Reference frames in language and thought

Beyond Mesoamerica

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Synopsis

• frame wars: what Whorf wrought
• unconfounding language
• frame use in discourse: Talking Animals
• frame use in recall memory: New Animals
• discussion
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)
Frame wars: What Whorf wrought (cont.)

- strong vs. weak interpretations and the role of linguistic vs. nonlinguistic influences on cognition

**Figure 1.** Strong interpretations of the LRH – language as the sole or dominant influence on nonverbal cognition

**Figure 2.** Weak interpretations of the LRH – language as one possible factor among others

**Figure 3.** Rejection of even weak interpretations of the LRH - apparent language-on-thought effects seen as epiphenomenal
• 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
Frame wars: What Whorf wrought (Cont.)

• classifying frames

<table>
<thead>
<tr>
<th></th>
<th>egocentric: axes “anchored” to the body of the observer</th>
<th>allocentric: axes independent of the body of the observer</th>
</tr>
</thead>
<tbody>
<tr>
<td>intrinsic</td>
<td>centered on the anchor (the model of the axes)</td>
<td></td>
</tr>
<tr>
<td>ex intrinsic</td>
<td>transposed from the anchor</td>
<td></td>
</tr>
<tr>
<td>The ball is in front of me</td>
<td>Direct (Danziger 2010)</td>
<td>The ball is in front of the chair</td>
</tr>
<tr>
<td>Relative</td>
<td>The ball is right of the chair</td>
<td>The ball is downriver of the chair</td>
</tr>
<tr>
<td>Geocentric</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. A classification of frame types based on Danziger (2010)
• crosslinguistic variation

**Figure 4.** *Reference frame use in small-scale horizontal space across languages (Bohnemeyer & Levinson ms.)*
**alignment between language and cognition**  
– preferences for particular frame types in discourse and recall memory covary

> **Figure 5. Animals-in-a-Row: design**

> **Figure 6. Animals-in-a-Row: results**

<table>
<thead>
<tr>
<th>Linguistically Relative</th>
<th>English, Dutch, Japanese, Tamil-Urban</th>
<th>Prediction: Non-verbal coding will be relative</th>
<th>N = 85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linguistically Absolute</td>
<td>Arrernte, Hai//om, Tzeltal, Longgu, Belhare, Tamil-Rural</td>
<td>Prediction: Non-verbal coding will be absolute</td>
<td>N = 99</td>
</tr>
</tbody>
</table>

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

- strong Whorfian interpretation: language as the sole or dominant factor driving frame use
  - however:

  “(...) no one, not even Whorf, ever held that our thought was in the infernal grip of our language. Whorf’s own idea was that certain grammatical patterns, through making obligatory semantic distinctions, might induce corresponding categories in habitual or non-reflective thought in just the relevant domains (...)”

  (Levinson 2003a: 33; emphasis JB et al).
Frame Wars: What Whorf wrought (cont.)

• competing interpretations (cont.)

– weak Whorfian interpretation: language as one potential factor among others
  • Bohnemeyer (2011); Bohnemeyer et al (2014, 2015); Le Guen 2011; Mishra et al 2003; Wassmann & Dasen 1998

– non-Whorfian interpretation: the language-cognition alignment is epiphenomenal (Li & Gleitman 2002)
  • frame use in both language and thought is driven by cultural and environmental variables
    – education, literacy, topography, population geography

Figure 1. Strong LRH
Figure 2. Weak LRH
Figure 3. No LRH
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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 9. Seeing the forest for the trees
Unconfounding language (cont.)

- previous research: *MesoSpace*
  - two studies: reference frame use in referential communication and recall memory
    - w/ speakers of 6 Mesoamerican languages, 2 non-Mesoamerican indigenous languages, and 3 dialects of Spanish
  - GLMMs regressing egocentric vs. geocentric use against
    - L1; L2 use; literacy; education; topography, pop. density
  - results
    - L1 makes a sig. contribution to almost all models
      - so the effect of language cannot apparently be reduced to covariation with other variables, 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
    - topography and pop. density influence geocentric models
    - no sig. contributions from literacy or education to any models
• and now: expanding beyond Mesoamerica
  – today’s studies apply a similar design to a new population sample
    • combining speakers of two Mesoamerican languages...
      – Yucatec Maya and Isthmus Zapotec
    • ... with eight Asian populations...
      – rural and urban Japanese speakers from Honchu vs. Okinawa
      – monolingual speakers of Mandarin vs. Taiwanese Southern Min (TSM) vs. Mandarin-TSM bilinguals
      – Vietnamese speakers
    • ... and English speakers
• goals

– study the effect of language, culture, and environment on populations that are
  • more urban, literate, and educated than Mesoamericans
  • have not been influenced by the Mesoamerican *sprachbund* (or by Spanish)

– study the effect of 3D vs. 2D stimuli on frame use
  • we introduce a new tool for the study of linguistic preferences of frame use, the Talking Animals task
  • this instrument is geared toward examining whether 3D stimuli afford more geocentric usage
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Frame use in discourse: Talking Animals

- which independent variables drive the use of FoRs in verbal reference to small scale space?
- 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

Figure 10. *Truth conditions of intrinsic and relative descriptions of Ball & Chair 3.9 (left) and 3.12*

| The ball is in front of the chair | relative | intrinsic |
| The ball is left of the chair    | intrinsic | relative  |
our tool for studying the use of FoRs in discourse
– a 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 11. Design of the Talking Animals task (Pederson et al. 1998: 562)

Figure 12. One of four Talking Animals trials
Frame use in discourse: Talking Animals (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)
analysis: assumptions

– every description comprises an arbitrary number of propositions

• each potentially coded in a different reference frame

(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’éel bòola 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 ( . . .)’

– thus, the odds of a given FoR type being used in response to an item

• are independent of the odds of any other type being used
  – in response to the same item
Frame use in discourse: Talking Animals (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

**Figure 14.** Study populations: L1, L2, researchers
Frame use in discourse: Talking Animals (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 15. Mean education and literacy scores by population
Frame use in discourse: Talking Animals (cont.)

- independent variables: geography of the fieldsites
  - topography: geomorphic ‘provinces’
    - 3-level categorical variable
      - volcanic belts; central high plateaus;
        coastal basins and littoral transgressions
  - population density: log of inhabitants/km²

<table>
<thead>
<tr>
<th>Language</th>
<th>Locality</th>
<th>Country</th>
<th>Density (population/km²)</th>
<th>log scale</th>
<th>Topographic classification</th>
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</thead>
<tbody>
<tr>
<td>Japanese</td>
<td>Setagaya</td>
<td>Japan (Mainland)</td>
<td>15,551</td>
<td>4.19</td>
<td>coastal</td>
</tr>
<tr>
<td>Taiwanese Southern Min</td>
<td>Taipei</td>
<td>Taiwan</td>
<td>9,949</td>
<td>4.00</td>
<td>coastal</td>
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<td>Mandarin Chinese</td>
<td>Taipei</td>
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<td>4.00</td>
<td>coastal</td>
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<tr>
<td>Japanese</td>
<td>Naha</td>
<td>Japan (Okinawa)</td>
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<tr>
<td>English</td>
<td>Buffalo</td>
<td>United States</td>
<td>2,569</td>
<td>3.41</td>
<td>plateau</td>
</tr>
<tr>
<td>Japanese</td>
<td>Yomitan</td>
<td>Japan (Okinawa)</td>
<td>1,200</td>
<td>3.08</td>
<td>coastal</td>
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<tr>
<td>Taiwanese Southern Min</td>
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<td>Taiwan</td>
<td>855</td>
<td>2.93</td>
<td>coastal</td>
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<tr>
<td>Vietnamese</td>
<td>Long MỸ</td>
<td>Vietnam</td>
<td>406</td>
<td>2.61</td>
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</tr>
<tr>
<td>Japanese</td>
<td>Fujinomiya</td>
<td>Japan (Mainland)</td>
<td>339</td>
<td>2.53</td>
<td>volcanic</td>
</tr>
<tr>
<td></td>
<td>Aizuwakamatsu</td>
<td>Japan (Mainland)</td>
<td>321</td>
<td>2.51</td>
<td>volcanic</td>
</tr>
<tr>
<td></td>
<td>Nago</td>
<td>Japan (Okinawa)</td>
<td>293</td>
<td>2.47</td>
<td>volcanic</td>
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<td></td>
<td>Miyakojima</td>
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<td>2.43</td>
<td>coastal</td>
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<tr>
<td></td>
<td>Shisho</td>
<td>Japan (Mainland)</td>
<td>64</td>
<td>1.81</td>
<td>volcanic</td>
</tr>
<tr>
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<td>Yonaguni</td>
<td>Japan (Okinawa)</td>
<td>58</td>
<td>1.76</td>
<td>coastal</td>
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<tr>
<td>Isthmus Zapotec</td>
<td>La Ventosa</td>
<td>Mexico</td>
<td>5</td>
<td>0.70</td>
<td>coastal</td>
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<tr>
<td></td>
<td>Juchitán de Zaragoza</td>
<td>Mexico</td>
<td>5</td>
<td>0.70</td>
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<tr>
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<td>Yaxley</td>
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<td>0.30</td>
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<tr>
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<td>Felipe Carrillo Puerto</td>
<td>Mexico</td>
<td>2</td>
<td>0.30</td>
<td>coastal</td>
</tr>
</tbody>
</table>
Frame use in discourse: Talking Animals (cont.)

- results: response strategies across populations

**Figure 16.** Percentage of spatial representations featuring an unambiguous response type by population/language and response type
• 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
  – models that included the topography variable failed to converge due to a collinearity problem
  • all and only L1-English speakers inhabit a ‘plateau’ region

Table 4. Regression models of the Talking Animals data: summary of effects
(Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 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)
  • we also again found sig. L2 effects – but see below!
– we also once again find an effect of geography
  • population geography is positively correlated w/ egocentrism and strongly negatively with geocentric frame use
  • however, unlike in the Ball & Chair study, we did not find an effect of topography
    – likely due to our classification of geozones being too coarse-grained
– the Talking Animals models show significant independent effects of literacy, unlike Ball & Chair
  • literacy boosts egocentrism and depresses geocentrism
• results: discussion (cont.)
  – the L2 effect appears to be spurious
    • it evaporates in models
      that contain L1 and L2 use as the sole fixed factors
  – 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: New Animals

• 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

\[\text{Figure 17. Layout of the AIAR memory recognition task}\]

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

– big drawback: no intrinsic response pattern
• 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 5 reflects only those participants whose responses were included in the analysis

Table 5. Participants whose responses were included in the analysis by language, age, and sex

<table>
<thead>
<tr>
<th>Gender</th>
<th>American English</th>
<th>Japanese</th>
<th>Mandarin Chinese</th>
<th>Taiwanese Southern Min</th>
<th>Vietnamese</th>
<th>Yucatec</th>
<th>Isthmus Zapotec</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>12.5</td>
<td>33</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>67.5</td>
</tr>
<tr>
<td>Female</td>
<td>7.5</td>
<td>15</td>
<td>7</td>
<td>19</td>
<td>16</td>
<td>10</td>
<td>11</td>
<td>85.5</td>
</tr>
<tr>
<td>Age</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>≥30</td>
<td>2</td>
<td>17</td>
<td>0</td>
<td>19</td>
<td>8</td>
<td>11</td>
<td>11</td>
<td>68</td>
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<tr>
<td>&lt;30</td>
<td>19</td>
<td>31</td>
<td>9</td>
<td>2</td>
<td>12</td>
<td>6</td>
<td>7</td>
<td>86</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>48</td>
<td>9</td>
<td>21</td>
<td>20</td>
<td>17</td>
<td>18</td>
<td>154</td>
</tr>
</tbody>
</table>
• 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
• results

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

– logistic regression of the probability of egocentric reconstructions showed L1 and population density
  • 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

Figure 18. Response type frequency by L1
• this study will have to be rerun with English-speaking participants
  – the original data collected from English speakers had to be thrown out
    • due to an error in the execution of the protocol that we caught too late
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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 and population density

• more work needed on operationalizing topography
• 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.”
• 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)
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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  - ... the participants in our studies
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References


References (cont.)


