# A Top-down Graph-based Tool for Modeling Classical Semantic Maps: A Crosslinguistic Case Study of Supplementary Adverbs

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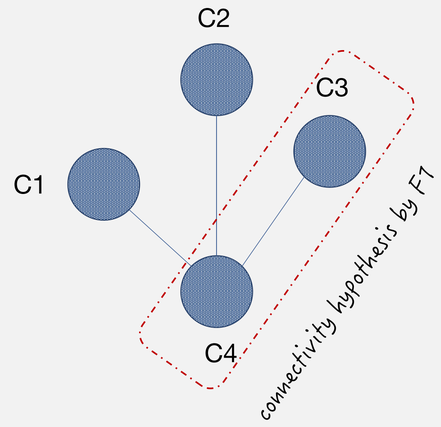
## What are clasical semantic maps?

| | C1 | C2 | C3 | C4 |
|---|---|---|---|---|
| F1 | | | ✓ | ✓ |
| F2 | | ✓ | | ✓ |
| F3 | ✓ | | | ✓ |
| F4 | ✓ | | | ✓ |

Form-Concept Table




Semantic Maps

**Node:** Concept / Meaning / Functions / Sense
**Forms:** Function or Content Words / Affixes / Constructions
**Edge:** Assoication between nodes
**Form-Concept Table:** Multifunctionality/Polysemous patterns

Connectivity Hypothesis (H1): concepts for one form must be connected!
Coverage-Predictivity Dilemma
Vacuous Map: Cycled graph without any predictions, avoid it!

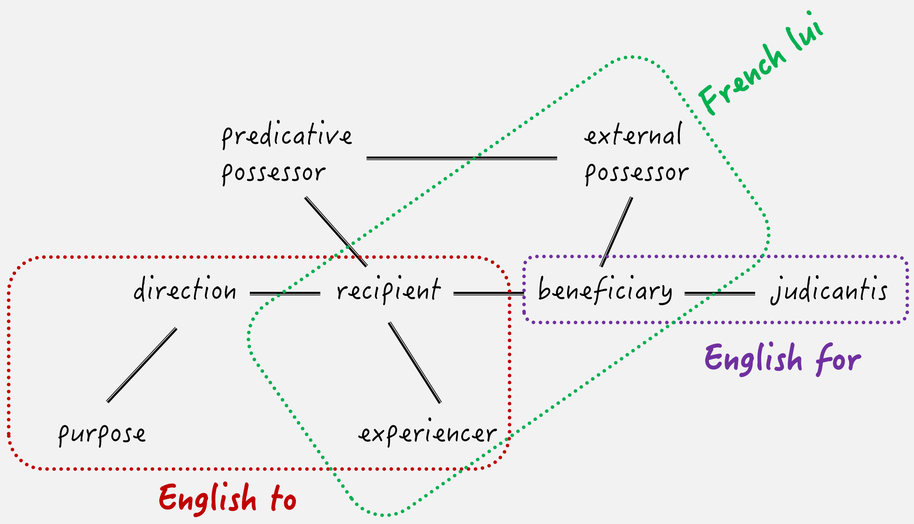
**English preposition to**
a. Goethe went to Vienna as a student. (direction)
b. Eve gave the apple to Adam. (recipient)
c. This seems outrageous to me. (experiencer)
d. I left the party early to get home in time. (purpose)

**English preposition for**
a. My mom bought a bike for the son. (benefactive)
b. The math is too difficult for me. (judicantis)

**French lui (DAT-case)**
a. Je lui donne le livre. [I'll give her the book] (recipient)
b. Je lui ai trouvé unemploi [I found a job for him.] (benefactive)
c. On lui a cassé la jambe [They broke his leg] (ext. possessor)
d. Ce livre lui plaît [He likes this book] (experiencer)

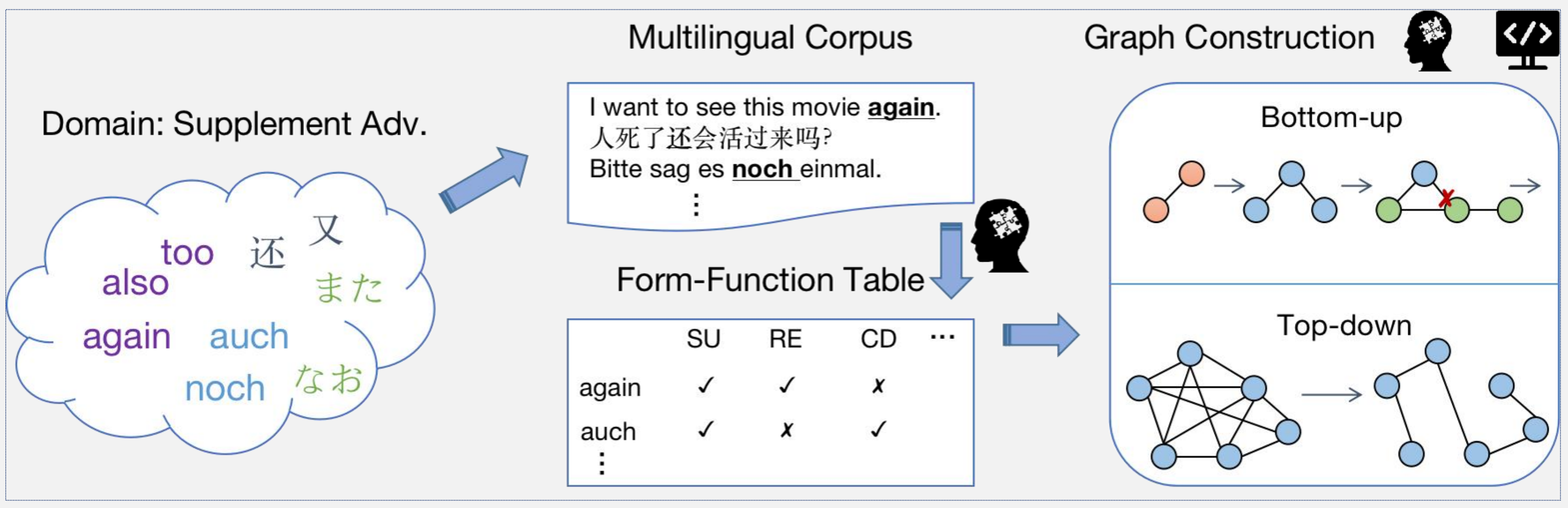
Russian: u, DATive-case
Chinese, Catalan, Homeric Greek, Basque ...

Croft, William 2003 Typology and Universals(2nd edition). Cambridge: Cambridge Universitiy Press.




Haspelmath M. External possession in a European areal perspective[J]. Typological studies in language, 1999, 39: 109-136.

## How to construct clasical semantic maps?




Bottom-up construction
- Expert or previous programme
- Iterative to meet conncectivity hypothesis (H1) case by case
- Avoid to generative cycles (vacuous graph) if necessary
- Time-consuming and hard to scale ✗

Top-down construction (ours)
- Initially generate a complete graph by calculating the nubmer of bifunctional coocurrence
- Convert the local connectivity H1 into a global H2
- Efficient and Automatic ✓

H2: Maximum spanning tree from the complete graph
- Whole connectivity
- Acylicity
- Maximum summed weights

## Evaluations on a case study

- 9 languages, 28 grammatical forms and 18 functions
- Supplementary Adverbs (The core meaning is to express supplement)
- The form-function table has been created by linguists in a bottom-up fashion.
- The golden map (GT) is provided as a reference

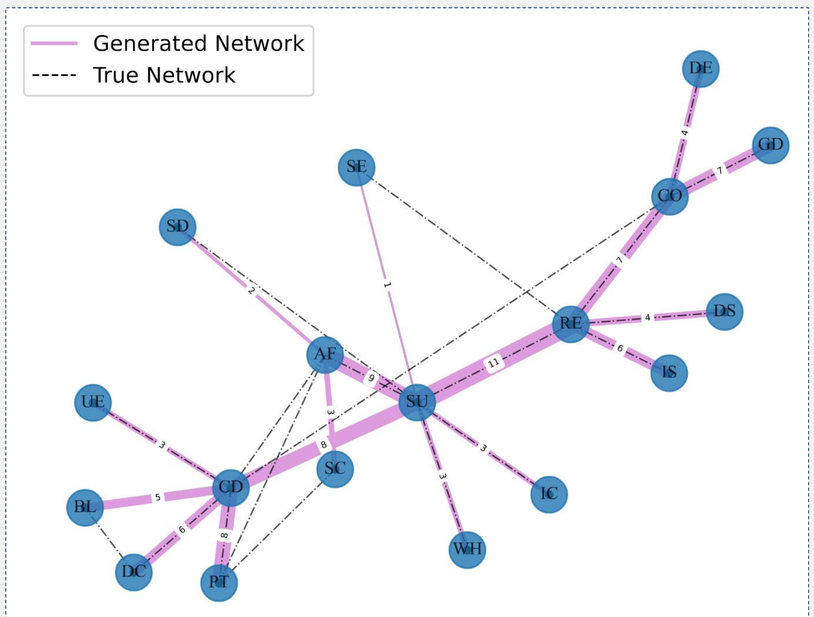
Metrics
- Size: summed weights
- Recall: {#cases meeting H1}/{Number of cases}
- Precision: {#cases meeting H1}/{Possible cases generated by graphs}
- Accuracy: matching proportion according to golden reference.

- Standard derivation of degrees: prefer a chain-like typology

- Baselines
- C: Complete graph
- LT: lower-bound with a "bad" tree without overlapping GT

| Index | Size↑ | Recall↑ | Precision↑ | Accuracy↑ |
|---|---|---|---|---|
| C | 286 | 1 | 0 | 50.0 |
| LT | - | - | - | 79.0 |
| GT | 91 | 1 | 0.20 | 1 |
| 0 | 90 | 85.7 | 0.17 | 92.6 |
| 1 | 89 | 82.1 | 0.21 | 91.4 |
| 2 | 89 | 82.1 | 0.44 | 90.1 |
| 3 | 88 | 82.1 | 0.34 | 91.4 |
| 4 | 88 | 78.6 | 0.50 | 88.9 |

| Round | RG_1 | RG_2 |
|---|---|---|
| 1 | -17.8 | -22.1 |
| 2 | -21.9 | -22.4 |
| 3 | -20.5 | -19.2 |
| 4 | -23.8 | -21.7 |
| 5 | -23.1 | -24.1 |
| Mean | -21.4 | -21.9 |
| Std. Dev. | 2.13 | 1.58 |




- a graph similar to that by experts (high accuracy)
- Multiple candidates
- A metric moderately correlated with the quality
- Failed edges mainly caused by the acyclicity (Like CD)

Rui Guo. 2010. A semantic map study of adverbs related to "supplement". In Paper presented at the International Symposium for Comparative and Typological Research on Languages of China, Hong Kong, China.

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