Modeling Folk Physics for Yucatec Maya Dispositionals

International Conference on Yucatec Linguistics
October 5, 2012

Timothy Tilbe
timothyt@buffalo.edu
University at Buffalo, State University of New York

Dispositional roots

- Often called "positionals" in the literature
- Mostly lexicalize noninherent spatial properties (Bohnemeyer & Brown 2007)
  - Including postures
- Make fine distinctions not lexicalized in more-studied languages
- Q'anjob'al has 600-700 dispositional roots (Martin 1977; Mateo-Toledo 2004)
- Tzeltal: 300+
- Tzotzil: 273+ (Haviland 1994)
- Yucatec: 160+

- For cross-linguistic context, see Ameka & Levinson (2007) and the special issue of Linguistics in which it appears

Research question

What are the dimensions of semantic contrast in the Yucatec Maya system of dispositionals?
That is, how can their semantic space be characterized in terms of cross-cutting but (ideally) independent kinds of distinctions?

Example of semantic dimensions: Berlin (1968) - Tzeltal numeral classifiers

Semantic domain of "severation":

<table>
<thead>
<tr>
<th>Definition of dimensions</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>'type fragment' (A)</td>
<td>slices (a1); slivers (a2); chunk-like (a3)</td>
</tr>
<tr>
<td>'kind of severation' (B)</td>
<td>halved (b1); not-halved (b2)</td>
</tr>
<tr>
<td>'length of fragment in reference to diameter' (C)</td>
<td>length greater than diameter (c1); length less than diameter (c2)</td>
</tr>
<tr>
<td>'placement of fragment' (E)</td>
<td>in situ (e1); not in situ (e2)</td>
</tr>
<tr>
<td>'angle of severation' (D)</td>
<td>90° (d1), not 90° (d2)</td>
</tr>
</tbody>
</table>

Just one example of YM dispositionals that differ in extension but receive the same translation in English or Spanish

‘hang (down)’ (Bricker et al. 1998)

Berlin’s definition of terms by components

<table>
<thead>
<tr>
<th>Classifier</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>/sik/</td>
<td>a1</td>
</tr>
<tr>
<td>/wel/</td>
<td>a2</td>
</tr>
<tr>
<td>/halp/</td>
<td>a3, b1, c1</td>
</tr>
<tr>
<td>/t'ahp/</td>
<td>a3, b1, c2</td>
</tr>
<tr>
<td>/sik'p/</td>
<td>a3, b2, d1, e1</td>
</tr>
<tr>
<td>/mahk'p/</td>
<td>a3, b2, d1, e2</td>
</tr>
<tr>
<td>/p'ahs/</td>
<td>a3, b2, d2, e2</td>
</tr>
</tbody>
</table>

Overview

- Initial data collection
- Hypotheses
- Method
- Results
- Discussion:
  - Lexical encoding of folk physics
  - Ontology
  - Toward a formalization of dispositional semantics
Folk Physics

- Folk physics or naive physics: “the commonsense beliefs that people hold about the way the world works, particularly with respect to classical mechanics” (Proffitt 2001).

Lexical folk physics

- The semantics of the Yucatec Maya dispositional class is full of concepts related to how things behave in the material world.
- (Linguistic) semantic representations and (non-linguistic) conceptual representations cannot be identical. (Levinson 1997)
- Still, the dispositional presuppose a lexical folk physics – an underlying conceptual model
  - Cf. Talmy (2000): Force Dynamics as a conceptual model that underlies causatives, etc.
- This lexical folk physics may or may not correspond to the folk physics beliefs of present-day Yucatec Maya speakers.
  - Communicative habits have developed throughout the history of the language, and so the lexicon may contain relics of no-longer-current folk physics

Why formalize?

- Allows precise definitions of dispositionals
- Facilitates cross-linguistic comparison of dispositional semantics

First stage of data collection

- Field work by Bohnemeyer in 2006
  - Site: Yaxley, Quintana Roo
  - Six informants
- Inspired by Berlin (1968)
- 148 dispositional roots were included in the study
  - The vast majority of the form class
- Typical themes for each root were elicited (Task 1)
- Demonstration task (Task 2):
  - Items used: Sticks, leaves, branches, toy snake, toy dog, toy car, dolls, corn plants, corn kernels, nails, shirt, rope, play dough, rocks, calabaza, plastic container, machete, water, sand
  - Task was organized by item in order to elicit contrasts between dispositional that are applicable to the same item(s)
  - Vkbal forms were used as prompts
  - Informants manipulated each item such that each applicable dispositional could be predicated of it
  - Task yielded video data on the extension of each dispositional

From extension to intension

- Next step: Attempt to infer the semantics of each dispositional from this extensional data
- Which properties of the demonstrations were determined by semantics, and which by pragmatics? (e.g., stereotype implicatures)
  - The only way to find out is to elicit judgments from native speakers

Hypothesized dimensions

- A list of proposed semantic dimensions was compiled
- Dimensions should explain the kinds of contrasts that can be made using the dispositional lexical class
  - They should characterize the class as a whole, and also make it possible to define each dispositional uniquely, using as few dimensions as possible
These dimensions were hypothesized to be:

- Configuration (of parts)
- Dispersion
- Contact
- Length of Vertical Dimension
- Configuration with Regard to Ground
- Containment
- Suspension
- Leaning
- Orientation
- Blockage of Motion
- Support
- Potential Energy
- Animacy
- Numerosity
- Material Properties

Coding

- Based on video data
  - All possible pairs of a dispositional and a dimension were coded:
    - Does the dispositional appear to be specified for a certain value of that dimension?
      - That is, do all demonstrations of that dispositional have a common property that can be described in terms of that dimension?

Testing hypotheses: Task 3

- For a selection of dispositional-dimension pairs, demonstrations were constructed
  - based on video data from Task 2, and using the same objects as themes
  - but differing from the native speakers’ demonstrations in the value of one dimension
- Judgment task: Can the dispositional be predicated of my demonstration?
- This provided evidence about the truth conditions of the dispositional
  - What do they entail when used as predicates?

Example

- Attested demonstration of bak’akbal ‘wound around,’ using piece of paper as figure,* from Task 2:

* Figure: In this context, entity of which a dispositional is predicated
Ground: Entity with which the figure stands in a locative relation

- Researchers constructed demonstration for Task 3:
  - Participant’s correction of the demonstration:

Unlike in the attested demonstrations, there is no stick to act as a ground. This tests the dimension Configuration with Regard to Ground.

Field site: Popolá, Yucatán

- Village just outside of Valladolid
- Task 3 was run with eight participants
- Sixty-three dispositional were tested on at least one dimension each
Results: Dimensions supported by the evidence

- Configuration (of parts)
- Dispersion
- Contact
- Configuration with Regard to Ground
- Containment
- Suspension
- Blockage of Motion
- Potential Energy
- Animacy
- Numerosity
- Material Properties

- Discarded dimension:
  - Leaning (subsumed under Configuration of Parts and Configuration with Regard to Ground)
- Dimensions with insufficient data:
  - Orientation
  - Support
- Questionable dimension:
  - Length of Vertical Dimension
    - Explains distinction between 'toyokbal and 'chohokbal, but could be explained instead in terms of the proportion of the figure that receives support

Limitations of Task 3

- Did not cover all dispositionals
- Did not cover every component of each dispositional

Formalization: Working assumptions

- Parsimony
- Certain concepts are likely to be available to speakers of most or all languages
  - These are concepts that have proven useful for semantic analysis in typologically diverse languages
    - Not necessarily lexicalized in all of them, but available for distinguishing between contrasting lexical items
  - Some candidate concepts:
    - Force – Talmy 2000
    - Time – e.g., Bohnemeyer 2002, Vapnarsky 1999
    - Paths – e.g., Schultze-Berndt 2000
    - Regions of space

An ontology for YM dispositionals

- Material entities
- Properties
- Relations
- Space
- Paths
- Time

Material entities

- These are the figures and grounds to which dispositionals can apply: objects, animals, people
- Mereology: There must be a procedure for decomposing material entities into named parts.
  - A dispositional can be predicated of just part of an entity
  - Mereology is needed for defining how parts are configured with regard to other parts
Properties

• Numerosity (one vs. many)
• Animacy (animate vs. inanimate)
  – Do plants make up a third category?
• Language-specific classification of material properties:
  – Main opposition is flexible vs. rigid
  – Liquid and fibrous entities are also treated as categories
  – Cf. Levinson (2007) on the classification of cut and break verbs in Yélî Dnye:
    • Coherent severance
      – With the grain
      – Against the grain
    • Incoherent severance
• Configurations (sitting, standing, bowing, etc.) are treated as gestalts until and unless they can be decomposed
• Energy
• Metric property: relative length? (chohokbal vs. t’oyokbal)

Relations

• Topological relations (in the sense of Piaget and Inhelder 1956): Proximity, contact, containment
  – Lexicalized elsewhere in the Yucatec lexicon
• Meronymy: “is a part of”
• Force dynamic relations

Space

• Material entities exist in three-dimensional space
• Dispositionals are independent of frames of reference

Paths

• Represent actual or possible movement of an entity
• Needed in order to account for, e.g., k’atakbal ‘lying athwart’: ground blocks figure’s path
• Also needed in order to refer to the force of gravity

Time

• Only marginally important to the dispositional class
  – The vast majority of dispositionals can be applied to a single moment of an entity’s history
• Required to account for he’lekbal ‘resting’
  – There must be a moment when the figure is moving, and a later moment when the figure is no longer moving

Not needed in this ontology

• Light
• Heat
• Color
• etc.
  – Dispositionals lexicalize many physical properties and relations, but do not exhaust knowledge of material world
Formalization

<table>
<thead>
<tr>
<th>Ontological category</th>
<th>Representation</th>
<th>Notation example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material entity</td>
<td>Variable</td>
<td>(x = \text{theme (corn, sticks, paper...)}, y = \text{ground})</td>
</tr>
<tr>
<td>Property</td>
<td>1-place predicate</td>
<td>(\text{Many}'[x])</td>
</tr>
<tr>
<td>Relation</td>
<td>2-place predicate</td>
<td>(\text{Contain}'[y, x])</td>
</tr>
<tr>
<td>Space</td>
<td>Locative relation</td>
<td>(\text{LOC}(a, b))</td>
</tr>
<tr>
<td>Path</td>
<td>Variable</td>
<td>(\exists z[\text{path}'(z) \land \text{LOC}(\text{beginning}'[z], \ldots) \land \text{LOC}(\text{end}'[z], \ldots))</td>
</tr>
<tr>
<td>Time</td>
<td>Relativize interpretation to moments or intervals of time</td>
<td>(t_i = \ldots)</td>
</tr>
</tbody>
</table>

Example of a formal definition

\(T\text{’oyokbal}\) can be predicated of figure \(x\) iff:

\[\text{Inanimate}'[x] \land \text{Flexible}'[x] \land \exists y[\exists a[\exists b[\text{PartOf}'(a, x) \land \text{PartOf}'(b, x) \land \text{Support}'(y, a) \land \neg\text{Support}'(y, b)]]\]

The predicate \text{Support}' must be defined in terms of contact and force dynamics.

Translation:

\(T\text{’oyokbal}\) can be predicated of a figure if and only if:

- The figure is inanimate and flexible
- Another object serves as a ground
- The ground supports some part of the figure, but not all of it

Underspecified dimensions are not included in the definition
- e.g., Length of Vertical Dimension (which is specified for \text{chohokbal} and \text{ch’uyukbal})

The problem of conceptual primitives

- Predicates like \text{Inanimate}', \text{Flexible}',..., relations like \text{PartOf}', \text{Support}'...
- How much should these predicates and relations be decomposed in order to be sufficiently explicit?

Further questions

- Is this account of the dispositionals consistent with the folk physics lexicalized in other Yucatec Maya word classes?
- Comparison to dispositionals in other Mayan languages
- How does the folk physics system actually used by Yucatec Maya speakers (in nonlinguistic cognition) compare to this lexicalized folk physics?

Special thanks to...

- Jürgen Bohnemeyer
- Ashlee Shinn
- Rosa María Couoh Pool
- Gerónimo Can Tec
- The UB Semantic Typology lab
References


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Mateo-Toledo, Eladio. 2004. *Directional markers in Q’anjob’al (Maya); their syntax and interaction with aspectual information*. Master’s thesis, University of Texas at Austin.


