

## Overview

- MesoSpace
- Yucatec
- meronymy: background
- meronymy: tools and tasks
- meronymy: findings
- spatial FoRs: tools and tasks
- spatial FoRs: findings
- conclusions
- appendix I: assigning surfaces
- appendix II: projection
- appendix III: coding the B&C data

## Volumes, surfaces, and extreme points

Meronymy and object-centered geometry in Yucatec Maya

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Jürgen Bohnemeyer, SUNY at Buffalo  
jb77@buffalo.edu

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## MesoSpace

- NSF award #BCS-0723694 "Spatial language and cognition in Mesoamerica"
- 15 field workers
- 13 MA languages
  - Mayan
    - Chol (J.-J. Vázquez)
    - Q'anjob'al (E. Mateo Toledo)
    - Tzeltal (G. Polian)
    - Yucatec (J. Bohnemeyer)
  - Mixe-Zoquean
    - Ayutla Mixe (R. Romero Méndez)
    - Soteapanec (S. Gutierrez Morales)
    - Tecpatán Zoque (R. Zavala Maldonado)
  - Oto-Manguean
    - Otomí (E. Palancar)
- San Lucas Quiavini Zapotec (G. Pérez Báez)
- Tarascan
  - Purepecha (A. Capistrán)
- Totonacan
  - Huehuetla Tepehua (S. Smythe Kung)
- Uto-Aztecan
  - Cora (V. Vázquez)
  - Pajapan Nawat (V. Peralta)



Figure 1. MesoSpace field sites

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- 3 controls
  - Seri (C. O'Meara)
  - Sumu (E. Benedicto)
  - Mexican Spanish (R. Romero Méndez)
- 2 (interrelated) domains
  - **meronyms** – labels for parts of entities
    - including, but not restricted to, *body part metaphors*

MesoSpace (Cont.)



Figure 2. MesoSpace field sites

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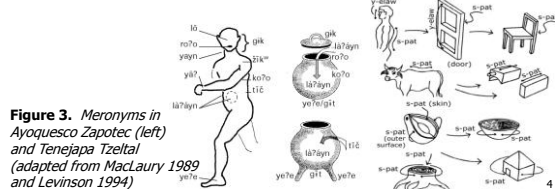


Figure 3. Meronyms in Ayoquesco Zapotec (left) and Tenejapa Tzeltal (adapted from MacLaury 1989 and Levinson 1994)

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MesoSpace (Cont.)

- spatial **frames of reference**
  - conceptual coordinate systems used to define orientation-dependent place functions (Jackendoff 1983)

- Intrinsic** – The man is on the side of the tree.
- Relative** – The man is to the right of the tree.
- Absolute** – The man is east of the tree.

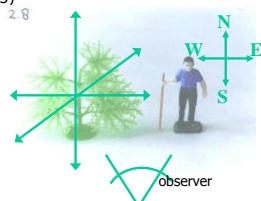


Figure 4. The three types of spatial FoRs distinguished in Levinson 1996

- why MA
  - productive meronymies
    - attested in Mixtec, Purepecha, Totonac, Trique, Tzeltal, Tzotzil, Yucatec, Zapotec

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MesoSpace (Cont.)

- meronymy as the primary lexical resource for spatial reference – few/no adpositions/case markers
  - including, e.g., in all of the above languages
- egocentric FoRs play a minor or no role
  - attested for Huave, Mopan, Olutec, Totonac, Tzeltal, Tzotzil, and Yucatec
- the MA *sprachbund* and specifically the evidence for calquing of meronyms
  - cf. Kaufman 1973; Campbell 1979; Campbell, Kaufman, & Smith-Stark 1986; Smith-Stark 1994
- the cultural uniformity and topographic and ecological diversity of the MA area
  - to distinguish between possible linguistic and cultural factors influencing spatial cognition
    - in response to Li & Gleitman 2002

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MesoSpace (Cont.)

- 2 big research questions
  - *does the availability of productive geometrical meronym systems bias FoR selection?*
    - **hypothesis:** meronymies favor the use of allocentric (intrinsic, geomorphic, or absolute) over egocentric FoRs
  - *does a possible effect of meronym terminology on FoR use extend to non-linguistic cognition?*
    - **hypothesis:** speakers of languages w/ productive meronymies tend to be allocentric thinkers
- oodles of smaller research questions
  - *how much spatial information is represented in language?*
  - *to what extent do languages differ in the expression of geometrical and functional object structure?*

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MesoSpace (Cont.)

- *do languages borrow from one another, not just metaphors (-> calques), but entire semantic frames*
  - *such as domain mapping strategies and reference frames*
- *is there variation in the role the human and animal body plays as a conceptual model*
  - *of the structure of objects across languages?*
- *do speakers of all languages employ the same conceptual processes*
  - *in mapping the structure of the body into that of objects?*

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MesoSpace (Cont.)

- timeline
  - winter 2007/8 – design of stimuli and tasks
  - spring 2008 – stimulus production and piloting at UB
  - June 2-7, 2008 – training workshop in San Cristóbal
  - June thru winter 2008/9 – field trips
    - our budget only provides for one field trip per researcher
  - spring 2009 – data processing and analysis
  - June 2009 – analysis workshop in San Cristóbal
  - June 2009 thru April 2011: dissemination of results and follow-up proposal

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## Yucatec

- the largest member of the Yucatecan branch of the Mayan language family
  - spoken by 759,000 people in the Mexican states of Campeche, Quintana Roo, and Yucatán
    - 2005 Census data show a decline by more than 40,000 speakers age five or older since 2000 (<http://www.inegi.gob.mx/.../ept.asp?t=mien10&c=3337>)
  - and approximately 5,000 people in the Cayo District of Belize (Gordon Ed. 2005)
- polysynthetic, purely head-marking, VOS, split-intransitive
- the field site: Yaxley
  - a village of about 800 people in the municipal district of Felipe Carrillo Puerto in Quintana Roo



Figure 5. Approximate dialect regions of Yucatec and location of the field site

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### Meronymy: background

- semantic transfer from body parts to object parts and spatial relations may be a universal
  - cf. Svorou 1994; Heine 1997
- what makes MA meronyms special
  - morphosyntactically: their use as spatial relators
    - i.e., in expressions of **place functions** (Jackendoff 1983)
  - semantically: their applicability to arbitrary objects on the basis of geometrical properties
- morphosyntactic properties of MA meronyms
  - two varieties
    - in Mayan and Oto-Manguanean languages, meronyms tend to be lexicalized as **relational nouns**
      - depending on the language, these may be **inalienable**
        - » see examples below

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Meronymy: background (cont.)

- in Totonacan and Mixe-Zoquean, meronyms constitute a special closed class of roots
  - these most commonly surface incorporated into verbs and require derivational morphology to form nouns
  - cf., e.g., Levy 1992 on Papantla Totonac and Romero Méndez 2008 on Ayutla Mixe
- in all MA languages, meronyms are the most important lexical resource for coding place functions
  - MA languages have no locative cases and, depending on the language, no or very few adpositions
  - when realized as relational nouns, meronyms are used in locative/motion descriptions as follows
    - they are possessed by the **ground-denoting nominal** (the noun referring to the entity serving as reference point)
    - the resulting possessed nominal either *is* the **ground phrase** (the phrase denoting the place projected from the ground object)
      - » or combines with a semantically pale adposition to form it

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Meronymy: background (cont.)

- the following examples from Juchiteco Zapotec illustrate the first possibility
  - » the possessed nominal headed by the meronym *is* the ground phrase

- (3.1) a. **ike**(=be\*)  
head=3  
'his/her head' / 'on him/her' (Pérez-Báez in press: 4)
- b. nuu\* sombre\*ru **i^ke**=be\*  
EXIST hat head=3  
'The hat is on his head' (Pérez-Báez p.c.)
- c. Dxi!ba za **ike** yoo  
raised.overcloud head house  
'The cloud is over the house' (Pérez-Báez in press: 11)
- in Yucatec, both constructions exist
    - » some meronyms head the ground phrase (e.g., *óok'ól'* 'top' in (3.2), others combine with the generic preposition *t'* (e.g., *ts'u'* 'core')
- (3.2) ...h-tàal u=balak' **y=óok'ól** le=pak'=o'  
PRV-come(B3SG) A3=roll A.3=top DET=brickwork=D2  
'...it came rolling on the wall'

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Meronymy: background (cont.)

- (3.3) H-òok le=chan xóot'+che'  
PRV-enter(B3SG) DET=DIM cut+wood  
tu=**ts'u'** le=chiina=o'  
PREP:A3=core DET=orange=D2  
'The little cut piece of wood entered in the interior of the orange'

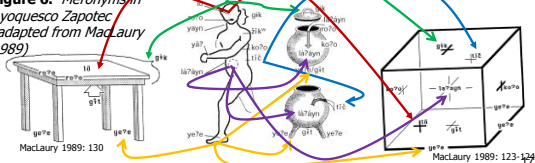
- as a result, the encoding of place functions in intrinsic and relative frames of reference
  - necessarily involves reference to body/object parts in MA
    - either directly or indirectly, via "normalization" – see Appendix II
  - in contrast, expressions of (non-vertical) absolute place functions do not involve meronyms
    - but rather expressions of cardinal directions or environmental gradients
- semantic properties of MA meronyms
  - productivity and generality: meronymies affording reference to arbitrary parts of arbitrary objects

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Meronymy: background (cont.)

- how does this work – what makes this productivity and regularity possible?
  - two proposals – **global analogies** (MacLaury) vs. **shape-analytical algorithms** (Levinson)
- MacLaury 1989 argues Ayoquesco Zapotec meronymy to operate on global analogical mapping
  - Ayoquesco has a set of seven body part terms that are freely extended to non-human bodies and inanimates

Figure 6. Meronyms in Ayoquesco Zapotec (adapted from MacLaury 1989)



Meronymy: background (cont.)

- according to MacLaury, these are global analogical domain mappings from the geometry of the human body
  - into that of the animal or plant body or object
  - as described by **Structure Mapping Theory** (Gentner 1983)
  - accounts of meronymy in other Oto-Manguanean languages have made similar assumptions and are compatible with MacLaury's
    - » cf., e.g., Sinha & Jensen de López 2000 and Pérez-Báez in press for other Zapotecan varieties
- Levinson 1994 rejects global analogical mapping for Tenejapan Tzeltal on the basis of three properties
  - all parts are named non-uniquely
    - so any object can have an arbitrary number of 'legs', 'noses', 'heads', 'backs', etc.
  - parts are named in first approximation on the basis of shape, regardless of place in the structure of the object
    - so 'arms' can be assigned growing out of 'heads', 'noses' out of 'buttocks', etc.

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Meronymy: background (cont.)

- the place of the labeled part in the structure of the object varies across classes of objects
- Levinson instead proposes an algorithm
  - that starts from the visual analysis of the outline of the object
    - segmenting it into volumes based on curvature discontinuities
    - and assigning axes to these volumes that generate them as generalized cones
      - » following Marr's (1982) theory of shape recognition
  - the parts on the ends of the axes of each volume are then labeled on the basis of their shape
  - the algorithm accounts for the meaning of body part terms as much as for their uses with inanimate objects
    - which on Levinson's analysis are non-metaphorical
    - e.g., the 'buttocks' are really the less convex end of the generating axis of the main volume

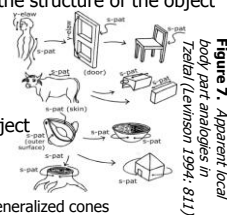


Figure 7. Apparent local body part analogies in Tzeltal (Levinson 1994: 811)

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Meronymy: background (cont.)

- research questions about meronymy
  - to what extent is it really possible across MA languages to label arbitrary parts generatively?
  - what is the distribution of global analogical mapping and shape-analytical algorithms across MA?
  - do these really exclude one another, as Levinson claims, or can they co-exist in one meronymy?
  - are the shape-based algorithms really non-metaphorical?

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## Meronymy: Tools and tasks

- picture book
  - human, animal and plant body parts
  - a set of artifacts identified through pictures in the elicitation manual
    - some customary in MA culture
    - some Western, with parts commonly identified functionally in Spanish
      - especially where the Spanish labels for these deviate from the labels predicted by geometry
  - task I: elicitation of part descriptors
  - task II: elicitation of locative descriptions w/ parts as ground
  - ideally w/ 10 speakers per language

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Tools and tasks (cont.)

- a set of plastic objects of unfamiliar shapes

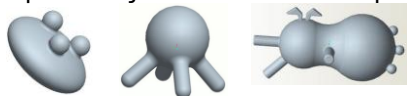


Figure 8. Some Novel Objects

- task I: referential communication; reference to parts
  - in each trial, one participant has an object with stickers attached to various parts in front of them
    - » while the other has an identical copy of the object w/o the stickers
  - the first speaker instructs the second speaker to put the stickers on the correct parts, identifying the parts in the process
  - to be carried out with five pairs of speakers
- task II: referential communication; placement wrt. parts
  - one participant per trial describes the location of color chips on, in, under, or near salient parts of each object
    - » so that the other can place a chip in the corresponding location wrt. their copy of the object
  - to be conducted with five pairs of speakers per language
  - the data will be analyzed both for the meronyms and for FoRs

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Meronymy: Tools and tasks (cont.)

- Yucatec participants
  - Picture book tasks: 7 speakers
    - six men and one woman in their thirties through sixties
  - Novel objects tasks: 5 pairs of speakers
    - five men and five women in their teens through sixties
    - two all-male dyads, two all-female dyads, and one married couple

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## Meronymy: Findings

- Yucatec meronymy involves a critical distinction between three semi-autonomous subsystems
  - for the labeling of **surfaces**, **volumes**, and **curvature extremes** (edges, corners, tips, etc.)
    - volume meronyms, but not surface and 'extreme' meronyms – can possess other meronyms

volumes	surfaces	extremes
<i>ho'l</i> 'pool head'	<i>áani'</i> bottom'	<i>pi'niit'</i> tip'
<i>ch'um</i> 'trunk'	<i>ich'il</i> 'inside'	<i>tu'k'</i> 'corner'
<i>ah'</i> 'anus'	<i>óok'ol</i> 'top'	<i>áat'</i> 'end'
<i>k'áal</i> 'neck'	<i>p'áach'</i> 'back'	
<i>k'áah'</i> 'hand/arm'	<i>áani'</i> 'foot'	
<i>na'k'</i> 'belly'	<i>á'et'</i> 'side'	
<i>ook'</i> 'ankle'		
<i>xba'et'</i> 'buttocks'		
<i>á'et'</i> 'ear'		

Table 1. Yucatec meronym classes

### Meronymy: Findings (cont.)

- only the subsystems for surface and curvature extreme naming are fully productive
  - volume naming shares many traits with the algorithm described by Levinson
    - yet, it is much more restricted with unfamiliar objects than surface and 'extreme' labeling
      - and often explicitly metaphorical

Table 2. Yucatec meronym classes and their properties

	volumes	surfaces	extremes
possession of other meronyms	deictic	does not occur	does not occur
'set'	not sharply defined, possibly open	closed	closed
productivity	limited by convention	fully productive	fully productive
use depends on orientation	no	yes	no
possession by descriptors of multi-volume entities	unrestricted	restricted	unrestricted
'projected region'	'bubble space'	'oriented region'	'bubble space'

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### Meronymy: Findings (cont.)

- volume meronyms are not nearly as productive as surface meronyms
  - during the *Novel Objects* sessions, body part terms played only a relatively minor role
    - except for *p'áach'* 'back'
  - objects 3 and 5-7 were said to have 'legs'
  - and 7 in addition for some speakers also has 'arms' and even a 'belly' and a 'head'
  - although the latter two assignments seem to be based on a local comparison to bottle gourds

Figure 9. Novel objects 3, 5-7; bottle gourd




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### Meronymy: Findings (cont.)

- in contrast, surface meronyms were used liberally in reference to all *Chunches*
- assignment of volume meronyms frequently involved similes and hedges
 

(5.11) *Ko'x a'l-ik u=k'ab*  
 HORT say-INC(B3SG) A3=arm(B3SG)  
 'Let's say (it's) his arm'


  - there is no evidence whatever that the assignment of surface meronyms was considered metaphorical
    - I expect the use of similes and hedges with surface meronyms to be anomalous - but didn't test this
- asked to name inanimate objects that have, e.g., 'heads' or 'bellies'
  - speakers quickly ran out of examples

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### Meronymy: Findings (cont.)

- there is a great deal of variation in these judgments
  - contrasting with a striking uniformity in surface labeling
- at the same time, there are important parallels to the algorithm Levinson proposed for Tzeltal
  - volume meronyms are assigned independently of the object's overall structure
    - e.g., a flashlight can be viewed as a 'leg' with a 'head' on one end and an 'anus' on the other
  - volume meronyms are assigned non-uniquely
    - objects can have multiple 'heads'...
      - e.g., hills with multiple tops
      - the 'head' of a village is its entrance, or the first house one passes when entering the village proper
        - » and a village can have as many of those as it has roads leading into it
    - ...and certainly an arbitrary number of 'arms', 'legs', 'ears'

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Meronymy: Findings (cont.)

- the evidence from volume meronyms suggests
  - that a shape-analytical algorithm as described by Levinson is not necessarily non-metaphorical
  - shape-analytical algorithmic mapping may be merely a *different kind of metaphorical mapping*
- surface meronyms are assigned fully productively
  - but, except for *pàach* 'back', cannot be assigned to humans or animals
    - but only to parts of their bodies – suggesting **surface meronyms are not body part terms**
  - the assignment of surface meronyms is likewise algorithmic, but based on a distinct algorithm
    - see the Appendix for details

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Meronymy: Findings (cont.)

- only surface meronyms project spatial regions that can be referenced in intrinsic or relative FoRs
  - volumes and extremes only occur as arguments of topological (i.e., orientation-free) place functions



Figure 11. Chunche #1

Figure 12. A Birdseye view of Chunche #1 and its projected spatial regions

Table 7. Surface meronyms and the expression of place functions

surface meronym	preferred construction for reference to projected region	gloss	preferred FoR for reference to regions	available alternative FoR
<i>òok'òl</i> 'top'	<i>òok'òl' t'òk'òl' t'òk'òl' t'òk'òl'</i> (NP)	'above'	topological	intrinsic
<i>tséel</i> 'side'	<i>tséel' t'òk'òl' t'òk'òl' t'òk'òl'</i> (NP)	'beside/outside'	intrinsic	relative
<i>pàach</i> 'back'	<i>pàach' t'òk'òl' t'òk'òl' t'òk'òl'</i> (NP)	'behind/outside'	intrinsic	relative
<i>tséel</i> 'side'	<i>tséel' t'òk'òl' t'òk'òl' t'òk'òl'</i> (NP)	'beside'	intrinsic	relative

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## Spatial FoRs: Tools and tasks

- linguistic tasks
  - referential communication:
    - Ball & Chair (B&C), to replace Men & Tree (M&T)
      - this new task/stimulus puts us in a position to assess preferences in the selection among all three types of FoRs
        - » in room-sized domains
        - » M&T effectively suppresses intrinsic choices for a variety of reasons

Figure 13. Layout of Men and Tree task (Pederson et al. 1998: 502)

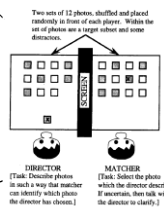


Figure 14. Two Ball & Chair pictures, featuring an intrinsic contrast

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Spatial FoRs: Tools and tasks (cont.)

- recall memory task: New Animals
  - a near-identical replication of the Animals In A Row (AIAR) design
    - of Levinson 1996 and Pederson et al. 1998

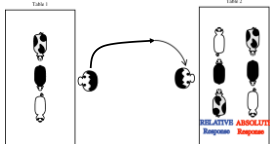


Figure 15. Layout of the AIAR memory recognition task

- minor differences: the toy animals used; the number of trials; ...

- big drawback: no intrinsic response pattern
  - during pilots in Buffalo, we tried to engineer one
    - but all our attempts would push *all* participants towards using intrinsic FoRs

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Spatial FoRs: Tools and tasks (cont.)

- Yucatec participants
  - Ball & Chair: 5 pairs of speakers
    - five men and five women in their teens through sixties
      - these are the same participants who also did the two Novel Objects (aka *Chunches*) tasks
      - all participants completed the Novel Objects tasks before doing B&C
  - New Animals: 18 speakers
    - eight male speakers in their teens thru sixties and ten female speakers in their teens thru forties
    - two of the male speakers' responses were excluded from analysis because of high error rates
      - these two produced wrong-animal or wrong-order responses in at least 50% of the trials
    - 7 of the 18 participants also did some of the other tasks
      - all of these did New Animals before any of the other tasks

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## Spatial FoRs: Findings

- FoRs in discourse: Ball & Chair
  - all five pairs of speakers used the relative FoR
    - but not necessarily the terms for 'left' and 'right'; see below
  - whereas only the first two dyads - the all-male dyads - used the absolute FoR
    - the third pair used it once
  - this in line with previous reports (Bohnermeyer & Stolz 2006; Le Guen ms.)
  - for the task of locating the Ball vis-à-vis the Chair, the intrinsic FoR is the most important
    - for all five pairs of speakers
    - this is likewise as predicted by previous work

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Spatial FoRs: Findings (cont.)

- when the direct is lumped with the intrinsic
  - as per Levinson's (1996) typology – see Appendix III
- the intrinsic can be considered the dominant FoR for this task

Figure 16. Response type frequencies in the Yucatec Ball & Chair data (fine-grained coding)

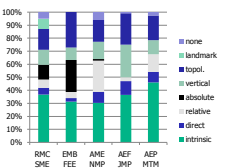
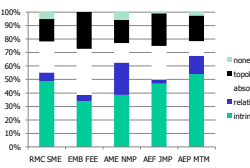


Figure 17. Response type frequencies in the Yucatec Ball & Chair data (course-grained coding)



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Spatial FoRs: Findings (cont.)

- for the task of orienting the Chair ...
  - where the intrinsic FoR plays for obvious reasons no role
    - except in the guise of landmark-based and direct reference
      - » which are considered intrinsic in Levinson's typology)
  - ...the five dyads are pretty much all over the place
    - the all-male dyads use absolute, landmark-based, and direct frames
    - with the married couple, the relative FoR dominates
    - the all-female dyads relied predominantly on the direct
- the use of cardinal direction terms *could* be a "genderlect" phenomenon in Yucatec
  - Bohnermeyer & Stolz 2006, Le Guen ms., and the present study all find a strong gender bias
  - however, there is no evidence that the use of cardinal direction terms is *interpreted* as expressing masculinity

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Spatial FoRs: Findings (cont.)

- "referential promiscuity"
  - use of all types of FoRs in table-top space is customary in the community
  - all adult speakers are extremely versatile and switching between different FoRs
    - and combining multiple FoRs in a single description

(7.1) T-u=**tséel**, te=x-**ts'iik** te-estée-le=**chik'in**=o'  
 PREP-A3=**side** PREP:DET=F-**left** PREP:DET-HESIT-DET=**west**=D2  
 hun-p'éeel b'òola yàan=i', ch'uy-k'ah-a'n (...)  
 one-CL.IN ball EXIST(B3SG)=D4 hang-MIDDLE-RES(B3SG)  
 'On (the Chair's) side, on the left in the, uh, the west, there is a ball, it is suspended (...)'



Figure 18. Ball & Chair 2.2

- predictions for New Animals task
  - no clear predictions
    - neither the relative nor the absolute FoR is linguistically dominant

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Spatial FoRs: Findings (cont.)

- FoRs in recall memory: New Animals

Table 5 - Cross-tabulation of participants (N = 16) by age group, gender, and predominant response type (at least three trials have to instantiate a particular type in order for that type to qualify as the predominant type for the participant; "mixed" means there was no dominant type)

Age group	Gender	Predominant response type				Total
		absolute	relative	unidirectional	mixed	
< 30	male	1	1	0	0	2
	female	3	0	0	1	4
≥ 30	male	3	0	2	0	5
	female	2	5	1	5	13
Total		9 (56.3%)	6 (32.5%)	3 (18.8%)	2 (12.5%)	16

- interpreting the response types
  - the "absolute" response type is produced by absolute, geocentric, and landmark-based FoRs
    - and by coincidence

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Spatial FoRs: Findings (cont.)

- "relative" responses are produced by relative and direct FoRs - and by coincidence
- intrinsic FoRs (in the narrow sense) are compatible with both response types
- "unidirectional" means the participant lined the animals up in the same direction in every trial

**Table 6** - Break down by trial. Unidirectional responders' responses are mixed in as "absolute" or "relative" since they are not manifest at the trial level

Age group	Gender	Responses in individual trials					Total
		absolute	relative	non-aligned	wrong order	wrong animal	
< 30	Male (N=2)	7	5	0	0	0	12
	Female (N=4)	17	1	3	2	1	24
≥ 30	male (N=5)	17	4	4	3	2	30
	female (N=5)	14	8	3	5	0	30
Total		55 (57.3%)	18 (19%)	10 (10.4%)	10 (10.4%)	3 (3.1%)	96

Spatial FoRs: Findings (cont.)

- non-aligned responses are "relative" in terms of facing direction and "absolute" in terms of order
  - or vice versa
  - each variant occurred five times
- the frequency of mixed, unidirectional, and non-aligned responses *could* be a reflex of intrinsic use
- there is no obvious effect of age or gender
- the "relative" response type is more marked and the "absolute" one more frequent
  - and widespread
  - than the B&C data predict on a Whorfian account
- but: there are arguably no clear "Whorfian" predictions for Yucatec
  - due to its "referential promiscuity" and the role of the intrinsic FoR

Spatial FoRs: Findings (cont.)

- Le Guen (ms.) finds the same discrepancy
  - based on evidence from a battery of tasks
    - conducted with a substantially larger population of participants (57)
  - he points out that the cardinal directions play a role in ritual practice and horticulture
    - that isn't quite reflected in their use in everyday linguistic interactions
  - however, this does not explain the uniformity of the responses across the adult population
    - Le Guen's account predict a strong gender effect in the non-linguistic data
      - » comparable to that in the linguistic data
      - contrary to fact

Spatial FoRs: Background (cont.)

- making sense of the meronymy-allocentrism hypothesis
  - productive geometrical meronymies *afford* the consistent use of intrinsic frames of reference
    - b/c the ability to consistently use intrinsic FoRs entails the ability to consistently reference object geometry
    - and/or object function
  - using relative FoRs in a language like Yucatec means assigning meronyms egocentrically
    - thus *overriding* the geometry of the object
    - this is always *possible* in Yucatec (contrary to Bohnermeyer & Stolz 2006!) - but always dispreferred
    - it seems that the availability of a productive geometrical meronymy boosts the salience of intrinsic interpretations
    - this may well be a *Thinking-for-Speaking* effect (Slobin 2003)

Spatial FoRs: Background (cont.)

- in contrast, productive meronymies do not affect the use of absolute FoRs
  - because geomorphic and absolute systems do not use meronyms and thus do not create a potential for clashes

## Overview

- MesoSpace
- Yucatec
- meronymy: background
- meronymy: tools and tasks
- meronymy: findings
- spatial FoRs: tools and tasks
- spatial FoRs: findings
- conclusions
- appendix I: assigning surfaces
- appendix II: projection
- appendix III: coding the B&C data



## Conclusions

- Yucatec has a productive geometric meronymy
  - like Tenejapa Tzeltal and Ayoquesco Zapotec
  - supporting the hypothesis that such meronymies are an areal feature of Mesoamerican languages
- novelty value – Yucatec meronymy has traits not attested in previously studied systems
  - in particular, the division into subsystems for volumes, surfaces, and curvature extremes
- good news and bad news for Levinson's (1994) non-metaphorical analysis
  - good news: the (fully productive) surface terms are not (used as) body part terms
    - with the exception of *pàach* 'back'

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### Conclusions (cont.)

- the intrinsic FoR is the most important FoR for expressing place functions among all speakers
- mixed news for the Whorfian interpretation of the results of Pederson et al.
  - good news: "relative" responses play a minor role in recall memory as the relative FoR does in discourse
  - not-so-good news: "absolute" responses far more pervasive than what seems predicted linguistically
  - but: no clear predictions anyway, due to "referential promiscuity" and the salience of the intrinsic FoR
- confirmed: productive geometrical meronymy aligns w/ dominance of the intrinsic FoR

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### Conclusions (cont.)

- bad news: volume labeling has all the signature traits of the algorithm Levinson described for Tzeltal
  - and yet is not fully productive and frequently involves hedges and similes
    - suggesting algorithmic mapping is not necessarily non-metaphorical
- referential promiscuity and the dominance of the intrinsic FoR
  - the Ball & Chair data confirm
    - all three types of FoRs of the Levinson classification are used commonly and frequently in table top space
    - speakers routinely switch between FoRs or combine multiple FoRs in their descriptions
    - in terms of distribution over speakers, the relative FoR is more widespread than the use of the cardinal directions
      - the latter are mostly restricted to (adult or older adolescent) male speakers

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## References

- Bohnermeyer, J. & Stolz, C. (2006). Spatial reference in Yucatek Maya: a survey. In S. C. Levinson & D. P. Wilkins (eds.), *Grammars of Space*. Cambridge: Cambridge University Press. 273-310.
- Campbell, L. 1979. Middle American languages. In L. Campbell & M. Mithun (eds.), *The languages of Native America: Historical and comparative assessment*. Austin, TX: University of Texas Press. 902-1000.
- Campbell, L., Kaufman, T., & T. C. Smith-Stark. 1986. Meso-America as a linguistic area. *Language* 62(3): 530-570.
- Carlson-Radvansky, L. A. & D. A. Irwin. 1993. Frames of reference in vision and language: Where is above? *Cognition* 46: 223-244.
- Daziger, E. in press. Deixis, gesture and spatial frame of reference. *Studies in Language*.
- Danziger, E. & E. Pederson. 1998. Through the looking glass: Literacy, writing systems, and mirror image discrimination. *Written Language and Literacy* 1: 153-164.
- Gentner, D. 1983. Structure-mapping: A theoretical framework for analogy. *Cognitive Science* 7: 155-170.
- Gordon, R. G. Jr. 2005. *Ethnologue: Languages of the World, Fifteenth Edition*. Dallas, TX: SIL International. Online version: <http://www.ethnologue.com>.
- Heine, B. 1997. *Cognitive foundations of grammar*. Oxford: Oxford University Press.
- Jackendoff, R. S. 1983. *Semantics and cognition*. Cambridge, MA: MIT Press.
- Kaufman, T. 1973. Areal linguistics and Middle America. In T. A. Sebeok (ed.), *Current trends in linguistics. Vol. 11: Diachronic, areal, and typological linguistics* (H. M. Hoenigswald and R. E. Longacre, associate eds.), The Hague etc.: Mouton. 459-483.
- Landau, B. & R. S. Jackendoff. 1993. 'What' and 'where' in spatial language and spatial cognition. *Behavioral and Brain Sciences* 16: 217-265.

### References (Cont.)

- Le Guen, O. Ms. Culture in cognition: Geocentric representation of space among the Yucatec Maya. Manuscript, Max Planck Institute for Psycholinguistics.
- Levelt, W. J. M. 1984. Some perceptual limitation on talking about space. In A. van Doorn, W. van de Grind, and J. Koenderink (Eds.), *Limits of perception: Essays in honour of Maarten A. Bouman*. Utrecht: VNU Science Press. 323-358.
- Levelt, W. J. M. 1996. Perspective taking and ellipsis in spatial descriptions. In P. Bloom, M. A. Peterson, L. Nadel, & M. F. Garrett (eds.), *Language and space*. Cambridge, MA: MIT Press. 77-107.
- Levinson, S. C. 1994. Vision, shape, and linguistic description: Tzeltal body-part terminology and object description. In S. C. Levinson & J. B. Haviland (eds.), *Space in Mayan languages*. Special issue of *Linguistics* 32 (4): 791-856.
- Levinson, S. C. 1996. Frames of reference and Molyneux's Question: Crosslinguistic evidence. In P. Bloom, M. A. Peterson, L. Nadel, & M. F. Garrett (eds.), *Language and space*. Cambridge, MA: MIT Press. 109-169.
- Levinson, S. C. 2003. *Space in language and cognition*. Cambridge: Cambridge University Press.
- Levy, P. 1992. Body-part prefixes in Papantla Totonac. In L. de León & S. C. Levinson (eds.), *Spatial description in Mesoamerican languages*. Special issue of *Zeitschrift für Phonetik, Sprachwissenschaft und Kommunikationsforschung* 45 (6): 530-542.
- Li, P., & L. Gleitman. 2002. Turning the tables: Language and spatial reasoning. *Cognition* 83: 265-294.
- MacLaury, R. E. 1989. Zapotec body-part locatives: prototypes and metaphorical extensions. *International Journal of American Linguistics* 55: 119-154.

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### References (Cont.)

- 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.
- Marr, D. 1982. *Vision*. New York: Freeman.
- Pederson, E., Danziger, E., Wilkins, D., Levinson, S., S. Kita & Senft, G. (1998). Semantic typology and spatial conceptualization. *Language* 74: 557-589.
- Pérez Báez, G. In press. Adnominal spatial relators in locative constructions in Juchiteco. In S. H. Sonnenschein & B. L. Lillehaugen (eds.), *Expressing location in Zapotec*. Munich: LINCOM.
- Piaget, J. & B. Inhelder. 1956. *The child's conception of space*. London: Routledge and Kegan Paul.
- Romero Méndez, R. 2008. *A descriptive grammar of Ayutla Mixe (Tukyo'm Ayuujk)*. Doctoral dissertation, University at Buffalo – SUNY.
- Sinha, C. and Jensen de López, K. 2000. Language, Culture and the Embodiment of Spatial Cognition. *Cognitive Linguistics* 11(1-2): 17-41.
- Slobin, D. I. 2003. Language and thought online. In D. Gentner & S. Goldin-Meadow (eds.), *Language in mind*. Cambridge, MA: MIT Press. 157-192.
- Smith-Stark, T. C. 1994. Mesoamerican calques. In C. Mackay & V. Vázquez (eds.), *Investigaciones lingüísticas en Mesoamérica*. Mexico City: Instituto de Investigaciones Filológicas, Universidad Nacional Autónoma de México. 15-50.
- Svorou, S. 1994. *The grammar of space*. Amsterdam; Philadelphia: John Benjamins.
- Terrill, A. and N. Burenhult. 2008. Orientation as a strategy of spatial reference. *Studies in Language* 32.1.

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## Appendix I: Assigning surfaces

- the assignment of surface meronyms appears to be likewise based on a Levinsonian algorithm
  - if a volume has only a single surface, that surface is its 'back'
    - the entire skin of an avocado is its 'back'
      - as is the bark of a tree
      - there is a separate term that means 'peel' or 'bark'
        - which remains applicable even when the peel/bark is no longer attached to the fruit/tree, which 'back' of course does not
    - the outer surface of baskets and jugs are their 'backs'
  - if a volume has two surfaces, one convex and one planar or less convex
    - think of a cylinder - ignoring its circular surfaces at the 'ends' for the moment - that has been "squashed" on one side
      - or cut in half parallel to the generating axis
    - the more convex side is the 'back' and the less convex one the 'front'

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Appendix I: Assigning surfaces (cont.)

- if a volume has two surfaces and an edge
  - like a table top, a piece of paper, a coin, the body of a hammock, etc.
  - there are a number of possible solutions
    - if both surfaces are flat, both can be 'fronts'
    - alternatively, if the object has a canonical vertical orientation, one surface can be the 'top'
      - and the other the 'bottom'
- in the case of flat curved objects like a comal, a hammock, or a spoon
  - the convex side is the 'back' or the 'bottom'
  - and the concave side can be the 'front', the 'top', or the 'inside'
    - the hammock can be said to have an 'inside' and a 'bottom'

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Appendix I: Assigning surfaces (cont.)

- the spoon an 'inside' and a 'back'
- and the comal a 'front' and a 'bottom' or 'back'
- there is variation in judgments here
  - some prefer one solution or the other, others consider multiple solutions equally acceptable
- if a volume has two flat and one convex surfaces
  - a cylinder, or for example the first of the *Chunches*
    - the convex surface is the 'back' and the planar surfaces are 'top' and 'bottom'
    - if the volume is canonically oriented in the vertical such that the two surfaces wind up in the appropriate places
    - and 'sides' otherwise
- 'sides' are assigned by the remainder principle



Figure A1. Chuncha #1 57

Appendix I: Assigning surfaces (cont.)

- reference to parts does not seem to depend much on the object's *actual* orientation at all
- for parts - unlike for projected regions - there is no uniqueness requirement
  - in principle, an object can have an arbitrary number of 'backs', 'fronts', and so on
  - an example of an object with two 'backs' is a cylinder squashed along the generating axis
    - at opposite sides so that the two resulting convex surfaces are more salient than the two concave ones
      - sort of the inverse of the fourth of the *Chunches*
    - if the two convex surfaces are roughly symmetrical, they are both 'backs'



Figure A2. Cross-section of an object with two 'backs'

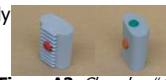


Figure A3. Chuncha #4

## Appendix II: Projection

- next up: the role meronyms play in reference to spatial **regions**
  - in the expression of the kind of **place functions** (Jackendoff 1983)
    - whose interpretation depends on **spatial frames of reference** (FoRs)
      - i.e., place functions that map referential or **ground objects** into "quadrants" of coordinate systems defined with respect to them
    - as opposed to orientation-free "**topological**" (Piaget & Imholder 1956) place functions
  - how does the shape and the labeling of projected regions interact with the meronymy?
    - consider for an introductory example again the first of the *Chunches*



Figure A4. Chuncha #1 59

Appendix II: Projection (cont.)

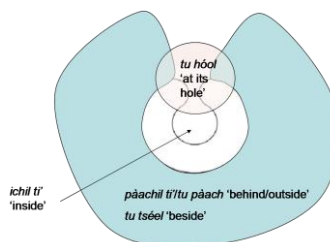


Figure A5. A Birdseye view of Chuncha #1 and its projected spatial regions

- the entire convex outside surface is both the 'back' (*paaeh*) and the 'side' (*tsel*) of the object
  - so the entire region represented by the blue shape in the figure can be referred to
    - either as *paaeh-il ti'* (NP) back-REL PREP (NP) 'behind/outside (NP)',
      - t-u=paaeh* (NP) PREP-A3=back (NP) 'behind/outside (NP)',
      - or *t-u=tsel* (NP) PREP-A3=side (NP) 'beside (NP)'

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Appendix II: Projection (cont.)

- the aperture can be labeled with a variety of more or less ad-hoc volume meronyms
  - including for example *hóol* 'hole' (from the verb root *hol* 'perforate')
- if this volume meronym heads the complement of the generic preposition *ti'*
  - the resulting ground phrase *t-u=hóol (NP)* PREP-A3=hole (NP) describes a region defined by proximity to the opening
  - a "bubble space"
- bubble spaces
  - the construction *ti' POSS=N<sub>M</sub> (NP)*...
    - where *ti'* or *t-* is the generic preposition and *N<sub>M</sub>* the meronym
  - ...is available for all meronyms (except for *ich(il)* 'in(side)')
    - not just the volume meronyms
  - it does not distinguish between projected regions and surface contact

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Appendix II: Projection (cont.)

- for example *t-u=páach* can be used both for a mosquito in the air behind a person and for one sitting on their back feeding
- but for volume and "extreme" meronyms, this construction is the only one available
  - whereas all the surface meronyms except for *tséel* 'side' have alternative constructions
    - » which are preferred for reference to projected regions
- I do not think that there are separate "logics" for the projection of oriented regions and "bubble spaces"
- I suspect this distinction is simply an artifact of the same "logic" interacting with the distinct geometrical properties
  - of surfaces vs. volumes and "extremes"
- implications
  - surface meronyms are *the* lexical resource for reference to "oriented regions" in Yucatec

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Appendix II: Projection (cont.)

- the expressions in the second column of the table below are the only or the most frequent expression
  - of the meanings represented in the middle column
- this groups Yucatec together with Tzeltal and Zapotec
  - and distinguishes it from Spanish and English and other European languages
    - » where orientation-dependent place functions are expressed by adpositions that may etymologically relate to meronyms
    - » but do not synchronically involve them

**Table A1.** *Surface meronyms and the expression of place functions*

surface meronym	preferred construction for reference to projected region	gloss	preferred FoR for reference to regions	available alternative FoR
<i>áanál</i> 'bottom'	<i>áanál (NP)</i>	'below'	absolute	intrinsic
<i>ichil</i> 'inside'	<i>ich'il ti' (NP)</i>	'in(side)'	topological	
<i>óok'ól</i> 'top'	<i>óok'ól (NP)</i>	'on/above'	absolute	intrinsic
<i>páach</i> 'back'	<i>páach-il ti' (NP)</i>	'behind/pút side'	intrinsic	relative
<i>táan</i> 'front'	<i>táan-il ti' (NP)</i>	'in front of/on'	intrinsic	relative
<i>tséel</i> 'side'	<i>ti' #tséel (NP)</i>	'beside'	intrinsic	relative

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Appendix II: Projection (cont.)

- the shape of the projected regions in intrinsic FoRs depends on the language-specific logic
  - of the meronym system
    - the example of the 'back'/side' region of the horseshoe *Chunche* illustrates this well
- "normalization"
  - the regions intrinsically referred to using the expressions in the second column of the table
    - are generally the regions geometrically projected from the parts named by the corresponding meronyms
  - there are a number of important exceptions
    - the intrinsic 'back' region of animals is not the region geometrically projected from the 'back' part
      - but rather the one opposite the 'front' region
      - the region above the 'back' part is referred to using *óok'ól* 'top'

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Appendix II: Projection (cont.)

- » both interpretations are available with the "general purpose" construction *tu=páach*
- » whereas the specific surface meronym construction *páachil ti'* only permits the interpretation familiar from European languages
- in the case of objects that have a canonically horizontal *táan* 'front'
  - » such as tables, altars, chairs, comales, and many more
  - *t-u=táan* is used for surface contact
  - but the region geometrically projected from the surface is exclusively referred to using *óok'ól* 'top'
    - » if the object has an intrinsic horizontal front *part* in addition to the horizontal surface (e.g., altars)
      - » *táanil ti'* will refer to that region
      - » otherwise, *táanil ti'* is used relatively
- both of these exceptions follow the same rationale
  - the region above the object in canonical orientation is always designated by *óok'ól*
    - whether or not there is a corresponding 'top' surface

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Appendix II: Projection (cont.)

- something similar happens in the horizontal
  - humans and animals project an intrinsic front region designated by *táan-il ti'*
    - the region in which they face in canonical orientation
    - even though they lack a part that can be identified as *u=táan* 'their front'
- so there is a sense in which projection relies on a "fixed armatures" logic
  - similar to what Levinson (2003) attributes to Zapotec
- however
  - the Yucatec system relies on fixed armatures only for projection, not for part labeling
  - the regions projected geometrically from parts named by using *páach* 'back' or *tséel* 'side' are "normalized"
    - in the vertical but not in the horizontal - as per the horseshoe example

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## Projection (cont.)

- the “fixed armatures” of Yucatec are still intrinsic
  - in the sense that they only depend on the object’s canonical orientation, not on its actual one
  - the vertical terms *dokol* ‘top’ and *áanal* ‘bottom’ are used intrinsically in reference to projected regions in Yucatec
    - » although the absolute use based on the object’s actual orientation in the Earth’s gravitational field appears to be the preferred one
- the \$64,000 question
  - does the availability of a productive shape-based meronymy favor the use of the intrinsic FoR?
  - for Yucatec, the case can be made
    - the terms used for reference to oriented regions are based transparently on meronyms
    - and these meronyms are applied fully productively to arbitrary objects on the basis of their geometry.
      - the “normalization” of the front and back regions does not reduce the validity of this analysis

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## Appendix II: Projection (cont.)

- » since it only applies to exceptional cases which are themselves defined in geometrical terms
- the apparent predominantly absolute use of the terms for the top and bottom regions only strengthens the case
  - » since the use of these terms is *not* based on the geometry of the object
    - » *any* object has ‘top’ and ‘bottom’ regions regardless of whether it has a ‘top’ part, a ‘head’ part, or neither
      - » as in the case of containers of liquids

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## Appendix III: Coding the B&amp;C data

- **absolute** - exclusively for the cardinal direction terms
- **direct** - (Danziger in press)
  - for descriptions in which the body of speaker/addressee serve as both “anchor” and ground
    - e.g., ‘in your direction’ or ‘on your left’, referring to the side of the picture closest to the addressee’s left hand
- **intrinsic** – the design of B&C makes it generally possible to distinguish intrinsic from relative uses
  - however, cases in which the same term can describe the same configuration intrinsically and relatively exist
    - e.g., if the Ball is at the intrinsic back of the Chair while the Chair is turned with its front towards the observer
      - » it’s impossible to tell whether ‘behind the Chair’ is used intrinsically or relatively
  - I coded such responses as intrinsic

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## Appendix III: Coding the B&amp;C data (cont.)

- **landmark-based** – ad hoc landmarks used as points of reference
  - the fan, window, me, the volleyball *cancha* outside
  - a special case of intrinsic reference in Levinson 1996
  - however, if the landmark is the “anchor” but not the ground
    - » e.g., if a landmark is used to locate the Ball wrt. the Chair
      - then landmark-based systems do in fact pattern with absolute systems in terms of their logical (“rotational”) properties
- **relative** - the most frequent use of the relative FoR was not with ‘left’ and ‘right’
  - but with ‘front’, ‘back’, and ‘side’
  - the distinction between direct and relative uses of ‘left’ and ‘right’ is subtle

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## Appendix III: Coding the B&amp;C data (cont.)

- **topological** - i.e., no FoR involved
- **vertical** - apparently all Yucatec speakers use ‘top’/‘above’ and ‘bottom’/‘below’ intrinsically
  - as well as with respect to the gravitational vertical
  - I coded the first type of use as ‘intrinsic’ and the second as ‘vertical’
  - in Levinson’s typology, the gravitational vertical is an absolute FoR
    - I treat it as a category apart since it clearly does not pattern with other absolute FoRs in terms of its cross-linguistic distribution

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