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Spatial frames of reference in Sumu-Mayangna

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ABSTRACT

A linguistic spatial task, conducted with five dyads of Sumu-Mayangna speakers, provides evidence that while speakers have diffuse access to spatial Frames of Reference (FoRs), the direct was most preferred. Further, the absolute FoR is found to be restricted to the lateral/east–west axis, with older generations displaying a greater proportion of use than younger ones. In addition, the possible exploitation of a meronymy system is discussed. A nonlinguistic spatial memory task indicates a bias toward an absolute solution type, and this partly mirrors observed trends in the linguistic task, providing some evidence for alignment between language and cognition.

1. Introduction: Spatial Frames of Reference

This paper provides an analysis of the preferred spatial Frames of Reference (FoRs) classes used by speakers of Sumu-Mayangna, and adopts the spatial FoR classification proposed by Bohnemeyer (2008) and outlined by O'Meara and Pérez-Báez (2011b). Spatial FoRs are manifested by the angular relationships between objects in space, wherein a figure object is located with respect to some ground object. However, the ways in which speakers can preferentially organize space can be conceptually different from one language to another, in part due to crosslinguistic variation in the kinds of available linguistic resources (Levinson, 1996; Bohnemeyer and Stolz, 2006; Levinson and Wilkins, 2006; Bohnemeyer, 2008). A language's set of linguistic resources makes particular FoRs possible, and a speaker may then choose among this set of possibilities to describe a spatial array. If a particular set of linguistic resources is not present in a language, then speakers cannot use them (obviously) and this may impact the spatial frames of reference available to them. Guugu Yimithirr is just such a case where a 'left' and 'right' distinction is not present in the language and the absence of this resource has direct consequence on the spatial strategies preferred by its speakers (Levinson, 1997). This results in the restriction of speakers' access to the relative spatial FoR, at least in comparison to speakers of a language that does make use of left and right terms (Levinson, 1997).

Abbreviations: ADV, adverbial; ASP, aspectual; AUX_{CL}, auxiliary classifer; CONJ, conjunctor; CS, construct state; DET, determiner; DIM, diminutive; DISJ, disjunctor; FOR, frame of reference; FUT, future; INCL, inclusive; IND, indefinite; INF, infinitive; LOC, locative; N, noun; $-NA_{STAT}$, stative verb form; MA, Mesoamerican; P, postposition; PL, plural marker; POSS, possessive; PP, postpositional phrase; PTC, particle; RES, resultative; RN, relational noun; S, singular; UNSP, unspecified; V, verb.

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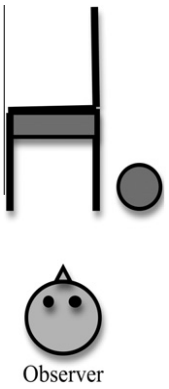

Fig. 1. Relative FoR.

We can formally distinguish spatial FoR classes on the basis of three elements: figure, ground, and anchor. The 'figure' is defined as a "moving or conceptually movable entity whose site, path, or orientation is conceived as a variable by the particular value of which is the relevant issue" (Talmy, 2000, p. 312). 'Ground' is used here as a "reference entity, one that has a stationary setting relative to a frame, with respect to which, the figure's site, path, or orientation is characterized" (Talmy, 2000, p. 312). The anchor is the origin of the search domain, and from which the vector, moving from ground to figure, is calculated (Danziger, 2010). On the basis of the figure, ground, and anchor entities, and their relationships with each other, we can logically distinguish the three-way classification of FoRs identified by Levinson (1996, 2003) as well as the expanded, more fine grained classification of those FoRs used for this study (see Section 1.2). First, let us discuss the three-way FoR distinction of relative, intrinsic, and absolute proposed by Levinson, as it forms the basis for the more finely-grained FoR classes discussed in Section 1.2.

For the relative FoR, the speaker anchors the frame, and his or her perspective forms the egocentric axes which are projected onto the ground object. Meanwhile, the figure is some other external entity and is located with respect to the ground object *vis à vis* the anchor. Since the anchor of this FoR is the speaker, the truth-value of the FoR is dependent upon the orientation of the speaker. In describing a physically real figure-ground array, we can say (see Fig. 1):

(1) The ball is to the right of the chair

Here, the speaker anchors the frame, as the origin of the vector that determines the search domain begins with her. The figure is the ball, the ground is the chair, as it is the reference entity by which the figure object can be located. Moving to the object-centered intrinsic FoR, the same three elements of anchor, figure, and ground are definitional, though their relationship with each other is different. Here, the anchor is the ground, which is some external entity and different from the speaker. The search domain of the anchor originates in the ground object and projects outward. The figure object is located within the search domain projected from the anchor/ground object. Notice that here the anchor and ground identify the same entity. If we say (see Fig. 2):

(2) The ball is at the back of the chair

and the ball is understood to be at the part of the chair that is the 'back', then the figure is the ball, the ground is the chair, and the anchor is also the chair. Moving to the absolute FoR, this again is defined by the same three elements of figure, ground, and anchor. The absolute FoR is manifested by the projection of some environmental gradient onto the

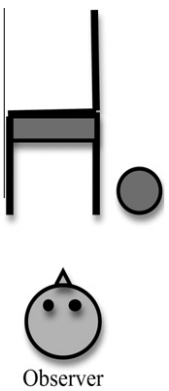

Fig. 2. Intrinsic FoR.

figure-ground array. This environmental gradient projection serves as the anchor by which the figure object can be located *vis à vis* the ground. Notice that the figure, anchor, and ground all identify distinct entities, in contrast with the object-centered intrinsic FoR defined above. Additionally, if we say (see Fig. 3):

(3) The ball is north of the chair

then, here, the anchor is the abstract system of cardinal directions which is projected onto the figure-ground array. The figure-ground array, in turn, is manifested by the ball and chair, respectively.

Substantial crosslinguistic evidence exists that some languages prefer one of the aforementioned three FoR types over the other. In a few cases, more than one of the three FoRs are preferred. The robust, crosslinguistic studies show that the Indo-European languages of English, Dutch, German, as well as the isolate Japanese all prefer the relative frame of reference with some secondary use of the intrinsic. Meanwhile, the absolute frame of reference does not appear to be available to speakers of these languages for use in table-top space (Pederson et al., 1998; Majid et al., 2004). Contrastively, speakers of the Australian language Guugu Yimithirr (Pama Nyungan) prefer the absolute FoR to the exclusion of both relative and intrinsic FoRs, while Tseltal (Mayan) and Warwa (Nyulnyulan) speakers have been reported to prefer the absolute FoR with a secondary alternative use of the intrinsic (Pederson et al., 1998; Majid et al., 2004). The relative FoR is reported to not be available to speakers of Tseltal and Warwa in table-top space, (though see Polian and Bohnemeyer, 2011, for another take on the use of relative in Tseltal populations).

In addition to crosslinguistic evidence suggesting that speakers of particular languages can prefer a particular FoR to the exclusion of others, there is also substantial crosslinguistic evidence that speakers of a particular language employ the same spatial references to solve linguistic tasks as they do for nonlinguistic tasks (Carlson-Radvansky and Irwin, 1993; Levinson, 1996; Pederson et al., 1998; Wassmann and Dasen, 1998; Levinson, 2002, 2003; Majid et al., 2004). A correspondence of spatial reference use between simultaneous speech (linguistic use) and gesture (nonlinguistic use) has also been found in several studies (McNeill, 1992; Haviland, 1993; Levinson, 2003; Danziger, 2010). These studies point to the growing body of literature devoted to identifying the possible correlation between the way space is described linguistically by speakers, and the way space is navigated nonlinguistically by speakers. As these studies have shown, the alignment of both linguistic and nonlinguistic performance suggests that the language one speaks may shape perception, memory, reasoning, i.e., cognition.

Majid and colleagues identified another candidate that could have an effect on nonlinguistic thought: environment. Do speakers who live in industrial societies disprefer the absolute FoR, in comparison to speakers of hunter-gatherer communities? Or, is it the case that the more insular, and geographically cohesive a community of speakers is, the more they will prefer absolute FoR use (cf. Li and Gleitman, 2002)? Environment, though, is a problematic and ill-defined term. It could refer to ecological environments (i.e. climate and vegetation type), it could refer to topological topographic distinctions (e.g., mountainous, coastal or riverine) or it could refer to a region's density of inhabitants and degree of infrastructure (e.g. rural vs. urban). In attempting to find a correlation between a language, its preferred FoR, and possible 'environmental' factors, Majid and colleagues compared 20 languages from multiple continents. They compared the language and its preferred FoR to (i) its ecological/climatic environment (e.g., subtropical, tropical, temperate), (ii) the dwelling type of its speakers (urban or rural), and (iii) the mode of subsistence of its speakers (e.g., hunter-gatherer, stable agriculture, industrial) (2004). None of those types

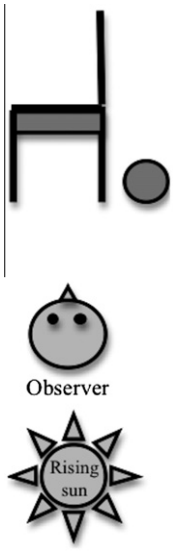

Fig. 3. Absolute FoR.

of environmental factors were found to be a determining factor in spatial FoR preference, though there was an association found between speakers who lived in an urban dwelling and the preferred use of a relative FoR (Majid et al., 2004, p. 112).

There remains skepticism toward the position that language can shape spatial cognition, as well as toward the apparent non-effect of environment in determining FoR preferences for a language. Li and Gleitman (2002) claimed that there were testing confounds present in previous spatial reference studies that feature nonlinguistic tasks. After reproducing a variety of nonlinguistic tasks with a population of undergraduate students from a university in the US, Li and Gleitman found that, by altering the testing environment, (i) the specific environmental cues of the nonlinguistic tasks can provoke speakers to choose a particular spatial FoR (2002, p. 287), and (ii) since speakers who live in a mutually familiar area must use mutually-agreed upon spatial references, then the ambient environment also influences speakers' spatial reference choices (2002, pp. 289–290). Following Li and Gleitman's argument, it seems clear that speakers are free to choose spatial FoR strategies that 'best fit' the spatial array they are describing. The 'best fit' model, however, contains two restrictions: first, that the linguistic resources made available by the language allow for the expression of a particular FoR, and second, that in discursive contexts, speakers choose descriptive strategies (i.e. spatial FoRs) that are mutually understood and accepted within the language community. This last point seems fairly obvious, but it is important to separate the capacity for producing a particular FoR, and its functional value as an accepted means of spatial description within the language community. For example, in English, it is possible to say: 'The glass is on the south side of the table'. English contains the requisite linguistic resources to express the absolute FoR in table-top space, by means of a lexicon for the cardinal directions and a prepositional phrase structure used for the expression of location. But most members of the English language community would have no idea where the glass is located on the table if one described its location this way, as cardinal directions are not used in local, personal space. We can infer from this that the absolute is not a viable spatial FoR for description at a manipulable, local scale for English, and indeed this has been found to be the case in experimental studies, as well (cf. Majid et al., 2004).

Following this line, it also does not appear to be enough to merely share 'a mutually-familiar space', as a recent experimental spatial cognition study with signers of Nicaraguan Sign Language (NSL) found no evidence that a mutually-shared space or a mutual culture supported commonalities in spatial cognition (Pyers et al., 2010). On the contrary, in testing two cohorts of native NSL signers, one cohort who learned the language while NSL was still in its infancy and developing, and the second cohort who learned it when it was fully developed, it was found that the second cohort consistently outperformed the other cohort both after experiencing disorientation and during rotational tasks. This suggests that the type and quality of linguistic resources available may be the most salient causal factor in determining a speaker's spatial FoR selection, as well as providing critical support for spatial cognition, in general.

1.1. Spatial frames of reference used for this study

This study, *Spatial language and cognition in Mesoamerica*, also known as MesoSpace, provided an opportunity to apply a more fine-grained FoR classification. This has resulted in the use of four additional FoR classes: landmark-based, geomorphic, vertical, and direct. To define these more fine-grained distinctions, the use of 'anchor', 'figure', and 'ground' are, as before, the critical elements in indentifying a particular spatial FoR. In addition, given that this study is part of a larger, collaborative effort,[2] it is especially important that the data be coded in ways that are equivalent and transparent so as to encourage cross-linguistic comparison. Meanwhile, the notion that more fine-grained distinctions are helpful in this regard has already been suggested in the literature,[3] however the MesoSpace study, at large, represents the first formal, crosslinguistic effort to apply these fine-grained distinctions systematically across a large body of data. For more on the motivations for the FoR classifications used here, see O'Meara and Pérez-Báez (2011b), as well as Bohnemeyer, (2011).

Let us begin with a discussion of the fine-grained FoR class distinctions employed by this study. The landmark-based and geomorphic FoR classes have a commonality in that the anchor cannot also serve as the ground. In the landmark-based FoR class, an *ad hoc* entity can serve as an anchor and is also the target at which the vector (s) of the frame are directed. The figure object is then located with respect to this search domain. Recall that vectors serve to define the search space in a spatial FoR, and as such it is important to identify their origin and their destination. In the landmark-based case, one can say,

(4) The ball is toward the courthouse from the chair

Here, the figure is the ball, the chair is the ground and the courthouse serves as an anchor toward which the vectors of the frame point. The facing direction of the anchor (i.e. courthouse) is of no consequence. In contrast, the orientation of the anchor is of consequence in the geomorphic case. The geomorphic FoR class requires that some external entity in the environment which has an inherent, directional axis or gradient serves as the anchor (e.g., a river, or a mountain). These axes are then projected onto the ground. The veracity of propositions of this type is assessed on the basis of the orientation or cline of the anchor, not on its location. An example of the geomorphic FoR class:

[2] As outlined in O'Meara and Pérez-Báez (2011b), Sumu-Mayangna is one of the control languages used for the MesoSpace collaborative research group.

[3] In his response to Li and Gleitman (2002), Levinson notes that a conflation of absolute and landmark FoR classes resulted in a flawed analysis of their data (cf. Levinson, 2002). Other controversial FoR analyses exist elsewhere in the literature as well, as Polian and Bohnemeyer (2011), have reported with regard to Li et al. (2005). The MesoSpace researchers are using these more fine-grained FoR class distinctions in order to provide a coding protocol that is as transparent as possible so as to better provide a means of crosslinguistic comparison.

(5) The ball is on the downhill side of the chair

In addition, the vertical FoR class was used to classify instances where the Earth's gravitational field provided the anchor component in a spatial expression. The vertical FoR class could be subsumed under the absolute, as it employs a projected abstraction of the earth's gravitational field as its anchor. However despite the similarity in anchoring, the vertical, unlike the absolute, appears to be accessible to all languages in a way not reflected by languages that use the non-vertical absolute. Using more fine-grained distinctions allows the researchers to code separately the non-vertical absolute which is typologically significant, from instances of vertical use. An example of the vertical is below.

(6) The ball is above the chair

In applying the direct FoR class, we adopted a version that includes instantiations of the type first proposed by Danziger (2010). In more coarsely-grained classifications, this FoR class has been collapsed with the intrinsic FoR, and in other instances was classified as a kind of egocentric use (cf. O'Meara and Pérez-Báez, 2011b). As the more finely-grained definition is applied in the classification used in this study, the direct FoRs, like relative FoRs, are anchored to the body of the speaker or addressee, however unlike the relative FoR, the direct does not involve a projection of the speaker's body axes onto an external ground. Crucially, the direction of the vector is reversed from that of the relative FoR, and points toward the anchor rather than away from it, as in (7):

(7) The chair is in front of me

Notice that in (7), the speaker's body functions as both anchor and ground in identifying the figure object. In (8), the speaker is again the anchor, but there may be an external ground distinct from the speaker from which the tail of the vector originates, in this case, the chair. In cases like (8) the external ground may be omitted in discourse, but the reading still entails that the tail of the vector must originate from somewhere. Examples like (8) present a distinct challenge for data coding, nevertheless we include this example to illustrate possible applications of the direct FoR.

(8) The ball is toward me (from the chair)

In orientation descriptions, we find the same logic identified in (7). In (9), the speaker is the anchor, and the facing direction of the chair is identified by a vector which points toward the speaker.

(9) The chair is facing me

The MesoSpace FoR classes can also be viewed both in terms of the Levinsonian three-way distinction (Levinson, 1996, 2003) and the three-way referent-based distinction made in the psychology literature (Wassmann and Dasen, 1998; Li and Gleitman, 2002). For the linguistics literature, the intrinsic FoR is an umbrella for the following FoR subclass types: direct, object-centered intrinsic, geomorphic, and landmark-based. The relative and absolute FoR classes form distinct categories, respectively, from the intrinsic. In contrast, the psychology literature uses the egocentric category to subsume relative and direct FoRs, wherein the frame is anchored to the observer. The psychology literature additionally uses the geocentric category to group together the geomorphic, landmark-based, and absolute FoR classes, while the intrinsic category is used when the frame is anchored to the ground object.

In addition, spatial expressions that required no particular perspective to maintain their validity were coded as topological. A topological spatial expression is characterized by not requiring an FoR to be interpreted. Nevertheless, these items were coded in the data. An example of a topological relation follows:

(10) The ball is on the chair

As a brief explanation of the organization of the remainder of this article, Section 2 provides an overview of the linguistic and cultural context in which Sumu-Mayangna is spoken, its speakers, and its structural profile. In Section 3, we discuss the methods, both qualitative and experimental of this project in general, while outlining the protocol followed for each task. Section 4 summarizes the findings of the experimental tasks, focusing on how each FoR is realized in the results of the linguistic task, as well as the results of the nonlinguistic spatial array task. In Section 5, the results are evaluated, and Section 6 concludes.

2. Sumu-Mayangna and its speakers

2.1. Linguistic context

Sumu-Mayangna is a member of the endangered family, Misumalpan, which also includes Sumu-Ulwa (or Southern Sumu), Miskitu, and Matagalpan (now with no documented speakers) (Campbell, 1997). Sumu-Mayangna (or Northern

Fig. 4. Map of Sumu-Mayangna territory.

Sumu) communities are mostly located in the North Atlantic Autonomous Region of Nicaragua (RAAN) and they comprise two varieties: Tuahka and Panamahka. Both varieties are represented in the data for this study. Just beyond the northern border, in Honduras, there are communities of another variety, Tawahka. The location of the Sumu-Mayangna varieties is shown in Fig. 4. Ethnologue[4] reports a total population of 6700 speakers in Nicaragua as of 1982, though other accounts indicate 10–12,000 speakers. Many Sumu-Mayangna speakers are bi- or trilingual, with varying proficiencies in Miskitu – the dominant indigenous language in the area, as well as Nicaraguan-Spanish (Indo-European: Romance), the colonial language.

Bilingual education programs for the indigenous communities were established in the 1980s in the RAAN, where both varieties, Panamahka and Tuahka, are present, with the former being the dominant variety. As educational materials were developed, they were designed on the basis of the dominant variety alone. Therefore, Sumu-Mayangna children were only partially accommodated, since the materials excluded the Tuahka variety. Though the two varieties are mutually intelligible, the minority It should be noted that education in the first language only proceeds until high school, where students are then taught in Spanish.

The language of higher learning continues to be Spanish, in most cases. One important exception to this has been the formation of the Mayangna Yulbarangyang Balna, a group of linguists who are also native speakers of Sumu-Mayangna. The Mayangna Yulbarangyang Balna was created more than a decade ago from students studying linguistics at the Universidad de las Regiones Autonomas de la Costa Caribe Nicaragüense (URACCAN). Since then, some of these linguists have gone onto pursue graduate work in linguistics, anthropology, and education, meanwhile remaining dedicated to producing Sumu-Mayangna materials (e.g., dictionaries, folk stories, etc.), written in Sumu-Mayangna for the Sumu-Mayangna communities.

2.2. Structural profile

Shifting now to its grammatical structure, Sumu-Mayangna displays SOV word order, nominative-accusative alignment, and is a well-behaved head-final language, i.e. all phrasal types are head-final (Benedicto and Hale, 2000). The verbal inflection system marks for both person and tense, using seven person morphemes, with a distinction between first person plural

[4] Lewis (2009), cited here from the online edition http://www.ethnologue.com/show_language.asp?code=sum (20 July 2010).

inclusive and exclusive. There is no copula in present tense, however existential and locative constructions require an auxiliary classifier. Auxiliary classifiers identify dispositional-like properties of the subject, i.e. hanging, lying flat, standing upright (cf. Benedicto, 2002), and their use thus features prominently in most expressions of spatial reference. Elsewhere the auxiliary classifier paradigm has been called 'stative verb' (cf. Norwood, 1997), but formally they cannot be considered verbs, as they do not inflect as verbs proper, but as non-verbal predicates (Benedicto, 2002). The set of auxiliary classifiers includes seven items (*sak, lik, tus, pak, wit*) with their corresponding dual and plural forms. Examples (11) and (12) show two auxiliary classifiers in spatial constructions, *sak* and *wit*.[5]

(11)

kung-ni	*yak*	***sak***	***ki***
lip.N-CS	P	sak.AUX$_{CLS}$	PTC:3S

'[The ball] is at the edge [of the chair]'
Lit: The ball is at the lip of the chair
(T1_AM 3:06-3:08)

(12)

wara	*bal-ni*	*kidik*	*tingpal*	*sait*
now.DM	ball.N-CS	DET	right.hand	sait
kauh	*mâyak*	***wit***	***ki***	
P	ADV	wit.AUX$_{CL}$	PTC:3S	

'Now, the ball is hanging up (in the air) toward the right hand side.'
(T2_AM 1:00-1:03)

The Sumu-Mayangna adjectival system inflects for number, and this inflection is manifested as a partial reduplication of the prominent mora of the prosodic foot of the root (*salani* [sg] 'fat' – *salalani* [pl]). The nominal paradigm inflects for person and number of the possessor using the 7-person system described for the verbal paradigm. Nominal inflection is accomplished through affixation, and the location of the affix on the head noun is also determined by the prosodic structure of the word, appearing after the first foot. If the first syllable is heavy, it constitutes a foot, and therefore the affix will appear immediately after it; if it is light, the affix will follow the second syllable. An example follows:

(13)

	û – 'house'	*wakisa* – 'banana'
1 s.	û***ki*** 'my house'	*waki-**ki**-sa* 'my banana'
2 s.	û***ma*** 'your house'	*waki-**ma**-sa* 'your banana'
3 s.	û***ni*** 'her, his house'	*waki- **ni**-sa* 'her, his banana'

Mayangna also has a set of relational nouns (RNs) (Norwood, 1997), though previous literature (cf. Campbell et al., 1986, p. 546) had indicated that the Misumalpan relational noun construction did not exist. Like the languages in the Mesoamerican (MA) *sprachbund* to the north, Sumu-Mayangna has relational nouns (RNs), which express locative information. In addition to the auxiliary classifiers, they also constitute a central component of spatial constructions. Some of these relational nouns are morphologically related to body-part nouns, with the addition of a final *–t* (in line with the morphological structure of the other relational nouns). A comparison table can be seen below in Fig. 5.

The most commonly used relational nouns include: *dinit* 'under', *minit* 'on top of', *dangnit* 'behind', *tanit* 'ahead of', *usnit* 'behind' but possibly at some distance away, *yaihnit* 'close to', *muhnit* 'in front of'. Morphologically, relational nouns in Sumu-Mayangna are composed of a mostly phonologically defective root and a possessive pronominal infix. Examples (14)–(16) show the singular inflection of relational nouns.

(14)

mi-ki-t	*ma-ma-t*	*mi-ni-t*
above.RN:1S	above.RN:2S	above.RN:3S
'above me' (*-ki-* 'my')	'above you' (*-ma-* 'your')	'above him' (*-ni-* 'his')

(15)

muh-ki-t	*muh-ma-t*	*muh-ni-t*
face.RN:1S	face:RN:2S	face.RN:3S
'in front of me'	'in front of you'	'in front of him'

[5] A note on glossing: throughout this article the auxiliary classifiers are not glossed with English lexical items as their meaning is not always strictly mapable to an English counterpart. This policy respects the conceptual integrity of the auxiliary classifier concept and also does not mislead readers. Additionally sait is glossed throughout as sait, because although it is derived from an English loan word (cf. Eggleston et al., 2010), it appears to identify a more concrete facet of an object than would necessarily be identified by the English word side.

Meaning	Nominal form (construct state)	Nominal meaning	Relational noun form (3rd Singular)	Relational noun meaning
'back'	*dang-ni*	'her/his back'	*dang-ni-t*	'behind her/him'
'face'	*muh-ni*	'her/his face'	*muh-ni-t*	'in front of her/him'

Fig. 5. Comparison of nominal and relational noun forms.

(16) *dang-ki-t* *dang-ma-t* *dang-ni-t*
back.RN:1S back.RN:2S back.RN:3S
'behind me' 'behind you' 'behind him'

In the cases of a defective root (as in (14) *mahmat*, above), the vowel of the affix is copied onto the vowel slot of the preceding syllable of the root (Viñas de Puig, 2008). Additionally, Sumu-Mayangna RNs frequently occur with a postposition, as in (17).

(17) û ***mi-ni-t*** ***yak*** *dî lawan* *as* *sak* *dai*
house.N above.RN:3S P bird.N DET AUX_{CL} ASP
'There is a bird above the house.'

3. Methods

The qualitative and experimental methods used in this study were integrated in such a way as to ensure that the linguistic data was both collected and analyzed in an appropriate way. The qualitative methods used ensure that the codification and interpretation of the data reflects the appropriate sense and intention of the speakers. The experimental methods described here are drawn from both the manual of MesoSpace tasks (Bohnemeyer, 2008) and the manner in which the tasks were conducted while under real field conditions.

3.1. Qualitative method: Participatory Action Research (PAR)

The research for this project was conducted under a Participatory Action Research (PAR) approach. Participatory Action Research (PAR) promotes an egalitarian relationship between the researcher and the language community, and has been supported by anthropologists, language activists, and linguists alike (Deloria, 1969; Hinton and Hale, 2001; Rice, 2004). PAR is a process by which the internal researchers and external researchers are both recognized as having equally valuable kinds of knowledge, though their knowledge domains may differ. Benedicto and Mayangna Yulbarangyang Balna (2007) describe the creation of this process as being one that shifts the community from being an 'object of research' to being an 'agent' equal in its role to the external researcher as 'agent', where both are equally involved in the collaborative process of creating knowledge. Eventually, through the collaborative research process, the members of the community are equal in every sense to the outside researcher, in terms of formal training, theoretical work, familiarity with technology, etc., and they additionally have (the superior) access to their native speaker intuitions and knowledge of the culture. In their approach, Benedicto and Mayangna Yulbarangyang Balna (2007) propose three implementation mechanisms for PAR: (i) joint decision-making on the part of both external researchers and community (internal) researchers; (ii) a continuous training program for the internal researchers; and (iii) a continuous process of self-evaluation. The first mechanism must be maintained throughout the project, from beginning to end, with internally-generated research projects being the norm. In the case of externally generated research projects, as with this study, internal researchers should in the beginning decide whether they even want to proceed with it, and if so, what materials they would like to obtain from the project. In the case of internally-generated research projects, this step is predetermined by the community, therefore it remains a vital first step for an externally-originating research initiative. The second component involves the continued transfer of technical and linguistic training of *both* the external and internal researchers, whereby both groups train each other in the knowledge resources each has. This was accomplished through extensive training with and alongside the community (internal) linguists prior to this particular project, but it also extended throughout the duration of the project. This allowed for both the external linguists and the internal Sumu-Mayangna linguists to become more familiar and adept at using digital video cameras, ELAN linguistic software, and the procedures for data collection and storage. Through the collaborative training process with the internal Sumu-Mayangna linguists, the external linguists participated in the same learning process as the internal linguists, especially in terms of acquiring media and data management skills. In addition, the internal linguists participated in the linguistic, cultural, and social training of the outsider linguists. The, third component, 'self-evaluation', is an important one for both the internal and external researchers. At every phase of the project, the internal researchers should be actively involved in assessing the progress of the project, its viability, and worth. And, at each of these junctures, their assessments should inform the continued status of the project as well as the research outcomes. These assessments should

manifest as an elaborated exchange between the internal and external researchers until all agree on the best course with which to proceed with the agreed-upon project. Additionally, the external linguists need to assess their own performance as project collaborators as well as if there were opportunities to share a larger portion of the research responsibility with their collaborators, and to identify a method of encouraging that outcome.

The priorities of a PAR approach entail that both the interpretation of the data and even the conclusions that fall from that, be confirmed and discussed with the speakers of the language community. In addition, the project or its results must have some functional value or use for the community, as determined by the community itself. These goals serve to ensure that, first, there is a collaborative conversation on the nature and results of the experimental tasks between both the external and internal researchers. Second, a PAR approach ensures that the interpretation of the language data on the part of the external researchers is correct, and in addition, the interpretation of the data can be enriched by native speaker intuitions and insights.

3.2. Experimental methods

The research reported here was conducted in the summer and fall of 2008 in the Las Minas area of the RAAN of Nicaragua for the MesoSpace project. The tasks were conducted jointly with the Mayangna Yulbarangyang Balna.

3.2.1. Ball & Chair task

The Ball & Chair (B&C) task (Bohnemeyer, 2008) is a linguistic task designed to elicit spatial FoR preferences. It is a linguistic matching game, wherein two participants sit side by side with a screen or some barrier between them preventing them from sharing visual cues with each other, like hand gestures. The participants match four sets of twelve photos, each containing only a chair and a ball in some configuration. The task procedure was as follows: The tables where the participants sat were aligned along the east/west axis. One participant was designated the leader/director,[6] and the other, the matcher. An identical but unordered array of twelve photos was provided to both the leader/director and the matcher, and the leader/director was also given 12 coins. The leader/director chose a photo, whichever one s/he desired, and proceeded to describe it in a way that the matcher could distinguish it from the others in the same set. The leader/director and matcher negotiated back and forth particular details about the orientation and position of the ball and chair in the chosen photo. When the leader and matcher thought they both had a match, the matcher would show the card to the leader, and then to the experimenter who would confirm the match. The leader then placed one of her coins over the photo to mark it as 'already matched' and so, to not be used again. However, the matcher was not permitted to mark matches in any way, but was required to return the photo back to the array. The participants switched roles after each of the four sets of twelve photos, so each was the leader twice during the task. Fig. 6 below shows the task set-up.

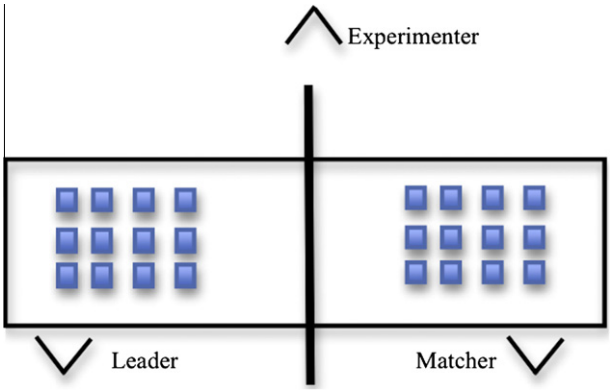

Fig. 6. Ball & Chair task set-up.

Some details regarding the task design: each set of photos is designed contrastively, i.e. each photo is selected purposefully for each set on the basis of some distinguishing arrangement of the ball and chair, with regard to their position and orientation relative to each other. There are four sets of twelve photos, and each set was designed to induce participants to make their explanation of the ball and chair configuration explicit, so as to distinguish between two or more photos in the same set. The sets must be given to the participants in the order that they were designed, but the order of the individual photos in each set was not predetermined. In addition, the requirement that the matcher does not mark matches in anyway, but returns each photo to the array, was intentional.

All instances of the B&C task were video-recorded, and from those video-recordings we had both video files with sound, and sound files alone. The media files for the B&C tasks were subsequently imported into ELAN, transcribed and translated by the Mayangna Yulbarangyang Balna. They were then coded by the first two authors with additional input and clarification

[6] While it is common for this participant role to be termed 'director' in the literature, we use 'leader' here in our description of the experimental methodology, as this term is closest to the way in which the task was explained to participants.

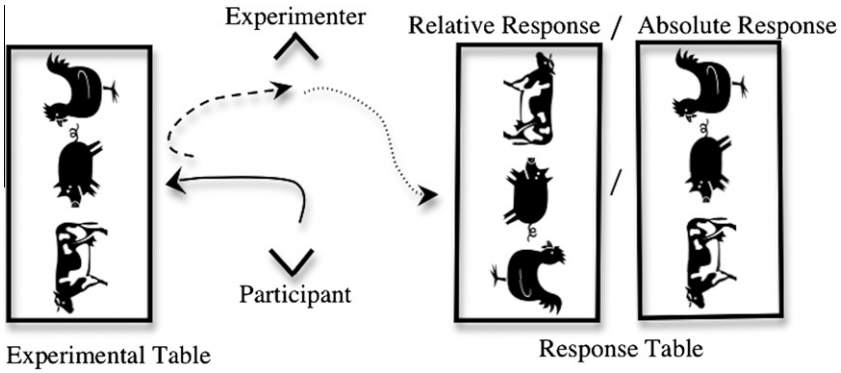

Fig. 7. New Animals set-up.

provided by the Mayangna Yulbarangyang Balna. Specific FoR information was tallied separately in an etic grid, the format of which was used by all the members of the MesoSpace project.

3.2.2. New Animals task

The New Animals task abbreviated NA (Bohnemeyer, 2008) is a nonlinguistic task that requires participants to reproduce a spatial array. The purpose of the NA task is to establish which spatial FoRs speakers use when solving a problem that requires cognitive resources that pull from both memory and spatial cognition. The task design closely follows the Animals In A Row (AIAR) design developed by Steve Levinson and Bernadette Schmitt of the Cognitive Anthropology Research Group at the Max Planck Institute for Psycholinguistics (Levinson and Schmitt, 1993). Participants were required to remember the order of objects on a table in a spatial array and then were asked to reproduce that array on another table, after having been turned around 180 degrees. If participants use an egocentric FoR (i.e., relative or direct), they should reproduce the spatial array as shown in Fig. 7 below. However, if participants employ an absolute FoR (e.g. absolute, landmark-based, or geomorphic), they should reproduce the other response shown in Fig. 7. If participants employ an object-centered FoR to solve the task, they could reproduce a response that is the same as either the absolute or the egocentric one. This task can only uniquely discriminate between absolute and egocentric FoR usage in a nonlinguistic situation.

The task procedure was as follows: participants were shown four toy farm animals: a chicken, cow, horse, and pig.[7] Then, a practice trial was run, wherein three of the four animals were placed in an array. The participant was asked to memorize the array. Once the participant indicated that they had memorized the array, the three animals were removed by the experimenter and after one minute, the experimenter asked the participant to turn around 180 degrees to the response table, which was parallel to the stimulus table. The participant was then given all four animals and instructed in Sumu-Mayangna to 'make it the same' on the response table. The participant then had to choose the correct three animals out of the total four possible animals and place them in the correct order. Once the participant was able to successfully reproduce the array on the response table, the actual task could commence. The task itself has six iterations, and each task result was recorded on coding sheets. The task was given to 14 participants: 9 women ranging in age from early 20s to 50s, and 5 men ranging in age from 20s to late 40s. Six of the participants also participated in the B&C task. Three speakers' results were flagged for having produced three or more errors during the production of the task (wrong animal, or wrong order of animals) and were not included in the final analysis.

4. Results

4.1. Linguistic results for Ball & Chair task

Speakers of Sumu-Mayangna show a clear ability to access the spatial FoR types discussed in Section 1, with the exception of the geomorphic frame. Though the other six spatial FoRs were attested (in addition to topological relations), there were clear tendencies of use in terms of the speakers' usage preferences: the direct FoR was used proportionally more than the others, followed closely by the object-centered intrinsic FoR. However, when grouped together, allocentric (non-egocentric) FoR options were clearly in the majority, well over egocentric options. This is addressed at the end of this section (see Fig. 23).

What follows is an overview of how each FoR is manifested in Sumu-Mayangna, as well as the trends in stimuli types that provoked those FoRs. Beginning with the absolute FoR class for those dyads who used it productively, this FoR was available for describing the facing direction of the chair, as well as the location of the ball in the photo. The relators most often used for the absolute FoR are mostly restricted to the lexical items *mâ kilwa* and *mâ kâwa*, which correspond with 'where the sun goes up' and 'where the sun comes in', respectively. There is also productive use of another term, *mâsar*, but speakers disagree as to whether this functions the same as *mâ kilwa* or *mâ kâwa*. The examples (18) and (19) that follow show the absolute usage

[7] The four animals chosen were selected for their cultural appropriateness for the Sumu-Mayangna speakers. Other studies in this volume may have used the toy figure of the sheep, instead of that of the chicken, as we did here.

of these terms in response to the B&C task with their corresponding stimuli photos after each example (Figs. 8 and 9). An interesting feature of (19) is its exemplification of sequential FoR use, where the intrinsic frame is used, followed by the absolute. This sequential use of FoRs was typical for the B&C task.

(18)

yalahnin	*pân*	*mûnh*	*kidika*	***mâ***	***kilwa***
sit.V-INF	place.N-CS	face.N-CS	DET	sun	go-up.V:3S
saitni	*yak*	*sak*	*ki*		
sait.N-CS	P	sak.AUX$_{CLS}$	PTC:3S		

'The front of the chair faces the **side** (where the) **sun goes up**.'
(Lit: 'The face of the chair is on/at the side (where) the sun goes up.')
(D1_GM 5:09–5:14)

Fig. 8. B&C, 1–1.

(19)

kidi	*yalahnin*	*pân*	*dangni*	*yakat*	*sak*
DEM	sit.V-INF	place.N-CS	back.N-CS	P	sak.AUX$_{CL}$
ki,	***mâ***	***kâwa***	***sait***		
PTC:3S	sun	enter.V:3S	sait		

'[The ball is] behind the chair, on the **side [of the chair] where the sun comes in.'**
(D2_GM 1:56–2:00)

Fig. 9. B&C, 2–11.

As discussed in Section 1.2, the vertical FoR class makes use of the earth's gravitational field ('up' or 'down'). However, the vertical distinction appears to be available to all languages, unlike the typologically exclusionary behavior observed for absolute. This FoR was typically used to describe the position of the ball, e.g., when the ball was 'in the air' or when the ball was perceived as 'down'. Example (20) and its corresponding photo that follows, provide an instance of vertical FoR use (see Fig. 10).

(20)	*kun*	*balni*	*kidi*	***mâyak***	*sak*	*ki*
	DISJ	ball.N-CS	DET	ADV	sak.AUX_{CL}	PTC:3S

'The ball is **up** there.'
(D3_CY 5:54–6:00)

Fig. 10. B&C, 3–8.

When the landmark-based FoR was used, it was used typically in *ad hoc* contexts. For example, an artifact of the room (e.g., the window on the east side of the room) was a particular favorite, as well as the people in the room. Examples (21) and (22) that follow exemplify this use of it ad hoc landmarks (see Figs. 11, 12).

Fig. 11. B&C, 3–11.

Fig. 12. B&C, 2–4.

(21) ûk kidika sini kidika ***windar*** ***sait*** muh sak ki
other.Q DET chair.N-CS DET window.N sait face sak.AUX$_{CL}$ PTC:3S
'The other one, the chair, is facing **the side of the window**.'
(D3_AM 2:38–2:40)

(22) ***libro*** ***balna*** ***bang*** ***saitni*** yak balni bin
book.N PL bang.AUX$_{CL}$ sait.N-CS P ball.N-CS DIM
kidi sait yak sak ki
DET sait P sak.AUX$_{CL}$ PTC:3S
'**The side [of the chair] where the books are**, the ball is on that side.'
(D2_AN 4:55–4:58)

The object-centered intrinsic FoR in Sumu-Mayangna can make use of part terms of the chair, which function as ground entities for the figure object, the ball. Some of these part terms appear to function as shape-based meronyms, or part terms, though this remains a topic for further exploration in Sumu-Mayangna. The following examples use the terms *nangtak*, and *udun*, as well as the body-part relational noun *muhnit* (from *muh* 'face') to mark specific locations or regions of the chair. Examples (23) to (25) provide a subset of these lexical items that serve to identify locations or regions of a ground object, animate or inanimate. For example while *nangtak* can refer to a human nose, it also functions more generally to identify a volumetric extension with a tip, as in (23) (see Fig. 13).

(23) dawak balni kidika mâ dangki âda kidika,
CONJ ball.N-CS DET 1P.INCL back.N-POSS:1P.INCL put.V:1P.INCL DET
kidi ***nangtak*** yakat dû kiuna sak ki, kunh
DEM nose.N P have.V go.V-NA$_{STAT}$ sak.AUX$_{CL}$ PTC:3S DSJ
nangtak kidi nû man bû ki
nose.N DET know.V:2S two PTC:3S
'The ball is where we put our backs, at the **nose** [of the chair], but you know, there are two **noses**.'
(D1_GM 3:33–3:37)

Udun can identify the human navel, but serves more generally to identify the region on an object that roughly correlates to its 'middle', as seen in (24) (see Fig. 14).

Fig. 13. B&C, 1–10.

Fig. 14. B&C, 3–10.

(24)

tuyuln	*kidika*	*aining*	*kidi*	*lakanh*	*yakat*	*kâ*	*dânin*
round.N-CS	DET	DSC	DEM	center.N	P	enter.V	V.ASP
ki	*tat*	*as*	***udun***	*yakat*	*kil*	*dâna*	
PTC:3S	boards.N	DET.IND	navel.N	P	go-up.V	V.ASP	
kat	*dûwi*						
P	have.V-PRES:3S						

'The ball is there in the center, it enters the **navel** of the boards [that form the seat] and that go up.' (1b_JR 00:23–00:27).

Muhnit is used to identify the facet of the frontal part of an entity, be it that of a human or of a chair, as shown in (25) (see Fig. 15).

(25)

semh	*sinini*	*kidik*	*ais*	*dânaman*	*yakat*	*sak*		
same	seat.N-CS	DET	INT-IND	leave.V-PST:2S.	P	sak.AUX_{CL}		
ki	*dawak*	*bal*	*kidik*	***muhnit***	*yak*	*sutni*	*sak*	*ki*
PTC:3S	CONJ	ball.N	DET	face.RN:3S	P	tip	sak.AUX_{CL}	PTC:3S

'The same chair is there, as you left it, and the ball is in **front of** it [the chair] at the tip.' (D2_AM 3:57–4:06)

Fig. 15. B&C 2–3.

Similarly *kungni*, can identify a human lip, but can also identify edges and borders of some volumetric object, as seen in example (11); and *dangni* can identify the back of a human or of a chair (as in (26) below). The search space projected from these locations or regions on the ground object provides for the identification of the position of the figure, which in these cases is the ball. While the B&C task was not designed to specifically elicit meronymic usage, some evidence for shape-based, geometric meronyms (Levinson, 1996) was manifested in the B&C data for intrinsic FoR contexts.

Recall that the topological figure-ground configuration does not require any particular FoR for its interpretation, moreover its validity is maintained regardless of rotation of the figure-ground array, or the speaker. (26) provides an example of the topological expression in Sumu-Mayangna (see Fig. 16).

(26)

yalahnin	*pan*	*dangni*	*kat*	*kidi*	*bal*	*sak*	*ki*
sit.V-INF	place.N-CS	back.N-CS	P	DET	ball.N	sak.AUX_{CLS}	PTC:3S
sau	***yak***	*lakna*	*sak*	*ki*			
ground.N	P	lie-down.V-NA_{STAT}	sak.AUX_{CL}	PTC:3S			

'The ball is at the chair's back, it [the ball] is lying **on the ground**.'
(D2_GM 1:33–1:38)

Fig. 16. B&C, 2–11.

The direct FoR was used productively by all five dyads, as well as the most proportionally preferred FoR. Example (27) below shows a standard use of a direct FoR, wherein the speaker is using her body as the anchor and ground in order to identify the facing direction of the figure object, here identified as the chair. Crucially, the direction of the vector points toward the speaker, as the photo in Fig. 17 illustrates.

(27)

mayang	***saitni***	*yakat*	*sak*	*ki*
1P.INCL	side.N-CS	P	sak.AUX_{CLS}	PTC:3S

'[The chair] is on **our side**.'
(D4_GM 4:38–4:41)

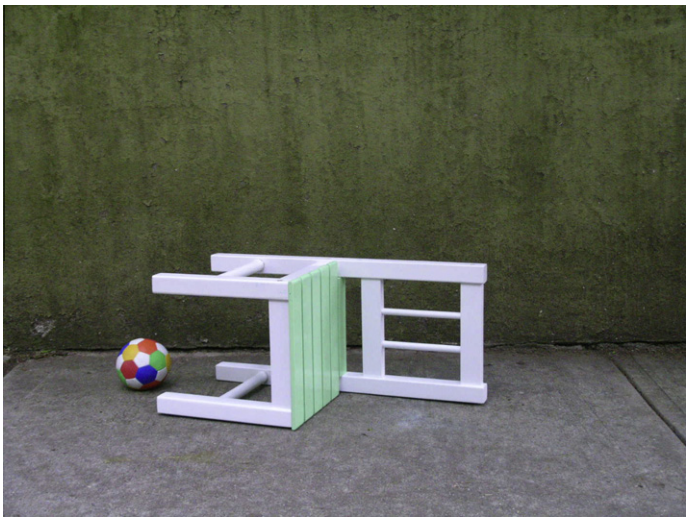

Fig. 17. B&C 4–5.

The direct FoR was typically used to describe the orientation of the chair as well as the location of the ball (e.g., toward or away from the speaker). The vast majority of direct FoR usage were of the sort identified in (7) and (9), wherein the speaker or addressee functions as both anchor and ground. However, in addition to the typical use of direct, Sumu-Mayangna participants also appeared to employ a variant of a direct FoR during the B&C task. In this variant form, the anchoring and ground are still with the speaker/addressee, but the speaker positions herself elsewhere than where she physically is. In this way, it constitutes a disembodied or projected direct, as (28) shows. It should be noted that in examples like (28), speakers were often insecure with using left and right distinctions alone, and would often provide an additional landmark-based frame to accompany the prior one so as to ensure that the hearer's interpretation would be correct (see Fig. 18).

Fig. 18. B&C 4–10.

Fig. 19. B&C, 2–10.

(28)	*yalahdarang*	*tem*	*kidik*	***mâ***	***mûk***	*kidika*
	sit.V-FUT:1P.INCL	when	DET	1P.INCL	face.N-POSS:1P.INCL	DET
	tingramh	*saitni*	*yakat*	*kiunin*	*awi*	*yuldarang*
	righthand	sait.N-CS	P	go.V-INF	Aux:3s	say.V-FUT:1P.INCL
	kat	*windar*	*sait*	*yakat*	*ki*	
	CONJ	window	sait	P	ptc:3s	

'If we sat, **our face** would go to the right-hand side, so to say, toward the window side.'
(D4_JR 1:13–1:20)

The speaker collapses the perspective of both herself and the addressee in (28), which provides the anchor for the frame. The speaker/addressee also function as the ground in the frame because it is the orientation of their body which allows for the identification of the figure's orientation. That the speaker projects herself onto the frame is not material to the logic of the frame, if we first accept the alternative anchoring and grounding the speaker proposes. Note that the speaker could easily have said the chair was facing their right side, and employed a relative FoR, a strategy this pair had successfully used before.

In order to process the frame in (29), it is clear that, as with (28) above, the speaker is hypothetically projecting herself and/or the addressee into the frame and sitting on the chair, (as it is shown in Fig. 19). Additionally, the frame is anchored with the speaker or addressee with respect to the projection of their seated bodies within the photo. Once that alternative positioning is accepted, it is then possible to locate the figure object, here, the ball, with respect to where the addressee's feet would be, resulting in its location as being closest to the facet of space projected directly under their feet.

(29)	*yalahdarang*	*tem*	*kidi,*	*sau*	*yakat*	*sak*	*ki*
	sit.V-FUT:1P.INCL	when	DET	ground.N	P	sak.AUX$_{CL}$	PTC:3S
	tuyuln	*kidika*	*kidi,*	*mâ*	*kalk*	*dinit*	*pirin*
	ball.N-CS	DET	DET	1P.INCL	foot.N-POSS:1P.INCL	under.RN:3S	side.N-CS
	apis	*linh*	*yakat*	*kalahna*	*sak*	*ki*	
	almost		P	leave.V-NA$_{STAT}$	sak.AUX$_{CL}$	PTC:3S	

'If we sat, the ball would be on the ground, under our feet, a little to the side.'
'(D2_JR 5:28–5:32)

The two variant forms of the direct FoR identified here represent a ready ability of speakers to mentally manipulate the spatial relationship between both figure-ground arrays and themselves in a way that allowed them to imagine hypothetical situations wherein their own body was projected onto the photo. This manipulation usually resulted in spatial constructions that relied on either the conditional or future tense verb forms, so as to express this non-real, non-physical relationship between the speaker (as ground and anchor) and the figure object in the photo. However, the increased use of the direct, as well as the projected variants, are just part of the picture of spatial FoRs as manifested in Sumu-Mayangna. What follows is a frequency analysis of spatial FoR use.

4.2. Quantitative results for the B&C task

This section provides a descriptive and quantitative analysis of spatial FoR usage, focusing first on the broad behavior of the data among the five dyads, and then on a pair-by-pair analysis of use. Finally, we identify the specific stimuli conditions

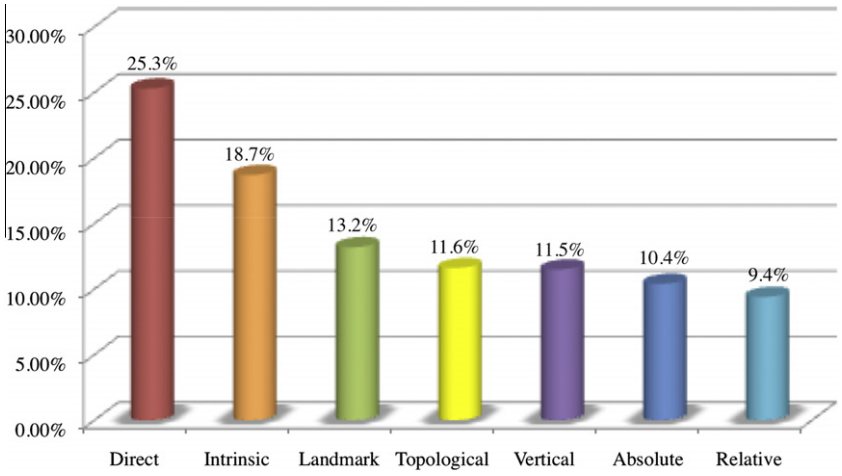

Fig. 20. Spatial FoR usage summary for B&C task.

which provoke the particular instances of spatial FoR usage among the speakers. We begin with Fig. 20 below, which shows that among the six FoR classes attested in Sumu-Mayangna (plus topological relations) and coded for this work, the direct FoR was, proportionally speaking, used more than the others during the B&C task, followed by the intrinsic FoR. All speakers also clearly had access to the same FoR classes.

Fig. 20 indicates that there is diffuse access across spatial FoR classes. At this point, it can be useful to compare the picture offered by a coding based on the MesoSpace system (Bohnemeyer, 2008; O'Meara and Pérez-Báez, 2011b) as in Fig. 20, with previous systems, such as the allocentric/egocentric system, or with the Levinsonian three-way system.

If we group the results in accordance to their allocentric and egocentric distributions, the following picture arises:

We find that a pattern arises out of grouping together the different FoR classes according to their corresponding allo- or egocentric categories. As we mentioned earlier, there is a basic difference in anchoring between these two categorizations; either the frame is anchored to the speaker, and is therefore egocentric, or it is anchored to some external entity and is allocentric (which would include object-centered intrinsic and geocentric[8]). Following this line, when the spatial FoR classes are separated according to their anchoring contexts, with relative and direct housed under the egocentric category, and intrinsic, absolute, landmark-based, and vertical under the allocentric category, we find that Sumu-Mayangna shows more allocentric usage than egocentric. Fig. 21 displays this variance. No longer is one single FoR (i.e., direct) seen as dominant over the others, but rather the larger allocentric category dominates over the egocentric one.

However, when the data is organized according to the ego- and allocentric category distinctions, it is difficult to get a clear picture of what kinds of anchor-ground relationships are being utilized. If we subsequently re-analyze the data according to the Levinsonian distinctions, we see an overwhelming use of the intrinsic FoR, as seen in Fig. 22.

Again, the primary issue with the data being sorted according to the Levinsonian system (for Sumu-Mayangna) is that the distribution can appear misleading. Given Sumu-Mayangna's extensive use of the direct FoR class, when the data is sorted according to the Levinsonian three-way FoR system, it implies an overwhelming use of the intrinsic FoR (cf. Fig. 22), which is not the entire story. The direct FoR class is accessible by most languages and is not typologically predictive, unlike, e.g., the absolute FoR. Further, a simple comparison of the anchor-ground identities involved in direct and intrinsic FoRs reveals that their underlying logic (and application) are different. Coalescing these FoR categories, in the case of Sumu-Mayangna, could unintentionally mislead researchers into classifying Sumu-Mayangna as a language for which the object-centered intrinsic is overwhelmingly predominant, a conclusion which the data thus far does not support.

By comparing the data distribution patterns between the three classification systems, i.e. the MesoSpace classification, the two-way allocentric and egocentric classification, and the Levinsonian classification, we find that the potential conflation of FoR classes that can occur in the latter two categorization systems obscures the behavior of the data for Sumu-Mayangna. A supplemental analysis is needed, in conjunction with the MesoSpace classification system, in order to identify the particular environmental cues that provoke particular spatial FoR usage. In the following section, we first describe the spatial FoR use for each of the five dyads, before turning to an analysis of how Sumu-Mayangna exploits orientation, in addition to FoRs.

4.2.1. Quantitative results for each dyad in the B&C task

When inspecting the FoR usage for each of the five dyads, we find that two patterns emerge. While substantial usage of the direct FoR is maintained among all the pairs with the object-centered intrinsic FoR closely following, substantial use of the absolute FoR was exhibited by our two most senior participant pairs. In contrast, the three younger pairs showed almost

[8] Geocentric, in this case, would include (pure) absolute, vertical and landmark.

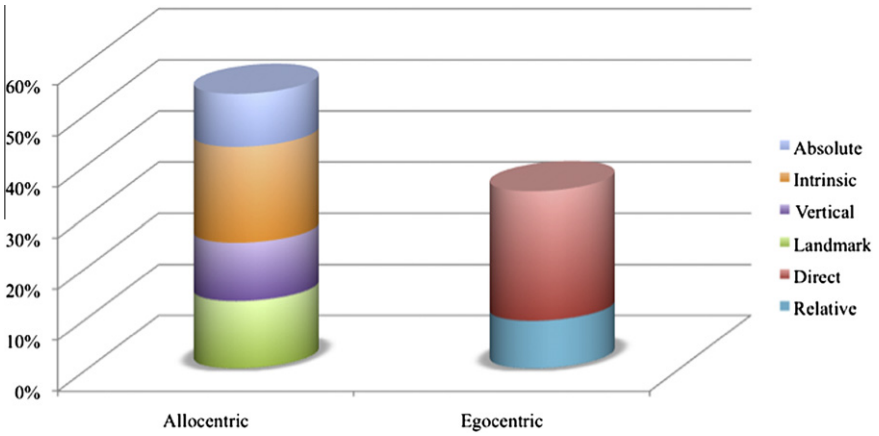

Fig. 21. Allocentric and egocentric use.

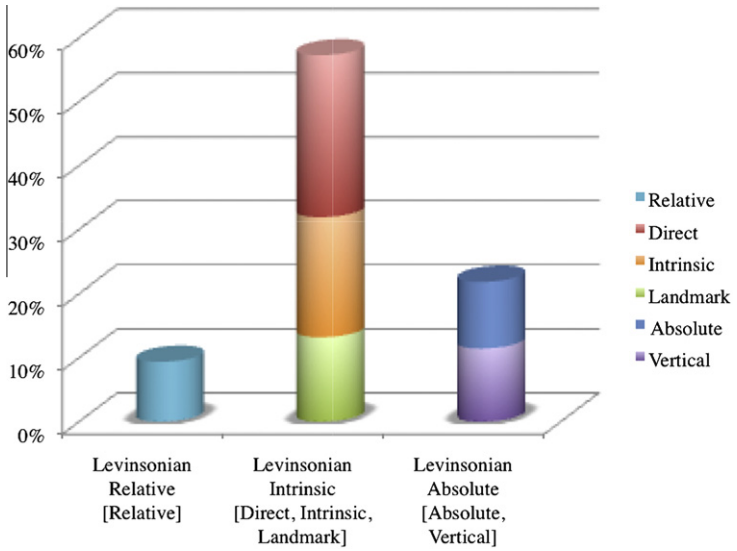

Fig. 22. Levinsonian three-way distinction.

no functional use of the absolute frame. Let us first look at the individual results of each individual dyad. Fig. 23 shows the spatial FoR performance for each of the five dyads.

Notice that if we set aside dyads 1 and 2 (who are our most senior participants) from those of dyads 3, 4, and 5; the two patterns in the data distinguish themselves more clearly. Below, Fig. 24 shows only dyads 1 and 2, which are the dyads that showed both productive use of the absolute frame as well as substantial usage of the direct frame. We term these Type A coders. Dyad 1 is composed of two women, one in her early 60s and the other in her early 40s. Dyad 2 is composed of two men, both in their 40s.

In contrast, Fig. 25 below shows only dyads 3, 4, and 5, wherein almost no use of the absolute frame was manifested. Like dyads 1 and 2, these dyads also show substantial use of the direct frame. Dyad 3 is composed of two men, both in their 30s, while two women in their 20s comprise dyad 4. A woman and a man, both in their 30s, are the 5th dyad, which completes the data set for the B&C task. Those dyads showing a dispreference for the absolute FoR are termed Type B coders.

We cannot rely on gender or traditional types of labor to explain the difference in absolute FoR usage profiles between the Type A and B coders shown in Figs. 24 and 25, respectively. Dyad 1 of the Type A coders was comprised of a pair of women and their absolute FoR usage was still proportionally high. This is in contrast to other linguistic phenomena reported on the absolute FoR, whose usage has been noted as especially relevant for male speakers due to traditional labor roles that can take them far from their home-base (cf. Bohnemeyer and Stolz, 2006, p. 309). In fact, in subsequent conversations with several Sumu-Mayangna speakers of the older generation, it was confirmed that the absolute FoR continues to be used in everyday discursive contexts by both genders. Additionally, all the participants in these 5 dyads had a similar educational level. The

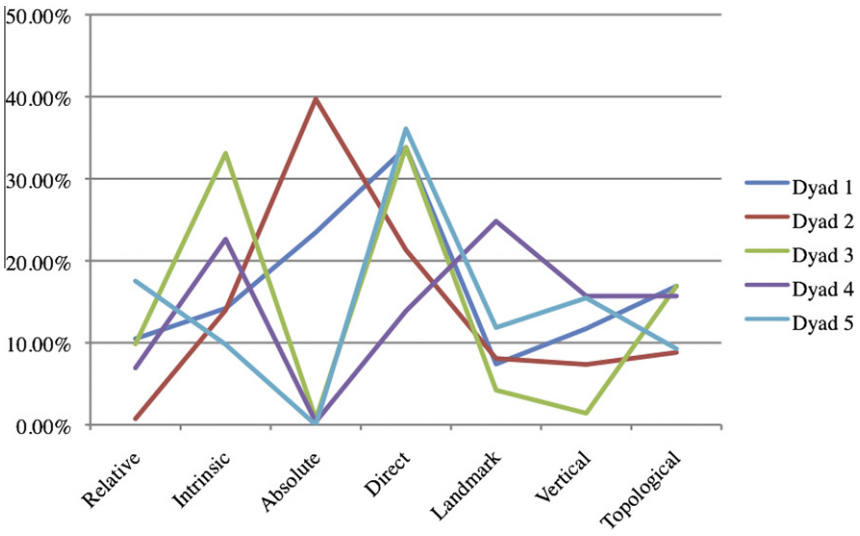

Fig. 23. Spatial FoR usage summary for individual dyads.

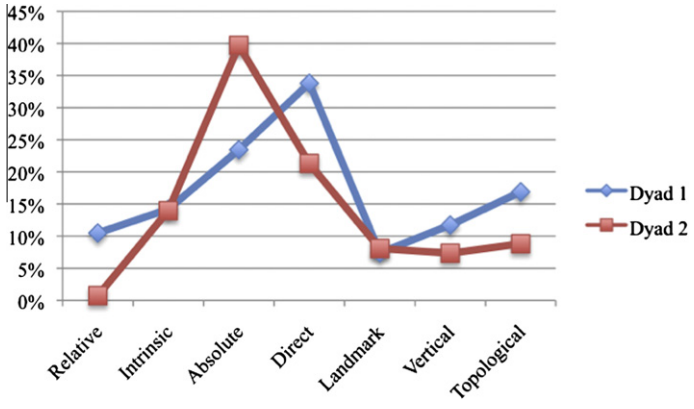

Fig. 24. Type A coders: productive use of absolute in two dyads.

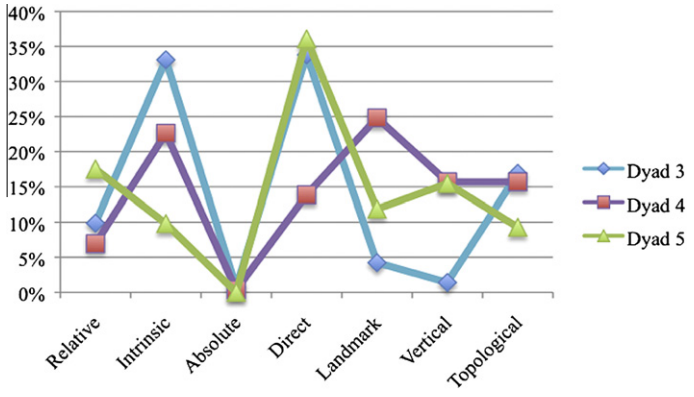

Fig. 25. Type B coders: dispreference for absolute in three dyads.

level of education of the participants, if widely different, could have potentially influenced participants' performance outcomes, as other studies have proposed the extralinguistic and cultural factors may skew spatial FoR preferences (Li and Gleitman, 2002).

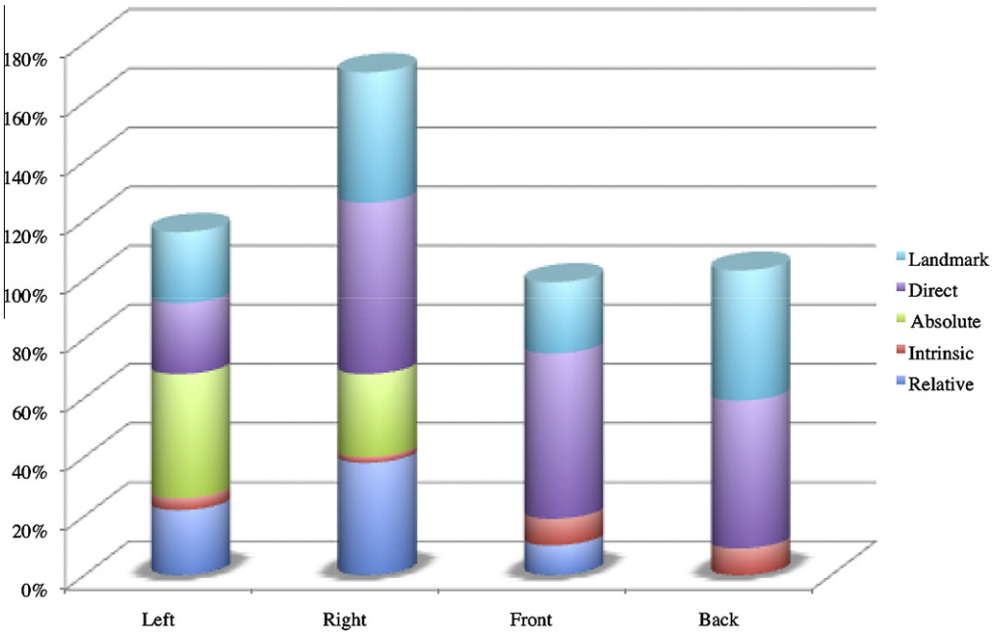

Fig. 26. Facing orientation.

Crucially, the absolute FoR usage context appears to be restricted to the axis that aligns with the east and west directions, as manifested by the perceived path of the sun across the sky.[9] This data confirms that the absolute is both available and productive for local spatial expressions as well, at least for this same older generation. As for the younger speakers, we have no evidence for absolute FoR usage based on this task. The unanswered question remains: what is driving this disparity in absolute FoR usage between older and younger generations of speakers? At the time of this writing, there have been no studies that can demonstrate a strong causal relation between the loss of a FoR and some other extra-linguistic factor. Though purely speculative, we suspect that the variance in the use of the absolute may be traced to a variety of sociolinguistic forces at work within the RAAN of Nicaragua. It could be an effect of formal education (in Spanish), as well as increasing migrations to urban areas, as both have been mentioned as possible extralinguistic, cultural and environmental factors that could be potentially correlated with the decreased use of the absolute FoR (Li and Gleitman, 2002; Majid et al., 2004). Majid et al. identifies an association between the relative FoR use and formal education (Majid et al., 2004). This observation, if coupled with the notion that a preference for either the relative or absolute FoR is language-specific and typologically exclusive, i.e. languages do not tend to prefer both simultaneously for use in local space, would suggest that in the face of higher levels of education, younger speakers would begin to use the relative FoR in preference over their elders' use of the absolute. However, with the exception of their age, the participants of this study are remarkably homogenous – they all have the equivalent of a Bachelor's degree education, all work in the field of education within the community, and all reside in the same area, wherein the infrastructure is marked by both rural and urban environments. And so, outside effects of education and environment cannot have had much of a role in the divergent use of the absolute between the two generations. The motivation for this difference in preference remains undiscovered.

Given that the direct FoR features so predominantly in the data, we wanted to identify if there were any particular figure-ground cues that provoked its use. Instead, we found it to be available for all facets. In contrast, the absolute usage was restricted to only lateral east/west facing contexts and this is the data to which we turn now. In sorting the data according to orientation contexts (cf. Terrill and Burenhult, 2008), we first turn to those stimuli in which the chair is facing left, right, front, or back, while in its normal, upright position. Fig. 26 shows that, as expected, speakers have access to, and employ, the direct FoR for all of the facing orientations of the chair. What is crucially revealed in the facing data is that the absolute is only employable for instances of left- or right- facing of the chair, an axis that was aligned with the east/west axis in the experimental setup. As we saw in Fig. 26, the Type A coders only had access to the absolute along the east–west axis. This begs the question: what are the Type B coders using *in place of* the absolute along the east–west, right-left axis, when describing the facing orientation of the chair?

In Fig. 27, a qualitative schematic of what is happening between the Type A and B coders is provided. The Type A coders' responses are located in the left-most box of each of the Cartesian axes, while the Type B coders' responses are located in the

[9] This is expected since the language does have expressions for East and West (mâ kilwa and mâ kâwa, literally '(where) the sun goes up' and '(where) the sun comes in') but not for North and South.

corresponding right-most box of each of the axes. For the east–west axis, Type B coders are using every spatial FoR class available to them to aid them in identifying the chair's facing information. In stark contrast, the Type A coding strategy has the benefit of efficiency – they require fewer auxiliary spatial strategies to confirm the east–west facing of the chair, than do their Type B coding counterparts. Additionally interesting, just as the Type A coders prefer the direct and landmark-based FoR classes for the front/back distinction, so do the Type B coders, however the Type B coders also leverage these framing strategies for the lateral axis as well, helping them to identify similar kinds of facing information for the lateral axis that the Type As efficiently resolve with the absolute FoR strategy.

In this section, we have shown that with the aid of an analysis of orientation, we can better employ the MesoSpace spatial FoR classification to not only provide a transparent account of the anchor-figure-ground relationships as they are preferentially organized in Sumu-Mayangna, but also the particular orientation environments which provoke their complementary use. Those participants who used the absolute FoR made use of it along the lateral axis, while exploiting the direct and landmark-based FoRs for front/back distinctions, meanwhile those participants who did not use the absolute, employed the direct and landmark-based FoRs in lieu of it along the lateral axis, as well as preserving the direct and landmark-based uses for front/back distinctions.

In the following section, we discuss quantitative results of the nonlinguistic NA task, which serves to investigate the possibility of an alignment in linguistic FoR preferences and cognitive performance.

4.3. Results for the New Animals (NA) task

The nonlinguistic NA task represents a first-look at nonlinguistic spatial performance for Sumu-Mayangna speakers. As such, the task serves as a point of comparison for the linguistic task, but is not intended to be the final word on the issue of cognitive-linguistic alignment in Sumu-Mayangna. Before presenting the data for the NA task, let us review what predictions could be made for Sumu-Mayangna based on both the linguistic results of the B&C task, and the task design of NA. The data for the B&C task indicates that Sumu-Mayangna speakers on the whole preferentially use absolute, landmark-based, and direct FoR strategies for the lateral (east/west) axis. If speakers use absolute or landmark-based strategies in discourse they should produce the absolute solution type in the non-linguistic NA task; conversely, if speakers use the direct or relative strategy in discourse, they should produce the relative response type in the memory-recall NA task. An object-centered intrinsic response type is possible as well, but would be indistinguishable from the other two response types, with the exception being if the participant changed the axis of the array of animals. Since speakers in the B&C task showed a complemen-

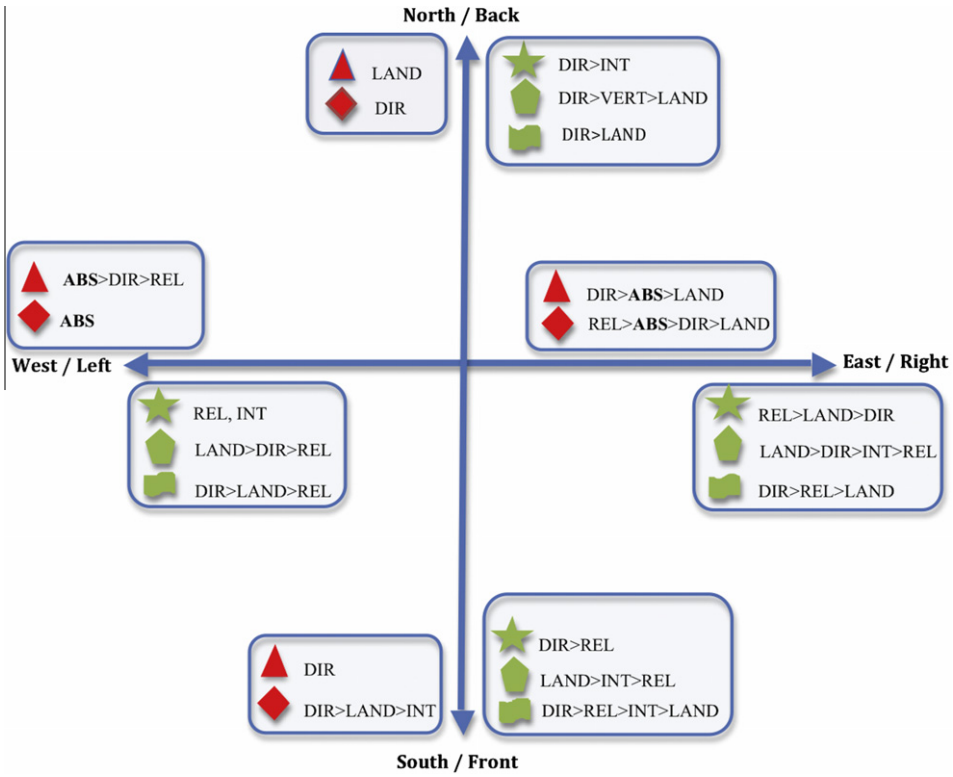

Fig. 27. Qualitative sketch of spatial FoR use for orientation.

tary preference for either absolute or direct, relative, and landmark-based descriptions for the lateral (east/west) axis, we suspect that the response type preferred for the NA task would be similarly mixed. This prediction was borne out in the data to some degree, but there was a clear preference for the absolute solution type.

To illustrate this, Fig. 28 shows the clear preference for the absolute solution type over that of the relative. As a point of comparison, recall that Fig. 21 showed the same skewing of allocentric uses over that of egocentric ones. The results of these two datasets are compared in Section 5.

Table 1 details the demographics of the participants and their performance on the task. A participant was coded as a 'relative' or 'absolute' coder if three or more of their responses were of the same type. Similarly, if a participant made three or more errors during the six trials, his or her results were excluded from the final analysis.

From Table 1, we can see that the male speakers uniformly chose absolute response types, and that three female speakers had more than three errors during their six trials. Due to this error, their data was excluded from the final analysis below. The response rate for the absolute solution was 64% and for the relative, 14%. Table 2 below shows the response type for each of the six trials, cross-tabulated with the individual participants and their demographic information. Response type coding is as follows: R is relative, A is absolute, and * is error.

From Table 2, we can see that Sumu-Mayangna speakers overwhelmingly preferred absolute solution types during the nonlinguistic task. The alignment effects between both the linguistic and nonlinguistic task types are discussed below in Section 5.

5. Evaluating FoR performance: linguistic and nonlinguistic alignment

The larger picture of spatial FoR use in Sumu-Mayangna reveals that, though having access to all FoRs classes, speakers seem to preferentially employ the direct spatial FoR overall. However, use of the absolute FoR is substantial in the lateral east/west axis and, in particular, restricted to that condition. Further, for those dyads who did not display use of the absolute FoR, we see an additional, diffuse access to all of the other available FoR classes to describe location along the lateral east/west axis.

As a point of comparison, the nonlinguistic NA task only discriminates between relative and absolute solution types. The results for the NA task show a bias toward absolute solutions among participants and this, combined with the B&C results of the Type A coders, could suggest alignment between linguistic use and cognitive practice. However, the B&C data seems to hint at a shift that is taking place between the older generation (the Type A coders) and the younger one (Type B coders). In

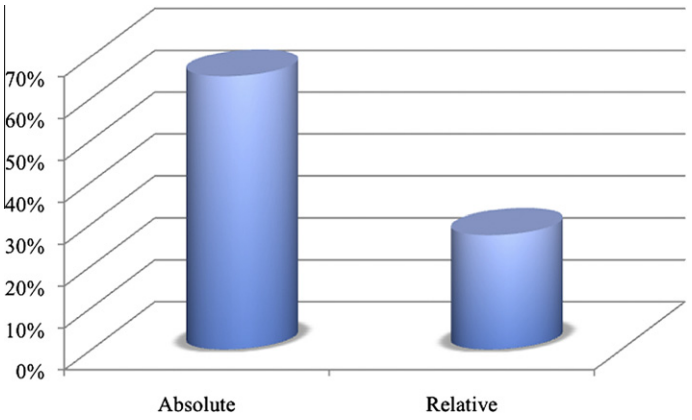

Fig. 28. New Animals response summary.

Table 1
Participants by age, gender, and response type.

Age	Gender	Response type			Total
		Relative	Absolute	Error	
20–40	Female	1	3	1	5
	Male	0	4	0	4
40–60	Female	1	1	2	4
	Male	0	1	0	1
Total		2 (14%)	9 (64%)	3 (21%)	14

Table 2
Performance by trial.

Gender	Age	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Total		
								Relative	Absolute	Error
F	N/A	R	A	R	R	A	R	4	2	0
F	<40	A	A	A	*	R	A	1	4	1
F	33	A	A	R	A	*	A	1	4	1
F	43	R	R	R	R	A	R	5	1	0
F	<40	A	A	A	A	A	A	0	6	0
F	23	R	R	A	A	A	A	2	4	0
M	20	A	A	A	A	*	R	1	4	1
M	30	A	A	R	R	*	A	2	3	1
M	<40	A	*	A	R	A	A	1	4	1
M	26	R	A	A	A	A	A	1	5	0
M	47	A	A	A	A	A	A	0	6	0
Total								18	43	5
%								27.27%	65.15%	7.58%

light of this, one would expect perhaps more relative solution types in the NA data, given the clear access to both direct and relative FoRs that was manifested in the B&C data, for the lateral axis.

5.1. Effects of language contact and education

The linguistic and cultural context of the North Atlantic coast of Nicaragua entails that at a minimum, two colonial languages – English and Spanish – have been in historical contact with the indigenous languages there. In addition to the colonial languages present, Nicaraguan Caribbean Creole (Kriol), Miskitu, and Sumu-Mayangna have been in contact since the 1700s. For Sumu-Mayangna, the cycle of linguistic borrowings usually begins with English as filtered through Kriol, Miskitu (the dominant indigenous language in the region), and then finally into Sumu-Mayangna and adapted to its phonetic system. That is to say, the connection between Sumu-Mayangna and English is not a direct one. To add another layer of complexity to this situation, the Sumu-Mayangna's bilingual education system uses Spanish as the language of instruction during secondary education. For the youngest generation of Sumu-Mayangna speakers, the linguistic pressure comes from all sides. While we have no clear evidence at this time, we can venture a conjecture that the variance in use of the absolute frame between younger and older speakers could be related to the linguistic pressure and increasing formal education in Spanish. These forces may combine to provide a 'hidden curriculum' for young people such that ostensibly basic things like location are learned and used from a Spanish linguistic and cultural perspective, i.e. one that only uses the absolute on the geographical scale. As we observed, in discourse, the older speakers employed the absolute whereas the younger speakers did not. In addition, when the relative FoR was used, the younger speakers used it more than the older speakers. These results could indicate that, at least discursively, the speakers are trending away from the use of the absolute FoR. However, we repeat, this is pure speculation, though it does provide a possible line of inquiry for future research.

5.2. Relevance for MesoSpace

Although Sumu-Mayangna is a control language for MesoSpace, and is not considered a part of the MA *Sprachbund*, it does share some of the features associated with this family. Most notably, its formation of relational nouns is quite similar to what has been reported for the MA languages (Campbell et al., 1986), though it is likely that Sumu-Mayangna has a smaller set of these lexical items than do most MA languages. These relational nouns, along with auxiliary classifiers, form the basis of most spatial constructions in the language. In addition, the results of the B&C task show access to all of the FoR classes (except for the geomorphic), a result not unlike what has been found in the other MA languages of the project (e.g., Bohnemeyer, 2011). Further, the other control language in the study, Seri, shows significant preference for the direct FoR (see O'Meara and Pérez-Báez, 2011a), a phenomenon also observed for Sumu-Mayangna.

Productive use of a meronymy system is also a characteristic of MA languages. The B&C task results showed a possible exploitation of a meronymic system in Sumu-Mayangna, as shown in Section 4, examples (23)–(26). Though the B&C task was not designed to elicit meronym usage, the meronyms identified from this task, and others currently in preparation, provide a basis for further exploration of their productivity within Sumu-Mayangna, especially with regard to their use in con-

junction with spatial FoRs. These findings have uncovered possible commonalities between Sumu-Mayangna and the larger MA *Sprachbund*, both in the way that Sumu-Mayangna speakers perform on the linguistic tasks and the kinds of linguistic resources they have at their disposal. The key here is that the available linguistic resources for a language are the limiting factors for determining spatial constructions and their corresponding FoR classes. In the case of Sumu-Mayangna, there are more commonalities than initially expected in terms of its lexical resources, in the case of meronymies, and structural ones as well, in the case of its spatial relational nouns. Future research will focus on integrating an analysis of the Sumu-Mayangna meronymy system with speakers FoR preferences, as well as to what extent these specific lexical and structural resources make possible the linguistic representation of the preferred FoRs.

6. Conclusions

We showed several features of the Sumu-Mayangna spatial FoR profile that provide a first look into how space is organized for speakers of this language. While the direct FoR was proportionally used more than any other FoR, speakers clearly had access to all of the others, excluding the geomorphic. In exploring the direct FoR usage, an additional projected form was identified in the data, though in a minority of cases. Adding to the complexity of the FoR profile for Sumu-Mayangna, the five dyads exhibited two trends with regard to access to the absolute FoR, with the two oldest pairs showing highly productive use of it along the lateral east/west axis, and the three youngest pairs exhibiting virtually no use of the absolute FoR. Speculative possibilities for this variance include the effects of linguistic pressure from Spanish, as well as the effects that formal education may have on the formation of young people's strategies for identifying location and orientation, though no hard data is available at this time. In order to account for particular environmental cues that might provoke a particular FoR strategy, an analysis of the FoR use for the orientation of the chair was provided. Here, it was discovered that younger speakers (Type B coders) extend the usage of the direct and landmark-based FoR strategies (among others) to identify the lateral east/west facing information that the Type A coders were able to resolve with absolute usage.

The results of the NA task showed that speakers clearly preferred the absolute solution type, with all males coding absolute responses for the majority of the six trials. A comparison of performance between the B&C linguistic task and the NA task indicates that although some degree of cognitive and linguistic alignment may be present, we might expect more relative response types for the NA task, given that the B&C data showed a preference for the direct FoR, which would manifest as a relative solution type in the NA task. However, this study serves as a first look at the linguistic alignment hypothesis as it holds in Sumu-Mayangna. Future veins of inquiry will look to increase the datasets for both tasks as well as to compare additional nonlinguistic and linguistic task types.

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