Cognitive Science 2.0

Language, culture, and the environment shape spatial cognition

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Synopsis

- paradigm shift or paradigm maturation?
- frame wars: what Whorf wrought
- unconfounding language
- frame use in discourse: Mesoamerica
- frame use in discourse: the "world"
- frame use in recall memory: Mesoamerica
- frame use in recall memory: the "world"
- a pan-simian geocentrism bias?
- discussion

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Paradigm shift
or paradigm maturation?

Cognitive science 1.0:
rationalist foundational assumptions:
- innate knowledge
- symbolic processing
- modularity

Cognitive science 2.0:
empiricist turn; embrace of:
- culture-specificity
- individual variation
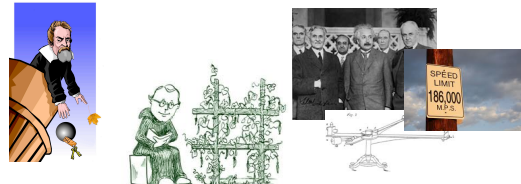- brain plasticity

- is cognitive science 2.0 still cognitive science?

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Paradigm shift or paradigm maturation? (cont.)

- the empiricist turn in the cognitive sciences resembles a general dynamic in paradigm evolution
  - by which idealizations previously deemed necessary are made obsolete by empirical progress

SPEED LIMIT 186,000 M.P.S.

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Paradigm shift or paradigm maturation? (cont.)

- looking for culture in cognition
  - sources of knowledge
    - nature – biological transmission
    - nurture – cultural transmission
    - individual experience

Figure 1. *Biological transmission*
mossysanimals.blogspot.com

Figure 2. *Cultural transmission*
bringingaba.blogspot.com

Figure 3. *Individual experience*
thenextfamily.com

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Looking for culture in cognition (cont.)

- culture-specificity in cognition
  - example I: ethnobotany
    - how many species of trees can you identify and name?
      - for more on Yucatec ethnobiology, cf. Atran et al (1999, 2001, 2003)

Figure 4. *The selva of central Quintana Roo*

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- culture-specificity in cognition (cont.)
  – example II: "dead-reckoning"
    - how accurately can you point "home"
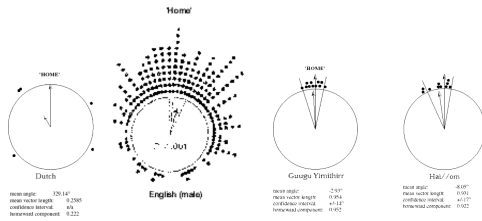   – after having been taken to a windowless room in another town?

Figure 5. *Results of dead-reckoning pointing accuracy experiments (Levinson 2003: 233-240)*

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- but just how deep does culture-specificity run in cognition?
- plus, the transmission problem: how would deep culture-specific ***cognitive practices*** be transmitted?
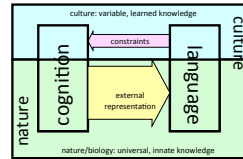 - two contemporary views

Figure 6. *The mainstream vision*
Cognitive science 1.0
- culture-specificity in cognition is shallow and irrelevant to theorizing how the mind works
- no deep transmission – observable behavior such as speech and gesture cannot "restructure" cognition
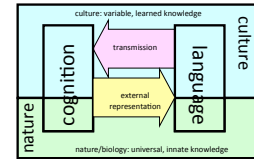
Figure 7. *The Neo-Whorfean vision*
Cognitive science 2.0
- the mind is a 'bio-cultural hybrid' (Evans & Levinson 2009)
- culture-specific cognitive practices are transmitted through observable behavior, including speech and gesture

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Frame wars: What Whorf wrought

- the Linguist Relativity Hypothesis (LRH): strong vs. weak interpretations

> **The strong (deterministic) orthodox interpretation of the LRH:**
> "The structure of anyone's native language strongly influences or fully determines the world-view he will acquire as he learns the language."
>
> **The weak (non-deterministic) neo-Whorfian interpretation of the LRH:**
> "Structural differences between language systems will, in general, be paralleled by nonlinguistic cognitive differences, of an unspecified sort, in the native speakers of the two languages." (Brown 1976: 128)

  – the recent neo-Whorfian debate has focused on the weak interpretation
    - i.e., on the *existence* of language-on-thought effects
  – there are to our knowledge no contemporary proponents of the strong interpretation

- proposed versions of the "big picture"
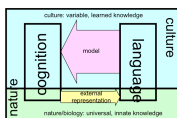
Figure 8. *The big picture according to Whorf*
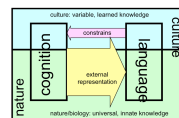
Figure 9. *The big picture according to mainstream cognitive science*
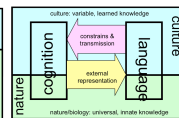
Figure 10. *The big picture according to Neo-Whorfians*

- the proper goal of the "Neo-Whorfian" program
  – determine the role of culture in human cognition

- the test case: spatial frames of reference
  – cognitive axis ("coordinate") systems used to interpret 'projective' (Piaget & Inhelder 1956) spatial relations
    - in representations of location, motion, and orientation

Slide (top left)

Frame wars: What Whorf wrought (Cont.)

- classifying frames

Table 1. *A classification of frame types based on Danziger (2010)*

|	**egocentric**: axes "anchored" to the body of the observer	**allocentric**: axes independent of the body of the observer
intrinsic: centered on the **anchor** (the model of the axes)	*The ball is in front of me* **Direct** (Danziger 2010)	*The ball is in front of the chair* **Object-centered** (Carlson-Radvansky & Irwin 1993)
extrinsic: transposed from the anchor	*The ball is right of the chair* **Relative** (Levinson 1996)	*The ball is downriver of the chair* **Geocentric**

Slide (top right)

Frame wars: What Whorf wrought (cont.)

- crosslinguistic variation

Key:
- relative and intrinsic
- relative, intrinsic, and absolute/geocentric
- absolute/geocentric and intrinsic; relative restricted (to unfeatured grounds, loan words, and/or bilingual speakers)
- absolute/geocentric and intrinsic
- variation by linguistic variety (dialect)
- (absence of evidence of variation is represented as absence of variation)

Sources: 1 – Pederson *et al.* 1998; 2 – Wassmann & Dasen 1998; 3 – Levinson 2003; 4 – Mishra, Dasen, & Niraula 2003; 5 – Levinson & Wilkins eds. 2006; 6 – Terrill & Burenhult 2008; 7 – O'Meara & Pérez Báez eds. 2011; 8 – Li et al. 2011; 9 – Eggleston 2012

Figure 11. *Reference frame use in small-scale horizontal space across languages (Bohnemeyer & Levinson ms.)*

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Frame wars: What Whorf wrought (cont.)

- alignment between language and cognition
  - preferences for particular frame types in discourse and recall memory covary

step I: memorize row of animals
step II: turn 180° to the recall table
step III: reconstruct the array

egocentric solution
geocentric solution

Figure 12. *Animals-in-a-Row: design*

Table 2. *Animals-in-a-Row in Levinson 2003: the large sample*

Linguistically Relative	English, Dutch, Japanese, Tamil-Urban	*Prediction:* Non-verbal coding will be relative	N = 85
Linguistically Absolute	Arrernte, Hai//om, Tzeltal, Longgu, Belhare, Tamil-Rural	*Prediction:* Non-verbal coding will be absolute	N= 99

Figure 13. *Animals-in-a-Row: results (Levinson 2003: 184)*

- geocentric languages
- relative languages

% of participants
% of geocentric responses

Slide (middle right)

Frame wars: What Whorf wrought (cont.)

- two competing interpretations

Figure 14. *The mainstream vision*

Figure 15. *The Neo-Whorfian vision*

Non-Whorfian interpretation (Li & Gleitman 2002; Li et al 2011; *inter alia*)
- innate knowledge of all frame types
- variation only in usage preferences
- variation caused by adaptation to the environment - topography, population geography, education, literacy
- language plays no role in the cultural transmission of practices of spatial reference

Neo-Whorfian interpretation (Levinson 1996, 2003; Pederson et al 1998; *inter alia*)
- knowledge of some frame types is culturally transmitted
- language plays a key role in the cultural transmission of practices of spatial reference
- the adaptation to the environment happens at the phylogenetic level, not at the ontogenetic level

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Slide (bottom right)

Unconfounding language

- the forest, the trees, and statistics
  - adjudicating b/w neo- and non-Whorfian interpretations
    - presupposes isolating the effects of language, literacy, education, topography, etc., on the use of reference frames
  - the problem: many of these factors can co-vary
    - e.g., populations that speak different languages may also differ in their levels of education and literacy
      - and they will of course differ on geographic variables
  - the solution: larger population samples and multivariate statistics

Figure 16. *Seeing the forest for the trees*

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Frames in discourse: Mesoamerica

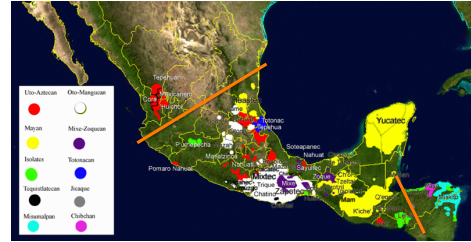- a test case: the Mesoamerican *sprachbund*
  – cf. Campbell 1979; Campbell et al 1986

Figure 17. *Mesoamerican language map (contemporary distribution) source: http://en.wikipedia.org/wiki/Image:Mesoamericanlanguages.png; lines showing approximate boundaries of Mesoamerican area added by the authors*

Frames in discourse: Mesoamerica (cont.)

- our tool for studying the use of FoRs in discourse
  – a referential communication task: Ball & Chair (B&C)
    – replacing Men & Tree (M&T) in Pederson et al (1998) etc.
    – B&C allows us to discover selection preferences for any of the FoR types
      » at the in-door scale
      » M&T may for various reasons depress the use of intrinsic FoRs

Figure 18. *Design of the Men and Tree task (Pederson et al. 1998: 562)*

Two sets of 12 photos, shuffled and placed randomly in front of each player. Within the set of photos are a target subset and some distractors.

DIRECTOR
[Task: Describe photos in such a way that matcher can identify which photo the director has chosen.]

MATCHER
[Task: Select the photo which the director describes. If uncertain, then talk with the director to clarify.]
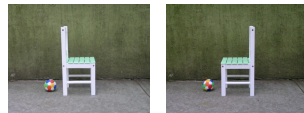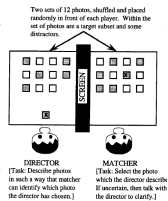
Figure 19. *Two of the Ball & Chair photos, featuring an intrinsic contrast*

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Frames in discourse: Mesoamerica (cont.)

- the data set of the present study
  – B&C data from 11 varieties
    - 6 Mesoamerican languages
      – Yucatec Maya (J. Bohnemeyer)
      – Ayutla Mixe (R. Romero;)
      – San Ildefonso Tultepec Otomí (N. Hernández, S. Hernández, E. Palancar)
      – Purépecha (or Tarascan; A. Capistrán)
      – Chacoma Tseltal (G. Polian)
      – Juchitán (Isthmus) Zapotec (G. Pérez)
    - 2 non-Mesoamerican indigenous languages
      – Seri (C. O'Meara)
      – Sumu-Mayangna (E. Benedicto, A. Eggleston, Mayangna Yulbarangyang Balna)
    - 3 varieties of Spanish
      – from Barcelona (A. Eggleston), Mexico (H. Romero, H. Rodriguez, R. Tucker), and Nicaragua (A. Eggleston)

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Frames in discourse: Mesoamerica (cont.)

- these are all the languages of the MesoSpace sample the data from which have been coded so far

- data from five dyads of participants per variety are included in the analysis
  – six in the case of Isthmus Zapotec and Barcelonan Spanish

- responses are accompanied by (a) the researchers' estimates and (b) the participants' self-estimates of the participants'…
  - …level of education
  - …frequency of use of Spanish as a second language (L2)
  - …frequency of reading and writing

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Frames in discourse: Mesoamerica (cont.)

- we included two geographic variables capturing properties of the recording field sites
  - topography
    – a categorical variable classifying elevation and geomorphological patterns based on published map data
      » cf. Hernández Santana et al 2007
  - population density
    – calculated from
      » the size of the community's population according to census data
      » the size of the community's area according to Google Earth

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Frames in discourse: Mesoamerica (cont.)

- coding
  - we coded descriptions of the location and orientation of the animals, distinguishing among eight categories
    - egocentric
      - egocentric intrinsic = direct (Danziger 2010)
      - egocentric extrinsic = relative (Levinson 1996)
    - allocentric
      - allocentric intrinsic
      - geocentric
        » absolute or geomorphic
        » based on an internal landmark (another animal as landmark)
        » based on an external landmark
    - intrinsic-relative ambiguity
      » i.e., the description is true of the same picture under both allocentric intrinsic and egocentric extrinsic interpretations
    - topological (no reference frame involved; Piaget & Inhelder 1956)

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Frames in discourse: Mesoamerica (cont.)

- all of the languages in the sample have the lexical and grammatical resources for using all FoR types
  - in no case does the grammar or lexicon of the language constrain the use of particular frame types
  - reference frames are semantic patterns
    - which are only indirectly related to particular lexical items

true in which type of FoR?

	relative	intrinsic
The ball is in front of the chair	relative	intrinsic
The ball is left of the chair	intrinsic	relative

Figure 20. *Truth conditions of intrinsic and relative descriptions of Ball & Chair 3.9 (left) and 3.12*

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Frames in discourse: Mesoamerica (cont.)

- a given speech community's preferences for using particular frame types are strictly a matter of usage
  - they are a part of the community's practices of language use
- the question the studies reported here address is this:
  - to what extent does the frame use of individual speakers/ dyads reflect the practices of the community
    - and those of communities whose languages they use as L2 speakers
  - as opposed to depending exclusively on the speaker's level of education and literacy?

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Frames in discourse: Mesoamerica (cont.)

- the flow of the quantitative analysis
  - step I: identify the response variables that showed the greatest differentiation among participants
    - response variables: the (frequency/probability of) use of each of the eight strategies we coded the data for
  - procedure: multi-dimensional scaling over a similarity matrix comparing the participant dyads to one another
    - in terms of their use of the eight strategies
  - results
    - first dimension of the MDS model correlates most strongly with the use of geocentric and relative frames
    - 2nd dimension correlates strongly w/ topological descriptions

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Frames in discourse: Mesoamerica (cont.)

- the flow of the quantitative analysis (cont.)
  - step II: mixed-effects logistic regression models to find the significant predictor variables
    - driving the use of relative and geocentric frames
    - predictor variables (fixed effects): L1 group, L2 use, reading, writing, education, topography, population density
      - L1 group: Mesoamerican vs. non-Mesoamerican indigenous vs. Spanish
      - models based on an 11-valued L1 variable failed to converge
    - intercepts (random effects): participant; individual language

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Frames in discourse: Mesoamerica (cont.)

- innovation
  - previous multivariate analyses in semantic typology have treated the stimulus items as the unit of analysis
    - cf. Levinson & Meira 2003; Majid et al 2008
  - in contrast, our MDS analysis treats the (dyads of) participants as statistical units
    - and both the MDS analysis and the GLMMs operate on data accumulated from across the sample populations
  - this allows us to treat language as a direct predictor variable

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Frames in discourse: Mesoamerica (cont.)

- findings
  - cf. Bohnemeyer et al (2014, 2015, ms.)
  - L1 makes a sig. contribution to almost all models
    - so the effect of language cannot apparently be reduced to covariation with other variables
    - the effect of language is not epiphenomenal
      - contrary to Li & Gleitman (2002)
  - L2 use makes a sig. contribution to egocentric models
    - exposure to Spanish is a conduit for the cultural diffusion of egocentric cognition in Mesoamerica
      - cf. Bohnemeyer et al (2015)

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Frames in discourse: Mesoamerica (cont.)

- findings (cont.)
  - topography and population density influence geocentric models
    - more relative usage in coastal basins than in volcanic belts
    - first quantitative demonstration of an effect of the environment on reference frame use
  - no sig. contributions from literacy or education to any models

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Frame use in discourse: the "world"

- another referential communication task: Talking Animals (TA)
  - TA allows us to discover selection preferences for any of the FoR types
    » at the small (personally manipulable) scale
  - advantages over previous tools employing photographs
    » Men & Tree (M&T, Pederson et al 1998); Ball & Chair (B&C; Bohnemeyer et al 2014, 2015)
    » 2D stimuli seem to slightly depress the use of geocentric frames
    » M&T may for various reasons depress the use of intrinsic FoRs

Figure 21. *Design of the Talking Animals task (Pederson et al. 1998: 562)*
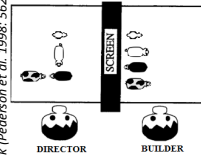
Figure 22. *One of four Talking Animals trials*

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Frame use in discourse: the "world" (cont.)

- independent variables: language (L1; L2 use)
  - we modeled L2 use on a 3-point frequency scale
    - none > occasional > frequent
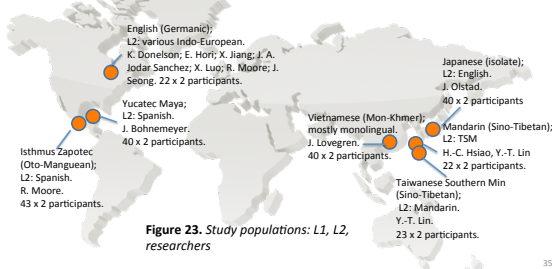   - based on participants' responses to a questionnaire

English (Germanic);
L2: various Indo-European.
K. Donelson; E. Hori; X. Jiang; J. A.
Jodar Sanchez; X. Luo; R. Moore; J.
Seong. 22 x 2 participants.

Yucatec Maya;
L2: Spanish.
J. Bohnemeyer.
40 x 2 participants.

Isthmus Zapotec
(Oto-Manguean);
L2: Spanish.
R. Moore.
43 x 2 participants.

Japanese (isolate);
L2: English.
J. Olstad.
40 x 2 participants

Vietnamese (Mon-Khmer);
mostly monolingual.
J. Lovegren.
40 x 2 participants.

Mandarin (Sino-Tibetan);
L2: TSM
H.-C. Hsiao, Y.-T. Lin
22 x 2 participants.

Taiwanese Southern Min
(Sino-Tibetan);
L2: Mandarin.
Y.-T. Lin.
23 x 2 participants.

Figure 23. *Study populations: L1, L2, researchers*

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Frame use in discourse: the "world" (cont.)

- independent variables: literacy and education
  - education: 3-point scale
    - elementary school only > some secondary > any post-secondary
  - writing (frequency): 4-point scale
    - none > rarely > occasional > frequent/regular
    - no writing data was collected from the Vietnamese participants
  - reading (frequency): 4-point scale
    - none > rarely > occasional > frequent/regular
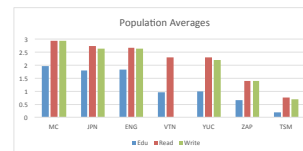 - assessed again based on questionnaire responses

Figure 24. *Mean education and literacy scores by population*

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Frame use in discourse: the "world" (cont.)

- independent variables: geography of the fieldsites
  - topography: geomorphic 'provinces'
    - 5-level categorical variable based on ESRI 2011
      - flat plains, hills, table lands, low mountains, high mountains
  - population density: log of inhabitants/km^2

Language	Locality	Country	Density	Density Log Scale	Topographic Classification
Japanese	Setagaya	Japan (Mainland)	15551	4.19	flat
Taiwanese Southern Min	Taipei	Taiwan	9949	4.00	flat
Mandarin Chinese	Taipei	Taiwan	9949	4.00	flat
Japanese	Naha	Japan (Okinawa)	8244	3.92	hills
English	Buffalo	United States	2569	3.41	flat
Japanese	Yomitan	Japan (Okinawa)	1200	3.08	hills
Taiwanese Southern Min	Tainan	Taiwan	855	2.93	flat
Vietnamese	Long Mỹ	Vietnam	406	2.61	flat
Japanese	Fujinomiya	Japan (Mainland)	339	2.53	low mountains
	Aizuwakamatsu	Japan (Mainland)	321	2.51	low mountains
	Nago	Japan (Okinawa)	293	2.47	low mountains
	Miyakojima	Japan (Okinawa)	268	2.43	hills
	Yonaguni	Japan (Okinawa)	58	1.76	hills
	Shisho	Japan (Mainland)	49	1.69	low mountains
Isthmus Zapotec	La Ventosa	Mexico	5	0.70	flat
	Juchitán de Zaragoza	Mexico	5	0.70	flat
Yucatec	Yaxley	Mexico	2	0.30	flat
	Felipe Carillo Puerto	Mexico	2	0.30	flat

Table 3. *Field sites by population density and geomorphology*

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Frame use in discourse: the "world" (cont.)

- results: response strategies across populations
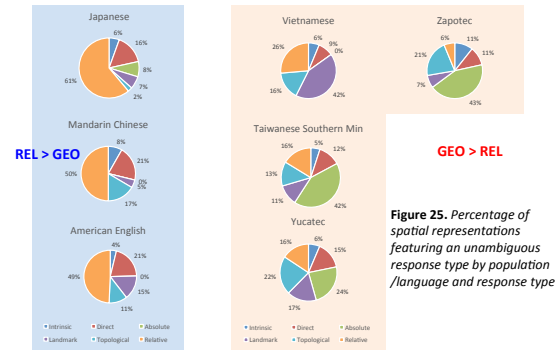
Figure 25. *Percentage of spatial representations featuring an unambiguous response type by population/language and response type*

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Frame use in discourse: the "world" (cont.)

- results: efficacy of the independent variables
  - we fitted binomial mixed-effects logistic regression models of the probability of use of two response types
    - relative (egocentric extrinsic) and geocentric frames
      - using the lme4 package in R
  - we eliminated the education factor from the models
    - since one model containing it failed to converge
      - and none of the others showed a significant education effect

Table 4. *Regression models of the Talking Animals data: summary of effects (Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1)*

Dependent variable	Literacy variable		Independent variables (fixed effects)				
	Writing	Reading	L1	L2 use	Literacy	Topography	Pop. density
Geocentric	Yes	No	***		**		***
	No	Yes	**	•	***		***
Relative	Yes	No	***		***	•	**
	No	Yes	***		**	•	**

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Frame use in discourse: the "world" (cont.)

- results: discussion
  - as in the Ball & Chair study, language makes an irreducible contribution to predicting frame use
    - this contribution cannot apparently be reduced to covariance with the nonlinguistic variables, contra Li & Gleitman (2002)
      - there was however no significant L2 effect, contrary to the B&C study
  - we also once again found effects of geography
    - population geography is positively correlated w/ egocentrism and strongly negatively with geocentric frame use
      - however, there were no significant topography effects
  - all models showed small but highly sig. literacy effects
    - both the frequency of writing and that of reading were
      - positively correlated with the use of relative frames
      - negatively correlated with the use of geocentric frames

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Frame use in discourse: the "world" (cont.)

- results: discussion (cont.)
  - these findings are in line with weak interpretations of the Linguistic Relativity Hypothesis
    - the effect of language on spatial cognition does not appear to be epiphenomenal
      - at least not with respect to the variables proposed by Li & Gleitman
    - but it is not the only one

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Frames in recall memory: Mesoamerica

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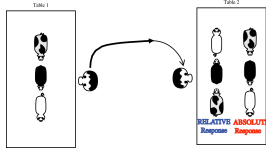   - of Levinson 1996 and Pederson *et al.* 1998

Figure 26. *Layout of the AIAR memory recognition task*
  - minor differences: the toy animals used; the number of trials; …

  - big drawback: no intrinsic response pattern

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- participants
  - we tested b/w 11 and 28 speakers of each variety
    - the mean number was 16.8
  - data from participants with errors in more than two of the six trials was excluded from the analysis

Table 5. *Participants whose responses were included in the analysis by language, site, age, sex, and study (MA – Mesoamerican; NMA – non-Mesoamerican indigenous; Sp. – Spanish)*

Language Group	Locality	Age < 30 / ≥ 30	Sex M / F
		NA	NA
Tseltal (MA)	Chacoma	9/7	9/7
Yucatec (MA)	Yaxley	4/10	7/7
	Felipe Carrillo Puerto	0/1	0/1
Mixe (MA)	Ayutla	4/8	3/9
Otomi (MA)	San Ildefonso Tultepec	0/5	1/4
Zapotec (MA)	La Ventosa	4/8	3/9
Tarascan (MA)	Santa Fe de la Laguna	7/9	8/8
Seri (NMA)	El Desemboque	0/2	1/1
Sumu (NMA)	Rosita	4/6	4/6
Mexican Sp.	San Miguel Balderas	5/6	4/7
Nicaraguan Sp.	Rosita	5/13	4/14
European Sp.	Barcelona	6/4	6/4
Total		**48/79**	**50/77**

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- coding
  - facing direction: egocentric vs. geocentric vs. neither
  - order of animals: egocentric vs. geocentric vs. neither
    - the analysis presented here is based on order only
- errors
  - wrong animal; wrong order
  - responses by participants who produced errors in more than two of the six trials were excluded altogether

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- analysis
  - regression models of the probability of egocentric reconstructions
    - against the same set of predictor variables used in the analysis of the linguistic data
- results

Sample		Models			
		1	2	3	4
Sample	L1-SPANISH SPEAKERS INCLUDED	Yes	Yes	No	No
LITERACY assessed based on		Writing	Reading	Writing	Reading
Effects	LANGUAGE GROUP	*	*		
	L2-SPANISH USE				
	LITERACY				
	TOPOGRAPHY	*	**		
	POPULATION DENSITY	*	**		

Table 6. *Summary of the four regression models of the probability of egocentric reconstructions of the NA arrays. Models that include L1-Spanish speakers exclude L2 use as a predictor variable. (Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.')*

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- results (cont.)
  - as before, EDUCATION did not yield an effect and was eliminated to improve the AIC
  - LANGUAGE GROUP effects in the models that included the L1-Spanish speakers
  - TOPOGRAPHY and POPULATION DENSITY effects in the models that include the L1-Spanish speakers
  - no L2-SPANISH use or LITERACY effects
    - a possible explanation: most populations preferred geocentric responses
      - even those that did not show a linguistic egocentrism bias

Sample		Models			
		1	2	3	4
Sample	L1-SPANISH SPEAKERS INCLUDED	Yes	Yes	No	No
		Writing	Reading	Writing	Reading
Effects	LANGUAGE GROUP	*	*		
	L2-SPANISH USE				
	LITERACY				
	TOPOGRAPHY	*	**		
	POPULATION DENSITY	*	**		

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Synopsis

- paradigm shift or paradigm maturation?
- frame wars: what Whorf wrought
- unconfounding language
- frame use in discourse: Mesoamerica
- frame use in discourse: the "world"
- frame use in recall memory: Mesoamerica
- frame use in recall memory: the "world"
- a pan-simian geocentrism bias?
- discussion

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Frames in recall memory: the "world"

- New Animals – same protocol as before
- participants
  - we tested at least 16 speakers of each variety
  - data from participants with errors in more than two of the six trials was excluded from the analysis
  - Table 7 reflects only those participants whose responses were included in the analysis

Table 7. *Participants whose responses were included in the analysis by language, age, and sex*

		American English	Japanese	Mandarin Chinese	Taiwanese Southern Min	Vietnamese	Yucatec	Isthmus Zapotec	Total
Gender	Male	12.5	33	2	2	4	7	7	67.5
	Female	7.5	15	7	19	16	10	11	85.5
Age	≥30	2	17	0	19	8	11	11	68
	< 30	19	31	9	2	12	6	7	86
Total		21	48	9	21	20	17	18	154

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- results
  - the populations preferred egocentric or geocentric responses as predicted by their L1

Figure 18. *Response type frequency by L1*

  - logistic regression of the probability of egocentric reconstructions
    - showed L1, population density, and topography as the sole significant factors (p < .01; p < .05, respectively)
    - we excluded L2 from this model, as we hypothesize different populations to be pulled by their L2 in different directions

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A pan-simian geocentrism bias?

- a twist
  - Table 8 compares linguistic and recall memory data for **five** Spanish-speaking populations
    - including **three Mexican Spanish** ones
  - all and only those populations that preferred relative descriptions also preferred egocentric reconstructions
  - all other populations preferred geocentric reconstructions!

Table 8: *Responses to the two tasks from members of five Spanish-speaking communities. A Fisher's exact test shows the distribution of egocentric and geocentric reconstructions across speakers from Barcelona, Santa Ines, Rosita, and San Miguel, to be highly significant (one-tailed p < .0001).*

Community	B&C	#	%	NA	#	%
Santa Ines	Relative	49	33	Egocentric	42	58
	Intrinsic	24	17	Geocentric	28	39
	Geocentric	2	1			
San Miguel Balderas	Relative	50	17	Egocentric	10	24
	Intrinsic	133	46	Geocentric	22	52
	Geocentric	8	3			
Chimalacatlán	Relative	87	52	Egocentric	N/A	N/A
	Intrinsic	45	27	Geocentric	N/A	N/A
	Geocentric	4	2			
Rosita	Relative	84	35	Egocentric	41	33
	Intrinsic	81	34	Geocentric	73	58
	Geocentric	5	2			
Barcelona	Relative	131	45	Egocentric	63	75
	Intrinsic	61	21	Geocentric	14	17
	Geocentric	0	0			

- a twist (cont.)
  - similarly, Yucatec speakers show no clear overall bias for egocentric or geocentric descriptions in discourse
    - yet strongly prefer geocentrism in the recall memory task
      - cf. Bohnemeyer (2011); Le Guen (2011)

Figure 28. *Percentage of spatial representations featuring an unambiguous response type in the Yucatec TA responses*
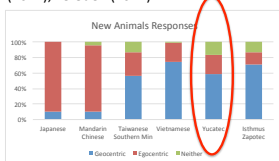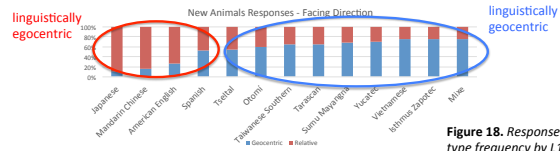
Figure 29. *New Animals response type frequency by L1*

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- a possible explanation: a pan-simian innate bias for processing geocentric information
- supporting evidence
  - Haun et al (2006) conducted recall memory experiments with all Great Ape species and with German preschoolers
    - all populations committed more errors in egocentric than in geocentric conditions
  - developmental studies indicate early acquisition of geocentric terms in populations with a geocentric bias
    - Brown 2001; Brown & Levinson 2000, 2001; de León 1994
      - however, Cablitz 200? did not find this effect in Marquesan
- this geocentric bias would be readily supplanted by a learned, culturally transmitted preference
  - for using egocentric frames in small-scale space
  - since the primitives for computing reference frames of any type are the same: vectors, angles, and distances

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A pan-simian geocentrism bias? (cont.)

- an evolutionary scenario:
  the conquest of small-scale space
  – in the course of hominid evolution,
    control of small-scale space gains in importance
    - with the advent of tool use and enclosed living spaces
  – the rise of small-scale space management
    boosts the cognitive efficiency of egocentrism
  – a possible turning point is the invention of writing
    - characters may be the first "objects" that have a canonical
      orientation in the horizontal defined egocentrically
  – as egocentrism rises, speech and gesture serve
    as the primary conduits of its cultural transmission

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Discussion

- confirmed: L1 makes an irreducible contribution
  to spatial cognition
  – the effect of language on reference frame use
    does not appear to be epiphenomenal
- non-linguistic factors driving reference frame use
  – literacy, population density, topography
- more work needed on operationalizing topography

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Discussion (Cont.)

- a new take:
  the **Linguist Transmission Hypothesis (LTH)**

> **Linguistic Transmission Hypothesis (LTH) – abstract formulation:**
> "Using a language or linguistic variety may facilitate the acquisition of cultural
> practices of nonlinguistic cognition shared among the speakers of the language."

  – more concretely:

> **Linguistic Transmission Hypothesis (LTH) – concrete formulation:**
> "The comprehension of utterances may provide clues to the cognitive practices
> involved in their production, and both the comprehension and the production of
> utterances may afford habituation to these cognitive practices. The cognitive
> practices so acquired may or may not subsequently be extended beyond the
> domain of speech production."

Discussion (Cont.)

- the LTH compared to the LRH
  – the LTH entails cognitive effects of language *use*,
    but does not entail effects from the lexicon or grammar
  – it emphasizes the role of language as a potential conduit
    - in the transmission of cultural practices of cognition
    - a role it shares with other types of perceivable behavior
      – e.g., co-speech gesture (Haviland 1979; Le Guen 2011);
        agricultural and religious practices (Bohnemeyer 2011)

Discussion (Cont.)

- the LTH is not a new idea
  – a precursor: Levinson (2003: 315-325)
  – closely related: Slobin's (1996, 2003) work
    on Thinking-for-Speaking (TfS) effects
    - since the LTH talks about the relation
      between language use and cognitive practices
      » and TfS effects concern the relation
        between grammar/lexicon and language use
      – a combination of the two has the scope of the traditional LRH

  (2)   TfS + LTH = LRH

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