Diachronic and areal patterns: New applications of the semantic map model in lexical typology

Stéphane Polis
(F.R.S.-FNRS / ULiège)

(resorting to joint work with Thanasis Georgakopoulos, ULiège; E. Grossman & D. Nikolaev, Jerusalem)

16.04.2018
National Research University Higher School of Economics - Moscow
Outline of the talk

- Semantic maps
  - Background information: Different types of maps
  - Principles of the classical model
    - Connectivity hypothesis
    - Economy principle
Outline of the talk

- Semantic maps
  - Background information: Different types of maps
  - Principles of the classical model
    - Connectivity hypothesis
    - Economy principle
- Le Diasema
  - Focus on the lexicon and diachrony
Outline of the talk

- Semantic maps
  - Background information: Different types of maps
  - Principles of the classical model
    - Connectivity hypothesis
    - Economy principle
- Le Diasema
  - Focus on the lexicon and diachrony
- Two case-studies
  - Diachrony: dynamicizing a map of time-related meanings
Outline of the talk

- Semantic maps
  - Background information: Different types of maps
  - Principles of the classical model
    - Connectivity hypothesis
    - Economy principle
- Le Diasema
  - Focus on the lexicon and diachrony
- Two case-studies
  - Diachrony: dynamicizing a map of time-related meanings
  - Areality: patterns of polysemy for the verbs of perception and cognition
Semantic maps

- Basic assumption
  - Co-expressions (aka, polyfunctionality, polysemy, colexification patterns, etc.) point to recurrent relationships between meanings across languages
Semantic maps

- Basic assumption
  - Co-expressions (aka, polyfunctionality, polysemy, colexification patterns, etc.) point to recurrent relationships between meanings across languages
Semantic maps

➢ Basic assumption
  o Co-expressions (aka, polyfunctionality, polysemy, colexification patterns, etc.) point to recurrent relationships between meanings across languages
Semantic maps

- Basic assumption
  - Co-expressions (aka, polyfunctionality, polysemy, colexification patterns, etc.) point to recurrent relationships between meanings across languages

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Language</th>
<th>ISO</th>
<th>Family</th>
<th>Source</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Araona</td>
<td>aro</td>
<td>Tacanan</td>
<td>IDS</td>
<td>ba</td>
</tr>
<tr>
<td>2</td>
<td>Ayoreo</td>
<td>ayo</td>
<td>Zamucoan</td>
<td>IDS</td>
<td>i moi?</td>
</tr>
<tr>
<td>3</td>
<td>Hawaiian</td>
<td>haw</td>
<td>Austronesian</td>
<td>IDS</td>
<td>?ike</td>
</tr>
<tr>
<td>4</td>
<td>Ese</td>
<td>mcq</td>
<td>Trans-New Guinea</td>
<td>IDS</td>
<td>banana</td>
</tr>
<tr>
<td>5</td>
<td>Maori</td>
<td>mri</td>
<td>Austronesian</td>
<td>IDS</td>
<td>kitea</td>
</tr>
<tr>
<td>6</td>
<td>Telugu</td>
<td>tel</td>
<td>Dravidian</td>
<td>SPRÅKBANKEN</td>
<td>aarayu</td>
</tr>
<tr>
<td>7</td>
<td>Telugu</td>
<td>tel</td>
<td>Dravidian</td>
<td>SPRÅKBANKEN</td>
<td>aaru</td>
</tr>
</tbody>
</table>

(CLICs; http://clics.lingpy.org/direct.php; List et al. 2014)
Semantic maps

- Basic assumption
  - Co-expressions (aka, polyfunctionality, polysemy, colexification patterns, etc.) point to recurrent relationships between meanings across languages

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Language</th>
<th>ISO</th>
<th>Family</th>
<th>Source</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Araona</td>
<td>aro</td>
<td>Tacanan</td>
<td>IDS</td>
<td>ba</td>
</tr>
<tr>
<td>2</td>
<td>Ayoreo</td>
<td>ayo</td>
<td>Zamucoan</td>
<td>IDS</td>
<td>i mo?</td>
</tr>
<tr>
<td>3</td>
<td>Hawaiian</td>
<td>haw</td>
<td>Austronesian</td>
<td>IDS</td>
<td>like</td>
</tr>
<tr>
<td>4</td>
<td>Ese</td>
<td>mcq</td>
<td>Trans-New Guinea</td>
<td>IDS</td>
<td>banaha</td>
</tr>
<tr>
<td>5</td>
<td>Maori</td>
<td>mri</td>
<td>Austronesian</td>
<td>IDS</td>
<td>kitéa</td>
</tr>
<tr>
<td>6</td>
<td>Telugu</td>
<td>tel</td>
<td>Dravidian</td>
<td>SPRÅKBANKEN</td>
<td>aarayu</td>
</tr>
<tr>
<td>7</td>
<td>Telugu</td>
<td>tel</td>
<td>Dravidian</td>
<td>SPRÅKBANKEN</td>
<td>aarayu</td>
</tr>
</tbody>
</table>

(CLICs; http://clics.lingpy.org/direct.php; List et al. 2014)
Semantic maps

- Basic assumption
  - Co-expressions (aka, polyfunctionality, polysemy, colexification patterns, etc.) point to recurrent relationships between meanings across languages

Found 3 colexifications for "see" and "read".

Note that the number of attested colexifications may differ from the number of languages in which the colexifications were attested.

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Language</th>
<th>ISO</th>
<th>Family</th>
<th>Source</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Waorani</td>
<td>auc</td>
<td>unknown</td>
<td>IDS</td>
<td>a</td>
</tr>
<tr>
<td>2</td>
<td>Tuyuca</td>
<td>tuc</td>
<td>Tucanoan</td>
<td>IDS</td>
<td>ũyä</td>
</tr>
<tr>
<td>3</td>
<td>Yagua</td>
<td>yad</td>
<td>Peba-Yagan</td>
<td>IDS</td>
<td>hũnũy</td>
</tr>
</tbody>
</table>

(CLICs; http://clics.lingpy.org/direct.php; List et al. 2014)
Semantic maps

- Two main types
  - Connectivity maps
  - Proximity maps
Semantic maps

- Two main types
  - Connectivity maps (= classical maps)
  - Proximity maps

Figure 1a. Haspelmath’s (1997: 4) original semantic map of the indefinite pronouns functions

- Graph
  - Nodes = meanings
  - Edges = relationships between meanings
Semantic maps

- Two main types
  - Connectivity maps
  - **Proximity maps** (= MDS maps)

  ![Graph](image1)

  ![MDS analysis](image2)

  **Figure 1a.** Haspelmath’s (1997: 4) original semantic map of the indefinite pronouns functions

  **Figure 1b.** MDS analysis of Haspelmath’s (1997) data on indefinite pronouns (Croft & Poole 2008: 15)

- Graph
  - Nodes = meanings
  - Edges = relationships between meanings

- Two-dimensional space
  - Points = meanings (or contexts)
  - Proximity = similarity between meanings (or contexts)
Semantic maps

- Two main types
  - Connectivity maps
  - Proximity maps

Figure 1a. Haspelmath's (1997: 4) original semantic map of the indefinite pronouns functions

Figure 1b. MDS analysis of Haspelmath's (1997) data on indefinite pronouns (Croft & Poole 2008: 15)
Semantic maps

- Two main types
  - Connectivity maps
  - Proximity maps

![Figure 1a. Haspelmath’s (1997: 4) original semantic map of the indefinite pronouns functions](image1)

![Figure 1b. MDS analysis of Haspelmath’s (1997) data on indefinite pronouns (Croft & Poole 2008: 15)](image2)

1. **Specific known**

   *Somebody* called you, guess who
Semantic maps

- Two main types
  - Connectivity maps
  - Proximity maps

Figure 1a. Haspelmath’s (1997: 4) original semantic map of the indefinite pronouns functions

1. **Specific known**
   *Somebody* called you, guess who

2. **Specific unknown:**
   *Somebody* called you, but I don’t know who

Figure 1b. MDS analysis of Haspelmath’s (1997) data on indefinite pronouns (Croft & Poole 2008: 15)
Semantic maps

- Two main types
  - Connectivity maps
  - Proximity maps

1. Specific known
   *Somebody* called you, guess who

2. Specific unknown:
   *Somebody* called you, but I don’t know who

6. Indirect negation:
   I don’t think that *anybody* called
Semantic maps

- Two main types
  - Connectivity maps
  - Proximity maps

Figure 1a. Haspelmath’s (1997: 4) original semantic map of the indefinite pronouns functions

Figure 1b. MDS analysis of Haspelmath’s (1997) data on indefinite pronouns (Croft & Poole 2008: 15)

Other application: ‘Typology without types’
- Points = contexts
- Shape of the points = lexical items
- Proximity = higher probability of co-expression
Semantic maps

Two main types
- Connectivity maps
- Proximity maps

Figure 1a. Haspelmath’s (1997: 4) original semantic map of the indefinite pronouns functions

Figure 2. A MDS map of ‘go’, ‘come’, and ‘arrive’ in Spanish (Wälchli & Cysouw 2012: 692)

Other application: ‘Typology without types’
- Points = contexts
- Shape of the points = lexical items
- Proximity = higher probability of co-expression
Semantic maps

- Two main types
  - Connectivity maps
  - Proximity maps
Semantic maps

- Two main types
  - Connectivity maps
    - Classical maps (= simple graphs)
    - Lattices (= ‘hierarchical’ graphs)
Semantic maps
Semantic maps

Figure 3. FCA analysis of Haspelmath’s (1997) data

FCA solves the problem of form/meaning mapping
Semantic maps

FCA solves the problem of form/meaning mapping, since it shows:

✔ How forms maps onto meanings

Figure 3. FCA analysis of Haspelmath’s (1997) data
Semantic maps

FCA solves the problem of form/meaning mapping, since it shows:

✓ How forms maps onto meanings
✓ Which concepts are lexicalized and which are not

Figure 3. FCA analysis of Haspelmath’s (1997) data
Semantic maps

FCA solves the problem of form/meaning mapping, since it shows:

✓ How forms maps onto meanings
✓ Which concepts are lexicalized and which are not

Figure 3. FCA analysis of Haspelmath’s (1997) data
Semantic maps

FCA solves the problem of form/meaning mapping, since it shows:

- How forms maps onto meanings
- Which concepts are lexicalized and which are not
- Implication sets can be computed automatically

Le Diasema
Semantic maps

FCA solves the problem of form/meaning mapping, since it shows:

- How forms maps onto meanings
- Which concepts are lexicalized and which are not
- Implication sets can be computed automatically

Figure 3. FCA analysis of Haspelmath's (1997) data

Le Diasema
Semantic maps

FCA solves the problem of form/meaning mapping, since it shows:

- How forms maps onto meanings
- Which concepts are lexicalized and which are not
- Implication sets can be computed automatically
Semantic maps

FCA solves the problem of form/meaning mapping, since it shows:

- How forms map onto meanings
- Which concepts are lexicalized and which are not
- Implication sets can be computed automatically
FCA solves the problem of form/meaning mapping, since it shows:

- How forms maps onto meanings
- Which concepts are lexicalized and which are not
- Implication sets can be computed automatically

- But, less ‘reader-friendly’ (especially with many meanings = attributes)
FCA solves the problem of form/meaning mapping, since it shows:

- How forms maps onto meanings
- Which concepts are lexicalized and which are not
- Implication sets can be computed automatically

- But, less ‘reader-friendly’ (especially with many meanings = attributes)
FCA solves the problem of form/meaning mapping, since it shows:

- How forms maps onto meanings
- Which concepts are lexicalized and which are not
- Implication sets can be computed automatically

- But, less ‘reader-friendly’ (especially with many meanings = attributes)
- Complementarity between the two approaches
Semantic maps

- Semantic maps
  - Background information: Different types of maps
  - Principles of the classical model
Semantic maps

- Background information: Different types of maps
- Principles of the classical model
  - *Connectivity hypothesis* (Croft 2001): any language-specific item should map on a connected region of the graph
  - *Economy principle* (Georgakopoulos & Polis 2018): given three meanings (Meaning_1, Meaning_2, Meaning_3), if the linguistic items expressing Meaning_1 and Meaning_3 always express Meaning_2, there is no need to draw an edge between Meaning_1 and Meaning_3
Semantic maps

English:
• ‘Direction’: The teacher is going to the school
• ‘Purpose’: The lifeguard ran to rescue the child
• ‘Recipient’: The teacher gave the book to the student

(Haselmath 2003)
Semantic maps

English:
- ‘Direction’: The teacher is going \textit{to} the school
- ‘Purpose’: The lifeguard ran \textit{to} rescue the child
- ‘Recipient’: The teacher gave the book \textit{to} the student

\begin{itemize}
  \item \textbf{purpose}
  \item \textbf{direction}
  \item \textbf{recipient}
\end{itemize}

(Haspelmath 2003)
Semantic maps

German:
• ‘Purpose’: Anna ging zum Spielen in den Garten
• ‘Direction’: Ich gehe zu Anna

≠
• ‘Recipient’: Ich gebe dir das Buch
German:
• ‘Purpose’: Anna ging zum Spielen in den Garten
• ‘Direction’: Ich gehe zu Anna

≠
• ‘Recipient’: Ich gebe dir das Buch
Semantic maps

French:

• ‘Purpose’: Je donne la balle *pour* jouer dans le jardin ≠
• ‘Direction’: Je vais à Moscou
• ‘Recipient’: Je donne le livre à Paul
Semantic maps

French:
• ‘Purpose’: Je donne la balle *pour* jouer dans le jardin
  ≠
• ‘Direction’: Je vais *à* Moscou
• ‘Recipient’: Je donne le livre *à* Paul
Semantic maps

German

- purpose
- direction
- recipient

French

- purpose
- direction
- recipient

Connectivity hypothesis
Semantic maps

German

French

Mini-map

Connectivity hypothesis
Semantic maps

Mini-map

Economy principle

purpose — direction — recipient
Semantic maps

Mini-map

- purpose
- direction
- recipient

Economy principle
Le Diasema
- Adding the diachronic dimension to semantic maps of content words

- “[T]he best synchronic semantic map is a diachronic one”
  (van der Auwera 2008: 43)
• Adding the diachronic dimension to semantic maps of content words

• “[T]he best synchronic semantic map is a diachronic one”
  (van der Auwera 2008: 43)
Objectives

- To plot automatically weighted and diachronic semantic maps (tomorrow 9AM)

- To incorporate the diachronic dimension into semantic maps of content words and to provide information about the cognitive and cultural factors behind the development of the various meanings (today)
  - Protocol to construct lexical diachronic semantic maps
  - Case-study: The semantic extension of time-related lexemes

- To investigate areal patterns of polysemy with semantic maps (today)
  - Case-study: The verbs of perception and cognition in typological perspective
Case-study 1
Lexical diachronic semantic maps

The semantic extension of time-related lexemes
Protocol to construct a (lexical) diachronic semantic map

1. Choose the concepts/ domains
2. Identify cross-linguistic polysemy patterns
3. Build a lexical matrix
4. Plot a weighted semantic map
5. Remove infrequent polysemy patterns
6. Select languages with diachronic data
7. Add diachronic information
Protocol to construct a (lexical) diachronic semantic map

Choice of concepts

- For the purpose of universality and stability, we chose the entries for time-related concepts in the Swadesh 200-word list (Swadesh 1952: 456-457)

  - DAY/DAYTIME
  - NIGHT
  - YEAR

THE TEST VOCABULARY

in, to kill, to know (focus), lake, to laugh, lead (trail), left (hand), let, to live (on side), to live, man, long, house, man (male human), many, near (fish), mother, mountain, mouth, name, number, near, neck, new, night, nose, not, old, one, other, person, to play, to pull, to push, to rain, red, right (correct), right (hand), root, read (car wall), root, rope, rotten (especially big), to rub, salt, sand, to say, to scratch (has with fingersail to relieve itch), sea (ocean), to see, seed, to see, sharp (as knife), short, to sing, to sit, skin (person's), sky, to sleep, small.
to smell (perspiration odor), smoke (of fire), smooth, smile, snow, some, to split, to split, to squeeze, to stub (or stick), to stand, star stick (of wood), stone, straight, to suck, sun, to swell, to swim, tall.
that, these, thin, thick, thin, to think, this, there, three, to throw, to lie, tongue, tooth (front rather than molar), tree, to turn (change one's direction), two, to walk, warm (of weather), to wash, water, to wet, what, when, where, which, who, wide, wife, wind, wing, to wise, with (accompanying), woman, words, worn, yr, year, yellow.
Protocol to construct a (lexical) diachronic semantic map

Choice of concepts

- We chose the entries for time-related concepts also for the sake of comparability (see, e.g., Youn et al. 2016)
Protocol to construct a (lexical) diachronic semantic map

Identify cross-linguistic polysemy patterns

- $N$ of lgs: 221
- $N$ of lg families: 64
- $N$ of concepts: 1280

- Identify in CLICS (List et al. 2014) the main polysemy patterns attested for these three meanings (subgraph approach) [16 meanings]
Identify cross-linguistic polysemy patterns

- Identify in CLICS (List et al. 2014) the main polysemy patterns attested for these three meanings (subgraph approach) [16 meanings]

- **DAY/DAYTIME**: CLOCK/TIMEPIECE, HOUR, SEASON, SUN, TIME, WEATHER
- **NIGHT**: DARK (in color), DARKNESS, BLACK, OBSCURE
- **YEAR**: AGE, SPRING, SUMMER
Identify cross-linguistic polysemy patterns

- All the colexification patterns attested for these 16 meanings were gathered from the CLICs source files (http://clics.lingpy.org/download.php):

  ➤ 381 colexification patterns
Protocol to construct a (lexical) diachronic semantic map

Convert the polysemy patterns into a lexical matrix

Python script $\alpha$

Lexical matrix

<table>
<thead>
<tr>
<th>Languages</th>
<th>Forms</th>
<th>Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>acid, sour</td>
<td>city, town</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

1 when a meaning is attested for one form
Protocol to construct a (lexical) diachronic semantic map

Plot a weighted semantic map

Tomorrow 9AM
The semantic extension of time-related lexemes

* A method to extract the community structure of large networks. Here, the different colors point to modules (also called clusters or communities) with dense connections between the nodes within the network.

Full semantic map for time-related senses, visualized with modularity analysis* (Blondel et al. 2008) in Gephi
Semantic map of time-related senses
(colexification patterns attested in 2+ languages)

Two connected sub-networks
- NIGHT/DARKNESS/DARK
- DAY/TIME/AGE/YEAR

Remove infrequent polysemy patterns
Semantic map of time-related senses (colexification patterns attested in 2+ languages)

Two connected sub-networks:
- NIGHT/DARKNESS/DARK
- DAY/TIME/AGE/YEAR

Remove infrequent polysemy patterns
Remove infrequent polysemy patterns

- In order to investigate directionality of change, 13 meanings that are connected on this map in at least 8 different languages were kept as a basis for diachronic investigation (in the sub-graph day/year)
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

• The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

• The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)

(1) Meanings: tree (source)—forest (target) (ID: 600); Form: dar; Language: Aghul; Realization Type: synchronic polysemy
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

- The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)

(1) **Meanings**: tree *(source)*—forest *(target)* (ID: 600); **Form**: dar; **Language**: Aghul; **Realization Type**: **synchronic polysemy**

(2) **Meanings**: doll *(source)*—nymph, chrysalis *(target)* (ID: 927); **Form**: kukla; **Language pair**: Russian —Czech; **Realization Type**: **Cognate**
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

- The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)

(1) **Meanings**: tree *(source)*—forest *(target)* (ID: 600); **Form**: dar; **Language**: Aghul; **Realization Type**: **synchronic polysemy**

(2) **Meanings**: doll *(source)*—nymph, chrysalis *(target)* (ID: 927); **Form**: kukla; **Language pair**: Russian —Czech; **Realization Type**: **Cognate**

(3) **Meanings**: arc *(source)* → rainbow *(target)* (ID: 393); **Form**: Bogen → Regenbogen; **Language**: German; **Realization Type**: **Morphological derivation**
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

• The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)

(1) Meanings: tree (source) → forest (target) (ID: 600); Form: dar; Language: Aghul; Realization Type: *synchronous polysemy*

(2) Meanings: doll (source) → nymph, chrysalis (target) (ID: 927); Form: kukla; Language pair: Russian → Czech; Realization Type: *Cognate*

(3) Meanings: arc (source) → rainbow (target) (ID: 393); Form: Bogen → Regenbogen; Language: German; Realization Type: *Morphological derivation*

(4) Meanings: to count (source) → speech (target) (ID: 11); Forms: ratio → Rede; Languages: Latin (donor) → German (target); Realization Type: *Borrowing*
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

- The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)

(1) **Meanings**: tree *(source)*—forest *(target)* (ID: 600); **Form**: dar; **Language**: Aghul; Realization Type: **synchronic polysemy**

(2) **Meanings**: doll *(source)*—nymph, chrysalis *(target)* (ID: 927); **Form**: kukla; **Language pair**: Russian — Czech; Realization Type: **Cognate**

(3) **Meanings**: arc *(source)* → rainbow *(target)* (ID: 393); **Form**: Bogen → Regenbogen;
   **Language**: German; Realization Type: **Morphological derivation**

(4) **Meanings**: to count *(source)* → speech *(target)* (ID: 11); **Forms**: ratio → Rede; **Languages**: Latin *(donor)* → German *(target)*; Realization Type: **Borrowing**

(5) **Meanings**: to catch *(source)* → to hunt *(target)* (ID: 415); **Forms**: capto → cacciare;
   **Languages**: Latin → Italian; Realization Type: **Diachronic semantic evolution**
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

- The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

• The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)

DatSemShifts

<table>
<thead>
<tr>
<th>ID</th>
<th>Source</th>
<th>Direction</th>
<th>Target</th>
<th>Status</th>
<th>Contributed by</th>
<th>Accepted realization</th>
<th>Show</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>time</td>
<td>—</td>
<td>weather</td>
<td>Accepted</td>
<td>DG</td>
<td>4</td>
<td>Show</td>
</tr>
<tr>
<td>109</td>
<td>time</td>
<td>—</td>
<td>opportunity</td>
<td>Accepted</td>
<td>IG</td>
<td>2</td>
<td>Show</td>
</tr>
<tr>
<td>395</td>
<td>time</td>
<td>—</td>
<td>hour</td>
<td>Accepted</td>
<td>DG</td>
<td>2</td>
<td>Show</td>
</tr>
<tr>
<td>406</td>
<td>time</td>
<td>—</td>
<td>24 hours</td>
<td>Suspended</td>
<td>DG</td>
<td>0</td>
<td>Show</td>
</tr>
<tr>
<td>795</td>
<td>time</td>
<td>→</td>
<td>one time, once</td>
<td>New</td>
<td>MB</td>
<td>0</td>
<td>Show</td>
</tr>
<tr>
<td>1446</td>
<td>time</td>
<td>→</td>
<td>journal, magazine</td>
<td>Accepted</td>
<td>IG</td>
<td>3</td>
<td>Show</td>
</tr>
</tbody>
</table>
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data


<table>
<thead>
<tr>
<th>ID</th>
<th>Source</th>
<th>Direction</th>
<th>Target</th>
<th>Status</th>
<th>Contributed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1446</td>
<td>time</td>
<td>→</td>
<td>journal, magazine</td>
<td>Accepted</td>
<td>IG</td>
</tr>
</tbody>
</table>

Comments:
Ср. греч. хронограф, откуда могут быть кальки.
Confirmed by 3 Guru(s)

Derivation: German Zeit → Zeitung, Zeitschrift 'newspaper, journal'

Derivation: Karaim вахь 'time' → вахты 'journal'

Polysemy: Polish czas 'time' → 'journal'
Protocol to construct a (lexical) diachronic semantic map

Select languages with diachronic data

- **Ancient Greek (8\textsuperscript{th} – 4\textsuperscript{th} c. BC; in a few cases till 1\textsuperscript{st} c. BC)**
  - Perseus digital library (http://www.perseus.tufts.edu/hopper/), TLG (http://stephanus.tlg.uci.edu)
  - Cunliffe \textit{(A lexicon of the Homeric Dialect)}, LSJ

- **Ancient Egyptian (26th c. BC – 10th c. AD)**
  - Thesaurus Linguae Aegyptiae (http://aaew.bbaw.de/tla/)
  - The Ramses corpus (http://ramses.ulg.ac.be),
  - Lexical resources (Coptic etymological dictionaries)
The semantic extension of time-related lexemes

Add diachronic information

• The diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  • TIME?
The semantic extension of time-related lexemes

- **Ancient Greek:** *hóra* ‘season/time/moment’

(1) *hóssá*  *te*  *phúlla*  *kaì*  *ánthea*

*REL.NOM.PL.N  PTC  leave:ACC.PL.N  CONJ  flower:ACC.PL.N*

gíngetai  *hórēi*

*become:PRS.3SG  season:DAT.SG.F*

‘as are the leaves and the flowers in their season’ (Homer, *Iliad* 2.468)

(2) *óphra*  *Poseidáōni*  *kaì*  *állois*  *athanátoisin*

*CONJ  Poseidon:DAT.SG.M  CONJ  other:DAT.PL  immortal:DAT.PL*

*speísantes*  *koítoio*  *medómetha:*

*pour.libation:PART.AOR.NOM.PL.M  bed:GEN.SG.M  think.of:PRS.1PL.SUBJ.M/P*

*toîo*  *gàr*  *hórē*

*DEM.GEN.SG  PTC  time:NOM.SG.F*

‘that when we have poured libations to Poseidon and the other immortals, we may bethink us of sleep; for it is the time thereto’ (Homer, *Odyssey* 3.333-334)
The semantic extension of time-related lexemes

- **Ancient Greek:** hóra ‘season/time/moment’ $\Rightarrow$ ‘hour’

Approx. 5th c. BC

(3) anastás raise.up:PTCP.AOR.NOM.SG.M
dè early PTC
prôi deceive:AOR.PASS.NOM.SG.M
pseustheîs
tês time:GEN.SG.F
hôras badízein
ART.GEN.SG.F walk:PRS.INF

‘He arose early, mistaking the time/hour, and started off on his walk’
(Andocides, On the Mysteries 1.38)

Approx. 1st c. AD

(4) oukhì twelve hôrai be.PRS.3PL
dódeka hour:NOM.PL.F hêméras;
NEG Ein
hôraî
tês day:GEN.SG.F

‘Aren’t there twelve hours of daylight?’ (New Testament, John 11.9.2)
The semantic extension of time-related lexemes

Add diachronic information

Metonymy: due to the correlation between the canonical time periods and the time these take to unfold
The semantic extension of time-related lexemes

‘Dynamicizing’ the map

- The diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  - TIME?
The semantic extension of time-related lexemes

‘Dynamicizing’ the map

A recurring issue: English as metalanguage and the lack of (contextualized) definitions for the meanings in the typological literature and resources

<table>
<thead>
<tr>
<th></th>
<th>Stage A</th>
<th>Stage B</th>
<th>Stage C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Moment</td>
<td>–</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Event</td>
<td>–</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Matrix</td>
<td>–</td>
<td>✓</td>
<td>–</td>
</tr>
<tr>
<td>Agentive</td>
<td>–</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Commodity</td>
<td>–</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Measurement-system</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Grammatical</td>
<td>–</td>
<td>–</td>
<td>✓</td>
</tr>
</tbody>
</table>

1: The Duration Sense
2: Matrix Sense
2.1: Agent Sense
3: Moment Sense
3.1: Event Sense
4: Commodity Sense
5: Grammatical Sense

The radial structure of *khrinos* in AG
(Georgakopoulos & Piata 2012)
The semantic extension of time-related lexemes

‘Dynamicizing’ the map

A recurring issue: English as metalanguage and the lack of (contextualized) definitions for the meanings in the typological literature and resources

<table>
<thead>
<tr>
<th>Stage A</th>
<th>Stage B</th>
<th>Stage C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Moment</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Event</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Matrix</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Agentive</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Commodity</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Measurement-system</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Grammatical</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

1: The Duration Sense  
2: Matrix Sense  
2.1: Agent Sense  
3: Moment Sense  
3.1: Event Sense  
4: Commodity Sense  
5: Grammatical Sense

The radial structure of *khrínos* in AG  
(Georgakopoulos & Piata 2012)

The senses of *khrínos* in the diachrony of AG  
(Georgakopoulos & Piata 2012)

Ekaterina Rakhilina and Tatiana Reznikova

4. A Frame-based methodology for lexical typology

Le Diasema
The semantic extension of time-related lexemes

Enriching the map

- The material allows us to add new polysemy patterns, and to provide a diachronic account
  - SUMMER?
The semantic extension of time-related lexemes

Enriching the map

- Summer?

<table>
<thead>
<tr>
<th>Concept</th>
<th>IDS-Key</th>
<th>Occurrences</th>
<th>Families</th>
<th>Languages</th>
<th>Network</th>
<th>Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>year</td>
<td>14.73</td>
<td>233</td>
<td>10</td>
<td>16</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>age</td>
<td>14.12</td>
<td>257</td>
<td>2</td>
<td>3</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>bow</td>
<td>20.24</td>
<td>231</td>
<td>2</td>
<td>2</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>spring</td>
<td>14.75</td>
<td>174</td>
<td>2</td>
<td>3</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>autumn</td>
<td>14.77</td>
<td>167</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>cave</td>
<td>1.28</td>
<td>256</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>cousin</td>
<td>2.55</td>
<td>346</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>hang up</td>
<td>9.341</td>
<td>280</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>hot</td>
<td>15.85</td>
<td>303</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>put</td>
<td>12.12</td>
<td>306</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>rain (noun)</td>
<td>1.75</td>
<td>257</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>reach, arrive</td>
<td>10.55</td>
<td>329</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>rise</td>
<td>10.21</td>
<td>334</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>season</td>
<td>14.78</td>
<td>193</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>sun</td>
<td>1.52</td>
<td>245</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>wall</td>
<td>7.27</td>
<td>239</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
<tr>
<td>wine</td>
<td>5.92</td>
<td>162</td>
<td>1</td>
<td>1</td>
<td>COM</td>
<td>SUB</td>
</tr>
</tbody>
</table>

(http://clics.lingpy.org/all.php?gloss=summer)
The semantic extension of time-related lexemes

Language-specific colexification patterns

- **Ancient Greek**: théros ‘summer’ ⇒ ‘harvest’

(5) autàr epèn élthēisi théros tethaluían
    PTC when come:AOR.SUBJ.3SG summer:NOM.SG.M thrive:PART.PERF.NOM.SG.F

‘But when **summer** comes and rich autumn’ (Homer, *Odyssey* 11.192)

(6) kâit’ anèr édoksen eînai, tallótrion
    ADV man:NOM.SG.M seem:AOR.3SG be.INF another:GEN.SG

    amôn théros
    reap.corn:PTCP.PRS.NOM.SG.M summer:ACC.SG.N

‘he has only made himself a name by reaping another’s **harvest**’
(Aristophanes, *Knights* 392)
The semantic extension of time-related lexemes

Language-specific colexification patterns

Ancient Egyptian: šmw ‘summer’ ⇒ šmw ‘harvest’
The semantic extension of time-related lexemes

Language-specific colexification patterns

- The material allows us to add new polysemy patterns, and to provide a diachronic account
  - SUMMER?

Metonymy

HARVEST
The semantic extension of time-related lexemes

Language-specific colexification patterns

• The material allows us to highlight unexpected pathways of change:
  • From temporal proximity to spatial proximity

• What about the TIME IS SPACE Metaphor?
  • (Cross-linguistically Time to Space transfers are extremely rare; cf. French depuis; Haspelmath 1997)
The semantic extension of time-related lexemes

Ancient Egyptian

(7) \[ \begin{array}{c}
    m \quad rk \quad hm-f \\
    in \quad time
    \end{array} \]

\[ \text{Peasant, B1, 103-104} \]

\( m \) \( rk \) \( hm-f \) \( nswt-bity \) \( nb-k\wedge w-r^c \)
in \text{ time Majesty-3SG.M King of U. and L. Egypt Nebkaure}

‘(Now, the peasant spoke these word) during the time of his Majesty, the King of Upper and Lower Egypt, Nebkaure (the justified)’ (= Parkinson 1991: 19)

(8) \[ \begin{array}{c}
    sbty \quad dr \quad m \quad rk \\
    \text{rampart strong in proximity army-3SG.M}
    \end{array} \]

\( = \text{KRI II, 6,8} \)

 Approx. 1400 BC

 Approx. 1250 BC

(speaking of the King who is)

‘A strong rampart around his army, (their shield in the day of fighting)’
The semantic extension of time-related lexemes

Ancient Egyptian

(Stage I)

rk

‘temporal proximity’

(Stage II)

rk

‘spatial proximity’
The semantic extension of time-related lexemes

Ancient Egyptian

(9) \textit{m} h₃w nb t₃-wj nb-pḥ.tj-rᶜ \\
\textit{in} prox-time lord land-DU Nebphtire

(And then I became a soldier (...),) 
\textit{during the time} of the lord of the Two Lands, Nebpehtire (justified, when I was a young man, not having a wife yet)’ (\textit{Urk. IV, 2,13})

(10) \textit{m} h₃w nh.t \\
\textit{in} prox-space Sycamore

\textit{‘(I crossed the place called The Two Truths,) in the vicinity of The Sycamore” (and I landed at The Island of Snefru)’ (\textit{Koch 1990: 14})}
The semantic extension of time-related lexemes

Ancient Egyptian

(Stage I)

(Stage II)

‘temporal proximity’ \( h\text{\text{\texttt{3}}\text{\text{\texttt{w}}}} \) ‘spatial proximity’
The semantic extension of time-related lexemes

Ancient Egyptian

- ‘temporal proximity’
- ‘spatial proximity’
- ‘temporal proximity’
The semantic extension of time-related lexemes

Ancient Egyptian

\( h₃w \)

‘temporal proximity’

‘spatial proximity’

\( rₖ \)

‘temporal proximity’

‘spatial proximity’

(Stage I)

(Stage II)

Le Diasema
The semantic extension of time-related lexemes

Language-specific colexification patterns

From undirected

- 'temporal proximity'
- 'spatial proximity'
The semantic extension of time-related lexemes

Language-specific colexification patterns

From undirected $\Rightarrow$ to directed

\begin{tikzpicture}
  \node (temporal) at (0,0) {\textit{`temporal proximity'}
  \node (spatial) at (2,0) {\textit{`spatial proximity'}
  \path[->] (temporal) edge (spatial);\end{tikzpicture}
The semantic extension of time-related lexemes

Language-specific colexification patterns

From undirected > to directed > to mixed graphs
Case-study 2
Semantic maps for areal lexical typology?

The verbs of perception and cognition
Perception and Cognition

Choice of concepts

• Perception and cognition are among the basic concepts that are lexicalized in the languages of the world (e.g. Swadesh 1952)

• The domain is well studied: our results can be compared (e.g. Sweetser 1990; Evans & Wilkins 2000; Vanhove 2008)

• The literature has revealed both universal and culture-specific patterns
Perception and Cognition

Verbs of perception & cognition

Semantic extensions

**Intrafield** (= *Intradomain*)
(senses: same semantic field)

**Interfield** (= *Interdomain*/ *Transfield*)
(senses: different semantic field)

(based on Wilkins 1996: 274; cf. Matisoff 1978)
Verbs of perception & cognition

Intrafield extensions

\[ \text{sight} \succ \text{hearing} \succ \text{touch} \succ \begin{cases} \text{smell} \\ \text{taste} \end{cases} \]

**Figure.** Viberg's sense modality hierarchy for semantic extensions and polysemies of perception verbs
(Viberg 1984: 136)

**Table.** Inventories of the verbs of perception
(Viberg 1984: 140)

<table>
<thead>
<tr>
<th>Language</th>
<th>Source</th>
<th>Word 1</th>
<th>Word 2</th>
<th>Word 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walbiri (West Australia)</td>
<td>Hale 1971: 478</td>
<td>nja-</td>
<td>‘to see’</td>
<td>nyang- ‘see/look’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>puḍa-nja-</td>
<td>‘to hear, to feel’</td>
<td>pura-nyang- ‘hear/listen’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>paṇṭi-nja-</td>
<td>‘to smell’</td>
<td></td>
</tr>
<tr>
<td>Djaru (West Australia)</td>
<td>Tasaku 1981: 418</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesghian (East Caucasus)</td>
<td>Dixon 1979: note 54</td>
<td>akun</td>
<td></td>
<td>van akun ‘hear/listen’</td>
</tr>
</tbody>
</table>
Perception and Cognition

Interfield extensions

Mind-as-body-Metaphor:

The internal self is understood in terms of the bodily external self (Sweetser 1990: 45)

• Common cross-linguistically (if not universal): the connection between VISION and KNOWLEDGE (Sweetser 1990: 45)

**Figure.** The structure of our metaphors of perception (Sweetser 1990: 38)
Perception and Cognition

- Convenience sample: Central, East and North European languages
- Case study: Auditory and visual perception
  - *Opportunistic perception verbs = non-controlled experience* (e.g., hear)
  - *Explorative perception verbs = controlled activity* (e.g., listen)

- Goal: how the encoding of a specificity distinction may differ cross-linguistically.
  - (Probably a) typological rarum
  - But particular areal feature for Baltic languages

- Method: probabilistic semantic maps based on parallel corpora

---

Non-specific, specific and obscured perception verbs in Baltic languages

**Bernhard Wälchli**
Stockholm University
Perception and Cognition

Figure. Probabilistic semantic map of 44 auditory contexts in *Mark* based on 64 doculects in English (leb), Lithuanian (1998), Latgalian and Latvian (2012) (Wälchli 2016: 77)

Non-specific, specific and obscured perception verbs in Baltic languages

BERNARD WÄLCHLI
Stockholm University
Perception and Cognition

- **N of lgs**: 221
- **N of lg families**: 64
- **N of concepts**: 1280

<table>
<thead>
<tr>
<th>Meaning 1</th>
<th>Meaning 2</th>
<th>N of language</th>
<th>N of forms</th>
<th>language: form</th>
</tr>
</thead>
<tbody>
<tr>
<td>see</td>
<td>know</td>
<td>5</td>
<td>6</td>
<td>aro_std:[ba]//ayo_std:[iˈmo?]//haw_std:[ʔike]//mcq_std:_[ɓanahe]//mri_std:[kitea]//tel_std:[aarayu]//tel_std:[arayu]</td>
</tr>
<tr>
<td>see</td>
<td>find</td>
<td>15</td>
<td>23</td>
<td>agr_std:[wainat]//arn_std:[pe]//con_std:[‘atˈeɪe]//cwg_std:[yow]//emp_std:[uˈnu]//kgp_std:[we]//kpv_std:[addzim]//kyh_std:[mah]//mca_std:[wen]//mri_std:[kitea]//oym_std:[ɛsa]//pbb_std:[uy]//plt_std:[mahita]//pui_std:[duk]//ray_std:[tikeʔa]//rtm_std:[rae]//sap_Enlhet:[nənˈwetay]//sei_std:[aʔo]//shb_std:[taa]//sja_std:[unu]//swh_std:[ona]//tbc_std:[le]//yag_std:[tiki]</td>
</tr>
<tr>
<td>see</td>
<td>get, obtain</td>
<td>6</td>
<td>6</td>
<td>kgp_std:[we]//mbc_std:[eraʔma]//pbb_std:[uy]//sap_Sandard:[akwitayi]//srq_std:[tea]//udi_std:[ақъсун]</td>
</tr>
</tbody>
</table>

Polysemy data from CLiCs ([http://clics.lingpy.org/download.php](http://clics.lingpy.org/download.php))

(List et al. 2014)
Perception and Cognition

Figure. Complete sub-network in CLICS of which SEE is part.
Perception and Cognition

Figure. Weighted semantic map for the cognition-perception domain, visualized with modularity analysis* (Blondel et al. 2008) in Gephi
Perception and Cognition

Figure. Weighted semantic map for the cognition-perception domain (polysemy patterns in more than 1 language)
Perception and Cognition

Figure. Weighted semantic map for the cognition-perception domain (polysemy patterns in more than 1 language)

Some ‘universal’ observations
- Direct connection between perception verbs denoting non-controlled experience (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
**Figure.** Weighted semantic map for the cognition-perception domain (polysemy patterns in more than 1 language)

Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is *no intrafield extension* from SEE to HEAR without going through *interfield meanings*
Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is *no intrafield extension* from SEE to HEAR without going through *interfield meanings*
Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is no *intrafield extension* from SEE to HEAR without going through *interfield meanings*
Perception and Cognition

**Figure.** Weighted semantic map for the cognition-perception domain (polysemy patterns in more than 1 language)

Some ‘universal’ observations
- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is *no intrafield extension* from SEE to HEAR without going through *interfield meanings*
- Implicational hierarchies:
  - If THINK and SEE, then KNOW
  - If HEAR and LEARN, then KNOW

(Vanhove 2008)
Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is *no intrafield extension* from SEE to HEAR without going through interfield meanings
- Implicational hierarchies:
  - If THINK and SEE, then KNOW
  - If HEAR and LEARN, then KNOW

*(Vanhove 2008)*
Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is *no intrafield extension* from SEE to HEAR without going through interfield meanings
Perception and Cognition

**Figure.** Weighted semantic map for the cognition-perception domain (polysemy patterns in more than 1 language)

Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is *no intrafield extension* from SEE to HEAR without going through *interfield meanings*

```
1 < 8 > learn listen ==> hear;
2 < 4 > learn read ==> hear;
3 < 4 > listen read ==> hear;
4 < 2 > listen spot ==> hear learn read hark listen in heed;
5 < 3 > read spot ==> hear;
6 < 2 > hear learn read spot ==> listen hark listen in heed;
7 < 14 > learn understand ==> see visualize examine;
8 < 3 > listen understand ==> hear;
9 < 5 > spot understand ==> perceive see visualize watch;
10 < 9 > learn perceive ==> see;
11 < 1 > read perceive ==> hear spot;
12 < 1 > hear spot perceive ==> read;
13 < 8 > understand perceive ==> see visualize watch;
14 < 3 > hear interpret ==> understand;
15 < 32 > learn interpret ==> see meet;
16 < 1 > listen interpret ==> hear understand intend;
17 < 3 > spot interpret ==> learn see meet watch visit;
18 < 5 > perceive interpret ==> learn see meet watch visit;
19 < 1 > hear see ==> learn understand perceive interpret determine get catch visualize realize meet experience examine wa
```
Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is *no intrafield extension* from SEE to HEAR without going through *interfield meanings*
Some ‘universal’ observations

- Direct connection between perception verbs denoting *non-controlled experience* (e.g., HEAR, SEE) and cognitive verbs (e.g., UNDERSTAND)
- There is no *intrafield extension* from SEE to HEAR without going through *interfield meanings*
Perception and Cognition

Areal patterns (Vanhove 2008)
Areal patterns

• A general approach: scatter plot of the CLICS data (2D t-SNE)

Figure. A 2D t-SNE projection of the polysemy patterns of verbs with meanings HEAR or LISTEN and SEE or LOOK from the CLICS dataset

Le Diasema
Areal patterns

- Corrplot: Eurasia vs South America
Perception and Cognition

Areal patterns
- Corrplot: Eurasia vs South America
Areal patterns
  - Corrplot: Eurasia vs South America
Areal patterns
- Corrplot: Eurasia vs South America
Areal patterns
- Corrplot: Eurasia vs South America
Areal patterns

- Corrplot: Papua
Perception and Cognition

**Areal patterns**
- Corrplot: Papua

![Corrplot: Papua](image-url)
Areal patterns
• Corrplot: Papua
Areal patterns
- 2D t-SNE of the Wordnet data
Areal patterns

- 2D t-SNE of the Wordnet data
Areal patterns

- FCA of the Wordnet data
Areal patterns

- FCA of the Wordnet data
Areal patterns
- FCA of the Wordnet data (Arabic)
Areal patterns
- FCA of the Wordnet data (Arabic)
Areal patterns
- FCA of the Wordnet data (Arabic)
Areal patterns
• FCA of the Wordnet data (Arabic)
Areal patterns

- FCA of the Wordnet data (Arabic)

*f-h-m ‘to understand’* فهم
Areal patterns

- Corpus
  - Statistical significance is difficult to reach with the ‘small’ samples at our disposal
  - A sample of areally related, but genetically diverse languages (with enough languages in each family in order to reach statistical significance) would be the way to go in order to investigate further these questions (i.e., beyond semantic factors)
Areal patterns

• Corpus
  • Statistical significance is difficult to reach with the ‘small’ samples at our disposal
  • A sample of areally related, but genetically diverse languages (with enough languages in each family in order to reach statistical significance) would be the way to go in order to investigate further these questions (i.e., beyond semantic factors)

• Methodology
  • We used 2D t-SNE, correlation plot, and FCA, but did not take properly advantage of the graph model of the classical semantic maps.
  • We could compare minimal path distances and number of different paths between nodes in semantic maps for different domains in different areas. This would give us an estimate of the degree of connectedness of different verb senses in different regions, giving rise to different colexification networks.
Conclusions

More tomorrow (9AM)

Thanks!

s.polis@uliege.be