Dynamicized semantic maps of content words

Comparing long-term lexical changes in Ancient Egyptian and Greek
Outline of the talk

- Introduction
  - What are semantic maps?
  - Le Diasema (LExical DIAchronic SEmantic MApS)

- A case-study. The semantic extension of time-related lexemes in Ancient Egyptian and Ancient Greek
  - Automatically plotting synchronic semantic maps based on crosslinguistic colexification patterns
  - Adding the diachronic dimension to semantic maps of content words

- Conclusions
Introduction
Semantic maps & Le Diasema
What are semantic maps?

‘A semantic map is a geometrical representation of functions (…) that are linked by connecting lines and thus constitute a network’ (Haspelmath 2003). It constitutes a ‘model of attested variation’ (Cysouw 2007).
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Figure 1. A semantic map of typical dative functions / the boundaries of English to and French à (based on Haspelmath 2003: 213, 215)
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- Sense distinctions are based on cross-linguistic evidence and designed to have cross-linguistic validity.

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- They combine the **onomasiological** and the **semasiological** perspective

Figure 1. A semantic map of typical dative functions / the boundaries of English *to* and French *à* (based on Haspelmath 2003: 213, 215)
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• Sense distinctions are based on cross-linguistic evidence and designed to have cross-linguistic validity
• They combine the onomasiological and the semasiological perspective
• Multifunctionality. No commitment to a particular claim about conventionalsization of senses

Figure 1. A semantic map of typical dative functions / the boundaries of English to and French à (based on Haspelmath 2003: 213, 215)
What are semantic maps?

Diachronic (‘dynamicized’) semantic maps

Figure 2. Dynamicized semantic map of dative functions (Haspelmath 2003: 234)
What are semantic maps?

Lexical semantic maps

Colexification = polyfunctionality

“A given language is said to colexify two functionally distinct senses if, and only if, it can associate them with the same lexical form”

(François 2008: 170)

Figure 3. Overlapping polysemies:
Eng. straight vs. Fr. droit
(François 2008: 167)
What are semantic maps?

Lexical semantic maps

Figure 3. Overlapping polysemy:
Eng. straight vs. Fr. droit
(François 2008: 167)

Colexification = polyfunctionality

“A given language is said to colexify two functionally distinct senses if, and only if, it can associate them with the same lexical form”
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“A function is put on the map if there is at least one pair of languages that differ with respect to this function”
Le Diasema

Filling a gap

- Adding a diachronic dimension to semantic maps of content words
Le Diasema

Filling a gap

- Adding a diachronic dimension to semantic maps of content words

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

- **Duration**
  - December 2016 – December 2018

- **Main research question**
  - How semantic maps make significant predictions about language change at the lexical level?

- **Funding schemes**

http://web.philo.ulg.ac.be/lediasema/
Le Diasema

- To incorporate the diachronic dimension into semantic maps of content words
- To extend the method so as to also include information about the cognitive and cultural factors behind the development of the various meanings
- To create an online platform for automatically plotting diachronic semantic maps based on polysemy data from the languages of the world
Le Diasema

Specific objectives for today

- To incorporate the diachronic dimension into semantic maps of content words

- To extend the method so as to also include information about the cognitive and cultural factors behind the development of the various meanings

- To create an online platform for automatically plotting diachronic semantic maps based on polysemy data from the languages of the world
The semantic extension of time-related lexemes

Inferring a semantic map based on cross-linguistic colexification patterns
The semantic extension of time-related lexemes

Plotting a synchronic semantic map

- 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 semantic extension of time-related lexemes

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- For the purpose of comparability, these three concepts are adequate (cf., e.g., Youn et al. 2016)
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The semantic extension of time-related lexemes

Plotting a synchronic semantic map

- We identified in the database of Crosslinguistic Colexifications (CLICs; http://clics.lingpy.org/main.php; 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
The semantic extension of time-related lexemes

Plotting a synchronic semantic map

- All the colexification patterns attested for these 16 meanings were gathered in the CLICs source files (http://clics.lingpy.org/download.php), ending up with **381 colexification patterns**
The semantic extension of time-related lexemes

Plotting a synchronic semantic map

- All the colexification patterns attested for these 16 meanings were gathered in the CLICs source files (http://clics.lingpy.org/download.php), ending up with 381 colexification patterns.
- These synchronic polysemy patterns were converted into a lexical matrix.

```python
Tmap = [Tsenses]
for t in Tclean:
    split_langWord = t[2].split('///')
    for couple in split_langWord:
        langWord = couple.split(':')
        line = [langWord[0], langWord[1]]
        for i in range (2, len(Tsenses)):
            line.append('0')
        line[Tsenses.index(t[0])] = '1'
        line[Tsenses.index(t[1])] = '1'
        Tmap.append(line)
```

**Lexical matrix**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
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<th>F</th>
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<td>zamana</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
The semantic extension of time-related lexemes

Plotting a synchronic semantic map

- All the colexification patterns attested for these 16 meanings were gathered in the CLICs source files (http://clics.lingpy.org/download.php), ending up with 381 colexification patterns.

- These synchronic polysemy patterns were converted into a lexical matrix.

Python script α

<table>
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<tr>
<th>Languages</th>
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</thead>
<tbody>
<tr>
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<td>khv_Khvan</td>
<td>заманна</td>
<td>1</td>
<td>0</td>
<td>0</td>
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</tbody>
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Tmap = [Tsenses]
for t in Tclean:
    split_langWord = t[2].split('\\/\\/')
    for couple in split_langWord:
        langWord = couple.split('::')
        line = [langWord[0], langWord[1]]
        for i in range (2, len(Tsenses)):
            line.append('0')
        line[Tsenses.index(t[0])] = '1'
        line[Tsenses.index(t[1])] = '1'
        Tmap.append(line)
```

Lexical matrix
The semantic extension of time-related lexemes

Plotting a synchronic semantic map

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Python script $\alpha$

<table>
<thead>
<tr>
<th>Languages</th>
<th>Forms</th>
<th>Meanings</th>
</tr>
</thead>
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<td>acid, sour</td>
<td>city, town</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
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<td>9</td>
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<td>0</td>
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<tr>
<td>khv_Khvanshi</td>
<td>ызамана</td>
<td>1</td>
</tr>
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Tmap = [Tsenses]
for t in Tclean:
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Lexical matrix

1 when a meaning is attested for one form
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- These synchronic polysemy patterns were converted into a lexical matrix.
- From this lexical matrix, we inferred a weighted semantic map based on an adapted version of the algorithm suggested by Regier et al. (2013).

```python
# CREATE INITIAL GRAPH
# graph G: add each term's nodes, no edges in graph yet.
G = nx.Graph()  # create empty graph (undirected)
PossE = []       # list of possible edges, filled below
for t in T:
    # add all nodes in t, if not already in graph
    for n in t:
        if (not G.has_node(n)):
            G.add_node(n)

    # add to PossE a link between each pair of nodes in t
    # adding a link between every node in G is needless and slower
    for pair in allpairs(t):
        u = pair[0]
        v = pair[1]
        if (not ((u, v) in PossE) or ((v, u) in PossE)):
            PossE.append((u, v))
```

Python script β
Full semantic map for time-related senses, visualized with modularity analysis* (Blondel et al. 2008) in Gephi

* 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.
The semantic extension of time-related lexemes

Plotting a synchronic semantic map

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- These synchronic polysemy patterns were converted into a lexical matrix.
- From this lexical matrix, we inferred a weighted semantic map, based on an adapted version of the algorithm by Regier et al. (2013).
- Crucially, as opposed to the algorithm of Regier et al. (2013), the weighted edges allow us to get rid of poorly attested patterns of polysemy (keeping only those attested in $2^+$ languages).
Semantic maps of time-related senses (colexification patterns attested in 2+ languages)

Two connected sub-networks
- NIGHT/DARKNESS/DARK
- DAY/TIME/AGE/YEAR
Semantic maps of time-related senses (colexification patterns attested in 2+ languages)

Two connected sub-networks
- NIGHT/DARKNESS/DARK
- DAY/TIME/AGE/YEAR
The semantic extension of time-related lexemes

Dynamicizing the map based on diachronic data
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

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.
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- **Diachronic data**

<table>
<thead>
<tr>
<th>ID</th>
<th>Source</th>
<th>Direction</th>
<th>Target</th>
<th>Status</th>
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<th>Accepted realization</th>
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<tbody>
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<td>weather</td>
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<td>DG</td>
<td>4</td>
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<td>109</td>
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<tr>
<td>395</td>
<td>time</td>
<td>—</td>
<td>hour</td>
<td>Accepted</td>
<td>DG</td>
<td>2</td>
<td>Show</td>
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<tr>
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<td>→</td>
<td>one time, once</td>
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<td>MB</td>
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<tr>
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<td>time</td>
<td>→</td>
<td>journal, magazine</td>
<td>Accepted</td>
<td>IG</td>
<td>3</td>
<td>Show</td>
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The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- **Diachronic data**
  - The Catalogue of Semantic Shifts in the Languages of the World
    (Zalizniak, 2006; Zalizniak et al., 2012; [http://semshifts.iling-ran.ru/](http://semshifts.iling-ran.ru/))
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Comments:
Ср. греч. хронограф, откуда могут быть кальки.
Confirmed by 3 Guru(s)

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

**Derivation:** Karaim *вахт* 'time' → *вахтый* 'journal'

**Polysemy:** Polish *czas* 'time' — 'journal'
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

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Towards a dynamicized semantic map

**Diachronic data**

- The Catalogue of Semantic Shifts in the Languages of the World (Zalizniak, 2006; Zalizniak et al., 2012; http://semshifts.iling-ran.ru/)  
- **Ancient Greek** (8th – 4th c. BC; in a few cases till 1st c. BC)  
  - Perseus digital library (http://www.perseus.tufts.edu/hopper/), TLG (http://stephanus.tlg.uci.edu)  
  - Cunliffe (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
Towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
- SUN?
Ancient Greek

*hēlíos* ‘sun’ ⇒ ‘day’

(1) *pân* d’ êmar *pherómēn, háma d’*
whole:ACC.SG.N ptc day:ACC.SG.N carry:IMPF.1PL.M/P ADV PTC

*ēelíoi* *katadúnti káppeson en Lémnōi*
sun:DAT.SG.M set:PTCP.AOR.DAT.SG.M fall:AOR.1PL in Lemnos:DAT.SG

‘the whole day long I was carried headlong, and at *sunset* (lit. the sun setting down) I fell in Lemnos’ (Homer, *Iliad* 1.592-593)

(2) *ékheis, egó te sé: hēlíous dè muríous*
have:PRS.2SG 1SG.NOM PTC 2SG.ACC sun:ACC.PL.M PTC infinite:ACC.PL.M

*mólis dielθòn ēisthomēn tà tēs theoû*
ADV pass:PTCP.AOR. perceive:AOR. ART.ACC.PL.N ART.GEN.SG.F god:GEN.SG NOM.SG.M 1SG.MID

‘You have me, and I have you; although it was hard to live *through so many days*, I now understand the actions of the goddess’ (Euripides, *Helen* 652-653)
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  - **SUN** ⇒ **DAY**
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  - SUN ⇒ DAY
  - TIME?
Ancient Greek

hóra ‘season/time/moment’

(3) hóssá te phúlla kai ánthea
   REL.NOM.PL.N PTC leave:ACC.PL.N CONJ flower:ACC.PL.N
gíngnetai hóreí
   become:PRS.3SG season:DAT.SG.F
   ‘as are the leaves and the flowers in their season’ (Homer, Iliad 2.468)

(4) óphra Poseídáöni kai állois athanátoisin
   CONJ Poseidon:DAT.SG.M CONJ other:DAT.PL immortal:DAT.PL
   speísantes koítoio medómetha:
pour.libration:PART.AOR.NOM.PL.M bed:GEN.SG.M think.of:PRS.1PL.SUBJ.M/P
toîo gár hóreí
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)
**Ancient Greek**

*hóra* ‘season/time/moment’ ⇒ ‘hour’

(5) anastàs  dè  prói  pseustheìs
tèś  *hóras*  badízein
raise.up:PTCP.AOR.NOM.SG.M  PTC  early  deceive:PTCP.AOR.PASS.NOM.SG.M
ART.GEN.SG.F  time: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)

(6) oukì  dódeka  hóraì  eisin  tèś  hēméras;
NEG  twelve  hour:NOM.PL.F  be.PRS.3PL  ART.GEN.SG.F  day:GEN.SG.F

‘Aren’t there twelve hours of daylight?’ (New Testament, John 11.9.2)
Ancient Greek

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

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  - SUN ⇒ DAY
  - TIME ⇒ HOUR
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  - **SUN** ⇒ **DAY**
  - **TIME** ⇒ **HOUR**

- Opposite pathways?
Ancient Egyptian

nw ‘hour/moment (time)’ ⇒ ‘period (time)’

Pyr., §1383b (Spell 556)

(7) jw nw pn bkA
come hour/moment DEM.M second_day/tomorrow

‘When this hour/moment of tomorrow comes, (and this moment/hour of the third day comes, father Osiris Pepi …)’ (= Sethe 1910: 255)

P. Harris 500, v° 6, 1

(8) jw-n dy Hr ir-t nw
SBRD-1PL here PROG do-INF time

‘(It’s been three full months) that we’re here spending our time [jumping]’
(= LES 4,6-7)
Ancient Egyptian

nw ‘hour/moment/time’ ⇒ ‘period/time’

Diagram:

- 'hour'
- 'moment in time'

Old Kingdom
Ancient Egyptian

nw ‘hour/moment/time’ ⇒ ‘period/time’

‘hour’

‘moment in time’

‘period in time’

New Kingdom
The semantic extension of time-related lexemes
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The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  - SUN ⇒ DAY
  - TIME ⇒ HOUR

- Opposite pathways?
  - HOUR ⇒ TIME?

A recurring issue: English as metalanguage and the lack of (contextualized) definitions for the meanings in the typological literature and resources
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

<table>
<thead>
<tr>
<th></th>
<th>Stage A</th>
<th>Stage B</th>
<th>Stage C</th>
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<tbody>
<tr>
<td>Duration</td>
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<tr>
<td>Moment</td>
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<td>Event</td>
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</tbody>
</table>

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

The radial structure of *khrónos* in AG
(Georgakopoulos & Piata 2012)
The semantic extension of time-related lexemes
towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns:
  - \( \text{SUN} \Rightarrow \text{DAY} \)
  - \( \text{TIME} \Rightarrow \text{HOUR} \)

- Opposite pathways?
  - \( \text{HOUR} \Rightarrow \text{TIME} \)

- Pivot meanings
  - \( \text{TIME} \Rightarrow \text{DAY(LIGHT)} \)
Ancient Egyptian

nw ‘hour/moment/time’ ⇒ ‘day(light)’

Coptic ⲙⲧⲥ
(Crum 1959: 256-257)

- hour
- time
- day(light) [rare]
The semantic extension of time-related lexemes
Towards a dynamicized semantic map

- Our diachronic material allows us to add diachronic information (graphically, oriented edges) between frequent colexification patterns
  - SUN $\Rightarrow$ DAY
  - TIME $\Rightarrow$ HOUR

- Opposite pathways?
  - HOUR $\Rightarrow$ TIME

- Pivot meanings
  - TIME $\Rightarrow$ DAY(LIGHT)
(Ancient) culture-specific colexification patterns

- Summer?
Ancient Greek

théros ‘summer’ ⇒ ‘harvest’

(9) autár  epèn  élthēisi  théros  tethaluîá
PTC  when  come:AOR.SUBJ.3SG  summer:NOM.SG.M  thrive:PART.PERF.NOM.SG.F
t’  opórē
PTC  autumn:NOM.SG.F

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

(10) kāit’  anēr  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)
Ancient Egyptian

Smw ‘summer’ ⇒ Smw ‘harvest’

Old Kingdom

Middle Kingdom
(Ancient) culture-specific colexification patterns

- Languages and constructions shaping specific polysemy patterns
  - Time $\Rightarrow$ Space
    - Temporal proximity $\Rightarrow$ Spatial proximity
(Ancient) culture-specific colexification patterns

Peasant, B1, 103-104

(11) m rk   Hm-f   nswt-bity   nb-kAw-ra
  in   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)

(12) sbty   Dr   m rk   mSa-f   (= KRI II, 6,8)
  rampart   strong   in   proximity   army-3SG.M
  (speaking of the King who is)
  ‘A strong rampart around his army, (their shied in the day of fighting)’
(Ancient) culture-specific colexification patterns
(Ancient) culture-specific colexification patterns

- Counterexample to the TIME IS SPACE metaphor?
  - Cross-linguistically Time to Space transfers are extremely rare (cf. French *depuis*; Haspelmath 1997)
(Ancient) culture-specific colexification patterns

(13) m hAw nb tA-wj nb-pH.tj-ra
in prox-time lord land-DU Nebphtire
(And then I became a soldier (...),)
‘during the time of the lord of the Two Lands, Nebpehtire (justified, when I was a young man, not having a wife yet)’ (= Urk. IV, 2,13)

(14) m hAw nh.t
in prox-space Sycamore
‘(I crossed the place called The Two Truths,) in the vicinity of The Sycamore” (and I landed at The Island of Snefru)” (= Koch 1990: 14)

Biography of Ahmose, 5
Approx. 1350 BCE

Sinuhe, B8
Approx. 1500 BCE
(Ancient) culture-specific colexification patterns

hAw

‘temporal proximity’ — ‘spatial proximity’

(Stage I)
(Ancient) culture-specific colexification patterns

hAw

‘temporal proximity’ — ‘spatial proximity’

rk

‘temporal proximity’

(Stage I)
(Ancient) culture-specific colexification patterns

- hAw
  - ‘temporal proximity’
  - ‘spatial proximity’

- rk
  - ‘temporal proximity’
  - ‘spatial proximity’

(Stage I)
Conclusions
and avenues for future research
Conclusions

The diachronic dimension for semantic maps of content words, is an important extension to the semantic maps research.

- Replicable methodology
- Balance between large-scale typological works and small-scale linguistic studies, focusing on few languages (need for further attention to the hyper-/hyponymic relationships; van der Auwera 2013)

Language-specific studies reveal interesting colexification patterns, some of which might contradict well-established generalizations.

- (Ancient) culture specific colexification patterns
- Language internal polysemy copying


Thanks!

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