Making sense of time
the embodied nature of human abstraction

"If men... did not have the same conception of time, space, cause, number, etc. all contact between their minds would be impossible and with that all life together"
- Emile Durkheim, 1915

Do humans everywhere share the same fundamental abstract concepts?

Outline
- Conceptualizing time
  Background, theory, methods
- Universals? Radical variations?
  Aymara (Andes)
  Yupno (Papua New Guinea)
- Discussion

… at my hotel room in Tokyo …
Spatial construals of time

- Investigating conceptualization (rather than perception and psychophysics)
- Language, Behavior, Artifacts, Brain activity ...

Cognitive linguistics

- Waaaay back in the '50s …
- The week ahead of us …
- We are coming to the end of the quarter …
- It is 20 minutes ahead of 1 o'clock
- Halloween is almost here
- Spring follows winter …
- … (and, beyond words: illustrations)

Spatial construals of time

- **Time** is primarily construed in terms of 1d space
  - The week ahead looks good
  - We are approaching the end of the year
- but, what kinds of **spatial construals** are recruited?
Three spatial frames of reference

**OBJECT-CENTERED**

**EGO-CENTERED**

**GEOCENTRIC**

"The pig is in front of the cow"

"The pig is right of the cow"

"The pig is east of the cow"

Figure adapted from Haun et al. (2011)

Two types of time

**DEICTIC TIME**

- also called TENSED TIME
- past and future relative to now

- The week ahead looks good.
- She left two days ago.
- Move the meeting forward.

**SEQUENCE TIME**

- also called TENSELESS TIME
- mutually earlier/later than relationships

- Spring follows winter.
- Tuesday is before Thursday.
- Move the meeting forward.

(Haspelmath, 1997) and psychological experiments (e.g. Miles et al., 2010)

How is deictic time construed spatially?

- a cross-culturally widespread ego-centered pattern that preserves transitivity

- attested through linguistic analysis (Haspelmath, 1997) and psychological experiments (e.g. Miles et al., 2014)

- also evident in sign languages, e.g. ASL

How is deictic time construed spatially?

- But, ... is it universal?
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Aymara: Past expressions

ancha nayra pachana

Morpheme by morpheme gloss:

ancha  a lot
nayra  eye, sight, front
pacha  time
-na  in, on, at

Literal translation:
A lot eye/front time-at

Meaning:
(At a) long time ago

Aymara: Future expressions

akata q’iparu

Morpheme by morpheme gloss:

aka  here, this
-ta  from
q’ipa  back, behind
-ro  to, towards

Literal translation:
Here/this-from back-to

Meaning:
From now on

But, ... is this evidence of a truly ego-centered counter-universal?

- Nope. This could be a case like before yesterday or after tomorrow in English (sequence-based form)
  - Linguistic test: What is the reference point (RP)?

- In Aymara the test is NOT conclusive
  - purely linguistic evidence is insufficient
  - etymology says little about real-time cognitive reality
  - ... so, how can we tell?

A methodological challenge: the investigation of abstract concepts in isolated cultures

- issues include:
  - language is not transparent
  - ecological validity
  - overt judgments (internal validity)

- our approach: spontaneous co-speech gesture production!!
The study

- interviews with 30 participants
- 17 towns from Northern Chile
- 20 hours of raw video
- everyday temporal expressions, anecdotes, stories
- analysis of pointing directionality co-occurring with temporal terms

Example (1)

Example (2)

Results (more live examples)
Aymara case may be striking, but it is still ego-based (ego-centered)

Are there groups that construe time not ego-centrically, but geocentrically?

If so, what are the properties of such construals?
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Discussion
Why the Yupno?

- Topographic relations central in cosmology and everyday language (Wassmann, 1994).
- Topographic contrasts appear in spatial adverbs, verbs of motion, and the deictic system.
- Clues about spatial construals of time, e.g., word omoropmo “down there on the other side” is used in the expression omoropmo bilak “a few years ago.”

Field methods

- Preliminary interviews
- Selection/recording of 15 temporal expressions covering deictic time (past, present, future) on different scales
- Semi-structured interviews w/ pairs of adults
  - Inside & outside
  - Participants facing direction changed mid-interview
  - 27 participants (20 men, 7 women)

Field methods (cont’d)

- Orientation of all camera angles and houses recorded
- All interviews video-recorded in HD with Canon HV20

Gesture analysis: five stages

1. Annotation of every manual gesture co-produced with a predetermined set of temporal content words
2. Yielded corpus of 845 manual temporal gestures

Gesture analysis: five stages

1. Two coders rated (1-5) each manual gesture on three criteria: directionality, stroke-iness, displacement
2. 215 gestures w/ clearest morphological profile retained for further analyses
Results

- three deictic time categories
  - present (deictic center)
  - past
  - future

Gesture analysis: five stages

1. Two coders separated gestures into those with downward strokes & outward/upward strokes.
2. Reconstructed stroke trajectory of each outward/upward gesture from 3 views.
3. Two coders reconstructed participants' facing directions relative to known vectors: 1) camera angles; 2) fireplace orientations.
4. Gesture trajectories and participant facing directions combined to yield absolute orientation of gestures in geocentric space.

Results

deictic category (past, present, future) was significantly related to whether the gesture was directed toward the ground or to some other location. 

Major contributor to significance was the present category gestures which were overwhelmingly directed toward the ground (adjusted standardized residuals = 9.0).
**Results**

*past and future*

- pointing directions (top view) analysis

![](image1.png)

- Spherical statistics

**Results — outdoors**

*past and future*

Pointings produced in a non-isotropic manner
• Both past and future distributions have a significant concentration in a single direction
• Kuiper's tests of uniformity: past, n=18; Kuiper's V=2.1, p<0.01
  future, n=11; Kuiper's V=1.82, 0.025<p<0.05.
• Figure shows 95% confidence cone (based on 1000 parametric bootstrap estimates)

Núñez, Cooperrider, Doan, Wassmann, 2012

Mean Pointing directions
past: 69.21 degrees, and future: 180.84 degrees
• Different from each other (High concentration F-test circular ANOVA (F(1,27)=19.06, p=0.00017).
• Significant proportion of gestures pointing within a 90-degree quadrant around the corresponding mean direction (binomial test, past p=0.00123; future p=0.00119).

**Results — outdoors**

Mean Pointing directions aligned with topographic orientations
past: downhill, and future: uphill
• 95% confidence cone don’t include each other’s opposite directions No “time-line”

Núñez, Cooperrider, Doan, Wassmann, 2012

**Results — the human face**

![Human face images](image2.png)

Núñez, Cooperrider, Doan, Wassmann, 2012
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Discussion

- Universal trends in how humans construe time
  - TIME as 1-dimensional SPACE (sometimes extended to cyclic and helix-like forms)
  - deictic center associated w/ ego’s co-location
  - preservation of transitivity
- What factors motivate the Aymara and Yupno patterns?

Discussion (cont’d)

- What grounds the Aymara pattern?
  - overemphasis on visual perception as source of knowledge
  - strong use of evidentials, including in Castellano Andino
  - “Knowing is seeing”
    - Past is known and visible
    - Future is unknown, out of the visual field

Discussion (cont’d)

- What grounds the Yupno pattern?
  - centrality of topographic spatial system
  - association of macroscale downhill with ancestral past
  - entrance schema(!) for outdoor and indoor space
  - “Novel” dimensions of the Yupno pattern
    - geoentric (topographic), not ego-based
    - (essentially) no metaphorical language(!) — gesture
    - asymmetrical or “broken” in two senses: No time “line”(!)
“If men... did not have the same conception of time, space, cause, number, etc. all contact between their minds would be impossible and with that all life together”

- Emile Durkheim, 1915

Like in biological evolution, diversity and variation (especially regarding fundamental phenomena) are essential for the understanding of the human mind ... let’s take it seriously!

Thank you!

Aymara communities from inland Arica and Iquique, Chile
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