Overview

- FoRs and MesoSpace
- FoRs in Seri and Yucatec
- FoRs and vectors
- FoRs reclassified
- summary

FoRs and MesoSpace

- **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)
    - Tseltal (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; N. H. Green; S. Hernández-Gómez)
  - Juchitán 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*

- 3 controls
  - **Seri (C. O'Meara)**
  - Mayangna (E. Benedicto, A. Eggleston in collaboration with the Mayangna Yulbarangyang Balna)
  - Mexican Spanish (R. Romero Méndez)
- 2 (interrelated) domains
  - **FoRs** and **meronyms** – labels for parts of entities
    - including, but not restricted to, *body part metaphors*

Figure 2. The *MesoSpace team (minus V. Peralta and R. Tucker)*

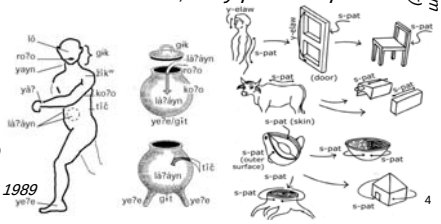


Figure 3. *Meronyms in Ayoquesco Zapotec (left) and Tenejapa Tseltal (adapted from MacLaury 1989 and Levinson 1994)*

- the MesoSpace tool for studying FoR use in discourse: the Ball & Chair pictures
  - 4 x 12 photos of configurations of a ball and chair for picture-to-picture matching
    - photographs of real objects
    - no animate entities
    - clear figure-ground asymmetry
      - Ball = unfeatured -> prototypical figure
      - Chair = highly featured -> prototypical ground
  - items differ in terms of
    - disposition of Chair (standing, lying on side, upside down)
    - horizontal orientation of Chair
    - location of Ball vis-à-vis Chair (or the floor)

Figure 4. *Set 3 of Ball & Chair*

- identifying FoRs in the data
  - Levinson's (1996) classification entails
    - that the three types of FoRs differ in the entity/feature on whose orientation they depend
      - the ground – intrinsic FoRs; the observer – relative FoRs; an entity or feature in the environment – absolute FoRs
    - we call this entity the **anchor**, following Danziger 2010

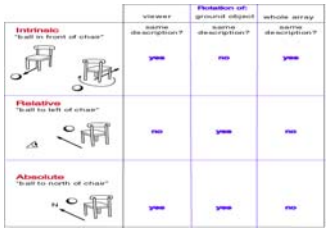


Figure 5. *Orientation dependencies as diagnostics in the classification of FoRs (Levinson 1996: 149)*

- the MesoSpace team cooks up trouble for the Levinson classification

(1.1)	…ziix	c-oqueht	quij	hant	com	
SER	thing	SBJ.NMLZ-bounce	DEF.ART.SG.sit	land	DEF.ART.SG.lie	
	i-ti	t-iij	ma,	haco	mos	**iglesia**
	3POSS-on	REAL.DEP-sit	SR	already	again	church
	cop		**i-icp**	**hac**		i-icp
	DEF.ART.SG.stand		3POSS-side	DEF.ART.SG.LOC		3POSS-side
	t-iij…					
	REAL.DEP-sit					

'…the ball (lit. thing that bounces) is on the ground, again, it is **on the side of the church**…'

Figure 6. *Ball & Chair 2.12*

  - the truth conditions of (1.1) depend neither on the orientation of the chair
    - nor on that of the church
- what's going on here?
  - what kind of FoR, if *any*, *is* this?

- our argument
  - (1.1) involves a previously unrecognized fourth type of FoR – **head-anchored** FoRs
  - the proper classification of (1.1) presupposes an in-depth look at the role FoRs play
    - not just in locative descriptions, but also in **orientation descriptions**
  - the critical notion that bridges between these uses is that of **vectors**
  - we base our discussion on MesoSpace data from Seri and Yucatec

Overview

FoRs in Seri and Yucatec

- we ran the Ball & Chair (B&C) task with five pairs of speakers per language
  - in the following, we are drawing on a corpus of
    - 5x4x12 = 240 picture descriptions for Yucatec
    - 215 picture descriptions for Seri
      - 240 descriptions were recorded for Seri, but only 216 have been transcribed and coded to date
        - » and of these, one is disregarded here as apparently incorrect
- all descriptions locate the Ball and almost all in addition orient the Chair

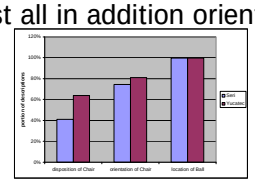


Figure 7. *Types of predication by frequency in the Seri and Yucatec Ball & Chair descriptions*

- describing the location of the Ball
  - the conceptually simplest locative descriptions are **topological** (Piaget & Inhelder 1956)
    - these are perspective-free, employing no FoR
    - 47% of Seri locative descriptions and 22% of Yucatec locative descriptions contain topological predications

(2.1)	(…) **i-hiin**	**hac** ,	ziix		
SER	3POSS-near	DEF.ART.SG.LOC	thing		
	c-oqueht	quij	i-ti	m-iij.	
	SBJ.NMLZ-bounce	DEF.ART.SG.sit	3POSS-on	RP-sit	

'(…) the ball (lit. thing that bounces) is **near it** [the chair].'

Figure 9. *Ball & Chair 2.12*

(2.2)	(…) te'l	**tu'x**	**k-u=kutal**	**máak=o', te=lu'm=o',**		
YUC	DADV	where	IMPF-A3=sit-INCH.INC	person=D2	PREP:DET=earth=D2	
	hun-p'éel	bòola	pek-ekbal	**hachtu=tu'k'=o'.**		
	one-CL.IN	ball	lie.as.if.dropped-DIS(B3SG)	really	PREP:A3=corner=D2	

'(…) there where one sits, **on (lit. with respect to) the ground**, a ball is lying, **right at its corner**.'

Figure 8. *Ball & Chair 2.6*

  - intrinsic FoRs
    - these occur in 18% of Seri descriptions and 37% of Yucatec descriptions

(2.3)	(…) **i-pac**	**i-icp**	**hac**,	i-toaa	i-icp	
SER	3POSS-back	3POSS-side	DEF.ART.SG.LOC	3POSS-foot	3POSS-side	
	hac	hi-ic	c-aap	cap		
	DEF.ART.SG.LOC	1.POSS-side	SBJ.NMLZ-stand	DEF.ART.SG.stand		
	ha ziix	c-oqueht	quij	i-ti	y-iij.	
	FOC thing	SBJ.NMLZ-bounce	DEF.ART.SG.sit	3POSS-on	DP-sit	

'(…) the ball is **behind it** [the chair] and on the side of the leg that is on my side.'

(2.4)	(…)tu=tséel=i',	bwèeno,	**tu=pàach**		
YUC	PREP:A3=side=D4	well	PREP:A3=back		
	te'l	tu'x	k-u=nak-tal	máak=o'	
	DADV	where	IMPF-A3=lean-INCH.DIS	person=D2	

'(…) on its side, well, **behind where one sits**'

Figure 10. *Ball & Chair 2.11*

– relative FoRs
  - these occur in 10% of Yucatec descriptions, but play only a negligible role in Seri

(2.5) Ti'=pek-kun-a'n
PREP=lie.as.if.dropped-CAUS-RES(B3SG)
hun-p'éel chan=bòola=i' **tu=tséel**=e'
one-CL.IN DIM=ball=D4 PREP:A3=side=D3
'There lies a little ball, **on (the chair's) side**.'

Figure 11. *Ball & Chair 2.11*

– absolute FoRs
  - both languages employ absolute FoRs in the horizontal
    – Seri has terms based on directions of prevailing winds
    – Yucatec has terms based on the sunrise/sunset
  - 8% of Yucatec locative descriptions used cardinal terms
    – as compared to a mere 1% of Seri descriptions

(2.6) Te'l **chik'in**=o', náats' te=lu'm=o',
YUC DADV west=D2 near(B3SG) PREP:DET=earth=D2
ti'=pek-ekbal hun-p'éel chan=bòola=i'.
PREP=lie.as.if.dropped-DIS(B3SG) one-CL.IN DIM=ball=D4
'There **in the west**, close by on the ground, there is lying a little ball.'

Figure 12. *Ball & Chair 3.12*

– in addition, 13% of Seri descriptions and 15% of Yucatec descriptions employed the absolute (= gravitational) vertical

– **and then there is the new 'head-anchored' type**
  - accounting for 17% of Seri locative descriptions and 8% of Yucatec locative descriptions
  - the descriptions may be 'anchored' to the speakers and/or addressee's body
    – without the truth conditions of the description depending on the orientation of the speaker/addressee
      » unlike in a relative FoR

(2.7) (…) cmaax ziix c-oqueht quij
SER now thing SBJ.NMLZ-bounce DEF.SG.ART.sit
hi-icp **hac** **ah** **i-ic** m-iij.
1.POSS-side DEF.ART.SG.LOC FOC 3POSS-side RP-sit
'(…) and now the ball (lit. thing that bounces) is **on my side**.'

Figure 13. *Ball & Chair 3.10*

(2.8) Te=pàarte **t-ak=tòoh-il-o'n** **bèeyhe'x** **kul-ik-o'n**
YUC PREP:DET=part PREP-A1PL=straight-REL-B1PL thus how sit-EXFOC-B1PL
bèey=a', ti'=pek-a'n te=lu'mo' hun-p'éel bòola
thus=D1, PREP-lie.as.if.dropped-RES(B3SG) PREP=earth=D2 one-CL.IN ball
'**In the part in our direction the way we are sitting like this**, there is a ball lying on the ground'

  - or the description may be anchored to some "landmark" entity in the environment
    – without the orientation of that entity affecting the truth conditions of the description
      » unlike in absolute (e.g., upriver/downriver or uphill/downhill) FoRs

(2.9) …ziix c-oqueht quij hant com
SER thing SBJ.NMLZ-bounce DEF.ART.SG.sit land DEF.ART.SG.lie
i-ti t-iij ma, haco mos **iglesia**
3POSS-on REAL.DEP-sit SR already again church
cop **i-icp** **hac** i-icp
DEF.ART.SG.stand 3POSS-side DEF.ART.SG.LOC 3POSS-side
t-iij…
REAL.DEP-sit
'…the ball (lit. thing that bounces) is on the ground, again, it is **on the side of the church**…'

Figure 14. *Ball & Chair 2.12*

- describing the orientation of the Chair
  – the Yucatec speakers used cardinal direction terms and relative FoRs to orient the Chair
    - in 20% and 15% of descriptions, respectively

(2.10) (…) le=pàarte tu'x k-u=kutal máak=o'
YUC DET=part where IMPF-A3=sit:INCH.INC person=D2
chik'in **súut-ul** (…)
west turn\MIDDLE-INC(B3SG)
'(…) the part where one sits, it's **turned west** (…)'

Figure 16. *Ball & Chair 3.9*

(2.11) (…)u=ho'l le=sìiya=o', estéen,
YUC A3=head DET=chair=D2 HESIT
x-no'h **súut-ul**
F-right(B3SG) turn\MIDDLE-INC(B3SG)
'(…) the backrest (lit. head) of the chair, it's **turned right**'

Figure 17. *Ball & Chair 1.12*

– this shows that orientation descriptions, like locative descriptions, are interpreted in FoRs

– but most orientation descriptions are parallel to the 'head-anchored' type of locative descriptions
  - 63% of Seri descriptions and 58% of Yucatec descriptions reference the speaker's and/or addressee's body
    – but without their truth conditions depending on the orientation of the speaker's/addressee's body, unlike in relative descriptions

(2.12) Hehe i-ti iquiicolim quij
SER wood 3POSS-on OBL.NMLZ.ABS.POSS.sit.PL DEF.ART.SG.sit
hi-iqui **t-ipac** **ma** (…)
1.POSS-toward REAL.DEP-back SR
'The chair (lit. wood one sits on) **has its back to me** (…)'

(2.13) Tu'x k-u=nak-tal máak=o',
YUC where(B3SG) IMPF-A3=lean.against-INCH.INC person=D2
estée **ta=frèente** súut-ul
HESIT PREP:A2=front turn\MIDDLE-INC(B3SG)
'The back (lit. where one leans against), uh, it's turned **towards your front**.'

Figure 18. *Ball & Chair 2.5*

FoRs in Seri and Yucatec (cont.)

- 33% of Seri and 7% of Yucatec descriptions orient the chair vis-a-vis some external landmark
  - again without their truth conditions depending on the orientation of the landmark, unlike in absolute descriptions

(2.14) SER

Hehe i-ti	iquiicolim		quij
wood 3POSS-on	OBL.NMLZ.ABS.POSS.sit.PL		DEF.ART.SG.sit
Xpanohax	**i-icp**	**hac**	**i-iqui**
Puerto.Libertad	3POSS-side	DEF.ART.SG.LOC	3POSS-toward
t-iizc (...)			
REAL.DEP.face			

'The chair (lit. what one sits on) is **facing Puerto Libertad** (...)'

Figure 19. *Ball & Chair 2.10*

(2.15) YUC

(...)u=frèente	tu'x	k-u=kutal	máak=o',
A3=front	where	IMPF-A3=sit:INCH.INC	person=D2
tu=tòoh-il		**le=kàancha=o'**	
PREP:A3=straight-REL		DET=court=D2	

'(...) its front where one sits, it's **in a straight line with respect to the volleyball court**.'

Figure 20. *Ball & Chair 4.12*

- overall, 96% of orientation descriptions in Seri and 65% in Yucatec are "head-anchored"

FoRs in Seri and Yucatec (cont.)

- comparison: locative vs. orientation descriptions

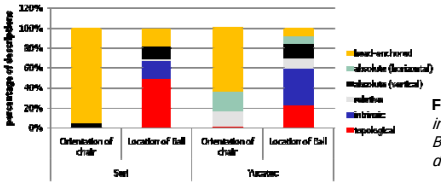


Figure 21. *FoR use in Seri and Yucatec Ball & Chair descriptions*

  - the 'head-anchored' type dominates in orientation descriptions
    - but plays only a minor role in locative descriptions
  - intrinsic FoRs play a major role in locative descriptions, but none in orientation descriptions
  - what's going on here?

FoRs in Seri and Yucatec (cont.)

- interim summary
  - orientation descriptions, like locative descriptions, may be interpreted with respect to FoRs
    - e.g., in Yucatec, they may employ cardinal direction terms and 'left'/'right' terms in relative interpretation
  - both locative and orientation descriptions may be 'head-anchored'
    - i.e., their 'anchor' is an entity whose orientation does not affect their truth conditions
      - so they appear to fall outside Levinson's 1996 classification
  - but the preferred types of FoRs differ between locative and orientation descriptions
    - the head-anchored type dominates in orientation descriptions, but plays a small role in locative descriptions
    - intrinsic FoRs are important in locative descriptions, but play apparently no role in orientation descriptions

Overview

- FoRs and MesoSpace
- FoRs in Seri and Yucatec
- FoRs and vectors
- FoRs reclassified
- summary

FoRs and vectors

- semantic primitives for the representation of orientation and direction of motion: **vectors**
  - cf. Bohnemeyer 2003; O'Keefe 1990, 1996, 2003; Zwarts 1997, 2003; Zwarts & Winter 2000
  - contra Jackendoff 1983, who treats orientation in terms of metaphorical motion paths

FoRs and vectors (cont.)

- representing orientation
  - objects are oriented by aligning any unique semiaxis with a suitably determined vector
    - in English, Seri, and Yucatec, the default is the front semiaxis

(3.1) (*The back/left of*) *the chair is facing me/the door*

(3.2)

Orientation: any vector $\vec{a}$ defines the orientation of an object iff
(i) the tail of $\vec{a}$ is the center of the object,
(ii) $\vec{a}$ is collinear with one of the object's semiaxes and pointing outward.
By default, $\vec{a}$ is collinear with the object's front semiaxis.

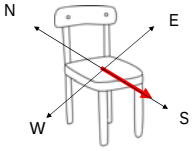


Figure 22. *Chair, facing south*

- two ways of defining vectors
  - in terms of an ordered pair of places (head and tail)
    (3.3) *The chair is facing the door*
  - in terms of an ordered pair of a place (tail) and an *angle*
    - between the vector and **the axis of some coordinate system = FoR**
      - by default, this angle is 0°
    (3.4) *The chair is facing (35°) S(SE)/right*

Figure 23. *Chair, facing door*

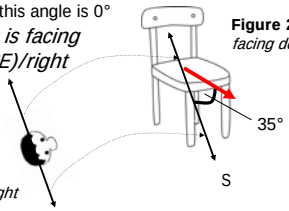


Figure 24. *Chair, facing (35°) S(SE)/right*

- FoRs in orientation descriptions
  - the axes of a relative or absolute FoR may be transferred onto the ***figure*** in order to orient it
    - the same way they would be transferred onto a ***ground*** entity in order to locate a figure with respect to it
    (3.5) *The chair is facing (35°) S(SE)/right/downriver*
    (3.6) *The ball is (35°) S(SE)/right/downriver of the chair*

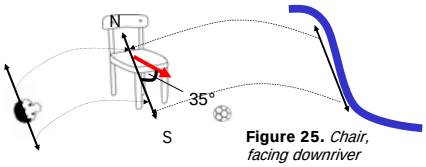
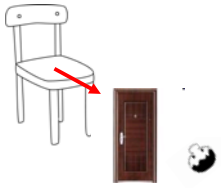


Figure 25. *Chair, facing downriver*

  - the alternative way of defining an orientation vector: instead of its angle, determine its head
    - as the location of an observer or a landmark
    - this is what constitutes head-anchored descriptions
    (3.7) *The chair is facing the door/us*
    - the conceptual simplicity of this kind of description may account for its frequency
      - 96% of orientation descriptions in Seri and 65% in Yucatec instantiate this type

Figure 26. *Chair, facing door/observer*



  - how does one know that this type of description involves any FoR at all?
    - because such descriptions imply the logical power of FoRs!
    - any vector has the power to partition space into regions which may serve as the "quadrants" of a FoR
    - head-anchored locative descriptions precisely tap into this potential
    (3.8) a. *The ball is towards the door/us from the chair*
    b. *The ball is away from the door/us with respect to the chair*
    (3.9) a. *The ball is on our side/the door's side of the chair*
    b. *The ball is on the other side of the door/us from the chair*

    - descriptions such as (3.8)-(3.9) involve a partitioning of space along a plane perpendicular to the vector
      » which runs through the center of the ground (the chair)
    - and a distinction between the region that contains the vector and the one that doesn't
    (3.8) a. *The ball is towards the door/us from the chair*
    b. *The ball is away from the door/us with respect to the chair*
    (3.9) a. *The ball is on our side/the door's side of the chair*
    b. *The ball is on the other side from the chair*

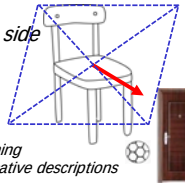
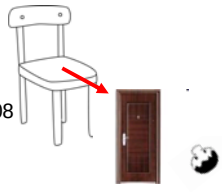


Figure 27. *Vector partitioning space in head-anchored locative descriptions*

- a false alternative analysis
  - head-anchored orientation descriptions involve intrinsic FoRs
    - since they are logically equivalent to intrinsic locative descriptions

    (3.10) *The chair is facing the door/us*
    ⇔ *We are/the door is/in front of the chair*

Figure 28. *Chair, facing door/observer*



  - we reject this analysis
    - as do Terrill & Burenhult 2008
      - though their argumentation is different from ours

- defeating the intrinsic analysis of head-anchored orientation descriptions
  - it is in fact possible to define direction vectors intrinsically – in *motion* descriptions!

(3.11) *The chair started to move forward/backward/sideways*

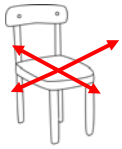


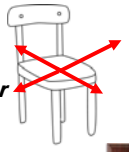
Figure 29. *Chair, moving forward/backward/ sideways*

  - clearly, such descriptions are intrinsic
    - as can be seen by contrasting them with relative/absolute ones

(3.12) *The chair started to move left/north/upriver*

  - but intrinsic terms are not able to describe the orientation of an entity
    - orientation descriptions inescapably require an extrinsic viewpoint/perspective

(3.13) *The chair is facing forward/backward/sideways* ***with respect to us/the door***



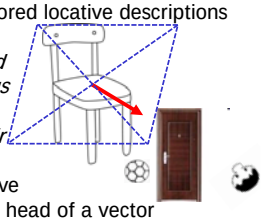
  - such descriptions are extrinsic
    - since they involve an external *anchor* marking the head of the orientation vector
    - this is why there are no intrinsic orientation descriptions!

Figure 30. *Orientation description require an external anchor*

  - the computations involved in head-anchored orientation descriptions are of the same kind
    - as those involved in head-anchored locative descriptions

(3.14) *The chair is facing forward with respect to the door/us*

(3.15) *The ball is on our side/ the door's side of the chair*



    - both types of descriptions involve an external anchor defining the head of a vector
    - but (3.15) cannot be intrinsic
      - it's truth-conditions do not depend on the orientation of the chair!

Figure 31. *Head-anchored FoRs in orientation and locative descriptions*

  - we conclude that both types of descriptions involve the same type of FoR
    - the **head-anchored** type

Overview

FoRs reclassified

- head-anchored vs. angular-anchored FoRs
  - the axes of "Levinsonian" relative, absolute, and intrinsic FoRs are modeled after the **anchor's** axes

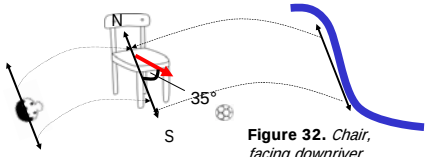


Figure 32. *Chair, facing downriver*

(4.1) *The chair is facing right/south/downriver*

(4.2) *The ball is in front of/right/south/downriver of the chair*

    - consequently, the truth-conditions of descriptions in such FoRs depend on the orientation of the anchor
  - let us call these **angular-anchored FoRs**

  - in contrast, the axes of **head-anchored** FoRs are vectors defined by determination of their heads

(4.3) *The chair is facing the door/us*

(4.4) *The ball is towards the door/us from the chair*

    - even though the vectors directly define only single semi-axes, logically every such vector entails an entire FoR

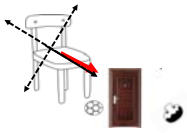


Figure 33. *Chair, facing door/observer*

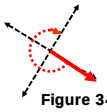


Figure 34. *A single vector – a place and an angle – defining an entire FoR*

    - this explains why the truth-conditions of head-anchored descriptions depend, not on the orientation of the anchor
      - but on the location of the anchor

FoRs reclassified (cont.)

- the revised classification of FoRs

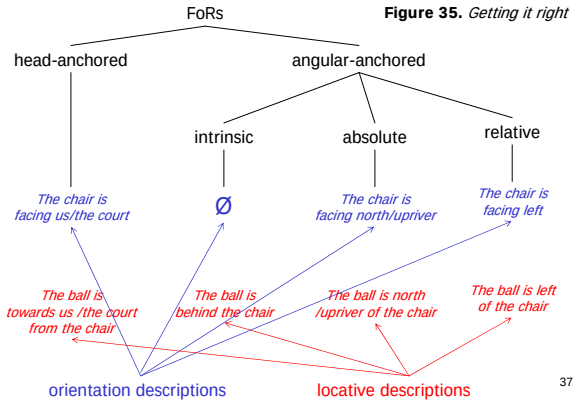


Figure 35. *Getting it right*

Overview

- FoRs and MesoSpace
- FoRs in Seri and Yucatec
- FoRs and vectors
- FoRs reclassified
- summary

Summary

- location and orientation are orthogonal spatial properties of entities
- both appear to be universally represented in language
- both may depend on spatial frames of reference (FoRs) for their interpretation
- orientation appears to be cognitively represented in terms of vectors
  - rather than in terms of metaphorical motion paths
- the semiaxes of FoRs and objects may be cognitively encoded as vectors

Summary (cont.)

- a comparison between locative and orientation descriptions suggests a new type of FoRs
  - head-anchored FoRs
  - these differ from the traditionally recognized intrinsic, relative, and absolute systems
    - in that their truth-conditions depend, not on the orientation or the anchor, but on the anchor's location
- orientation descriptions occur universally with head-anchored FoRs
  - but apparently only language-specifically also with relative and absolute FoRs
- orientation descriptions do not occur with intrinsic FoRs
  - they logically require some external anchor

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