Language, culture, and the environment shape spatial cognition

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

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?

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

Looking for culture in cognition (cont.)
- culture-specificity in cognition
  — example I: ethnobotany
    • how many species of trees can you identify and name?

• looking for culture in cognition
  — sources of knowledge
    • nature — biological transmission
    • nurture — cultural transmission
    • individual experience
Looking for culture in cognition (cont.)

- 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)

Looking for culture in cognition (cont.)

- 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-Whorfian 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

Frame wars: What Whorf wrought (cont.)

- proposed versions of the “big picture”

- the proper goal of the “Neo-Whorfian” program
  - determine the role of culture in human cognition

Frame wars: What Whorf wrought (Cont.)

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

<table>
<thead>
<tr>
<th>Intrinsic: centered on the anchor</th>
<th>Extrinsic: transposed from the anchor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Epocentric</strong>: axes independent of the body of the observer</td>
<td><strong>Allocentric</strong>: axes “anchored” to the body of the observer</td>
</tr>
<tr>
<td>The ball is in front of me (Danziger 2010)</td>
<td>The ball is in front of the chair (Carlson-Radavansky &amp; Irwin 1993)</td>
</tr>
<tr>
<td>The ball is right of the chair (Levinson 1996)</td>
<td>The ball is downstream of the chair (Levinson 1996)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Linguistically Relative</th>
<th>Prediction</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>English, Dutch</td>
<td>Non-verbal coding will be relative</td>
<td>N = 85</td>
</tr>
<tr>
<td>Japanese, Tamil, Urban</td>
<td>Non-verbal coding will be relative</td>
<td>N = 80</td>
</tr>
<tr>
<td>Arabic, Hausa, Telugu, Tibetan</td>
<td>Non-verbal coding will be absolute</td>
<td></td>
</tr>
</tbody>
</table>

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

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

Figure 13. Animals-in-a-Row

Figure 14. The mainstream vision

Figure 15. The Neo-Whorfian vision

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

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

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 Rafael Tulepec Otsomi (N. Hernández, S. Hernández, E. Palancar)
      - Purépecha (or Tarascan; A. Capistrán)
      - Tzotzil (G. Polian)
      - Juchitán (Isthmus) Zapotec (G. Pérez)
    - 2 non-Mesoamerican indigenous languages
      - Seri (C. O’Mara)
      - Sumá-Mayangna (E. Benedicto, A. Eggleston, Mayangna Yulbarangyang Bala)
    - 3 varieties of Spanish
      - from Barcelona (A. Eggleston), Mexico (H. Romero, H. Rodriguez, R. Tucker), and Nicaragua (A. Eggleston)

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
    - 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
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
        – absolute or geographic
        – 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)

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?

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
      • 1st dimension of the MDS model correlates most strongly with the use of geocentric and relative frames
      • 2nd dimension correlates strongly w/ topological descriptions

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
• findings
    – 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

• 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

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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
  — reading (frequency): 4-point scale
    — none > rarely > occasional > frequent/regular
  — assessed again based on questionnaire responses

Figure 21. Design of the Talking Animals task (Pederson et al. 1998: 562)
Figure 22. One of four Talking Animals trials
Figure 23. Study populations: L1, L2, researchers
Figure 24. Mean education and literacy scores by population
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/km²

- 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
  - 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>
<thead>
<tr>
<th>Language</th>
<th>Landmark</th>
<th>Intrinsic</th>
<th>Absolute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japanese</td>
<td>0.1</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>Mandarin Chinese</td>
<td>0.1</td>
<td>0.70</td>
<td>1.69</td>
</tr>
<tr>
<td>Vietnamese</td>
<td>0.1</td>
<td>0.70</td>
<td>2.47</td>
</tr>
<tr>
<td>Vietnamese</td>
<td>0.1</td>
<td>0.70</td>
<td>2.51</td>
</tr>
<tr>
<td>Taiwanese</td>
<td>0.1</td>
<td>0.70</td>
<td>2.53</td>
</tr>
<tr>
<td>Southern Min</td>
<td>0.1</td>
<td>0.70</td>
<td>2.61</td>
</tr>
<tr>
<td>Japanese</td>
<td>0.1</td>
<td>0.70</td>
<td>2.93</td>
</tr>
<tr>
<td>English</td>
<td>0.1</td>
<td>0.70</td>
<td>3.08</td>
</tr>
<tr>
<td>Taiwanese</td>
<td>0.1</td>
<td>0.70</td>
<td>3.41</td>
</tr>
<tr>
<td>Southern Min</td>
<td>0.1</td>
<td>0.70</td>
<td>3.92</td>
</tr>
<tr>
<td>Mandarin</td>
<td>0.1</td>
<td>0.70</td>
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<td>English</td>
<td>0.1</td>
<td>0.70</td>
<td>4.19</td>
</tr>
<tr>
<td>Taiwanese</td>
<td>0.1</td>
<td>0.70</td>
<td>4.30</td>
</tr>
<tr>
<td>Southern Min</td>
<td>0.1</td>
<td>0.70</td>
<td>4.40</td>
</tr>
</tbody>
</table>

  Table 6. Regression models of the Talking Animals data: summary of effects (Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 1)

- 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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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](image)

  - minor differences: the toy animals used; the number of trials;
  - big drawback: no intrinsic response pattern

Frames in recall memory: Mesoamerica (cont.)

- 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>
<thead>
<tr>
<th>Language Group</th>
<th>Locality</th>
<th>MA</th>
<th>NMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tzeltal (MA)</td>
<td>Chiapas</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Tzotzil (MA)</td>
<td>Chiapas</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mixe (NMA)</td>
<td>Oaxaca</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mixteco (NMA)</td>
<td>Oaxaca</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mixteco (NMA)</td>
<td>Oaxaca</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mixteco (NMA)</td>
<td>Oaxaca</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

- 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
  - 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

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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)
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

<table>
<thead>
<tr>
<th>Language</th>
<th>Age</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>American</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>18</td>
<td>185</td>
</tr>
<tr>
<td>Spanish</td>
<td>12</td>
<td>70</td>
</tr>
<tr>
<td>Japanese</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Mandarin</td>
<td>18</td>
<td>54</td>
</tr>
<tr>
<td>Taiwanese</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>Vietnamese</td>
<td>14</td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>526</td>
</tr>
</tbody>
</table>

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A pan-simian geocentrism bias? (cont.)

- 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 geocentric than in egocentric conditions
  - developmental studies indicate early acquisition of
    geocentric terms in populations with a geocentric bias
    - Brown 2001; Brown & Levinson 2000, 2003; de León 1994
  - however, Cablitz 2007 did not find this effect in Maniquan
  - 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

A pan-simian geocentrism bias? (cont.)

- results
  - the populations preferred egocentric or geocentric
    responses as predicted by their L1
  - logistic regression of the probability of egocentric
    reconstructions
    - showed L1, population density, and topography
    - 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

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
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

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 non-linguistic 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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References

- Levinson, S. C. (2006). Overview. In J. Bohnemeyer, K. Malouf, & C. O’Meara (Eds.), Spatial language and cognition beyond Mesoamerica: Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation

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Spatial language and cognition beyond Mesoamerica

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References (cont.)


