 participants in the NA non-linguistic task, at least 17 participants were literate and had some schooling with at least nine participants having completed high school (educational level and literacy skills could not be ascertained for two participants). Further, La Ventosa is a small but urban town, 20 min away from the large urban center of Juchitán de Zaragoza, with a variety of means of subsistence that range from small-scale commerce to vocational trades to professional careers and with farming and cattle raising no longer being the sole nor the primary means of subsistence for the community. Therefore, a dispreference for the relative FoR and the strong preference for the use of cardinal directions and the correlate absolute FoR cannot be the result of a confluence of rural life, low literacy and schooling. The causal relation between linguistic and non-linguistic FoR preferences requires further investigation, but some interesting facts can already be tagged as especially relevant to this question.

8. Conclusions and future research

The analysis presented here is the first published report from the research on spatial language and cognition conducted on Juchiteco in the context of the MesoSpace project. The data obtained show that FoR use among Juchiteco speakers in solving the tasks administered was predominantly intrinsic and allocentric as speakers relied on the object-centered, absolute and vertical FoRs almost exclusively. As such, Juchiteco contrasts with Yucatec speakers who frequently switch from one FoR to another even within single descriptions (Bohnemeyer, 2011). A clear dispreference for the relative FoR was attested in Juchiteco, as it was for Tseltal (Polian and Bohnemeyer, 2011), Tarascan (Capistrán Garza, 2011) and Otomí (Hernández-Green et al., 2011). In the context of the highly productive Juchiteco meronymic system, the dispreference for the relative FoR lends strong support for the MesoSpace hypothesis correlating these two linguistic features.

To segue from the previous section, future analysis of Juchiteco FoR preferences should focus on the alignment between linguistic and non-linguistic preferences, the factors that may be motivating this alignment and more interestingly, the direction of any identifiable influence. An important factor not yet explored is the increase in bilingualism rates across Mesoamerican communities. Bohnemeyer (2011) begin to explore the possible impact of an increase in Spanish proficiency in what appear to be increasing rates of use of the relative FoR among Tseltal speakers. The strongest contribution to come from

such analyses will be in the context of a comparative study across the data sets collected from the MesoSpace language sample.

Role of the funding source

This material is based upon work supported by the National Science Foundation under Grant No. (NSF BCS-0723694), entitled 'Spatial language and cognition in Mesoamerica' (PI J. Bohnemeyer). The analysis presented here is based on knowledge acquired in the course of my work as a researcher with the Project for the Documentation of the Languages of Mesoamerica, which has made it possible for me to conduct extensive linguistic elicitation since 2003 amounting to over six months of fieldwork.

Acknowledgement

I am grateful to the community of La Ventosa for welcoming me and assisting me with this research. I am especially indebted to Rosaura López Cartas, my collaborator and friend since 2004. I am grateful to Reyna Guadalupe López López and Edie López Robles for their work transcribing and translating a large portion of the data. Many thanks to all the consultants who agreed to participate in this research, and to my host in La Ventosa, Mrs. Velma Orozco. I also wish to thank my colleagues from the MesoSpace project for many hours of collaboration and valuable comments regarding my work, with special thanks to Carolyn O'Meara and Jürgen Bohnemeyer.

References

Anonymous, 1956. Alfabeto popular para la escritura del zapoteco del Istmo. Mexico City: La Sociedad Pro-Planeación Integral del Istmo, el Consejo de Lenguas Indígenas, and the Summer Institute of Linguistics.
Bohnemeyer, J., 2011. Spatial frames of reference in Yucatec: Referential promiscuity and task-specificity. Language Sciences 33 (6), 892–914.
Bohnemeyer, J., 2008. Elicitation task: frames of reference in discourse. In: Pérez Báez, G. (Ed.), MesoSpace: spatial language and cognition in Mesoamerica. 2008 Field Manual. Unpublished results, University at Buffalo – SUNY. pp. 34–37 <http://www.acsu.buffalo.edu/~jb77/MesoSpaceManual2008.pdf>.
Bohnemeyer, J., Stolz, C., 2006. Spatial reference in Yukatek Maya: a survey. In: Levinson, S.C., Wilkins, D.P. (Eds.), Grammars of Space. Cambridge University Press, Cambridge, pp. 273–310.
Brown, P., Levinson, S.C., 1993. 'Uphill' and 'downhill' in Tzeltal. Journal of Linguistic Anthropology 3 (1), 46–74.
Brown, P., Levinson, S.C., 2009. Language as mind tools: learning how to think through speaking. In: Guo, J., Lieven, E.V.M., Budwig, N., Ervin-Tripp, S., Nakamura, K., Ozcaliskan, S. (Eds.), Crosslinguistic Approaches to the Psychology of Language. Taylor & Francis Group, New York/London, pp. 451–463.
Brugman, C., 1983. The use of body-part terms as locatives in Chalcatongo Mixtec. Survey of California and Other Indian Languages 4, 239–290.
Brugman, C., Macaulay, M., 1986. Interacting semantic systems: Mixtec expressions of location. In: Nikiforidou, V., VanClay, M., Niepkuj, M., Feder, D. (Eds.), Proceedings of the 12th Annual Meeting of the Berkeley Linguistic Society. Berkeley Linguistics Society, Berkeley, pp. 315–327.
Campbell, L., Kauffman, T., Smith-Stark, T.C., 1986. Meso-America as a linguistic area. Language 62 (3), 530–570.
Capistrán Garza, A., 2011. Locative and orientation descriptions in Tarascan: topological relations and frames of reference. Language Sciences 33 (6), 1006–1024.
Casad, E.H., 1982. Cora locationals and structured imagery. Ph.D. dissertation, University of California, San Diego.
Clark, H., 1973. Space, time, semantics and the child. Cognitive development and the acquisition of language. In: Moore, T.E. (Ed.). Academic Press, New York, pp. 27–63.
Cordoua, I., 1578. Arte en lengva zapoteca. Casa de Pedro Balli, Mexico. 1886 re-edition by Nicolás León as Arte del idioma zapoteco de Juan de Córdova. Morelia: Imprenta del Gobierno en la Escuela de Artes. 1987 reprinted facsimile of the latter entitled Arte del idioma zapoteco. Mexico: Ediciones Toledo e INAH.
Danziger, E., 1996. Parts and their counter-parts: social and spatial relationships in Mopan Maya. The Journal of the Royal Anthropological Institute 2 (1), 67–82.
Danziger, E., 2010. Deixis, gesture, and cognition in spatial frame of reference typology. Studies in Language 34 (1), 167–185.
Friedrich, P., 1969. On the meaning of the tarascan suffixes of space. IJAL Memoir, 23.
Friedrich, P., 1970. Shape in grammar. Language 46 (2), 379–407.
Friedrich, P., 1971. The Tarascan suffixes of locative space. Language Science Monographs, vol. 9. Indiana University, Bloomington.
Goldap, C., 1992. Morphology and semantics of Yucatec space relators. In: de León, L., Levinson, S.C. (Eds.), Spatial description in Mesoamerican languages. Special issue of Zeitschrift für Phonetik, vol. 45. Sprachwissenschaft und Kommunikationsforschung, pp. 612–625.
Hernández-Green, N., Palancar, E.L., Hernández-Gómez, S., 2011. The Spanish loanword lado in Otomi spatial descriptions. Language Sciences 33 (6), 961–980.
Hollenbach, B.E., 1987. Semantic and syntactic extensions of body-part terms in Mixtecan. In: Paper presented at the 86th Annual Meeting of the American Anthropological Association, XXVIth Conference on American Indian Languages. Otomanguean, Chicago.
Hollenbach, B.E., 1988. Semantic and syntactic extensions of Copala Trique body-part nouns. Homenaje a Jorge Suarez. México, Colegio de México, México.
Instituto Nacional de Estadística, Geografía e Informática (INEGI). 2005. II Conteo de Población y Vivienda. Mexico. Online version at <www.inegi.org.mx>.
Levinson, S.C., 1994. Vision, shape, and linguistic description: Tzeltal body-part terminology and object description. In: Levinson, S.C., Haviland, J.B. (Eds.), Space in Mayan languages. Special issue of Linguistics, vol. 32, pp. 791–856.
Levinson, S.C., 1996. Frames of reference and Molyneux's question: crosslinguistic evidence. In: Bloom, P., Peterson, M.A., Nadel, L., Garrett, M.F. (Eds.), Language and Space. MIT Press, Cambridge, MA, pp. 109–169.
Levinson, S.C., 2003. Space in Language and Cognition. Cambridge University Press, Cambridge.
Levy, P., 1999. From 'part' to 'shape': Incorporation in Totonac and the issue of classification by verbs. International Journal of American Linguistics 65 (2), 127–175.
Levy, P., 2006. Los sustantivos relacionales en el totonaco de Papantla [Relational nouns in Papantla Totonac]. Paper presented at the IX Encuentro Internacional de Lingüistica en el Noroeste, Sonora, Mexico.
Lewis, M.P. (Ed.), 2009. Ethnologue: Languages of the World, Sixteenth ed. SIL International, Dallas <http://www.ethnologue.com>.
Li, P., Gleitman, L., 2002. Turning the tables: language and spatial reasoning. Cognition 83, 265–294.
Lillehaugen, B., 2006. Expressing Location in Tlacolula Valley Zapotec. PhD dissertation, University of California, Los Angeles.
Lyons, J., 1977. Semantics, vol. 2. Cambridge University Press, Cambridge.
Majid, A., Bowerman, M., Kita, S., Haun, D.B.M., Levinson, S.C., 2004. Can language restructure cognition? The case for space. Trends in Cognitive Sciences 8 (3), 108–114.

MacLaury, R.E., 1989. Zapotec body-part locatives: prototypes and metaphoric extensions. International Journal of American Linguistics 55 (2), 119–154.
Miller, G., Johnson-Laird, P., 1976. Language and Perception. Cambridge University Press, Cambridge.
O'Meara, C., Pérez Báez, G., 2011. Spatial frames of reference in Mesoamerican languages. Language Sciences 33 (6), 837–852.
Pederson, E., Danziger, E., Wilkins, D., Levinson, S.C., Kita, S., Senft, G., 1998. Semantic typology and spatial conceptualization. Language 74, 557–589.
Pérez Báez, G., in press. Semantics of body part terms in Juchiteco locative descriptions. In: Sonnenschein, A.H., Lillehaugen, B.L. (Eds.), Expressing location in Zapotec. LINCOM, Munich.
Pérez Báez, G., 2010. El sistema de merónimos en el zapoteco del istmo. Paper presented at the XI Encuentro Internacional de Lingüística en el Noroeste. November 17–19, 2010. Universidad de Sonora, Hermosillo, México.
Polian, G., Bohnemeyer, J., 2011. Uniformity and variation in Tseltal reference frame use. Language Sciences 33 (6), 868–891.
Pickett, V., and collaborators, 1988. Vocabulario Zapoteco del Istmo. Summer Institute of Linguistics, Mexico City, Mexico.
Pickett, V., Black, C., Marcial Cerqueda, V., 1998. Gramática popular del zapoteco de istmo, Second ed. Summer Institute of Linguistics, Tucson, AZ and Centro de Investigación y Desarrollo Binnizá, A.C., Juchitán, Oaxaca, Mexico.
Serrano Carreto, E., Gámez Montes, V., Maldonado Salazar, I., Bello Jiménez, E., Velázquez Rosendo, B., Ayala, M., García Vidales, L., Ramírez Martínez, B., Salas Serrato, J.A., 2006. Regiones Indígenas de México. Comisión Nacional para el Desarrollo de los Pueblos Indígenas. México City, México.
Smith-Stark, T.C., 2003. Algunas isoglosas zapotecas. In: Proceedings of the III Coloquio Internacional de Lingüística Mauricio Swadesh. Instituto de Investigaciones Antropológicas. UNAM, Mexico.
Stross, B., 1976. Tzeltal anatomical terminology: semantic processes. In: McClaran, M. (Ed.), Mayan Linguistics, vol. 1. American Indian Studies Center, University of California, Los Angeles.
Talmy, L., 2000. Toward a Cognitive Semantics, vol. I. The MIT Press, Cambridge, MA.