Using
language-internal similarities
to compare languages

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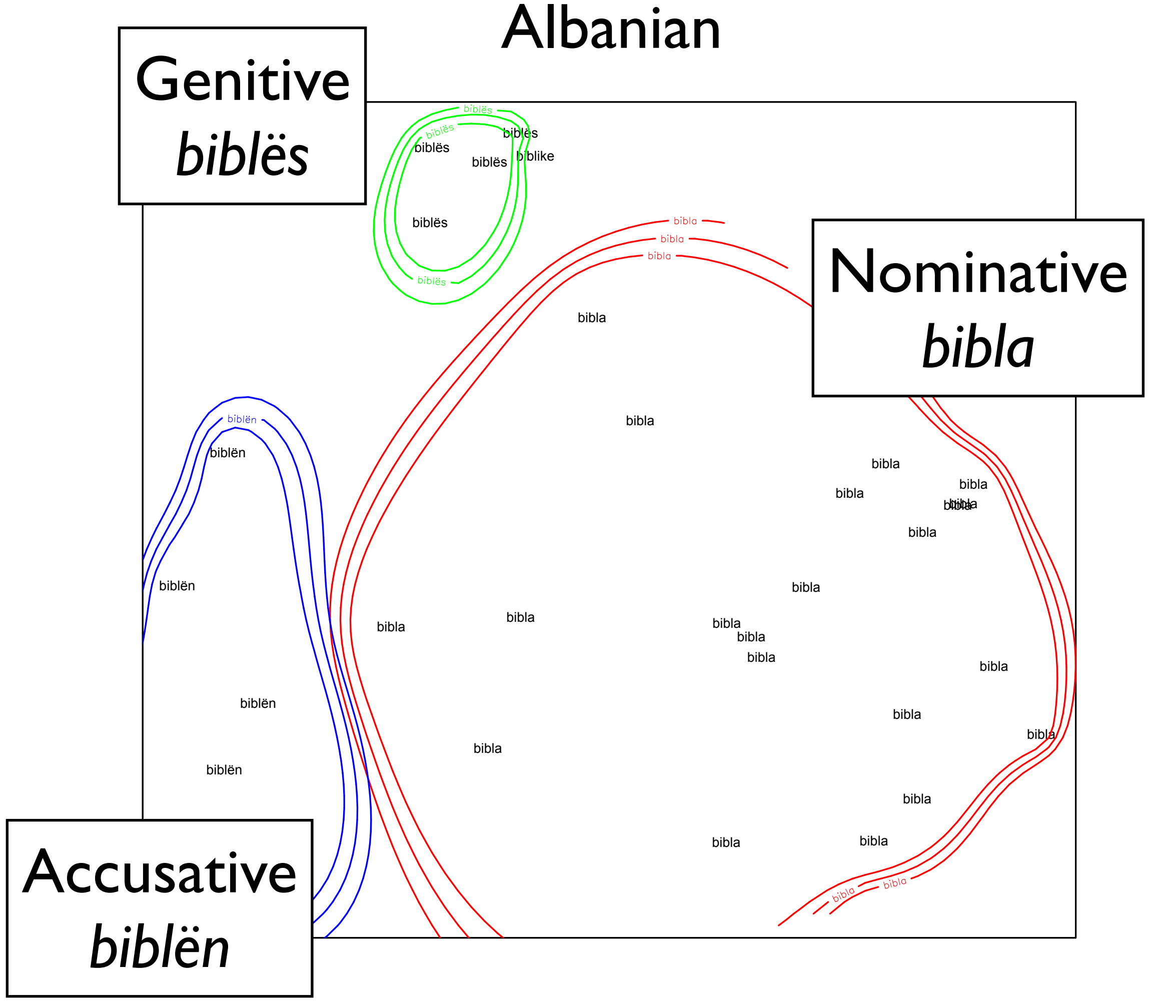
Morphosyntactic comparison: Case Marking

Albanian

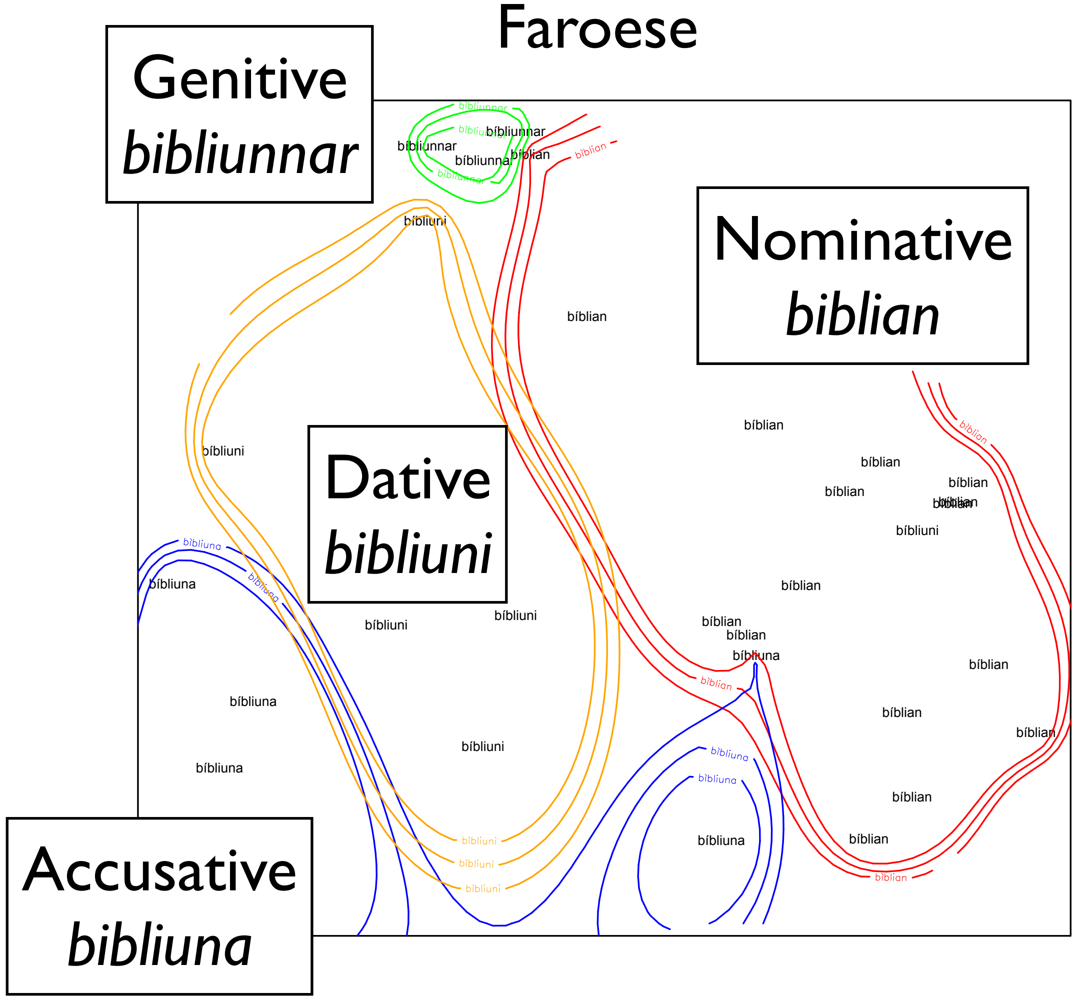


Genitive
biblës

Nominative
bibla

Accusative
biblën

Faroese



Genitive
bibliunnar

Nominative
biblian

Dative
bibliuni

Accusative
bibliuna

Assumptions (apparently slightly radical)

- Linguistic structures are language-specific
  - there is no universal ‘nominative’
    there are many different ‘Nominatives’
  - same holds also for phonemes!
- Nature of a language-specific structure is determined by the set of all occurrences
  - e.g. the meaning of the Albanian Nominative is defined by the collection of contexts in which it is used
  - a phoneme is defined by the set of
    all concrete occurrences in context

Case marking case-study

- Texts from watchtower.org
  - (Pamphlets of Jehovah's Witnesses)
- Translated into hundreds of languages
- Selection of 34 contexts in 15 languages that contain the word ‘Bible’
- Only consider bound ‘case’ marking in orthographic representation of word ‘Bible’

First 10 selected contexts

1. What important information is **contained in the Bible**?
2. Who is **the Bible's author**?
3. Why should **you study the Bible**?
4. **The Bible is** a precious gift from God.
5. **The Bible alone tells us** what we must do to please God.
6. **The Bible was written** by some 40 different men over a period of 1,600 years, beginning in 1513 B.C.E.
7. So God in heaven, not any human on earth, is **the Author of the Bible**.
8. God made sure that **the Bible was accurately copied** and preserved.
9. **More Bibles have been printed** than any other book.
10. Not everyone will be happy to see **you studying the Bible**, but do not let that stop you.

	Albanian	Irish	Faroese	Estonian	Aymara
1	bibla	bhíobla	bíbliuni	piibel	bibliaxa
2	biblës	bhíobla	bíbliunnar	piibli	bibliax
3	biblën	mbíobla	bíbliuna	piiblit	bibliat
4	bibla	bíobla	bíblian	piibel	bibliax
5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

	Albanian	Irish	Faroese	Estonian	Aymara
1	bibla	bhíobla	bíbliuni	piibel	bibliaxa
2	biblës	bhíobla	bíbliunnar	piibli	bibliax
3	biblën	mbíobla	bíbliuna	piiblit	bibliat
4	bibla	bíobla	bíblian	piibel	bibliax
5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

	Albanian	Irish	Faroese	Estonian	Aymara
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6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
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...	...	...	...	...	...

	Albanian	Irish	Faroese	Estonian	Aymara
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5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
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…	…	…	…	…	…

	Albanian	Irish	Faroese	Estonian	Aymara
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7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
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9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

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5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

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7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

	Albanian	Irish	Faroese	Estonian	Aymara
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4	bibla	bíobla	bíblian	piibel	bibliax
5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

The dilemma of language comparison:

There is no objective way to decide which structure from language A is to be compared with which structure from language B

(without any a-priori definition,

which would typically be a Eurocentric one)

Solution
to the dilemma:

Language-specific metrics

(similarity measures)

	Albanian	Irish	Faroese	Estonian	Aymara
1	bibla	bhíobla	bíbliuni	piibel	bibliaxa
2	biblës	bhíobla	bíbliunnar	piibli	bibliax
3	biblën	mbíobla	bíbliuna	piiblit	bibliat
4	bibla	bíobla	bíblian	piibel	bibliax
5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

	Albanian
1	bibla
2	biblës
3	biblën
4	bibla
5	bibla
6	bibla
7	biblës
8	bibla
9	bibla
10	biblën
...	...

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla										
2	biblës										
3	biblën										
4	bibla										
5	bibla										
6	bibla										
7	biblës										
8	bibla										
9	bibla										
10	biblën										
…	…										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0									
2	biblës		0								
3	biblën			0							
4	bibla				0						
5	bibla					0					
6	bibla						0				
7	biblës							0			
8	bibla								0		
9	bibla									0	
10	biblën										0
…	…										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0									
2	biblës		0								
3	biblën			0							
4	bibla				0						
5	bibla					0					
6	bibla						0				
7	biblës							0			
8	bibla								0		
9	bibla									0	
10	biblën										0
...	...										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0			0	0	0		0	0	
2	biblës		0								
3	biblën			0							
4	bibla	0			0	0	0		0	0	
5	bibla	0			0	0	0		0	0	
6	bibla	0			0	0	0		0	0	
7	biblës							0			
8	bibla	0			0	0	0		0	0	
9	bibla	0			0	0	0		0	0	
10	biblën										0
…	…										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0			0	0	0		0	0	
2	biblës		0								
3	biblën			0							
4	bibla	0			0	0	0		0	0	
5	bibla	0			0	0	0		0	0	
6	bibla	0			0	0	0		0	0	
7	biblës							0			
8	bibla	0			0	0	0		0	0	
9	bibla	0			0	0	0		0	0	
10	biblën										0
…	…										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0			0	0	0		0	0	
2	biblës		0					0			
3	biblën			0							
4	bibla	0			0	0	0		0	0	
5	bibla	0			0	0	0		0	0	
6	bibla	0			0	0	0		0	0	
7	biblës		0					0			
8	bibla	0			0	0	0		0	0	
9	bibla	0			0	0	0		0	0	
10	biblën										0
…	…										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0			0	0	0		0	0	
2	biblës		0					0			
3	biblën			0							
4	bibla	0			0	0	0		0	0	
5	bibla	0			0	0	0		0	0	
6	bibla	0			0	0	0		0	0	
7	biblës		0					0			
8	bibla	0			0	0	0		0	0	
9	bibla	0			0	0	0		0	0	
10	biblën										0
…	…										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0			0	0	0		0	0	
2	biblës		0					0			
3	biblën			0							0
4	bibla	0			0	0	0		0	0	
5	bibla	0			0	0	0		0	0	
6	bibla	0			0	0	0		0	0	
7	biblës		0					0			
8	bibla	0			0	0	0		0	0	
9	bibla	0			0	0	0		0	0	
10	biblën			0							0
…	…										

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0	1	1	0	0	0	1	0	0	1
2	biblës	1	0	1	1	1	1	0	1	1	1
3	biblën	1	1	0	1	1	1	1	1	1	0
4	bibla	0	1	1	0	0	0	1	0	0	1
5	bibla	0	1	1	0	0	0	1	0	0	1
6	bibla	0	1	1	0	0	0	1	0	0	1
7	biblës	1	0	1	1	1	1	0	1	1	1
8	bibla	0	1	1	0	0	0	1	0	0	1
9	bibla	0	1	1	0	0	0	1	0	0	1
10	biblën	1	1	0	1	1	1	1	1	1	0
…	…										

	Irish	1	2	3	4	5	6	7	8	9	10
1	bhíobla										
2	bhíobla										
3	mbíobla										
4	bíobla										
5	bíobla										
6	bhíobla										
7	bhíobla										
8	bíobla										
9	bhíobla										
10	bhíobla										
…	…										

	Irish	1	2	3	4	5	6	7	8	9	10
1	bhíobla	0	0	1	1	1	0	0	1	0	0
2	bhíobla	0	0	1	1	1	0	0	1	0	0
3	mbíobla	1	1	0	1	1	1	1	1	1	1
4	bíobla	1	1	1	0	0	1	1	0	1	1
5	bíobla	1	1	1	0	0	1	1	0	1	1
6	bhíobla	0	0	1	1	1	0	0	1	0	0
7	bhíobla	0	0	1	1	1	0	0	1	0	0
8	bíobla	1	1	1	0	0	1	1	0	1	1
9	bhíobla	0	0	1	1	1	0	0	1	0	0
10	bhíobla	0	0	1	1	1	0	0	1	0	0
…	…										

Language-specific metric
on sampled contexs

- Many more intricate possibilities to define such a similarity measure
- Important: the similarity only uses structure of one single language
- There is no language comparison (yet)!

	Albanian	Irish	Faroese	Estonian	Aymara
1	bibla	bhíobla	bíbliuni	piibel	bibliaxa
2	biblës	bhíobla	bíbliunnar	piibli	bibliax
3	biblën	mbíobla	bíbliuna	piiblit	bibliat
4	bibla	bíobla	bíblian	piibel	bibliax
5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

	Albanian	Irish	Faroese	Estonian	Aymara
1	bibla	bhíobla	bíbliuni	piibel	bibliaxa
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5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

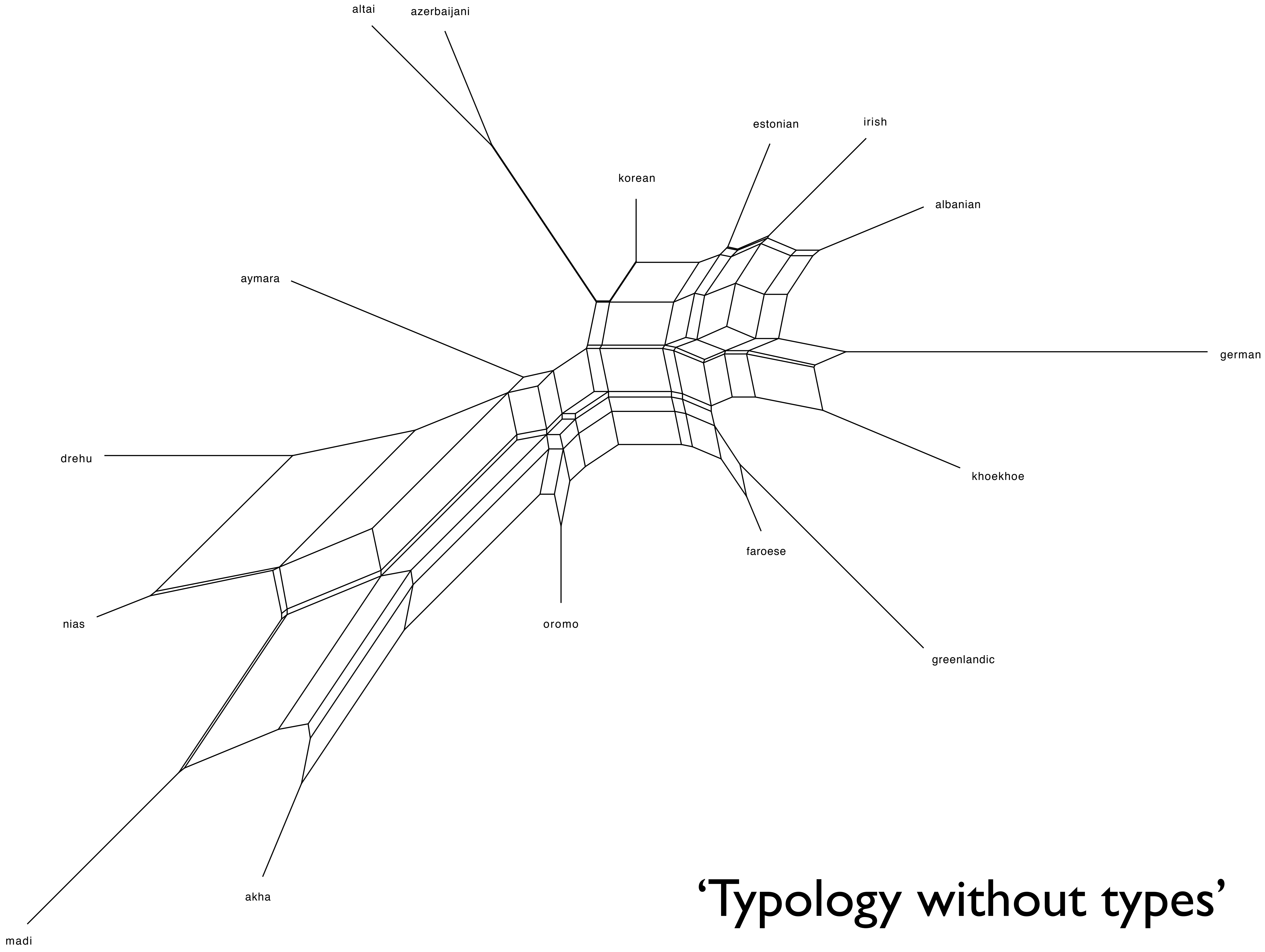
Similarity between languages ...

	Albanian	1	2	3	4	5	6	7	8	9	10
1	bibla	0	1	1	0	0	0	1	0	0	1
2	biblës	1	0	1	1	1	1	0	1	1	1
3	biblën	1	1	0	1	1	1	1	1	1	0
4	bibla	0	1	1	0	0	0	1	0	0	1
5	bibla	0	1	1	0	0	0	1	0	0	1
6	bibla	0	1	1	0	0	0	1	0	0	1
7	biblës	1	0	1	1	1	1	0	1	1	1
8	bibla	0	1	1	0	0	0	1	0	0	1
9	bibla	0	1	1	0	0	0	1	0	0	1
10	biblën	1	1	0	1	1	1	1	1	1	0
…	…										

	Irish	1	2	3	4	5	6	7	8	9	10
1	bhíobla	0	0	1	1	1	0	0	1	0	0
2	bhíobla	0	0	1	1	1	0	0	1	0	0
3	mbíobla	1	1	0	1	1	1	1	1	1	1
4	bíobla	1	1	1	0	0	1	1	0	1	1
5	bíobla	1	1	1	0	0	1	1	0	1	1
6	bhíobla	0	0	1	1	1	0	0	1	0	0
7	bhíobla	0	0	1	1	1	0	0	1	0	0
8	bíobla	1	1	1	0	0	1	1	0	1	1
9	bhíobla	0	0	1	1	1	0	0	1	0	0
10	bhíobla	0	0	1	1	1	0	0	1	0	0
…	…										

... by establishing a similarity between
language-specific similarities

	Language	1	2	3	4	5
1	Albanian	0.00	0.28	0.21	0.30	0.76
2	Irish	0.28	0.00	0.35	0.27	0.74
3	Faroese	0.21	0.35	0.00	0.33	0.42
4	Estonian	0.30	0.27	0.33	0.00	0.59
5	Aymara	0.76	0.74	0.42	0.59	0.00
…	…					



‘Typology without types’

	Albanian	Irish	Faroese	Estonian	Aymara
1	bibla	bhíobla	bíbliuni	piibel	bibliaxa
2	biblës	bhíobla	bíbliunnar	piibli	bibliax
3	biblën	mbíobla	bíbliuna	piiblit	bibliat
4	bibla	bíobla	bíblian	piibel	bibliax
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8	bibla	bíobla	bíblian	piiblit	bibliaxa
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10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

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3	biblën	mbíobla	bíbliuna	piiblit	bibliat
4	bibla	bíobla	bíblian	piibel	bibliax
5	bibla	bíobla	bíblian	piibel	bibliakiw
6	bibla	bhíobla	bíbliuna	piibli	bibliax
7	biblës	bhíobla	bíbliunnar	piibli	bibliaxa
8	bibla	bíobla	bíblian	piiblit	bibliaxa
9	bibla	bhíobla	(n.a.)	piiblit	bibliawa
10	biblën	bhíobla	bíbliuna	piiblit	bibliat
…	…	…	…	…	…

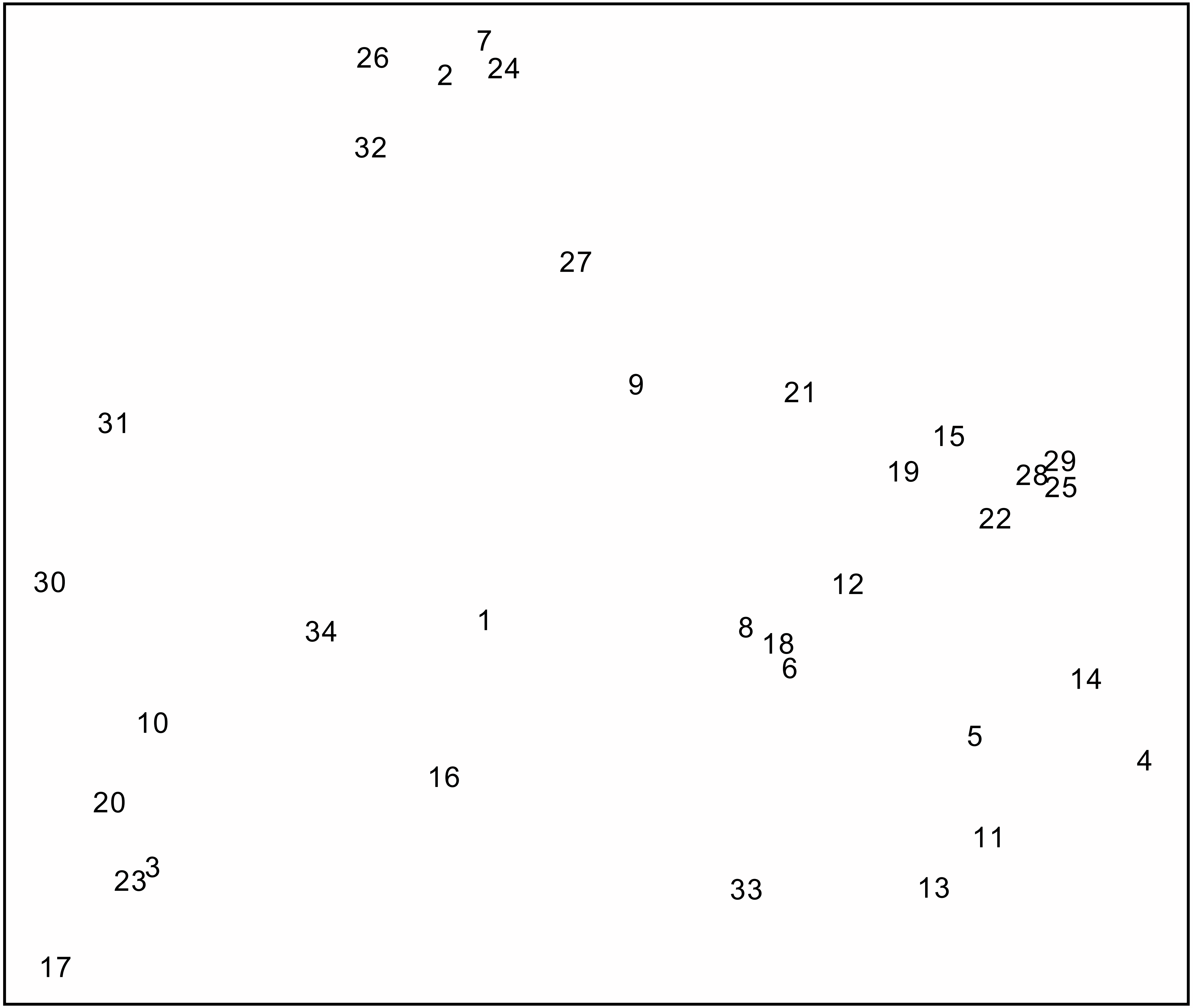
identically coded in 2 out of 5 languages

Cross-linguistic metric

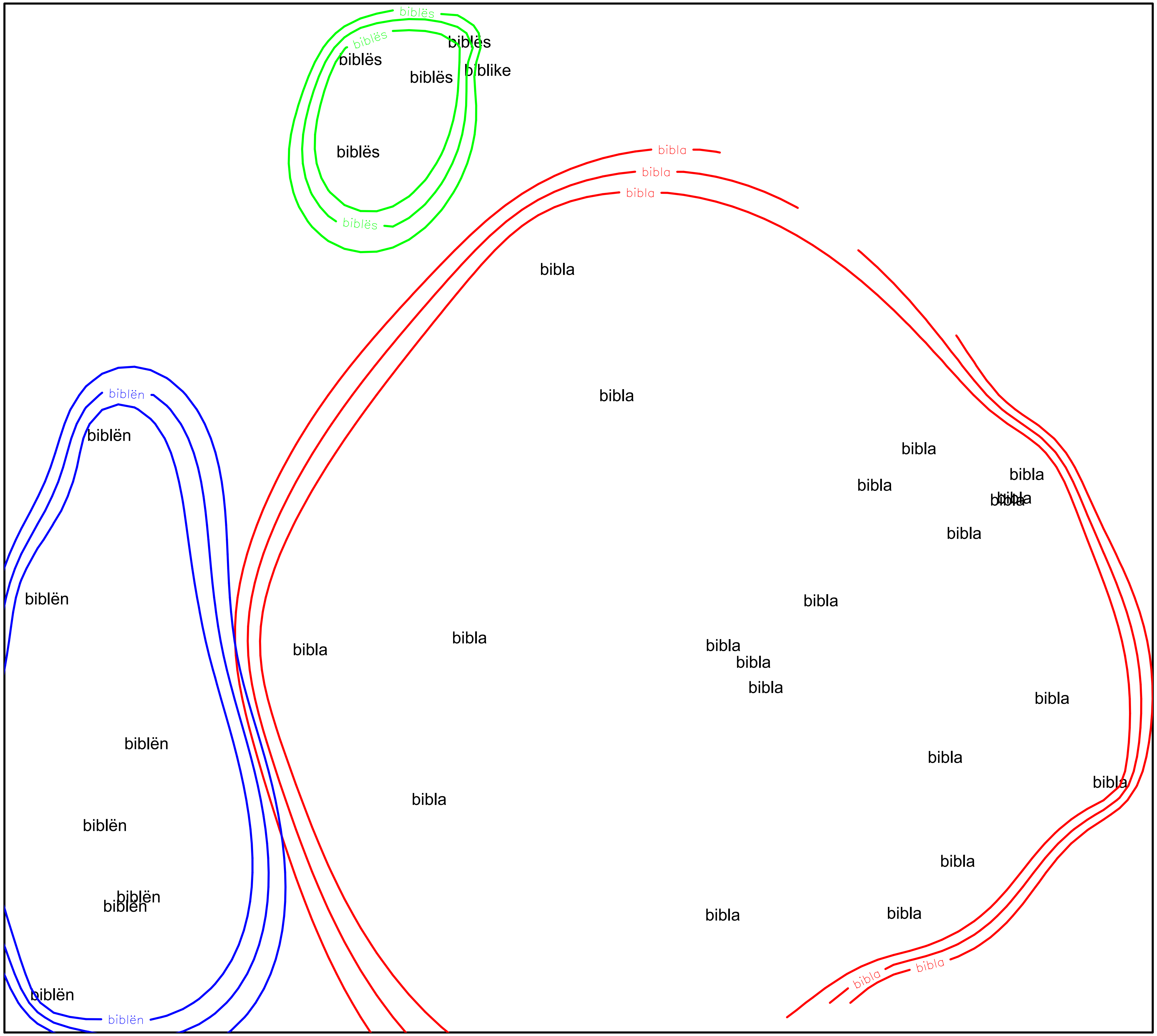
on sampled contexs

	1	2	3	4	5
1	0	0.28	0.21	0.30	0.76
2	0.28	0	0.35	0.27	0.74
3	0.21	0.35	0	0.33	0.42
4	0.30	0.27	0.33	0	0.59
5	0.76	0.74	0.42	0.59	0

(average of language-specific metrics)


7
26
24
2
32
27
9
21
31
15
29
19
28
25
22
30
12
1
8
34
18
6
14
10
5
4
16
20
11
3
23
13
33
17

albanian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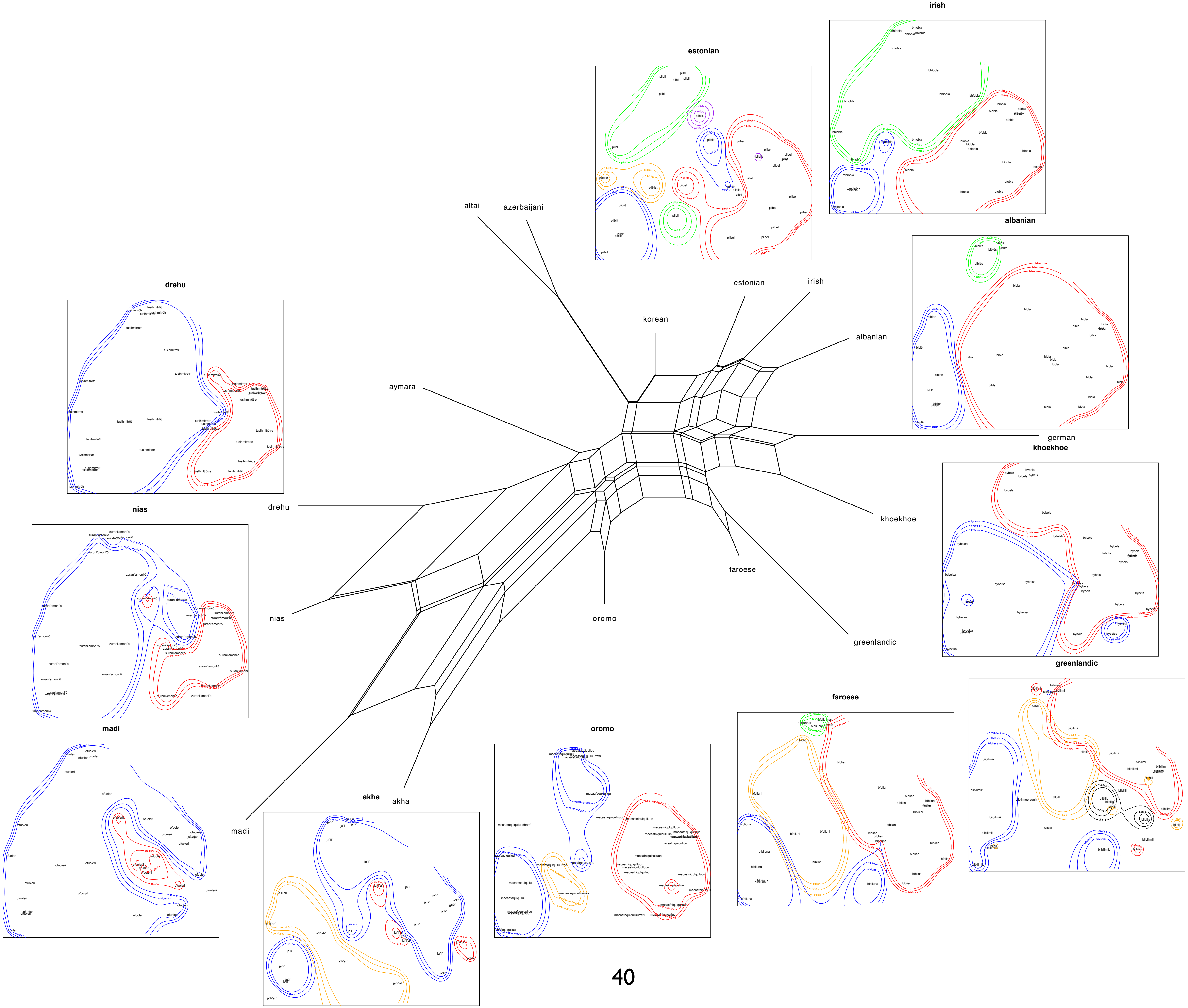
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estonian
irish
albanian
german
khoekhoe
faroese
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akha

Summary

- Language comparison has to be based on a suitable set of exemplars in context
  - Language-specific metrics on contexts
  - Only uses knowledge about the structure of one language
- Language comparison is reduced to a metric on language-specific metrics
  - ‘typology without types’
- Compare language-specific metric to an ‘average’ metric
  - Cross-linguistic metric on contexts
  - Visualize structure of individual languages on this basis